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SCIENCE AND SANITY

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SCIENCE AND SANITY

AN INTRODUCTION TO NON-ARISTOTELIAN SYSTEMS AND GENERAL SEMANTICS

BY

ALFRED KORZYBSKI

AUTHOR OF MANHOOD OF HUMANITY

DIRECTOR INSTITUTE OF GENERAL SEMANTICS

SECOND EDITION

WITH SUPPLEMENTARY INTRODUCTION AND BIBLIOGRAPHY

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"AT my alighting, I was surrounded with a crowd of people, but those who stood nearest seemed to be of better quality They beheld me with all the marks and circumstances of wonder. Neither, indeed, was I much in their debt, having never, till then, seen a race of mortals so singular in their shapes, habits, and countenances Their heads were all reclined either to the right or the left, one of their eyes turned inward, and the other directly up to the zenith Their outward garments were adorned with the figures of suns, moons, and stars, interwoven with those of fiddles, flutes, harps, trumpets, guitars, harpsicords, and many other instruments of music, unknown to us in Europe I observed, here and there, many in the habit of servants, with a blown bladder fastened like a flail to the end of a short stick, which they carried in their hands In each bladder was a small quantity of dried pease, or little pebbles (as I was afterwards informed) With these bladders they now and then flapped the mouths and ears of those who stood near them, of which practice I could not then conceive the meaning, it seems, the minds of these people are so taken up with intense speculations, that they neither can speak, nor attend to the discourses of others, without being roused by some external action upon the organs of speech and hearing, for which reason, those persons, who are able to afford it always keep a flapper (the original is *climenole*) in their family, as one of their domestics, nor ever walk abroad, or make visits, without him And the business of this officer is, when two or three more persons are in company, gently to strike with his bladder the mouth of him who is to speak, and the right ear of him or them to whom the speaker addresseth himself This flapper is likewise employed diligently to attend his master in his walks, and, upon occasion, to give him a soft flap on his eyes, because he is always so wrapped up in cogitation that he is in manifest danger of falling down every precipice, and bouncing his head against every post, and in the streets, of jostling others, or being jostled himself, into the kennel

It was necessary to give the reader this information, without which he would be at the same loss with me, to understand the proceedings of these people, as they conducted me up the stairs to the top of the island, and from thence to the royal palace While we were ascending, they forgot several times what they were about, and left me to myself, till their memories were again roused by their flappers, for they appeared altogether unmoved by the sight of my foreign habit and countenance, and by the shouts of the vulgar, whose thoughts and minds were more disengaged

And although they are dextrous enough upon a piece of paper in the management of the rule, the pencil, and the divider, yet, in the common actions and behaviour of life, I have not seen a more clumsy, awkward, and unhandy people, nor so slow and perplexed in their conceptions upon all other subjects, except those of mathematics and music They are very bad reasoners, and vehemently given to opposition, unless when they happen to be of the right opinion, which is seldom their case Imagination, fancy, and invention they are wholly strangers to, nor have any words in their language by which those ideas can be expressed, the whole compass of their thoughts and mind being shut up within the two forementioned sciences"

JONATHAN SWIFT (*Gulliver's Travels,* A Voyage to Laputa)

TO THE WORKS OF:

ARISTOTLE
ERIC T. BELL
EUGEN BLEULER
NIELS BOHR
GEORGE BOOLE
MAX BORN
LOUIS DE BROGLIE
GEORG CANTOR
ERNST CASSIRER
CHARLES M. CHILD
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J. C. MAXWELL
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HERMANN MINKOWSKI
ISAAC NEWTON
IVAN PAVLOV
GIUSEPPE PEANO
MAX PLANCK
PLATO
H. POINCARÉ
G. Y. RAINICH
G. F. B. RIEMANN
JOSIAH ROYCE
BERTRAND RUSSELL
ERNEST RUTHERFORD
E. SCHRODINGER
C. S. SHERRINGTON
SOCRATES
ARNOLD SOMMERFELD
OSWALD VEBLEN
WILLIAM A. WHITE
ALFRED N. WHITEHEAD
LUDWIG WITTGENSTEIN

WHICH HAVE GREATLY INFLUENCED MY ENQUIRY,
THIS SYSTEM IS DEDICATED

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INTRODUCTION TO THE SECOND EDITION
1941

> There is what may perhaps be called the method of optimism, which leads us either willfully or instinctively to shut our eyes to the possibility of evil Thus the optimist who treats a problem in algebra or analytic geometry will say, if he stops to reflect on what he is doing 'I know that I have no right to divide by zero, but there are so many other values which the expression by which I am dividing might have that I will assume that the Evil One has not thrown a zero in my denominator this time'
>
> MAXIME BÔCHER*

God may forgive you your sins,
but your nervous system won't

OLD MAXIM

When in perplexity, read on

OLD MAXIM

Section A Recent developments and the founding of the Institute of General Semantics.

Science and Sanity An Introduction to Non-aristotelian Systems and General Semantics, first published in October, 1933, was intended to be a textbook showing how in modern scientific methods we can find factors of sanity, to be tested empirically Although a great many scientific discoveries have been made since the first publication, it did not seem necessary to revise the text for this second edition because the methodological data given, important for our purpose, have not changed However, the list of books in preparation for the Non-aristotelian Library has been revised, and in this introduction I indicate some new developments in general semantics and include a short new bibliography, supplementing the bibliography of 619 titles given on page 767 ff

In 1935 I began to conduct seminar courses in general semantics in schools, colleges and universities, and before various groups of educators,** scientists, and physicians, including psychiatrists. In the same year a group of students of *Science and Sanity* organized the First Amer-

Congress of Arts and Science, St Louis, 1904, Vol I, p 472

** I use the word 'educator' in its standard English sense, namely, 'one who or that which educates' I use 'educate' in the sense of 'to rear bring up from childhood, so as to form habits, manners, mental and physical aptitudes To provide schooling for train generally train so as to develop some special aptitude, taste, or disposition' Etc (*The Shorter Oxford English Dictionary on Historical Principles*, Oxford, at the Clarendon Press, 1933) In this sense any teacher from nursery school through university professors are 'educators' From a *life point of view* this would include even parents, nurses, etc

ıcan Congress on General Semantıcs at the Washıngton College of Educatıon at Ellensburg, where a number of papers from varıous fields were presented. The present wrıter delıvered three addresses on the applıcatıon of general semantıcs to educatıon and medıcıne, whıch are prınted ın the proceedıngs of the Congress * The Second Amerıcan Congress on General Semantıcs wıll be held at the Unıversıty of Denver ın August, 1941. Thıs Congress ıs organızed by Professor Elwood Murray of the Unıversıty and M Kendıg, Educatıonal Dırector of the Instıtute

In 1938 the Instıtute of General Semantıcs was ıncorporated ın Chıcago for neuro-lınguıstıc, neuro-epıstemologıc, scıentıfic research and educatıon Sınce that date, as dırector of the Instıtute, my major efforts have been concentrated on further research and co-ordınatıon of rapıdly accumulatıng empırıcal data, along wıth the conduct of semınar courses to traın ın the new extensıonal methods for applıcatıon ın personal adjustment, and ın the respectıve specıal fields of the students At present several unıversıtıes are offerıng accredıted courses ın general semantıcs, and ın a number of other unıversıtıes and colleges general semantıcs ıs ıncorporated ın the presentatıon of other courses

From scıentıfic necessıty thıs book was wrıtten ınductıvely; the semınar courses are presented deductıvely, and so the two complement each other The semınars ınclude much ıllustratıve empırıcal materıal accumulated ın the fıve years of applıcatıon of the system by my co-workers and myself, together wıth the pertınent, factual, newest fındıngs of other scıences

The non-arıstotelıan system presented here has turned out to be a strıctly *empırıcal* scıence, as predıcted, wıth results whıch have greatly surpassed even my expectatıons General semantıcs is not any 'phılosophy', or 'psychology', or 'logıc', ın the ordınary sense. It ıs a new extensıonal dıscıplıne whıch explaıns and traıns us how to use our nervous systems most efficıently It ıs not a medıcal scıence, but lıke bacterıology, ıt ıs ındıspensable for medıcıne ın general, and for psychıatry, mental hygıene, and educatıon ın partıcular In brıef, ıt ıs the formulatıon of a new non-arıstotelıan system** of orıentatıon whıch affects every

* Arrow Edıtıons, New York, and also dıstrıbuted by the Instıtute of General Semantıcs, 1234 East 56th St, Chıcago

** The terms 'era', 'epoch' and 'system' wıll frequently appear here, and to avoıd confusıon ıt may be advısable to ındıcate ın what sense these terms are used 1) *Era* 'A date or an event, whıch begıns a new perıod ın the hıstory of anythıng, an ımportant date A perıod marked by the prevalence of some partıcular state of thıngs' Etc 2) *Epoch* ' a perıod of hıstory defıned by the prevalence of some partıcular state of thıngs A perıod ın the hıstory of a process' Etc 3) *System* 'A set or assemblage of thıngs connected, assocıated, or ınterdependent, so

branch of science and life The separate issues involved are not entirely new, their methodological formulation *as a system* which is workable, teachable and so elementary that it can be applied by children, is entirely new

The experience of my co-workers, mostly educators and psychiatrists, and my own, shows that about ninety per cent of those who train themselves seriously in the new extensional methods definitely benefit in various degrees, and in ways so varied as to be unpredictable

Theory and empirical results show that these new methods involve psychosomatic factors which help the balancing and integration of the functions of the nervous system, while the prevalent and traditional intensional methods of evaluation tend to disintegrate these functions The nervous mechanisms involved work automatically one way or another, harmfully or beneficially, depending on the methods with which we utilize them This has not been fully realized before

The new methods eliminate or alleviate different semantogenic blockages, many 'emotional disturbances', including even some neuroses and psychoses, various learning, reading, or speech difficulties, etc.; and general maladjustments in professional and/or personal lives These difficulties result to a large extent from the failure to use 'intelligence' adequately so as to bring about proper evaluation

It is well known that many psychosomatic symptoms such as some heart, digestive, respiratory, and 'sex' disorders, some chronic joint diseases, arthritis, dental caries, migraines, skin diseases, alcoholism, etc , to mention a few, have a semantogenic, and therefore neuro-semantic and neuro-linguistic origin In general semantic training we do not go into the medical angle as such. We eliminate the harmful semantogenic factors, and in most cases the corresponding symptoms disappear—provided the student is willing to work at himself seriously.

Section B Some difficulties to be surmounted.

1 *THE ATTITUDES OF 'PHILOSOPHERS', ETC*

'Philosophers', 'psychologists', 'logicians', mathematicians, etc., are somehow unable to comprehend that their work is the product of the

as to form a complex unity, a whole composed of parts in orderly arrangement according to some scheme or plan A set of principles, etc , a scheme, method The set of corollated principles or statements belonging to some department of knowledge a department of knowledge considered as an organized whole, a comprehensive body of doctrines, conclusions An organized scheme or plan of action, an orderly or regular method of procedure A formal, definite or established scheme or method systematic form or order' Etc (*The Shorter Oxford English Dictionary on Historical Principles*)

working of *their own nervous systems* For most of them it is only detached verbalism such as we often find in hospitals for 'mentally' ill For instance, a very gifted, well-minded mathematician and professor of 'philosophy' wrote to me 'I do not, however, think that neuro-psychology is relevant to the analysis of the nature of meaning . . I do not believe in confusing logic with neuro-psychology' These professionals would be shocked if they would study the many volumes of verbal rationalizations by patients in hospitals They would find very quickly that the words interplay with the other words somehow, but they have very little, if any, connection with the facts, and that is one reason why the patients are confined Why speculate on academic verbal definitions instead of investigating facts in such hospitals, where patients also pay no attention to the functioning of their own nervous systems? Even a gramophone record undergoes some physical changes before words or noises can be 'stored' and/or reproduced Is it so very difficult to understand that the extremely sensitive and highly complex human nervous system also undergoes some electro-colloidal changes before words, evaluations, etc , are stored, produced, or reproduced? In the work of general semantics we deal with the *living neuro*-semantic and *neuro*-linguistic reactions, not mere detached verbal chatter in the abstract In our experience we have found that even seriously maladjusted persons benefit considerably if we can succeed in making them 'think' about themselves in neurological electro-colloidal terms (see chapter IX)

Most 'philosophers' who reviewed this book made particularly shocking performances Average intelligent readers can understand this book, as they usually have some contact with life It is not so with those who indulge in mere verbalism I can give here only a classical example of some 'philosophical' performances A reviewer in the *Journal of Philosophy*, February 1, 1934, writes

'Except for his stimulating discussion of the mathematical infinite (p 206) and his hints on the nature of theory (p 253), he contributes nothing to the clarification of meanings by definite analyses of special problems Indeed, he only adds to the confusion when he declares that hypotheses contrary to the fact are meaningless (e g , p 168) , if his views were correct, science would come to an end His theory of meaning, like his theory of social causation, is very naive, to say the least '

I suggest that the reader verify whether on page 168 there is such a statement, or even a hint at such a notion, which I could not possibly have Besides, I do not give any theories of 'meaning' or of 'social causation'!

Most 'philosophers', 'logicians', and even mathematicians look at this non-aristotelian system of *evaluation* as some system of formal non-aris-

totelian 'logic', which is not the case They are somehow not able to take the natural science point of view that all science, mathematics, 'logic', 'philosophy', etc , are the product of the functioning of the human nervous system, involving some sort of internal orientations, or evaluations, which are not necessarily formalized. The analysis of such *living reactions* is the sole object of general semantics as a natural *empirical science.*

These 'philosophers', etc , seem unaware, to give a single example, that by teaching and preaching 'identity', which is empirically non-existent in this actual world, they are *neurologically* training future generations in the pathological identifications found in the 'mentally' ill or maladjusted As explained on page 409, and also Chapter XXVI, whatever we may *say* an object *'is', it is not,* because the statement is verbal, and the facts are not

It is pathetic, if not tragic, that society should invest millions of dollars to support such specialists who train future generations in maladjustments just because they disregard the unavoidable neuro-linguistic and neuro-semantic effects of their teachings on the lives of their pupils

Most scientists and educators are either entirely innocent of these problems, or indifferent and passive, or even negativistic Like some animals that can outwit humans because of their keen observations, the cunning, often pathological, thoroughly ignorant present day totalitarian leaders are not unaware of the academic shortcomings based on inertia, verbalism, etc , and openly proceed to utilize these human nervous weaknesses destructively, with very telling results Nazism, wars *of* and *on* nerves, wars of *verbal distortion,* etc , with their following disasters are in 1941 only too obvious examples. I will return to this subject at the end of this introduction

The terms 'philosophy', 'system', etc , as ordinarily used, stand for too broad generalizations Different 'philosophies' represent nothing but *methods of evaluation,* which may lead to empirical mis-evaluation if science and empirical facts are disregarded Different systems may be very broad and general, such as, say, the aristotelian system (A) (see Fig 1), within which is a more limited and less general system such as 'christianity' (C), within which is, for instance, the leibnitzian system (L), and within which there are individual, personal systems (P). Every $Smith_1$ has an individual interpretation of broader systems, and so in actuality has *a*

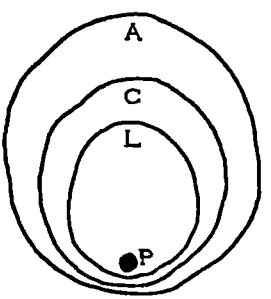

FIG 1

system of his own As a rule, personal systems are a part of, and influenced by, larger systems, which in turn are influenced by still more general systems Such problems can be handled at present only by the methods of general semantics and by topological methods *

'Mental' illness and every form of maladjustment are to be considered as mis-evaluations, involving some 'philosophies', public or individual, one within the other, as usual 'Philosophers', etc, who wish to become aware of such dangers, would do well to study the verbalizations and mis-evaluations of the 'mentally' ill in hospitals

2 *PERPLEXITIES IN THEORIES OF 'MEANING'*

There is a fundamental confusion between the notion of the older 'semantics' as connected with a theory of *verbal* 'meaning' and words defined by words, and the present theory of 'general semantics' where we deal only with *neuro*-semantic and *neuro*-linguistic *living reactions* of $Smith_1$, $Smith_2$, etc, as their reactions to neuro-semantic and neuro-linguistic *environments as environment*

The present day theories of 'meaning' are extremely confused and difficult, ultimately hopeless, and probably harmful to the sanity of the human race Of late in the United States some members of the progressive education movement have written much on 'referents' and 'operational' methods, in the abstract, based on verbalism Let us consider some facts, and how the theories of referents and operational methods fit *human evaluations*. Here is, for instance, $Smith_1$ who, through family, social, economic, political, etc, conditions has become 'insane' $Smith_1$ finally, in ordinary parlance, kills $Smith_2$ From a human point of view it is a very complex and tragic situation Let us account for it in terms of referents and operations The body and the heart of $Smith_2$, the hand of $Smith_1$, the knife, etc, are perfectly good referents The grabbing of the knife by $Smith_1$ and plunging it in the heart of $Smith_2$, the falling down on the ground by $Smith_2$ and the kicking of his legs are perfectly good operations However, where is *human evaluation?* Where is concern with 'sanity' and 'insanity'? Here we deal with some of the deepest human and social tragedies which, in this case, involve not only the killing of $Smith_2$ by $Smith_1$, but the sick, unhappy, twisted life of $Smith_1$, affecting all his life connections, and with which we must be concerned if we are to be *human beings* and different from apes

* Lewin, Kurt *Principles of Topological Psychology* McGraw-Hill, New York, 1936

Such an example is of course extreme and over-simplified, although it illustrates the principles However, officially teaching such *methods* which are *inadequate* to handle evaluation, and so human values, has a definite sinister effect, among others, on the 'sex' life of the students. Many of them are taught to orient themselves generally by referents and operations only, and so mere physiological performance is often *identified* with mature love life, etc, and is a causative factor in the wide-spread marital unhappiness, promiscuity and other lowerings of human cultural and ethical standards.

Thus, theories of 'meaning' or still worse, 'meaning of meaning', based on 'referents' and 'operational' -methods are thoroughly *inadequate* to account for human values, yet they do affect the nervous systems of humans We must, therefore, work out a *theory of evaluation* which is based on the optimum electro-colloidal action and reaction of the nervous system

There is no doubt that a civilized society needs some mature 'morals', 'ethics', etc In a general theory of evaluation and sanity we must consider seriously such problems, if we are to be sane humans at all. Theory and practice show that healthy, well-balanced people are naturally 'moral' and 'ethical', unless their educations have twisted their types of evaluations In general semantics we do not 'preach' 'morality' or 'ethics' *as such,* but we train students in consciousness of abstracting, consciousness of the multiordinal mechanisms of evaluation, *relational* orientations, etc, which bring about cortico-thalamic integration, and then as a result 'morality', 'ethics', awareness of social responsibilities, etc, follow automatically Unfortunately our educational systems are unaware of, or even negativistic toward, such *neuro*-semantic and *neuro*-linguistic issues These are sad observations to be made about our present educational systems

May I suggest that readers consult *Apes, Men and Morons* and *Why Men Behave Like Apes* by Earnest A Hooton, *The Mentality of Apes* by W Kohler, *The Social Life of Apes and Monkeys* by S Zuckerman, and many other studies of this kind. They might then more clearly understand how the aristotelian type of education leads to the humanly harmful, gross, macroscopic, brutalizing, biological, animalistic types of orientations which are shown today to be *humanly inadequate* These breed such 'fuhrers' as different Hitlers, Mussolinis, Stalins, etc, whether in political, financial, industrial, scientific, medical,* educational, or even publishing, etc, fields, fancying that they represent 'all' of the *human*

* See Carrel's *Man The Unknown.*

world! Such delusions must ultimately be destructive to *human* culture, and responsible for the tragic 'cultural lag', stressed so much today by social anthropologists

Existing theories of 'meaning' of any school do not take into consideration that any definition of words by words must be based ultimately on *undefined terms* To the best of my knowledge this problem is not considered at all in present day educational systems, outside of some sciences, and so the existing theories run in a vicious circle, just like a dog chasing his tail, and are bound to be ineffective, if not harmful.

As Professor Keyser aptly formulates the problem 'If he contend, as sometimes he will contend, that he has defined all his terms and proved all his propositions, then either he is a performer of logical miracles or he is an ass, and, as you know, logical miracles are impossible'*

Similarly the theorists in the 'theory of meaning' as described above disregard the *inadequacy* for human orientation of the subject-predicate form of representation I must refer the reader to my chapter on relations, page 188 ff, for further information.

In principle, a type of orientation which restricts formally everything to subject-predicate forms of representation can account only for symmetrical relations, and we may beat in the bush about 'meaning'; in principle, however, a theory of evaluation is then impossible *Evaluation* must be based on asymmetrical relations such as 'more' or 'less', etc., which cannot be dealt with at all adequately if restricted formally to subject-predicate forms of representation, that harmfully affect our orientations

What I have said here is correct in principle, however, in practice, in the neuro-semantic and neuro-linguistic development of the white race we had to invent, by living necessity, some asymmetrical relations such as 'more' or 'less', etc The difficulty lies in the fact that these methods of escape from a subject-predicate grammatical structure of language were used only haphazardly, and not formulated generally into a workable system based on asymmetrical relations, which would be *teachable.*

Similarly with the problem of intensional orientation by verbal definitions and extensional orientation by facts (see p 173), there is also confusion about it 'Pure' extension is humanly impossible, 'pure' intension is possible, and is often found in hospitals for 'mentally' ill, and in some chairs of 'philosophy' These issues and problems are seriously confusing to the average person because they have not been formulated before in a methodological system.

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*Keyser, Cassius J *Mathematical Philosophy* E P Dutton, New York. 1922, p 152

3 *INADEQUACY OF FORMS OF REPRESENTATION AND THEIR STRUCTURAL REVISION*

It is not generally realized what serious difficulties an *inadequate, unduly limited form of representation or theory* brings about This is well known in science Thus, for instance, the euclidean and newtonian systems cannot deal successfully with electricity and so it was imperative to produce non-euclidean and non-newtonian systems, which do apply to the sub-microscopic electrical levels and also to the macroscopic gross levels Similarly in life, the two-valued aristotelian system could not deal adequately with the electro-colloidal sub-microscopic levels of the functioning of our nervous systems, on which sanity depends Thus the formulation of the present infinite-valued non-aristotelian system became also an imperative necessity

I must stress that as the older systems are only special limitations of the new more general 'non' systems (see p 97), it would be incorrect to interpret a 'non' system as an 'anti' system

Such a non-aristotelian system is long overdue It was retarded because of persecution by the church and other influential bodies, the general belief that 'Aristotle said the last word', etc , and particularly because of the inherent difficulties of such a revision

The problem of inadequacy in the forms of representation has handicapped science and life a great deal until relatively adequate systems were produced In life the situation is much more aggravated, for if our orientations and evaluations are inadequate, our predictability is impaired, and we feel with the poet Housman, 'I, a stranger and afraid, in a world I never made' If we have a more adequate or proper evaluation, we would have more correct predictability, etc , (see p 58 ff and p 750 ff) We would then feel, 'We are *not* strangers, and *not* afraid, in this *human mess* you and I have made'

Another of the main difficulties is that a language or a system of a given structure can be somewhat altered from within, but cannot be *revised structurally* without going *outside* the former system For instance, all the attempts to revise the structure of the euclidean and newtonian systems from within were ineffective Those who revised these systems structurally had to go outside the systems first, after which they were able to produce different, independent, new systems Only then did an effective evaluation of the former systems become possible

Similarly the aristotelian, two-valued, intensional system can be revised structurally and evaluated properly only by building independently a non-aristotelian, infinite-valued, extensional system. This verifies the contention of Bertrand Russell made in 1922 that there is a 'possibility'

that 'every language has a structure concerning which, *in the language*, nothing can be said, but that there may be another language dealing with the structure of the first language, and having itself a new structure' * What Russell calls a 'possibility' becomes a fact once a system of *different structure* is built Then the issues become clear

Russell limits himself to the structure of a language, and disregards the fact that this limitation is artificial, and that any language involves structural assumptions which build up a *system of orientations* that may be racial, national, personal, etc

4 *IDENTIFICATIONS AND MIS-EVALUATIONS*

The problem of *general* identification is a major problem which does not seem to be understood at all even by specialists Psychiatrists know professionally the tragic consequences of identifications in their patients But what even psychiatrists do not realize is that identifications in daily life are extremely frequent and bring about every kind of difficulties

As a matter of fact we live in a world in which non-identity is as entirely general as gravitation, and so *every identification* is bound to be in some degree a mis-evaluation In a four-dimensional world where 'every geometrical point has a date', even an 'electron' at different dates is not identical with itself, because the sub-microscopic processes actually going on in this world cannot empirically be stopped but only transformed We can, however, through extensional and four-dimensional methods translate the dynamic into the static and the static into the dynamic, and so establish a similarity of structure between language and facts, which was impossible by aristotelian methods Unfortunately even some modern physicists are unable to understand these simple facts

To communicate to my classes what I want to convey to my readers here, the following procedure has been useful In my seminars I pick a young woman student and pre-arrange with her a demonstration about which the class knows nothing During the lecture she is called to the platform and I hand her a box of matches which she takes carelessly and drops on the desk That is the only 'crime' she has committed Then I begin to call her names, etc , with a display of anger, waving my fists in front of her face, and finally with a big gesture, I slap her face gently Seeing this 'slap', as a rule ninety per cent of the students recoil and shiver , ten per cent show no overt reactions The latter have seen what they have seen, but they *delayed their evaluations* Then I explain to the students that their recoil and shiver was an *organismal evaluation* very

* Wittgenstein, Ludwig *Tractatus Logico-Philosophicus*, with an introduction by Bertrand Russell Harcourt, Brace, New York, 1922, p 23

harmful in principle, because they *identified* the seen facts with their judgements, creeds, dogmas, etc Thus their reactions were entirely unjustified, as what they have *seen* turned out to be merely a scientific demonstration of the mechanism of identification, which identification I expected

Such identifications are very common The late Dr Joshua Rosett, formerly Professor of Neurology in Columbia University, and Scientific Director, Brain Research Foundation, New York, gives an example from his own experience 'A vivid picture on the cinema screen represented a boy and a girl pulling down hay from a stack for bedding I sneezed—from the dust of the hay shown on the screen'*

The problem of identification in values is neurologically strictly connected with the pathological reversal of the natural order of evaluation, which is found in different degrees in the maladjusted, neurotics, psychotics, and even in some 'normal' persons Thus, the supposedly innocent 'shiver' and the sneezing in the examples above, or the attack of hay fever when *paper* roses are shown (see p 128), etc, may as well in other cases end in a sudden death or in a neurosis or psychosis The neurological mechanisms are similar, involving identifications in values of different orders of abstractions, and therefore the very common reversal of the natural order of evaluation

In the evolution of the human race and language there was a natural order of evaluation established, namely, the life facts came first and labels (words) next in importance Today, from childhood up, we inculcate words and language first, and the facts they represent come next in value, another pathologically reversed order, by which we are unconsciously being trained to identify words with 'facts' Even in medicine we much too often evaluate by the definitions of 'diseases' instead of dealing with an individual sick patient, whose illness seldom fits textbook definitions

The foregoing considerations deal directly with aristotelian orientations by intension, or verbal definitions, where verbiage comes first in importance, and facts next By non-aristotelian methods we train in the natural order, namely, that first order empirical facts are more important than definitions or verbiage. It should be noticed that the average child is born extensional, and then his evaluations are distorted as the result of intensional training by parents, teachers, etc, who are unaware of the heavy neurological consequences

These are key problems involved in the passing from aristotelian to non-aristotelian orientations, which affect our future personal, national

*Rosett, Joshua *The Mechanism of Thought, Imagery, and Hallucination* Columbia University Press, New York, 1939, p 212

and international adjustments For a detailed discussion the reader is referred to this text, see index under the terms 'identification', 'order', 'natural order', etc

5 *METHODS OF THE MAGICIAN*

Another very serious difficulty arises due to the fact that our knowledge of the world and ourselves involves unavoidable factors of deception and self-deception A scientific study of magic with its methods of psycho-logical deception is most revealing, as it shows the mechanisms by which we are continually and unknowingly being deceived in science and daily life * The stock in trade of the magician to fool the public consists of methods of misdirection, of mis-evaluation, half-truths, etc , used to play on the ordinary associations and implications, habits of hasty generalizations, etc , of the audience, thus leading to misinterpretations, identifications, lack of predictability, etc These general, and so common, psycho-logical mechanisms are very deep, and to a large extent are connected with the aristotelian type of intensional, subject-predicate orientations, which ultimately may become harmful

For maximum adjustment, and therefore sanity, we need neurological methods to prevent and counteract these heretofore unavoidable old deceptions and self-deceptions In a non-aristotelian system these difficulties are recognized and empirical methods are discovered to eliminate them step by step Such methods of prevention and counteraction culminate in training in consciousness of abstracting (see Chapters XXVI, XXVII, XXIX and p 499 ff)

I must stress that as far as we humans are concerned, we cannot possibly be entirely ignorant about ourselves, we may have only *false knowledge* or *half-truths* It is psychiatrically known that in many instances false knowledge, particularly about ourselves, breeds maladjustments, often of a serious character, just because it is based fundamentally on self-deception In the meantime we react and act *'as if'* our half-truths or false knowledge were 'all there is to be known' Thus we are bound to be bewildered, confused, obsessed with fears, etc , because of mistakes due to our mis-evaluations, when we orient ourselves by verbal structures which do not fit facts

Section C Revolutions and evolutions.

One of the gravest difficulties facing the world today is the passing from one historical era to another Such passings, as history shows, have

* Kelley, Douglas M Conjuring as an Asset to Occupational Therapy *Occupational Therapy and Rehabilitation* Vol 19, No 2, April, 1940

always been painful, and pregnant with consequences To illustrate. the transition from papal control to non-papal control, passing through murderous religious persecutions and slaughters, including the devastating Thirty Years' War, etc , from French royalism to republicanism, passing through the ferocious French Revolution and Commune, from czarism to state capitalism, passing through the latest bloody Russian Revolution and a period of so-called 'communism' Now we are witnessing the struggles of 'democracies' with 'totalitarian states', passing as yet through the recent ruthless Spanish War, second World War, etc , etc

Similarly we can give illustrations of painful transitions from one system to another from the history of science, which were also accompanied by bewilderment and labour for instance, the passing from the ptolemaic to the copernican, from euclidean to non-euclidean, newtonian to non-newtonian (einsteinian), etc , systems

In all these transitions it took one or more generations before the upheaval subsided and an adjustment was made to the new conditions

No matter how painful and disturbing these transitions were, they were still changes and revisions *within* the then most general, intensional aristotelian system This system was imposed on the white race by the 'church fathers'. Its strength and influence was due to its academically rationalized general verbal formulations which were set forth in textbooks, and thus became teachable From the beginning the aristotelian system as formulated was inadequate and many attempts at corrections were made The white race was impressed by the church that 'Aristotle spake', and there was nothing more to be said In fact, attempts to revise this system were prohibited even up to very recent times Just the same, new facts which would not fit the aristotelian and church patterns were accumulating and so new methods, languages of special structure, etc., were required.

Perhaps an illustration from the history of mathematics will help For more than 2,000 years by necessity mathematicians differentiated and integrated in some clumsy fashion in order to solve individual problems But only after the formulation of a *general theory* by Newton and by Leibnitz did the *general method* become teachable and communicable as a general practical discipline (see p 574) which provided the foundations for future developments in mathematics

The aristotelian system had been formulated in a very rationalized way Non-aristotelian attempts have been and are being made continually in limited areas The difficulty was that no methodological general theory based on the new developments of life and science had been formulated until general semantics and a general, extensional, teachable

and communicable, non-aristotelian system was produced The main difficulties ahead are neuro-semantic and neuro-linguistic because for more than 2,000 years our nervous systems have been canalized in the inadequate, intensional, often delusional. aristotelian orientations, which are reflected even in the *structure of the language* we habitually use.

It may be helpful to indicate some historical facts of the development of our orientations since Socrates (469–399 B C) Socrates was the son of a *sculptor* and himself did *some work with the chisel and his hands* He became an important founder of a school of 'philosophy' In brief, this school had very high standards for science, seeking the application of the science of the time to life, so that it became what may be called a 'school of wisdom'

One of his students, Plato (427–347 B C), who came from an *aristocratic family,* became the founder of a different school, called the 'Academy', and the 'father' of what may be called 'mathematical philosophy' Unlike his teacher, he began, in his 'Doctrine of Ideas', to verbally split humans into 'body' *and* 'mind', as if they could be so split in living beings He built a system of *'immaterialism'* or *'idealism'*

Aristotle (384–322 B C), the son of a *physician,* was the student of Plato, and particularly interested in *biology, other natural sciences,* etc He founded the most influential of the three schools, which is called by his name He was undoubtedly one of the most gifted men mankind has ever known As usual in such cases, the study of one branch of knowledge leads to another, so Aristotle was led to the study of 'logic', *linguistic structure,* etc , about which he produced scholarly treatises or textbooks, ultimately formulating the most complete system of his time Because of the completeness of the system, backed by powerful influences, it has moulded our orientations and evaluations up to the present The man on the street, our education, medicine and even sciences, are still in the clutches of the system of Aristotle, a system *inadequate* for 1941 yet perhaps satisfactory 2,300 years ago, when conditions of life were relatively so simple, when orientations were on the macroscopic level only, and knowledge of scientific facts was practically nil (see p 371 ff).

In Aristotle's system *as applied,* the split becomes complete and institutionalized, with jails for the 'animal' and churches for the 'soul' Now we begin to realize how pernicious and retarding for civilization that split is For instance, only since Einstein and Minkowski do we begin to understand that 'space' *and* 'time' cannot be split empirically, otherwise we create for ourselves delusional worlds. Only since their work has modern sub-microscopic physics with all its accomplishments become possible

Similarly, and tragically, this applies to medicine Until recently we have had a split medicine One branch, general medicine, was interested in the 'body' (soma), the other was interested in the 'soul' ('psyche') The net result was that general medicine was a glorified form of veterinary science, while psychiatry remained metaphysical * However, it has been found empirically that a great many 'physical' ailments are of a semantogenic origin Only a few years ago general physicians began to understand that they cannot deal with humans without knowing something about psychiatry, and psychosomatic medicine began to be formulated I cannot go into further detail here, except to mention that this is another constructive step away from the aristotelian system, which as applied trains us in artificial, verbal splits

If we train in methods which in principle lead to splitting the personality, we obviously train or prepare the ground for dementia praecox or schizophrenia, which very often involves a split personality At any rate, it does not seem to be advisable for sanity, and so proper evaluation of 'facts' and 'reality', to train our children in delusional methods Personally, the author is always profoundly shocked that parents, who after all care for their children, can tolerate educators, physicians, scientists, etc, who train their children in such pernicious and hopelessly antiquated methods I also always wonder whether educators, physicians, scientists and other professionals realize what harm they can do by disregarding factors of sanity, or by ignoring them

It is pitiful to watch how even some of the most outstanding scientists in the world are unable to understand what a passing from one system to another means. Thus, for example, an Encyclopedia of Unified Science was projected. A number of very scholarly treatises were published in it, and yet because the difficulties were not faced squarely the authors are missing the point that neuro-semantic and neuro-linguistic mechanisms are involved and that we are passing from one system to another

One of the tremendous obstacles in the revision of the aristotelian system is exactly the excellence of the work of Aristotle based on the very few scientific facts known 2,300 years ago The aim of his work *circa* 350 B C was to formulate the *essential nature of science* (350 B C) and the forms and laws of science His immediate goal was entirely *methodological* (350 B C), and he aimed to formulate a *general method* for 'all' scientific work He was even expounding the theory of symmetrical relations, the relation of the general to the particular, etc In his days these orientations were by necessity two-valued and 'objective', hence

* Korzybski, Alfred Neuro-semantic and Neuro-linguistic Mechanisms of Extensionalization *American Journal of Psychiatry,* Vol 93, No. 1, July, 1936

follows his whole system, then more or less satisfactory on macroscopic levels. A modern revision of the aristotelian system or the building of a non-aristotelian system involves, or is based on, similar aims, namely, the formulation of a *general method* not only for scientific work, but also life, as we know it *today* (1941)

Modern scientific developments show that what we label 'objects' or 'objective' are mere nervous constructs inside of our skulls which our nervous systems have abstracted electro-colloidally from the actual world of electronic processes on the sub-microscopic level And so we have to face a complete methodological departure from two-valued, 'objective' orientations to *general, infinite-valued, process orientations,* as necessitated by scientific discoveries for at least the past sixty years

The aim of the work of Aristotle and the work of the non-aristotelians is similar, except for the date of our human development and the advance of science The problem is whether we shall deal with science and scientific methods of 350 B C or of 1941 A C In general semantics, in building up a non-aristotelian system, the aims of Aristotle are preserved yet scientific methods are brought up to date

Section D A non-aristotelian revision

In an attempt to convey the magnitude of the task we are now confronting, I can do no better than to summarize roughly in the following tabulation some of the more outstanding points of difference between the aristotelian system as it shapes our lives today, *and is lived by,* and a scientific, non-aristotelian system, as it will, perhaps, guide our lives sometime in the future

	Old Aristotelian Orientations (circa 350 B C)	New General Semantic Non-Aristotelian Orientations (1941 A C)
1	Subject-predicate methods	Relational methods
2	Symmetrical relations, inadequate for proper *evaluation*	Asymmetrical relations, indispensable for proper *evaluation*
3	*Static, 'objective',* 'permanent', 'substance', 'solid matter', etc, orientations	*Dynamic,* ever-changing, etc, electronic *process* orientations
4	'Properties' of 'substance', 'attributes', 'qualities' of 'matter,' etc	Relative invariance of function, dynamic structure, etc
5	Two-valued, 'either-or', inflexible, dogmatic orientations	Infinite-valued flexibility, degree orientations
6	Static, finalistic *'allness',* finite number of characteristics attitudes	Dynamic *non-allness,* infinite number of characteristics attitudes

	ARISTOTELIAN ORIENTATIONS	NON-ARISTOTELIAN ORIENTATIONS
7	*By definition* 'absolute sameness in "all" respects' ('identity')	*Empirical* non-identity, a natural law as universal as gravitation
8	Two-valued 'certainty', etc	Infinite-valued maximum probability
9	Static absolutism	Dynamic relativism
10	*By definition* 'absolute emptiness', 'absolute space', etc	*Empirical* fullness of electro-magnetic, gravitational, etc, fields
11	*By definition* 'absolute time'	*Empirical* space-time
12	*By definition* 'absolute simultaneity'	*Empirical* relative simultaneity
13	Additive ('and'), linear	Functional, non-linear
14	(3+1)-dimensional 'space' *and* 'time'	4-dimensional space-time
15	Euclidean system	Non-euclidean systems
16	Newtonian system	Einsteinian or non-newtonian systems
17	'Sense' data predominant	Inferential data as fundamental new factors
18	Macroscopic and microscopic levels	*Sub*-microscopic levels
19	Methods of magic (self-deception)	Elimination of self-deception
20	Fibers, neurons, etc, 'objective' orientations	Electro-colloidal *process* orientations
21	Eventual 'organism-as-a-whole', disregarding environmental factors	Organism-as-a-whole-*in-environments*, introducing new unavoidable factors
22	Elementalistic *structure* of language and orientations	Non-elementalistic *structure* of language and orientations
23	'Emotion' *and* 'intellect', etc	Semantic reactions
24	'Body' *and* 'mind', etc	Psychosomatic integration
25	Tendency to split 'personality'	Integrating 'personality'
26	Handicapping nervous integration	Producing automatically thalamo-cortical integration
27	Intensional *structure* of language and orientations, perpetuating	Extensional *structure* of language and orientations, producing
28	Identifications in value a) of electronic, electro-colloidal, etc, stages of processes with the silent, non-verbal, 'objective' levels b) of individuals, situations, etc c) of orders of abstractions	Consciousness of abstracting Extensional devices
29	Pathologically reversed order of evaluation	Natural order of evaluation
30	Conducive to neuro-semantic tension	Producing neuro-semantic relaxation

	ARISTOTELIAN ORIENTATIONS	NON-ARISTOTELIAN ORIENTATIONS
31	Injurious psychosomatic effects	Beneficial psychosomatic effects
32	Influencing toward un-sanity	Influencing toward sanity
33	'Action at a distance', metaphysical false-to-fact orientations	'Action by contact', neuro-physiological scientific orientations
34	Two-valued causality, and so consequent 'final causation'	Infinite-valued causality, where the 'final causation' hypothesis is not needed
35	Mathematics derived from 'logic', with resulting verbal paradoxes	'Logic' derived from mathematics, eliminating verbal paradoxes
36	Avoiding empirical paradoxes	Facing empirical paradoxes
37	Adjusting empirical facts to verbal patterns	Adjusting verbal patterns to empirical facts
38	Primitive static 'science' (religions)	Modern dynamic 'religions' (science)
39	Anthropomorphic	Non-anthropomorphic
40	*Non-similarity of structure* between language and facts	*Similarity of structure* between language and facts
41	Improper evaluations, resulting in	Proper evaluations, tested by·
42	Impaired predictability	Maximum predictability
43	*Disregarded*	Undefined terms
44	*Disregarded*	Self-reflexiveness of language
45	*Disregarded*	Multiordinal mechanisms and terms
46	*Disregarded*	$\frac{\text{Over}}{\text{Under}}$ defined character of terms
47	*Disregarded*	Inferential *terms* as *terms*
48	*Disregarded*	Neuro-linguistic environments considered as environment
49	*Disregarded*	Neuro-semantic environments considered as environment
50	*Disregarded*	Decisive, automatic effect of the *structure of language* on types of evaluation, and so neuro-semantic reactions
51	Elementalistic, verbal, intensional 'meaning', or still worse, 'meaning of meaning'	Non-elementalistic, extensional, by fact *evaluations*
52	Antiquated	Modern, 1941

THE NEW NON-ARISTOTELIAN ORIENTATIONS DIFFER AS MUCH FROM THE ARISTOTELIAN AS THE ARISTOTELIAN DIFFER FROM THE PRIMITIVE TYPES OF EVALUATION

The old orientations are being perpetuated, as a rule unknowingly, through the aristotelian structure of our language, our institutions, etc The new orientations are simpler than the old because they are closer to empirical facts, and so are even more easily absorbed by children—provided parents, teachers, etc, are themselves aware of the new methods and so can give the children guidance

The difficulties we are now facing, with the many important new factors introduced in a non-aristotelian system, listed roughly in the tabulation, cannot be evaluated effectively unless we understand the rôle that *new factors* play in our generalizations

Section E New factors the havoc they play with our generalizations.

In mathematics and science we use extensively the method of interpolation In building curves we do not have all the points or data We have a number of them and then connect the points with a smooth curve

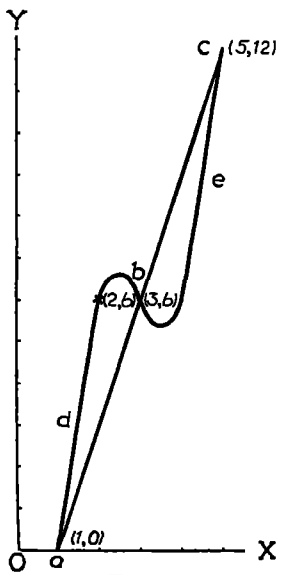

FIG 2

The equation of that curve is given on the basis of the actual data at hand The nervous processes which are involved in interpolations and building up equations are also involved in producing *ordinary generalizations* in daily life, that is, we interpolate from the data we have and then generalize in words instead of equations It is well known that sometimes when a new datum is discovered it transforms the curve entirely, with a corresponding change in the equation (generalization)

Fig. 2 as an illustration will make this clearer If we measure the experimental points (1,0), (3,6), (5,12), we would find them to lie on the line *abc* with the equation $y = 3x - 3$, and we might conclude therefrom that further similar experiments would confirm the linearity of the relationship being studied. But if a further analysis yields the point (2,6), the simplest curve fitting these data is now the curve *adbec*, expressed by the equation $y = x^3 - 9x^2 + 26x - 18$, which is different and much more complex than before, because it is a cubic equation instead of a linear equation *

*I am indebted for this example to Dr A S Householder, University of Chicago

It is not generally recognized what havoc the discovery of a single new, important, structural factor may play with our generalizations. In science and ordinary life we are coming across such new factors quite often, and we have to change our equations or generalizations, and so our standards of evaluation, if we do not want to build up delusional situations for ourselves

As an example I can suggest here the work of Professor W Burridge,* who in his physiological investigations introduced the new unavoidable factor of the electro-colloidal structure of life In this case it does not matter whether the particular colloidal theory suggested by Burridge is correct or not The fact that he introduced an important new structural factor leads to entirely different interpretations, generalizations, etc, although the first order empirical facts remain Such an introduction requires a complete revision of the generalizations of biology, physiology, neurology, etc, and therefore even medicine and psychiatry Incidentally, psychosomatic results become at least intelligible

Other examples may be given, such as the work of Professor William F Petersen,** who introduced the new factor of weather into medicine, or of Freud, who introduced the 'unconscious', etc , or of Lorentz, Einstein and others, who introduced the finite velocity of light into the newtonian system, etc., etc As is well known, the introduction of these new factors revolutionized constructively the older theories

The scientific requirements of a new theory are very exacting A new theory must account for the known facts and predict new facts following the new generalizations, which in turn depend upon the new factors or structural assumptions introduced The predicted new facts must then be verified empirically

In general semantics we introduce a number of new unavoidable structural factors, among others, our neuro-semantic (neuro-evaluational) and neuro-linguistic *environments as environment* Such introductions also require a radical revision of what we know, and have wide applications in daily life, as well as in sciences, including the foundation of mathematics (see chapters XIV, XV, XVIII, and XIX) and physics (see chapter XVII) These new factors should particularly interest parents, educators, medical men, psychiatrists, and other specialists

The introduction of new factors may at first produce seeming diffi-

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** Professor of Pathology, University of Illinois, College of Medicine

culties because of the unfamiliarity of a new terminology which embodies the new structural assumptions, and because of the necessity of a re-canalization of our neuro-linguistic habits, etc Yet after the new orientations are acquired, the new issues become much simpler than the older, because they are better understood (see p 97).

In at least one historical case, it was the omission of an unnecessary artificial assumption that brought about a transformation of the whole system. I speak here about euclidean geometry, which assumes the equal distance of parallels, and the non-euclidean geometries, which eliminated this equal distance postulate as unnecessary The results were very striking Thus, in the euclidean system we build curves out of little bits of 'straight lines' We do the opposite in the newer geometries—we start with curves, shortest distances, etc , not 'straight lines' (as no one knows what that means), and build up 'straight lines' as the limit of an arc of a circle with an 'infinite radius' (see p 590).

Further explanations are given in the text, but I hope that I have conveyed to the reader the fundamental character of these problems and some of the difficulties encountered at first when new structural factors are introduced Even the elimination of a postulate may be translated into an introduction of a new negative factor This translation is important in life, although it may be unimportant in technical mathematics In science as well as in life we deal all the time with this kind of problems, and when they are not understood structurally, we are only plunged into paradoxes and bewilderment, and potential maladjustment

Section F Non-aristotelian methods

1 *NEUROLOGICAL MECHANISMS OF EXTENSIONALIZATION*

There is an especially broad generalization, already referred to, which empirically indicates a fundamental difference between the traditional, aristotelian, intensional orientations, and the new non-aristotelian extensional orientations, and in many ways summarizes the radical differences between the two systems This is the problem of *intension* (spelled with an *s*) and *extension.* Aristotle, and his followers even today, recognized the difference between intension and extension However, they considered the problem *in the abstract,* never applying it to human *living reactions* as *living reactions,* which can be predominantly intensional or predominantly extensional The interested reader is advised to consult any textbook on 'logic' concerning 'intension' and 'extension', as well as the material given in this text (see index).

The difference can be illustrated briefly by giving examples of 'defini-

tions'. Thus a 'definition' by intension is given in terms of aristotelian 'properties' For instance, we may verbally 'define' 'man' as a 'featherless biped', 'rational animal', and what not, which really makes no difference, because no listing of 'properties' could possibly cover 'all' the characteristics of $Smith_1$, $Smith_2$, etc , and their inter-relations.

By extension 'man' is 'defined' by exhibiting a class of individuals made up of $Smith_1$, $Smith_2$, etc

On the surface this difference may appear unimportant, not so in *living life applications* The deeper problems of neurological mechanisms enter here If we orient ourselves predominantly by intension or verbal definitions, our orientations depend mostly on the cortical region If we orient ourselves by extension or facts, this type of orientation by necessity follows the natural order of evaluation, and involves thalamic factors, introducing automatically cortically delayed reactions. In other words, orientations by intension tend to train our nervous systems in a split between the functions of the cortical and thalamic regions; orientations by extension involve the integration of cortico-thalamic functions.

Orientations by extension induce an *automatic* delay of reactions, which *automatically* stimulates the cortical region and regulates and protects the reactions of the usually over-stimulated thalamic region.

What was said here is elementary from the point of view of neurology The difficulty is that this little bit of neurological knowledge is not applied in practice Neurologists, psychiatrists, etc , have treated these problems in an 'abstract', 'academic', detached way only, somehow, entirely unaware that living human reactions depend on the working of the human nervous system, from which dependence there is no escape. No wonder 'philosophers', 'logicians', mathematicians, etc , disregard the working of their nervous systems if even neurologists and psychiatrists still orient themselves by verbal fictions in the *'abstract'*

If we investigate, it seems appalling how little of the vast knowledge we have is actually applied Even the ancient Persians showed their understanding of the difference between *learning* and *applying* in their proverb 'He who learns and learns and yet *does* not what he knows, is one who plows and plows yet never sows'. In this new modern non-aristotelian system we have not only to *'know'* elementary facts of modern science, including neuro-linguistic and neuro-semantic researches, but also to *apply* them. In fact, the whole passage from the aristotelian to non-aristotelian systems depends on this change of attitude from intension to extension, from macroscopic to sub-microscopic orientations, from 'objective' to process orientations, from subject-predicate to relational evaluations, etc This is a laborious process and months of self-

discipline are required for adults before these new methods can be applied generally; children as a rule have no difficulties

If we stop to reflect, however, it seems obvious that those who are trained in two-valued, macroscopic, *'objective'*, aristotelian orientations only, are thoroughly unable to have modern, electro-colloidal, sub-microscopic, infinite-valued, *process* orientations in life, which can be acquired only by training in non-aristotelian methods

It is sad indeed to deal with even young scientists in the colloidal and quantum fields who, after taking off their aprons in the laboratory, relapse immediately into the two-valued, prevalent aristotelian orientations, thus ceasing to be scientific 1941 In many ways these scientists are worse off than the 'man on the street', because of the artificially *accentuated* split between their scientific and their life orientations Although they work in an infinite-valued, non-aristotelian field, even they need special training to become conscious of how to apply their own scientific non-aristotelian methods to life problems

Empirically the consequences of training in the new methods are astonishingly far-reaching This is easily understood after reflection, because the integrating of the functions of the cortical and thalamic regions brings about better functioning of glands, organs, etc Although general semantics is not a medical science, we can understand why the non-aristotelian extensional thalamo-cortical methods bring about a great deal of stabilization and even psychosomatic consequences, as the empirical results achieved by my psychiatric co-workers and myself indicate

2 *NEURO-SEMANTIC RELAXATION*

The optimum working of the nervous system depends, among other things, on 'normal' blood pressure, which is predominantly a thalamic function, supplying the nervous system with necessary blood circulation As both affective, or 'emotional', responses and blood pressure are neurologically closely connected, it is fundamental for 'emotional' balance to have 'normal' blood pressure, and *vice versa*

In general semantics we utilize what I call 'neuro-semantic relaxation', which, as attested by physicians, usually brings about 'normal' blood pressure, that is, it lowers abnormally high pressure and raises abnormally low pressure, thus regulating the essential *blood circulation,* and so blood supply The standards for 'normal' are given in statistical averages and are not accurate for the given individual, and at different times These conditions and beneficial consequences are strictly empirical, and must be taken into account, regardless of the fact that the present scientific theories on this subject are not yet clear It must be

realized that for the 'normal' working of the nervous system we must have a proper blood circulation, which may be affected by the *tension* of blood vessels, and is also connected with 'emotional' *tension* We are never aware of this particular steady kind of 'emotional' tension, which involves hidden fears, anxieties, uncertainties, frustrations, etc., and through the nervous mechanisms of projection colour harmfully our attitudes toward the world and life in general Such conditions result in *defensiveness, which is no defense,* but a wasteful, useless drain on the limited nervous capacities

Some details of the mechanisms and techniques involved, as they affect, among others, so-called 'speech difficulties', (stuttering, etc) are given by Professor Wendell Johnson, University of Iowa, in his *Language and Speech Hygiene An Application of General Semantics,* published as the first monograph of the Institute of General Semantics More details concerning neuro-semantic relaxation will be presented in professional papers

3 *EXTENSIONAL DEVICES AND SOME APPLICATIONS*

To achieve extensionalization we utilize what I call 'extensional devices':

1) Indexes	Working Devices
2) Dates	
3) Etc (*et cetera*)	
4) Quotes	Safety Devices
5) Hyphens	

It should be noticed that in a four-dimensional world dating is only a particular temporal index by which we can deal effectively with space-time In non-aristotelian orientations these extensional devices should be used habitually and permanently, with a slight motion of the hands to indicate absolute individuals, events, situations, etc , which change at different dates, also different orders of abstraction, etc Thus thalamic factors become involved, *without which the coveted thalamo-cortical integration cannot be accomplished*

I may add that all existing psychotherapy, no matter of what school, is based on the partial and particular extensionalization of a given patient, depending on the good luck and personal skill of the psychiatrist Unfortunately these specialists are in the main unaware of what is said here, and of the existence of a theory of sanity which gives general, simple, and workable thalamo-cortical methods for extensionalization, and so thalamo-cortical integration.

A few illustrations of the wide practical applications of some of the devices may be given here In many instances serious maladjustments

follow when 'hate' absorbs the whole of the affective energy of the given individual In such extreme cases 'hate' exhausts the *limited* affective energy No energy is left for positive feelings and the picture is often that of a dementia praecox, etc. Thus an individual 'hates' a *generalization* 'mother', 'father', etc, and so by identification 'hates' 'all mothers', 'all fathers', etc, in fact, hates the whole fabric of human society, and becomes a neurotic or even a psychotic Obviously, it is useless to preach 'love' for those who have hurt and have done the harm Just the opposite; as a preliminary step, by *indexing* we *allocate* or *limit* the 'hate' to the individual $Smith_1$, instead of a 'hate' for a generalization which spreads over the world In actual cases we can watch how this allocation or limitation of 'hate' from a generalization to an individual helps the given person The more they 'hate' the individual $Smith_1$ instead of a generalization, the more positive affective energy is liberated, and the more 'human' and 'normal' they become It is a long struggle, but so far empirically invariably successful, provided the student is willing to work persistently at himself.

But even this indexed *individualized* 'hate' is not desirable, and we eliminate it rather simply by *dating* Obviously $Smith_1^{1920}$ *is not* $Smith_1^{1940}$ and most of the time $hurt_1^{1920}$ would not be a 'hurt' in 1940 With such types of orientations the individual becomes adjusted, and serious improvements in family and social relationships follow, because the student has trained himself in a general method for handling his own problems.

Similar mechanisms of generalization through identifications are involved in morbid and other generalized *fears* which are so disastrous for daily adjustment Because *thalamic factors are involved*, these difficulties are helped greatly or eliminated by a similar use of the extensional devices to individualize and then date the allocated fears

What a heavy price we may sometimes pay for the disregard of extensional devices in connection with the structure of language, can be illustrated no better than by the life history and work of Dr Sigmund Freud In his writings Freud ascribed *one* intensional undifferentiated 'sex' even to infants, which revolted public opinion If Freud would have used the extensional devices he would not have gotten into such detrimental professional and other difficulties He would not have used the fiction 'sex' without indexes, dates and quotes, and he would have explained that an infant has a ticklish organ which could be labelled 'sex_0' at birth, 'sex_1' at the age of one, 'sex_2' at the age of two, etc These are obviously different in life, but the differences are hidden by the one abstract definitional term 'sex', and made obvious only by the extensional techniques

Let us be frank about it The intensional abstract 'sex' labels a fiction By extension or facts, 'sex' varies with every individual not only with age (dates), but in relation to endless other factors, and can be handled adequately only by the use of extensional devices.

4 *IMPLICATIONS OF THE STRUCTURE OF LANGUAGE*

In what is said above we were already dealing with the change from an intensional to an extensional *structure* of language, and so orientation We can investigate a step further, and find that the aristotelian structure of language is in the main *elementalistic,* implying, through structure, a split or separation of what in actuality cannot be separated For instance, we can verbally split 'body' *and* 'mind', 'emotion' *and* 'intellect', 'space' *and* 'time', etc , which as a matter of fact cannot be separated empirically, and can be split only verbally These elementalistic, splitting, structural characteristics of language have been firmly rooted in us through the aristotelian training It built for us a *fictitious animistic world* not much more advanced than that of the primitives, a world in which under present conditions an optimum adjustment is in principle impossible

In a non-aristotelian system we do not use elementalistic terminology to represent facts which are non-elementalistic We use terms like 'semantic reactions', 'psychosomatic', 'space-time', etc , which eliminate the verbally implied splits, and consequent mis-evaluations. In the beginning of my seminars when I am explaining space-time, students often react by saying, 'Oh, you mean "space" *and* "time" '. This translation would abolish the whole modern advances of physics, because of the structural implications of a delusional verbal split. Similarly the habitual use of the non-elementalistic term 'semantic reactions' eliminates metaphysical and verbal speculations on such elementalistic fictions as 'emotion' *and* 'intellect', etc , considered as separate entities

Unfortunately these considerations of structural implications have been entirely disregarded in daily life even by scientists, often befuddling issues very seriously Thus, the term 'concept' is widely used, and the users are not conscious that this term has elementalistic implications of 'mind' or 'intellect' taken *separately,* which then become verbal fictions. The actual facts, however, can be simply expressed with correct structural implications What is called 'concept' amounts to nothing more or less than a verbal *formulation,* a term which eliminates the false-to-fact implications Students of general semantics are strongly advised never to use the elementalistic term 'concept', but the non-elementalistic 'formulation' instead We could eventually berate and ridicule people for their

old neuro-linguistic habits, but in our work we take the *neurological attitude* and realize the difficulties of linguistic habits and neurological recanalization. From this point of view we only face understandingly the inherent difficulties I can even now hear the reactions of some of my readers, 'I fully agree with you, and I believe it is a very fine *concept*'! And so it goes

From the above it becomes obvious that without changing the language itself, which is practically impossible, we can easily change the *structure* of language to one free from false-to-fact implications This change is feasible

Another example may make issues clearer Thus the intensional verbal definition of 'man' or 'chair', etc, brings to our consciousness *similarities,* and, so to say, drives the *differences* into the 'unconscious' In a world of processes and non-identity it follows that no individual, 'object', event, etc, can be the 'same' from one moment to the next And so individualizing (indexes) and temporal devices (dates), etc, should be used *conjointly* Thus, obviously chair_1^{1000} is not the 'same' as chair_1^{1940}, nor is $\text{Smith}_1^{\text{Monday}}$ the 'same' as $\text{Smith}_1^{\text{Tuesday}}$ Orientations in such extensional terms bring to our consciousness not only similarities but also differences Through training in the consciousness of abstracting we become aware that characteristics are left out in the process of abstracting by our nervous systems, and so we become conscious of the possibility that new factors may arise at any time which would necessitate a change in our generalizations

Once more we can get a bit of wisdom from mathematical method I believe it was the great mathematician Sylvester who said that 'in mathematics we look for similarities in differences and differences in similarities', which statement should apply to our whole life orientation This is made uniquely applicable to life by the new non-aristotelian extensional structure of language and so orientations.

The reader will find in this work the use of certain terms which, although they are standard English words, are not habitually used The terms used here have been carefully selected and tested, and found to be more similar to the structure of the actual facts The power of terminology, because of its *structural implications,* is well known in science, but is entirely disregarded in our daily neuro-linguistic habits

It is shocking to realize that even such scholarly aristotelians as the Jesuits, and other devotees, are unable *or unwilling* to comprehend the obvious structural modern neuro-semantic and neuro-linguistic facts When confronted with them they hide behind a verbal smoke screen of medieval terms such as 'nominalism', 'realism', etc, which in modern sci-

ence are hopelessly antiquated, useless, confusing, and so eventually harmful Their attitude even today is that all those problems were settled and disposed of by different monks in the Middle Ages Modern researches reveal that nothing of the sort was settled or disposed of, and that a new, up-to-date revision is necessary to eliminate the false knowledge from which present day tragedies follow automatically. The reader is referred to the Encyclopaedia Britannica under such terms as 'nominalism', 'realism', and related terms

Section G $\frac{Over}{Under}$*defined terms* *

As was explained before, for a revision of a system we must first get outside of the system Only after producing a non-aristotelian extensional system can the aristotelian intensional structure of our traditional system and language be properly evaluated.

Here we introduce a most important technical term which describes a fundamental characteristic of a correct attitude toward language, namely, that most terms are '$\frac{over}{under}$defined' They are over-defined (over-limited) by intension, or verbal definition, because of our *belief* in the definition, and are hopelessly under-defined by extension or facts, when generalizations become merely hypothetical For instance, the euclidean parallels with their equal distance are over-defined by intension and under-defined by extension, as 'equal distance' is unnecessary and also is denied by facts Similarly the newtonian equations are over-defined (over-limited) by intension, while under-defined by extension, which includes the necessary finite velocity of a signal (Lorentz-Einstein)

From these two examples alone we may see how heavy the problem is, as the discovery of a new important factor makes it obvious that most generalizations must be $\frac{over}{under}$defined, depending upon whether our attitude is intensional or extensional Unfortunately only those who have studied psychiatry and/or general semantics can fully comprehend the difficulties involved Different maladjusted, neurotics, psychotics, etc., orient themselves by intension most of the time. This means they evaluate by over-definition, just because they *believe* in their limited verbal-

* The term 'over-defined class' was introduced to the best of my knowledge by Dr A S Householder This term is inadequate for our purpose, as it disregards the problems of intension and extension, which represent different types of evaluation Besides, the term 'class' is very ambiguous In science and life we deal mostly with $\frac{over}{under}$defined *terms*, as will be explained

isms, and not by extensional facts, which make us conscious of under-definition

To make this fundamental difficulty clearer I will use a rather trivial illustration. The dictionaries define 'house' as a 'building for human habitation or occupation', etc Let us imagine that we buy a house, this buying is an extensional activity, usually with some consequences If we orient ourselves by intension we are really buying a definition, although we may even inspect the house, which may appear desirable, etc Then suppose we move into the house with our furniture and the whole house collapses because termites have destroyed all the wood, leaving only a shell, perhaps satisfying to the eye Does the verbal definition of the house correspond to the extensional facts? Of course not It becomes obvious then that by intension the term 'house' was over-defined, or over-limited, while by extension, or actual facts, it was hopelessly under-defined, as many important characteristics were left out In no dictionary definition of a 'house' is the possibility of termites mentioned

'Philosophers', etc, and 'philosophizing' laymen, if they ever will be able to face facts and verbal paradoxes, will have a merry time arguing back and forth about the above human and neuro-linguistic situation because they know nothing about psychiatry and *empirical* data of general semantics Without serious neuro-linguistic study, including the 'philosophical treatises' of 'mentally' ill in hospitals, they will not be able to understand why, by intension or *belief* in verbal definitions, most terms are hopelessly over-defined, while by extension they are hopelessly under-defined Their analysis of intensional 'over-definitions' will be *extensional by necessity,* and they will have great difficulties in realizing the very important fact that we deal for the most part *only* with $\frac{\text{over}}{\text{under}}$-defined terms

I must stress again that this difficulty is not inherent in our language as such, but depends exclusively on our *attitude* toward the *use* of language

The ignorance of 'philosophers', etc, about *neuro*-semantic and *neuro*-linguistic issues is not only appalling, but positively harmful to sanity, civilization and culture To justify their own existence in civilization they should have investigated such problems professionally long ago, and incorporated them in their work Even the present world tragedies are one of the results of their intensional delusional *neuro*-semantic and *neuro*-linguistic detachment Present day totalitarianisms were built by the dumping on the human nervous systems of such terms as 'communism,' 'bolshevism,' etc, which induced corresponding fearful signal

reactions (see chapter XXI) of the ruling classes, resulting in their imbecilic and suicidal behaviour The ruling classes welcomed in many ways the totalitarians as an eventual safe-guard of their personal selfish interests The extensional results are that the dreaded 'communists' and 'bolshevists' have united with the totalitarians, and today, 1940, the 'communists' are as 'imperialistic' as any czar has ever been

To give another example of $\frac{\text{over}}{\text{under}}$defined terms, it may be helpful to cite a paradox formulated by the mathematician Frege in connection with linguistic difficulties underlying mathematical foundations.

In a village there was only one barber, who shaved only those who did not shave themselves The question arises whether the barber shaves himself or not. If we say 'yes,' then he did not shave himself; if we say 'no,' then he shaved himself In daily life we deal all the time with such paradoxes, which if not clarified result only in bewilderment.

The *term* 'barber' *as a term*, since it omits the living human being, is a label for a fiction, because there is no such thing as a 'barber' without a living human being By extension the given specialist in shaving, Smith_1, is not so simple He is peppered with complex chain-indexes and dates Thus, Smith_{1_1} may be by profession a barber, Smith_{1_2} may be a father, Smith_{1_3} may be a member of the village council, and anyway Smith_{1_n} is a living person who has his own life and personality outside his profession, and ultimately he has to shave himself if he does not want a beard, verbalism or no verbalism Obviously the *term* 'barber' is over-defined, over-limited, by intension, and is under-defined by extension.

One of my co-workers, commenting on this paradox, suggested that the barber may be a woman and have no beard, or, the barber may be a beardless hermaphrodite or eunuch, or, the barber may have a full beard. Thus, we have only traditionally assumed, in analyzing this old paradox, that the barber was a man with a beard which was somehow shaved.

The difficulties of this $\frac{\text{over}}{\text{under}}$defined terms situation affect not only our daily lives, but science as well. For example, H_2O is by intension or definition over-defined, by extension or in practice we do not deal with 'pure' H_2O, which is only a symbol on paper, because actually unavoidable impurities are always present.

Similarly let us consider *'blood transfusion'* In the beginning we used the term 'blood transfusion' as over-defined, by extension it turned out to be under-defined, because different bloods have different characteristics, and often blood of one type killed the patient who had blood of another type

Here I will list a few of the many heavy terms we use in science and

daily life which are the cause of endless verbal bickering and confusion, because of our lack of realization of their $\frac{\text{over}}{\text{under}}$defined character, depending uniquely on our attitudes Terms such as *variation* in biology and anthropology, *learning, frustration, education, needs, intelligence, instincts, genius, teacher, leadership, love, hate, fear, sex, man, woman, infantilism, maladjustment, dementia praecox, personality, democracy, totalitarianism, dollar, god, gold, war, peace, aggression, neutral, jew, number, velocity,* etc , etc , can serve as illustrations

One psychoanalyst suggests *ego* and *super-ego,* another writes 'I could quote you a considerable part of psychoanalytic terms'. An epistomologist says, '*Meaning* is a forbidden term in my courses . . . In linguistics the terms *phoneme, word, sentence* are mazes of confusion. . . . *Philosophy* is in as bad a situation *Metaphysics* is even worse' To quote a prominent anthropologist: '$\frac{\text{Over}}{\text{Under}}$definition is notably common in the field of so-called social anthropology in which students attempt to disregard the human organism and deal with human affairs as discrete phenomena'. For example, '*culture* may be technology, morals, philosophy, or a wooden leg—all most vaguely formulated . . When some change in the anatomy and physiology of the organism is attributed to *environment,* the latter term is not broken down into climate, rainfall, food supply, etc *Social environment* may be arts, industries, law, morals, religion, familial institutions, tradition, etc'

The following comment by a mathematician shows the generality of this problem· 'A term would seem to be extensionally under-defined so long as we cannot in practice exhaust its instances by enumeration But this much is true of just about every term of the kind traditionally known as "general concrete", e g *house, dime, star, neurone'*

A journalist suggests 'As an example recently come to our attention I would mention those magic words *Monroe Doctrine* Even when Mr. Hull discusses it, as he does as nearly correctly as anyone "in the know", he omits some real facts, such as the economic implications of overturning the international *status quo* in this hemisphere But when Japan and/or Germany (high order abstractions as used here) refer to Asiatic and/or European Monroe Doctrines, the meaning of the original words has been completely metamorphosed through $\frac{\text{over}}{\text{under}}$definition The American accepted meaning includes no actual control of those falling within the doctrine's sphere, whereas Japan and Germany mean an actual hegemony in their respective spheres The relationship between ours and theirs is therefore a vast confusion of terms

'Then consider the *incidents* growing out of *insults* in the interna-

tional fields. What is an insult? It is usually pure verbalism with great affective characteristics manipulated to sway others as the swayer directs To bring it into the domestic field, call a *Republican* (what is that?) a *New Dealer* (again, what is that?) and the fur begins to fly'

A leading moving picture executive says that actors have frequent verbal arguments about what is *funny* The only thing to do is to try it before an audience 'If it makes them laugh, it may be termed *funny* If it fails to make them laugh, it is *not funny*' In the meantime, 'your audience may tell you that the subject in dispute is neither funny nor not-funny. It is merely boring'

There is no need to give further examples here, as practically the whole dictionary could be quoted In my enquiry concerning $\frac{\text{over}}{\text{under}}$defined terms in many fields I got a number of answers which were very fundamental, which I gratefully acknowledge Some replies were to the effect that 'I would gladly give you examples such as you ask for, but I do not think I have any that would be new to you', which shows their understanding of the problem Yet the most extensional answer was given by that brilliant jurist, Dr Robert M Hutchins, who sent to me his Convocation Address of June, 1940 with a letter, which he has kindly given me permission to quote, as follows: 'I am afraid you will feel that all the words I use are examples of the errors you are attacking Here is my last Convocation Address, with a sample in every line' Such a judgement is profoundly justified whenever language is utilized This address is a splendid piece of work, and it implies the intuitive recognition of the fundamental neuro-linguistic difficulties we are up against

But an intuitive grasp by exceptional persons does not make that recognition *teachable* in general education. We need crisp, general *methodological formulations* which will make people aware of the rôle the structure of language plays in affecting our types of reactions For instance, our language may be elementalistic or non-elementalistic, intensional or extensional, in structure, etc We discover also the fundamental multiordinal character of the most important terms we have, the $\frac{\text{over}}{\text{under}}$defined character of most of our terms, etc

As the difficulties mentioned here are inherent in our neuro-semantic and neuro-linguistic mechanisms, which control our reactions, the only possible safe-guard against the dangers of hopeless bewilderment, fears, anxieties, etc, is the *consciousness of the mechanisms* Certainly 'philosophers', 'logicians', psychiatrists, educators, etc, should be aware of these problems, and introduce this consciousness even in elementary education and in psychotherapy

The problem of $\frac{\text{over}}{\text{under}}$defined terms is very difficult to explain briefly. It is discussed more fully in two of my papers presented before professional societies *

Section H The passing of the old aristotelian epoch

1 *'MAGINOT LINE MENTALITIES'*

Present day scientific researches and historical world developments show there is no doubt that the old aristotelian epoch of human evolution is dying The terrors and horrors we are witnessing in the East and the West are the deathbed agonies of that passing epoch, and not the beginning of a new system The changes of historical periods in human development are often accompanied by the disorganization, and sometimes acute suffering, of mankind, and the price is bound to be paid by one or more generations

I doubt if in the whole of human history there is a more accentuated illustration than the tragic and sudden collapse, in the summer of 1940, of the French government and army, and eventually of French culture and 'democracy' The degree of stupidity, treachery, graft, dishonesty, ignorance, and ultimately decadence, etc , the French plutocrats and politicians, and so-called 'intelligentsia' displayed is unprecedented, particularly because of the fine historical record the French have had. We test the freshness or deterioration of fishes by smelling the head end, and as we know at the date of this writing, the head ends of the French 'democracy' have a putrid odor This deterioration affected the French military men, who once were the finest in the world, and so the collapse was complete I can give no better, no more pitiful, no more shocking illustration of the collapse of the old system

The 'Maginot line mentality' will become a historical classic, and will be applied quite appropriately to other than military fields It means a thoughtless, self-deceptive, etc , 'security' in antiquated systems as matched against modern methods of 1940 Well, the French Marianna felt secure from the front and was taken from behind by the German army men, who traditionally pay no attention to such 'details'.

* (a) *General Semantics Monographs No II* General Semantics [illegible] Extensionalization in Mathematics, Mathematical Physics and Ge[illegible] purp[illegible] 35; [illegible] ets of [illegible]
II Thalamic Symbolism [illegible] Mathematics, [illegible]
These [illegible]
[illegible]

Dealing with those tragic and painful collapses in civilizations, and eventually passing to another spasm of civilization, what interests us most in considering the problems of sanity, is the newest, psychopathological methods of destroying sanity, not merely the organized orgies of murder, rape, arson, looting, drugging, and destruction under different dictators, mikados, etc

I mention the 'mikado' especially here as a tragic human example of the effect of $\frac{\text{over}}{\text{under}}$defined terms, which in *life application* sway the history of mankind By definition and/or creed the mikado is supposed to be some sort of a 'god', etc By extension or facts, the best we know, he is probably a sort of a nice, supposedly educated, collegian He has a wife and makes babies, but he is told about Japanese people, the behaviour of Japanese troops in China, etc , only as much as the ruling clique in Japan allows him to know If he would be allowed to know what 'his' soldiers, and so his representatives, are *actually* doing in China with their *governmentally organized* murder, rape, looting, drugging, etc , I doubt if he, as a 'nice collegian', would approve it However, if he would try to do something about it, he probably would be 'liquidated' by the ruling clique From a historical, civilization, human point of view he must be adjudged responsible, as the head of his government, for what the ruling clique and the Japanese army do in China in his name

This applies to many other 'rulers', who seldom know what is going on extensionally because they rely on the use of $\frac{\text{over}}{\text{under}}$defined terms in the reports of those who are in *actual* control Ignorance in high places cannot humanly be an excuse

Imagine a British empire tolerating so long a Chamberlain in the government, or the endless petty, befuddling, deluding, etc , bickerings of political partisanship, which are good enough to wreck any system of 'democracy' (in practice another $\frac{\text{over}}{\text{under}}$defined term).

It seems, however, there is at least one point the totalitarian and 'democratic' politicians have in common, best expressed by Kipling

''Ow the loot!
Bloomin' loot!
[illegible] the thing to make the boys git up an' shoot!
[illegible]ith dogs an' men,
[illegible]ome aga

[illegible]ion and in psychotherapy

2 *WARS* OF *AND* ON *NERVES*

It was explained already how the introduction of new factors is bound to change our generalizations and therefore evaluations. But this somehow is disregarded by most rulers and politicians who are on the defensive, while those who are on the offensive introduce new psycho-logical factors to confuse the old generalizations, as a rule successfully. Politicians, gangsters, military men, etc, without any understanding of the depth of destructiveness to the human nervous systems, utilize these methods quite successfully Magicians have studied those methods professionally, but they utilize them for entertainment, not for destruction

These destructive methods are the bases of the 'war *of* nerves', and the 'war *on* nerves', etc, to the point of using '*screaming*' bombs, verbal distortion, the 'psychology' of deception, etc These methods can be counteracted *only* when governments who feel their responsibility not only to the ruling classes, but also to the *people* of their nations, will employ experts in neuro-psychiatry, anthropology, general semantics, etc, for guidance, if the present world neurosis is to be checked

There are persistent reports that the Nazi government is utilizing a staff of psycho-logical experts for *destructive* purposes Other totalitarian governments ape their successfully worked out and tested methods The 'democratic' governments in this present fundamental *nerve contest* appear a tragic joke of ignorance, inefficiency, etc In practice this amounts to betrayal, because they fail to recognize the overwhelming importance and vulnerability of the human nervous system, and do not utilize such experts in a *constructive* way The 'scream' of a bomb, for instance, is much more destructive to the 'enemy' than the destruction by the bomb itself, which may kill a few people at the cost of at least $100,000 per corpse, while the 'scream' alone brings demoralizing terror to hundreds, if not thousands of people It is certainly an expertly calculated and efficient 'war *on human* nerves' But what can be done if ignorant 'democratic' governments refuse to live up to their duties?

Humanity, civilizations, cultures, etc, are ultimately based on the constructive use of neuro-semantic and neuro-linguistic mechanisms present in every one of us Many pathological Nazi leaders utilize these constructive mechanisms in civilization for destructive selfish purposes. Under experts they have turned against mank[illegible] ets of mankind The beginning [illegible]s 'mental' [illegible] nates [illegible]

fully because of the abysmal ignorance of modern scientific issues exhibited by the political verbalists and enchanters of other nations.

One of the most effective of these methods is the use of *pathological verbal distortion* such as is found among the 'mentally' ill For instance, a paranoiac may believe 'honestly' that he is persecuted, become dominated by 'hate', etc , and ultimately may kill to 'defend' himself. Unfortunately at present only psychiatrists, familiar with verbal distortions and 'rationalizations' of patients in hospitals, can fully understand these problems.

A 'mentally' ill person is not necessarily a 'genius,' but it is well known to psychiatrists that some 'mentally' ill are often very cunning and will outwit any doctor or nurse At present the people of the world do not realize that they are being trained in psychopathological uses of their nervous systems, and a future generation or two will become semantically crippled because trained in such distortions

The violation, through ignorance and/or *un*-sanity, of the similarity of structure in the map-territory relationship (see p 58 ff and p. 750 ff), and/or deliberate, professionally planned distortion of it, abolishes predictability, proper evaluation, trust, etc This results only in breeding fears, anxieties, hates, etc , which disorganize individuals and even nations There must be a correspondence and similarity of structure between language and facts, and so consequent thalamo-cortical integration, if we are to survive as a sane 'civilized' race

In a few years history will judge these dying spasms of the aristotelian system, a system which was the best of its kind 2,300 years ago, as formulated by a great man under the conditions of the very few scientific facts known at that date It is not so today, 1941 Most of the knowledge of scientific facts and methods of Aristotle are obsolete today, and in the main harmful, like the 'Maginot line' orientation

By necessity the aristotelian system was based on macroscopic or animal, 'sense', levels, which even now predominantly guide the masses It could take into consideration 'sense' data, etc , but cannot deal adequately with 1941 cultural as well as sanity conditions which, as we know today, are resultants of sub-microscopic, electro-colloidal processes

In a non-aristotelian system we are stressing the differences between the animal reflex automatic *signal* reactions, which do not involve 'thinking' [illegible] and human *symbol* reactions, with their [illegible]tions, etc These differences could

Professor Pavlov, Dr Chakotin bases his analysis of totalitarian methods on Pavlov's fundamental researches of conditional reactions in dogs

3 *HITLER AND PSYCHO-LOGICAL FACTORS IN HIS LIFE*

The groping dissatisfaction with the old system was so general that only a catalyst was needed to precipitate the crisis This catalyst was found in the son of Alois Schicklgruber (also spelled Schucklgruber) who later changed his name to 'Hitler' There was a history of illegitimacy in the family Rudolf Olden in his biography of Hitler says, 'Hitler has given the simplest and clearest picture possible of conditions in his father's home But we have only to look at the facts to see that, far from being simple, the married life of his father was unusual and tempestuous Three wives, seven children, one divorce, one birth before marriage, two shortly after the wedding, one wife fourteen years older than himself and another twenty-three years younger—that is saying a good deal for a Customs officer'

There were other important circumstances in Adolf Hitler's life which were influential and found their fulfillment in totalitarian systems (*a*) He was born from a peasant stock, by tradition prepared to carry a heavy load of work with persistency (*b*) He was baptized in the Catholic Church, an institution well known to have totalitarian orientations, and which up to this day in principle proclaims authority over 'all' the Catholics in the world Having absorbed that totalitarian orientation from childhood up, which applies also to Mussolini, Stalin, etc, it was simple for those so trained to switch to *state totalitarianism,* where such leaders could find a 'lebensraum' for themselves as individuals, thus enhancing their own 'egos', and incidentally filling their pockets No one who has actually studied the public appearances of various totalitarian 'fuhrers' can miss the utter similarity between their reactions and the reactions of the mobs to them. They act like little 'gods on wheels', and the mobs react with unreasoned, blind, fanatical subjection, which the fuhrers and their aides know how to manufacture

(*c*) Hitler was born into Austrian bureaucracy, one of the most inefficient, dishonest, hypocritical, etc, bureaucracies in the world, permeated with the Hapsburg motto, 'Divide et impera'. The older Schicklgruber wanted his son also to become a Hapsburg bureaucrat Schicklgruber, Jr had a natural repulsion for them, and so deliberately boycotted any education, to disqualify himself for such a fate This lack of education ostracized him from the class of so-called 'intelligentsia', to which a Hapsburg bureaucrat eventually belonged Through living necessities he had to become a plain labour hand, yet because of his para-

noia tendencies, delusions of grandeur based on unhealthy worship of historical 'heroes', etc, he was also not acceptable to the plain workers, who are generally sane and do not look at life as a Wagnerian opera So in reality he found that he was not acceptable anywhere, belonged nowhere. a misfit everywhere, until he adhered to totalitarianism as a 'religion' which he and his closest associates modified to suit the Prussian character, selected by them as a standard of German perfection, to be imposed on the rest of the world

(*d*) When he joined the German army with its orderly efficiency, etc., he found an ideal for himself as an escape from Hapsburg decadence No matter how he hated the Hapsburg polite perfidy, he was too much of an Austrian not to utilize to the limit the Hapsburg methods Ultimately through this combination of methods he 'out-Prussianed' the Prussians, whose particular arrogant, brutal methods were never approved and often disliked throughout the world and even in Germany

I give these data as partial explanations of how through life and other circumstances the whole life of Hitler, as well as his political program, was based on hate, revenge and destruction of what he feared and hated as a person, driven by his delusions of persecution and grandeur It was only natural in his 'chosen people' delusion that he should hate and try to destroy other 'chosen people', obviously there is no place in this world for two or more 'chosen people' The absurdity of Hitler's ignorant anthropological theories has been definitely established by science and history, and in fact are not taken seriously by many of the informed Nazi leaders themselves

Some such analysis of a few of the more important factors in Hitler's life indicates how his 'mental' illness developed, involving 'inferiority' and 'persecution' complexes, etc, and explains why for his own comfort he surrounded himself personally with mostly psychopathological people, although their psychiatric classifications may be different

Very soon psychiatric treatises will be written on the 'Jehovah complex' of Schicklgruber, Jr, etc. Perhaps the following quotations will illustrate how the 'Jehovah', as recorded in *Exodus* 19 and 20, is being copied today.

'Now therefore, if ye will obey my voice indeed, and keep my covenant, then ye shall be mine own possession from among all peoples. for all the earth is mine and ye shall be unto me a kingdom of priests, and a holy nation These are the words which thou shalt speak unto the children of Israel [Nazis] '

Or, 'I am Jehovah thy God, who brought thee . . . out of the house of bondage [England] '

Or, 'for I Jehovah thy God am a jealous God, visiting the iniquity of the fathers upon the children, upon the third and upon the fourth generation of them that hate me, and showing mercy unto thousands of them that love me and keep my commandments'

Or, 'An altar of earth thou shalt make unto me, and shalt sacrifice thereon thy burnt-offerings, and thy peace-offerings, thy sheep, and thine oxen in every place where I record my name I will come unto thee and I will bless thee' Etc, etc

These suggestions are given only to indicate how psychiatrists can help future historians

4 *EDUCATION FOR INTELLIGENCE AND DEMOCRACY*

It may become clearer why I speak of a dying, aristotelian, two-valued system by giving examples of how this type of evaluation is at the foundation of present day confusions and terrors Thus, for instance, the Nazi militant delusion of 'chosen people' gives us an excellent illustration of a two-valued, 'either-or' orientation The two-valued semantic twisting of 'real neutrality' is another significant example This distortion has kept the 'neutrals' in terrors, disorganizing their national and political life to the point of complete collapse, which today is a historical fact. The Nazi two-valued evaluation of 'neutrality' was. *either* be 'really neutral' and endorse and fight for the Nazis, *or* be 'not really neutral' and not help them According to this orientation a 'really neutral' Belgium, Holland, Denmark, Norway, etc, should fight against England, France, etc, to prove that they are 'really neutral'!

A similar analysis applies to the 'aggression' of China *against* Japan, Czechoslovakia *against* Germany, Poland *against* Germany, Poland *against* Russia, Finland *against* Russia, Greece *against* Italy, etc, and so on endlessly, which shows only the pathological application of the two-valued, 'either-or' patterns *in action* This analysis applies also to the first World War and the 'war guilt' In a non-aristotelian orientation we ask for actual facts, and do not accept mere verbalism Who invaded whom? The historical facts are simple We know by now *who invaded whom,* and never mind verbal definitions

When analysed *from a non-aristotelian point of view,* such orientations appear pathologically twisted Yet they produced results, as history shows It is not accidental that some years ago Hitler in one of his speeches took a definite stand for the prevailing aristotelianism, two-valued orientations, etc, and against modern science, which naturally develops in a non-aristotelian direction Quite soon whole volumes will

be written on this subject, here it is possible only to indicate the main *methodological* issues involved

Dr Irving J Lee in his article, 'General Semantics and Public Speaking', *Quarterly Journal of Speech,* December, 1940, formulates a fundamental contrast between the types of 'rhetorics' of Aristotle and Hitler, and the non-aristotelian type of communication found in general semantics which is based on proper evaluation, made possible by thalamocortical integration

We should not make the mistake of fancying that Hitler, etc , or the mikado are building a new non-aristotelian system, and a future new saner civilization It is only a rebellion *within* the old 'either-or' system, a changing from one scheme of selfishness, greed and force to another cabal of selfishness, greed, and brute force, this time unavoidably lowering human cultural standards by training future generations in pathological abuses of neuro-semantic and neuro-linguistic mechanisms, emasculating and misusing science, etc

A non-aristotelian system must include considerations of neuro-semantic and neuro-linguistic environments as environment Introductions of such new factors necessitate a complete revision of all known doctrines, pet creeds, etc , and make possible the building of a *science of man,* which under the old aristotelian conditions was impossible The tabulation given here indicates some of the many older fictitious factors which have been eliminated as false to facts and destructive, while new, constructive factors have been introduced This by necessity requires the utilization of more adequate methods and techniques by which we can cope with a new world

The new, non-aristotelian types of evaluations are forthcoming in every field of human endeavour, in science and/or life, necessitated by the urgencies of modern conditions The main problem today is to formulate *general methods* by which these many separate attempts can be unified into a general system of evaluation, which can become communicable to children and, with more difficulty, even to adults History shows that whenever older methods prove their inefficiency new methods are produced which meet the new conditions more effectively. But the difficulties involved must first be clearly *formulated* before methods and techniques can be devised with which we can deal with them more successfully

It seems unnecessary to enlarge on the present day world tragedies because many excellent volumes have already been written and are continuing to accumulate, psychiatric evaluations included I must stress, however, that no writer I know of has ever understood the depth of the

pending transition from the aristotelian system to an already formulated non-aristotelian system This transition is much deeper than the change from merely one aristotelian 'ism' to another

We argue so much today about 'democracy' versus 'totalitarianism' Democracy presupposes intelligence of the masses,* totalitarianism does *not* to the same degree But a 'democracy' without intelligence of the masses under modern conditions can be a worse human mess than any dictatorship could be ** Certainly present day education, while it may cram students' heads with some data, without giving them any *adequate methodological synthesis* and extensional working methods, does not train in 'intelligence' and how to become adjusted to life, and so does not work toward 'democracy' Experiments show that even a root can learn a lesson (see p. 120), and animals can learn by trial and error But we humans after these millions of years should have learned how to utilize the 'intelligence' which we supposedly have, with some predictability, etc, and use it *constructively,* not *destructively,* as, for example, the Nazis are doing under the guidance of specialists

In general semantics we believe that some such thing as healthy human intelligence is possible, and so somehow we believe in the eventual possibility of 'democracy' We work, therefore, at methods which could be embodied even in elementary education to develop the coveted thalamo-cortical integration, and so sane intelligence Naturally in our work *prevention* is the main aim, and this can be accomplished only through education, and as far as the present is concerned, through *re*-education, and *re*-training of the human nervous system

Section I. Constructive suggestions

As far back as 1933, on page 485 ff of the present book, I drew attention to the human dangers of the abuse of neuro-semantic and neuro-linguistic mechanisms, with suggestions for preventive measures In September, 1939, I advanced further constructive suggestions to some leading governments, urging the employment of permanent boards of neuro-psychiatrists, psycho-logicians, and other specialists, to counteract similar dangers in connection with the present world crises I received only *two* polite acknowledgements of my letters But both forewarnings of 1933 and 1939 have been disregarded in practice, even by specialists, with known disastrous results

* Mumford, Lewis *Men Must Act* Harcourt, Brace, New York, 1939

** Consult, for example, comments of Supreme Court justices about the impossibility of 'justice' when juries are made up of individuals of *low grade* 'mentality', etc

In the meantime the more far-sighted Nazi government employed a staff of specialists working at methods to *disorganize* the nervous functioning of their adversaries which, as facts show, have worked very successfully and devastatingly upon the unlucky citizens whom the short-sighted, unscientific, etc, governments never guided toward the proper use of their nervous systems, or safe-guarded from the abuses *

Perhaps at present, 1941, after some irreparable harm has been done, the governments of the world will awaken and realize that the proper functioning of the nervous systems of their citizens is in many ways more important than any gun, battleship or aeroplane, etc, could possibly be, as there must be a $Smith_1$ behind the gun!

No matter who is finally 'victorious' in the present world struggle, no matter which way we look at it, the return to the old conditions is impossible A complete neuro-semantic and neuro-linguistic revision is inevitable, and this revision is bound to lead away from aristotelianism. For this revision we are preparing the foundations in the formulations of general semantics Before any lasting adjustments in the future social, economic, political, ethical, etc, fields are accomplished we have to be able to *evaluate properly and talk sense.* Otherwise the situation is hopeless

Obviously, regardless of what the 'politicians' may say, in every country we necessarily have some kind of guidance by the government and executive power, no matter in what direction Even 'complete lack of guidance' must be considered guidance of some sort, in the direction, say, of 'rugged individualism', etc, which, if carried to the limit, becomes the unworkable ideal of anarchy In practical life such attitudes ultimately engender animal competition instead of human co-operation, and the very opposite of what we consider as the social feeling imperative for 'democracy'

The real question is whether the existing governments are informed enough about human neurological problems, sanity, etc, and are intelligent enough, honest enough, etc, to guide and advise their people *constructively and efficiently* in constantly emerging *neurological situations* such as occur in home and school lives, in national and international affairs, etc Unfortunately the answer is in the negative At present there is no such government I know of The Nazi government, on the other hand, has mobilized the psycho-logical knowledge available to them for *destructive* purposes, which must be *professionally counteracted* by the rest of the governments of the civilized world, if sanity is to prevail.

* Taylor, Edmond *The Strategy of Terror* Houghton-Mifflin, Boston, 1940

Depending on science for more and better killing *machines* is certainly not the solution for *human* problems, culture and civilization Without being sentimental, in a human civilization humans matter more than machines, or symbols such as a 'dollar', a 'pound sterling', a 'pound of flesh', a 'scalp', etc , or such verbal generalizations as 'liberty', 'equality', etc The *living reactions* of $Smith_1$ are more important than the verbalisms of $Smith_1$, who nevertheless can shake the air with his verbal tricks, as many of us too often do, affecting the nervous systems of others

At present the totalitarians have exploited neuro-semantic and neuro-linguistic mechanisms to their destructive limit, the best they knew how, to date Counteraction, reconstruction, and/or prevention are impossible unless such mechanisms are utilized *constructively* under the guidance of governmental specialists in the fields of anthropology, neuro-psychiatry, general semantics, etc , who would understand the language of their fellow workers in related scientific fields, and would be *free to devote their entire time and efforts to this task, and to further investigations*

Although practically all civilized states employ psychiatrists in their governmental hospitals for 'mentally' ill, these physicians are necessarily preoccupied with their patients and cannot undertake the special duties of the board I suggest Such a board would require the full time and attention of its members, as they would be called upon for consultation by various other governmental departments such as interior, state, labour, commerce, health, army, navy, etc , and so special studies and co-ordinating knowledge in related branches of science would be essential

It seems extremely short-sighted in 1941 that governments should employ permanently specialists in chemistry, physics, engineering, etc , other specialists who advise how to eliminate lice from poultry, raise pigs, conserve wild life, etc —and yet have no *permanent* consulting board of specialists who would advise how to conserve and prevent the abuse of human nervous systems Even a Chamberlain would have intelligence and/or honesty enough to pass a problem of a 'magnetic mine' to physicists and engineers, and not to party politicians, who know nothing about such mechanisms, but would nevertheless be ready to debate 'politically' on the subject

For example, if consulted, such a suggested body of governmental specialists would have studied *Mein Kampf* and various speeches of Hitler, Goebbels, etc , as a part of their duties, long ago, and would have advised their governments that psychopathological people are getting in control of world affairs and that their words cannot be trusted at all.

There would have been no 'appeasements', etc , and other measures would have been taken to cope with the depth of the problems involved

It seems that the suggestions made on page 485 ff , although necessary, are not sufficient at the date of this writing, and the latest suggestions become imperative to safe-guard our future.

CONCLUSION

To summarize, under present world conditions the rôle of governments is becoming more and more difficult and important With all modern complexities it is impossible for governmental men to be specialists in every field of science, and therefore they must depend on professional experts *attached to the government,* not only in the fields of chemistry, engineering, physics, agriculture, etc , which they already utilize , but also in anthropology, neuro-psychiatry, general semantics, and related professions Otherwise the governments will indefinitely play the rôle of the blind leading the blind It is unreasonable to wait ten or twenty years to learn by bitter experience how short-sighted and incompetent our governments have been Why not utilize some human intelligence, proper evaluation, etc , toward which extensional methods lead, and thereby have some *predictability* This is definitely an imperative, immediate need

We should not delude ourselves Once the psychopathological misuses of neuro-semantic and neuro-linguistic mechanisms have been so successfully introduced, they will remain with us unless reconstructive and preventive governmental measures are undertaken by experts, at once

The conditions of the world are such today that private scientific undertakings and even professional opinions of scientific societies, or international congresses, etc , are bound to be ineffective Only governmental interest, backing, financing, etc , can organize and enforce a serious movement for sanity, the more so since scientists, physicians, educators, and other professionals do not have the necessary time, money, authority, or even initiative to carry forward concerted plans We have learned this group wisdom by now in the case of smallpox vaccination, control of epidemics, etc , and I venture to suggest that only such group wisdom will be effective as far as the health of our nervous systems is concerned In terms of money certainly it would be economical to spend for *preventive* and *permanent* measures an amount even less than the cost of a single aeroplane which is made today and shot down tomorrow

It must be sadly admitted that even professionals, no matter how prominent they may be in their narrow specialties, as individuals or spe-

cialized groups are at present scientifically unequipped to deal with such large and complex problems as the passing from one system of orientation to another, because those whose duty it was to integrate methodologically the vast knowledge at hand, have failed Such conditions can be remedied only by diversified methodological investigations, co-operation, and *concerted action* of specialists in different fields, which no private undertaking can organize effectively The reader is referred to page 558 ff and also to my 'Science of Man' *

There can be little doubt that self-seeking politicians, to cover up their own tracks, will be against such scientific sanity guidance, but enlightened public opinion will sooner or later force the issues to the only possible intelligent solution

The prevalent and constantly increasing general deterioration of human values is an unavoidable consequence of the crippling misuse of *neuro*-linguistic and *neuro*-semantic mechanisms In general semantics we are concerned with the *sanity* of the race, including particularly methods of prevention, eliminating from home, elementary, and higher education inadequate aristotelian types of evaluation, which too often lead to the *un-sanity* of the race, and building up for the first time a positive theory of sanity, as a workable non-aristotelian *system*

The task ahead is gigantic if we are to avoid more personal, national, and even international tragedies based on unpredictability, insecurity, fears, anxieties, etc, which are steadily disorganizing the functioning of the human nervous system. Only when we face these facts fearlessly and intelligently may we save for future civilizations whatever there is left to save, and build from the ruins of a dying epoch a new and saner society.

I seriously appeal to scientists, educators, medical men, especially psychopathologists, parents, and other forward-looking citizens to investigate and co-operate in urging the governments to carry out their duty to guide the people scientifically, as suggested here

A non-aristotelian re-orientation is inevitable, the only problem today is when, and at what cost

A. K.

CHICAGO, MARCH, 1941

* Korzybski, A The Science of Man *Amer Jour of Psychiatry.* May, 1937.

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Alfred Korzybski

SUPPLEMENTARY BIBLIOGRAPHY
TO THE SECOND EDITION

The following bibliography is only illustrative of points made in the introduction to the second edition A number of volumes listed here give extensive bibliographies in their fields For instance, the book of Dr Dunbar has 130 pages of bibliography which cover 2,358 items Some of the most important and latest empirical data on electrical brain-waves, electro-physiology, conditional reactions in humans, electro-colloidal processes of the nervous system, experimental neuroses and psychoses in animals, the reactions of apes, data on human psychotherapy, the methods of deception and sensory misdirection as utilized by magicians, etc, are given mostly in technical journals and monographs, and the interested reader may find them in libraries

This applies also to the many applications of the methods of general semantics in education, mental hygiene, speech difficulties, etc, carried on in universities and colleges, as well as applications in the practice of physicians, including psychiatrists, these are in preparation, or printed at present only by professional journals or by the Institute of General Semantics (see special list)

I list also some new pertinent, professional publications such as *Psychosomatic Medicine, Journal of Symbolic Logic, Encyclopedia of Unified Science,* etc, without listing the titles of the individual contributions It is suggested that the interested reader, and particularly educators, medical men, etc, become acquainted with such material, or at least know that it does exist The reader is also referred to the foreword to the bibliography given on page 767, and the titles which follow

In science and life a great deal depends on proper evaluation, tested by predictability, which depends in turn on the similarity of structure between territory-map or fact-language Thus, we have to know scientific facts, as well as the intricacies and difficulties of language and its structure Fortunately there is a weekly *Science News Letter,* published by Science Service, Washington, D C, giving brief, authoritative, non-technical *factual* summaries of progress in science, mathematics, medicine, etc, including sources, which every specialist as well as intelligent layman should know

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PREFACE TO THE FIRST EDITION 1933

It is difficult for a philosopher to realise that anyone really is confining his discussion within the limits that I have set before you The boundary is set up just where he is beginning to get excited (573) A N WHITEHEAD

That all debunkers must add new boshes of their own to supply the vacua created by the annihilation of the old, is probably a law of nature (22) E T BELL

Teaching without a system makes learning difficult *The Talmud*

The layman, the 'practical' man, the man in the street, says, What is that to me? The answer is positive and weighty Our life is entirely dependent on the established doctrines of ethics, sociology, political economy, government, law, medical science, etc This affects everyone consciously or unconsciously, the man in the street in the first place, because he is the most defenseless (280) A. K

When new turns in behaviour cease to appear in the life of the individual its behaviour ceases to be intelligent (106) C E COGHILL

'Tis a lesson you should heed.
Try again;
If at first you don't succeed,
Try again;
Then your courage should appear,
For if you will persevere
You will conquer, never fear,
Try again.

WILLIAM EDWARD HICKSON.

The main portions of the present work have already been presented in the form of lectures before different universities, technological institutes, teachers' and physicians' associations, and other scientific bodies The general outline was presented for the first time before the International Mathematical Congress in Toronto in 1924, and published in the form of a booklet A further elaboration of the system was read before the Washington (D C) Society for Nervous and Mental Diseases in 1925, and the Washington (D C) Psychopathological Society in 1926, and later published A fuller draft was presented before the Congrès des mathématiciens des pays Slaves, in Warsaw, Poland, in 1929 A special and novel aspect of the subject, in connection with the conditional reflexes of Pavlov, was outlined before the First International Congress of Mental Hygiene, Washington, D

C, in 1930. Other aspects were discussed before the American Mathematical Society, October 25, 1930, and the Mathematical Section of The American Association for the Advancement of Science, December 28, 1931 The latter paper is printed as Supplement III in this volume

The general character of the present work is perhaps best indicated by the two following analogies It is well known that for the working of any machine some lubricant is needed Without expressing any judgement about the present 'machine age', we have to admit that technically it is very advanced, and that without this advancement many scientific investigations necessitating very refined instruments would be impossible Let us assume that mankind never had at its disposal a clean lubricant, but that existing lubricants always contained emery sand, the presence of which escaped our notice Under such conditions, existing technical developments, with all their consequences, would be impossible Any machine would last only a few weeks or months instead of many years, making the prices of machines and the cost of their utilization entirely prohibitive Technical development would thus be retarded for many centuries Let us now assume that somebody were to discover a simple means for the elimination of emery from the lubricants; at once the present technical developments would become possible, and be gradually accomplished

Something similar has occurred in our human affairs Technically we are very advanced, but the elementalistic premises underlying our human relations, practically since Aristotle, have not changed at all The present investigation reveals that in the functioning of our nervous systems a special harmful factor is involved, a 'lubricant with emery' so to speak, which retards the development of sane human relations and prevents general sanity It turns out that in the structure of our languages, methods, 'habits of thought', orientations, etc, we preserve delusional, psychopathological factors. These are in no way inevitable, as will be shown, but can be easily eliminated by special training, therapeutic in effect, and consequently of educational preventive value This 'emery' in the nervous system I call identification It involves deeply rooted 'principles' which are invariably false to facts and so our orientations based on them cannot lead to adjustment and sanity

A medical analogy here suggests itself We find a peculiar parallel between identification and infectious diseases History proves that under primitive conditions infectious diseases cannot be controlled They spread rapidly, sometimes killing off more than half of the affected population The infectious agent may be transmitted either

directly, or through rats, insects, etc With the advance of science, we are able to control the disease, and various important preventive methods, such as sanitation, vaccination, etc, are at our disposal

Identification appears also as something 'infectious', for it is transmitted directly or indirectly from parents and teachers to the child by the mechanism and structure of language, by established and inherited 'habits of thought', by rules for life-orientation, etc There are also large numbers of men and women who make a profession of spreading the disease Identification makes general sanity and complete adjustment impossible Training in non-identity plays a therapeutic role with adults The degree of recovery depends on many factors, such as the age of the individual, the severity of the 'infection', the diligence in training in non-identity, etc With children the training in non-identity is extremely simple It plays the role both of sanitation and of the equally simple and effective preventive vaccination

As in infectious diseases, certain individuals, although living in infected territory, are somehow immune to this disease Others are hopelessly susceptible

The present work is written on the level of the average intelligent layman, because before we can train children in non-identity by preventive education, parents and teachers must have a handbook for their own guidance It is not claimed that a millenium is at hand, far from it; yet it seems imperative that the *neuro*-psycho-logical factors which make general sanity impossible should be eliminated

I have prefaced the parts of the work and the chapters with a large number of important quotations I have done so to make the reader aware that, on the one hand, there is already afloat in the 'universe of discourse' a great deal of genuine knowledge and wisdom, and that, on the other hand, this wisdom is not generally applied and, to a large extent, cannot be applied as long as we fail to build a simple system based on the complete elimination of the pathological factors

A system, in the present sense, represents a complex whole of co-ordinated doctrines resulting in methodological rules and principles of procedure which affect the orientation by which we act and live Any system involves an enormous number of assumptions, presuppositions, etc, which, in the main, are not obvious but operate unconsciously As such, they are extremely dangerous, because should it happen that some of these unconscious presuppositions are false to facts, our whole life orientation would be vitiated by these unconscious delusional factors, with the necessary result of harmful behaviour and

maladjustment No system has ever been fully investigated as to its underlying unconscious presuppositions Every system is expressed in some language of some structure, which is based in turn on silent presuppositions, and ultimately reflects and reinforces those presuppositions on and in the system This connection is very close and allows us to investigate a system to a large extent by a linguistic structural analysis

The system by which the white race lives, suffers, 'prospers', starves, and dies today is not in a strict sense an aristotelian system Aristotle had far too much of the sense of actualities for that It represents, however, a system formulated by those who, for nearly two thousand years since Aristotle, have controlled our knowledge and methods of orientations, and who, for purposes of their own, selected what today appears as the worst from Aristotle and the worst from Plato and, with their own additions, imposed this composite system upon us In this they were greatly aided by the structure of language and psycho-logical habits, which from the primitive down to this very day have affected all of us consciously or unconsciously, and have introduced serious difficulties even in science and in mathematics

Our rulers politicians, 'diplomats', bankers, priests of every description, economists, lawyers, etc , and the majority of teachers remain at present largely or entirely ignorant of modern science, scientific methods, structural linguistic and semantic issues of 1933, and they also lack an essential historical and anthropological background, without which a sane orientation is impossible * This ignorance is often wilful as they mostly refuse, with various excuses, to read modern works dealing with such problems As a result a conflict is created and maintained between the advance of science affecting conditions of actual life and the orientations of our rulers, which often remain antiquated by centuries, or one or two thousand years The present world conditions are in chaos, psycho-logically there exists a state of helplessness—hopelessness, often resulting in the feelings of insecurity, bitterness, etc , and we have lately witnessed psychopathological mass outbursts, similar to those of the dark ages Few of us at present realize that, as long as such ignorance of our rulers prevails, *no solution of our human problems is possible*

* The literature of these subjects is very large and impossible to give here or in my bibliography, but as primers I may as well suggest numbers 299, 334, 492, 558, 589 in my bibliography These books in turn give further references

The distinctly novel issue in a non-aristotelian system seems to be that in a human class of life elementary methodological and structural ignorance about the world and ourselves, as revealed by science, is bound to introduce delusional factors, for no one can be free from some conscious or unconscious structural assumptions The real and only problem therefore seems to be whether our structural assumptions in 1933 are primitive or of the 1933 issue The older 'popularization of science' is not the solution, it often does harm The progress of science is due in the main to scientific methods and linguistic revisions, and so the new facts discovered by such methods cannot be properly utilized by antiquated psycho-logical orientations and languages Such utilization often results only in bewilderment and lack of balance Before we can adjust ourselves to the new conditions of life, created in the main by science, we must first of all revise our grossly antiquated methods of orientation Then only shall we be able to adjust ourselves properly to the new facts

Investigations show that the essential scientific structural data of 1933 about the world and ourselves are extremely simple, simpler even than any of the structural fancies of the primitives We usually have sense enough to fit our shoes to our feet, but not sense enough to revise our older methods of orientation to fit the facts The elimination of primitive identifications, which is easily accomplished once we take it seriously, produces the necessary psycho-logical change toward sanity

'Human nature' is not an elementalistic product of heredity alone, or of environment alone but represents a very complex organism-as-a-whole end-result of the enviro-genetic manifold It seems obvious, once stated, that in a human class of life, the linguistic, structural, and semantic issues represent powerful and ever present environmental factors, which constitute most important components of all our problems 'Human nature' *can be changed,* once we know how Experience and experiments show that this 'change of human nature', which under verbal elementalism was supposed to be impossible, can be accomplished in most cases in a few months, if we attack this problem by the non-elementalistic, *neuro*-psycho-logical, special non-identity technique

If the ignorance and identifications of our rulers could be eliminated a variety of delusional factors through home and school educational and other powerful agencies would cease to be imposed and enforced upon us, and the revision of our systems would be encouraged, rather than hampered Effective solutions of our problems would then appear spontaneously and in simple forms, our 'shoes' would fit our 'feet' and

we could 'walk through life' in comfort, instead of enduring the present sufferings

Since our existing systems appear to be in many respects unworkable and involve psychopathological factors owing in the main to certain presuppositions of the aristotelian system, and also for brevity's sake, I call the whole operating systemic complex 'aristotelian'. The outline of a new and modern system built after the rejection of the delusional factors I call 'non-aristotelian' To avoid misunderstandings I wish to acknowledge explicitly my profound admiration for the extraordinary genius of Aristotle, particularly in consideration of the period in which he lived Nevertheless, the twisting of his system and the imposed immobility of this twisted system, as enforced for nearly two thousand years by the controlling groups, often under threats of torture and death, have led and can only lead to more disasters From what we know about Aristotle, there is little doubt that, if alive, he would not tolerate such twistings and artificial immobility of the system usually ascribed to him

The connection between the study of psychiatry and the study of mathematics and the foundations of mathematics is very instructive In the development of civilization and science we find that some disciplines, for instance, the very young science of psychiatry, have progressed rapidly Other disciplines such as mathematics, physics, etc, until recently progressed slowly, mainly on account of certain dogmas and prejudices Of late some of these prejudices have been eliminated, and since then the progress of these sciences has become extremely rapid Still other disciplines such as 'psychology', the traditional 'philosophy', sociology, political economy, ethics, etc, have developed their principles very little in nearly two thousand years notwithstanding a wealth of accumulated new data

Many reasons are responsible for this curious state of affairs, but I will suggest only three, in the order of their importance (1) First of all, the last mentioned slowly developing disciplines are the closest to us humans, and a primitive man, or an entirely ignorant person 'knows all about' these most complex problems in existence This 'know it all' general tendency produces an environmental, psychological, linguistic, etc, manifold, filled with identifications which produce dogmas, prejudices, misunderstandings, fears, and what not, making an impersonal, impartial scientific approach next to impossible (2) Few of us realize the unbelievable traps, some of them of a psychopathological character, which the structure of our ordinary language sets before us These also make any scientific approach or

agreement on vital points impossible We grope by animalistic trial and error, and by equally animalistic strife, wars, revolutions, etc These first two points apply practically to all of us, and introduce great difficulties even into mathematics (3) One of the main reasons why psychiatry has advanced so rapidly in such a short period in contradistinction to 'psychology', is that it studies relatively simple and relatively singled-out symptoms But as these symptoms are not isolated, and represent the reactions of the organism-as-a-whole, their partial study yields glimpses of the general and fundamental mechanisms If we study mathematics and mathematical sciences as forms of human behaviour, we study also simplified and singled-out human reactions of the type 'one and one make two', 'two and one make three', etc , and we also get glimpses of general mechanisms In psychiatry we study simplified psycho-logical reactions at their worst; in mathematics and mathematical sciences we study simplified psychological reactions at their best When both types of reactions are studied conjointly, most unexpected and very far-reaching results follow which deeply affect every known phase of human life and activity, science included The results of such widely separated studies do not conflict, but supplement each other, elucidating very clearly a general mechanism which operates in all of us Psychiatrical studies help us most unexpectedly in the solution of mathematical paradoxes, and mathematical studies help us to solve very important problems in psychotherapy and in prevention of psycho-logical disorders

History shows that the advancement of science and civilization involves, first, an accumulation of observations, second, a preliminary formulation of some kind of 'principles' (which always involve some unconscious assumptions) , and, finally, as the numbers of observations increase, it leads to the revision and usually the rejection of unjustified, or false to facts 'principles', which ultimately are found to represent only postulates Because of the cumulative and non-elementalistic character of human knowledge, a mere challenge to a 'principle' does not carry us far For expediency, assumptions underlying a system have (1) to be discovered, (2) tested, (3) eventually challenged, (4) eventually rejected, and (5) a *system,* free from the eventually objectionable postulates, has to be built

Examples of this abound in every field, but the histories of the non-euclidean and non-newtonian systems supply the simplest and most obvious illustrations. For instance, the fifth postulate of Euclid did not satisfy even his contemporaries, but these challenges were ineffective for more than two thousand years Only in the nineteenth

century was the fifth postulate eliminated and non-euclidean systems built without it The appearance of such systems marked a profound revolution in human orientations In the twentieth century the much more important 'principles' underlying our notions about the physical world, such as 'absolute simultaneity', 'continuity' of atomic processes, 'certainty' of our experiments and conclusions, etc, were challenged, and systems were then built without them As a result, we now have the magnificent non-newtonian physics and world outlooks, based on the work of Einstein and the quantum pioneers

Finally, for the first time in our history, some of the most important 'principles' of all principles, this time in the 'mental world', were challenged by mathematicians For instance the universal validity of the so-called 'logical law of the excluded third' was questioned Unfortunately, as yet, no full-fledged systems based on this challenge have been formulated, and so it remains largely inoperative, although the possibilities of some non-aristotelian, though elementalistic and unsatisfactory 'logics', are made obvious

Further researches revealed that the *generality* of the 'law of the excluded third' is not an independent postulate, but that it is only an elementalistic consequence of a deeper, invariably false to facts principle of 'identity', often unconscious and consequently particularly pernicious Identity is defined as 'absolute sameness in all respects', and it is this 'all' which makes identity impossible If we eliminate this 'all' from the definition, then the word 'absolute' loses its meaning, we have 'sameness in some respects', but we have no 'identity', and only 'similarity', 'equivalence', 'equality', etc If we consider that all we deal with represents constantly changing sub-microscopic, interrelated processes which are not, and cannot be 'identical with themselves', the old dictum that 'everything is identical with itself' becomes in 1933 a principle invariably false to facts

Someone may say, 'Granted, but why fuss so much about it?' My answer would be, 'Identification is found in all known primitive peoples, in all known forms of "mental" ills, and in the great majority of personal, national, and international maladjustments It is important, therefore, to eliminate such a harmful factor from our prevailing systems' Certainly no one would care to contaminate his child with a dangerous germ, once it is known that the given factor is dangerous Furthermore, the results of a complete elimination of identity are so far-reaching and beneficial for the daily life of everyone, and for science,*

* While correcting the proofs of this Preface, I read a telegraphic press report from London by Science Service, that Professor Max Born, by the applica-

that such 'fussing' is not only justified, but becomes one of the primary tasks before us Anyone who will study the present work will be easily convinced by observations of human difficulties in life, and science, that the majority of these difficulties arise from necessary false evaluations, in consequence of the unconscious false to facts identifications

The present work therefore formulates a system, called non-aristotelian, which is based on the complete rejection of identity and its derivatives, and shows what very simple yet powerful structural factors of sanity can be found in science The experimental development of science and civilization invariably involves more and more refined discriminations Each refinement means the elimination of some identifications somewhere, but many still remain in a partial and mostly unconscious form The non-aristotelian system formulates the general problem of non-identity, and gives childishly simple non-elementalistic means for a complete and conscious elimination of identification, and other delusional or psychopathological factors in all known fields of human endeavours, in science, education, and all known phases of private, national, and international life This work, in its application to education and psychotherapy, has been experimental for more than six years

The volume is divided into three main divisions Book I gives a general survey of non-aristotelian structural factors discovered by science, which are essential in a textbook Only such data are selected, interpreted and evaluated as are necessary for a full mastery of the system Book II presents a general introduction to non-aristotelian systems and general semantics free from identity, and gives a technique for the elimination of delusional factors from our psychological reactions Book III gives additional structural data about languages, and also an outline of the essential structural characteristics of the empirical world, but only such as are pertinent for training in the non-aristotelian discipline

Following each quotation prefacing each part and chapter, the number in parenthesis indicates the number of the book in the bibliography from which the quotation is taken

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tion of the *non-elementalistic* methods of Einstein, has succeeded in making a major contribution to the formulation of a unified field theory which now includes the quantum mechanics Should this announcement be verified in its scientific aspects, our understanding of the structure of 'matter', 'electron', etc, would be greatly advanced, and would involve of course most important practical applications For the semantic aspects of these problems, see pp 378, 386 f, 541, 667, 698–701, and Chapter XXXIX

I have tried to avoid footnotes as much as possible The small numbers after some words in the text refer to the Notes on p 763 ff , where the references to the bibliography are given

Book II is largely self-contained and therefore can be read independently of the others, after the reader has become acquainted with the short tables of abbreviations given on pp 15 and 16, and with Chapters II and IV I believe, however, that for the best results the book should be read consecutively without stopping at passages which at first are not entirely clear, and read at least twice On the second reading, passages which at first were not clear will become obvious because, in such a wide system, the beginning presupposes the end, and vice versa

The discovery of such important and entirely general delusional factors in the older systems leads to a far-reaching revision of all existing disciplines Because of modern complexities of knowledge this revision can only be accomplished by the activities of specialists working together as a group, and unified by one principle of non-identity, which necessitates a structural treatment

To facilitate this most urgent need, and to present the results of this work to the public at reasonable prices, an International Non-aristotelian Library has been organized, to be printed and distributed by The Science Press Printing Company, Lancaster, Pennsylvania, U S A , and Grand Central Terminal, New York City

It is also intended to organize an International Non-aristotelian Society with branches in connection with all institutions of learning throughout the world, where co-operative scientific work for the elimination of identity can be carried out, as this work is beyond the capacities of any one man

Since the scope of the Library and Societies is international, I have accepted, in the main, the Oxford spelling and rules, which are a happy medium between the English used in the United States of America and that of the rest of the world In certain instances I had to utilize some forms of expressions which are not entirely customary, but these slight deviations were forced upon me by the character of the subject, the need for clarity, and the necessity for cautiousness in generalizations The revision of the manuscript and reading of the proofs in connection with other editorial and publishing duties has been a very laborious task for one man, and I only hope that not too many mistakes have been overlooked Corrections and suggestions from the readers are invited

The International Non-aristotelian Library is a non-commercial,

scientific venture, and the interest and help of scientists, teachers, and those who are not indifferent to the advancement of science, civilization, sanity, peace, and to the improvement of social, economic, international, etc, conditions, will be greatly appreciated

From one point of view, this enquiry has been independent, from another, much material has been adapted In some instances it is impossible to give specific credit to an author, particularly in a textbook, and it is simpler and fairer to state that the works of Professors H F Biggs, G Birtwistle, E Bleuler, R Bonola, M Born, P W Bridgman, E Cassirer, C M Child, A S Eddington, A Einstein, A Haas, H Head, L V Heilbrunn, C J Herrick, S E Jelliffe, C J Keyser, C I Lewis, J Loeb, H Minkowski, W F Osgood, H Piéron, G Y Rainich, B Russell, C S Sherrington, L Silberstein, A Sommerfeld, E H Starling, A V Vasiliev, H Weyl, W A White, A N. Whitehead, E B Wilson, L Wittgenstein and J. W Young have been constantly consulted

Although I have had no opportunity to use directly the fundamental researches of Doctor Henry Head on aphasia, and particularly on semantic aphasia, my whole work has been seriously influenced by his great contributions Doctor Head's work, in connection with a non-elementalistic analysis, makes obvious the close connection between· (1) identifications, (2) structural ignorance, (3) lack of proper evaluations in general, and of the full significance of words and phrases in particular, and (4) the corresponding necessary, at least colloidal lesions of the nervous system

I am under heavy obligations to Professors E T Bell, P W. Bridgman, C M Child, B F Dostal, M H Fischer, R R Gates (London), C Judson Herrick, H S Jennings, R J Kennedy, R S Lillie, B Malinowski (London), R Pearl, G Y Rainich, Bertrand Russell (London), M Tramer (Bern), W M Wheeler, H B Williams, W H Wilmer, and Doctors C B Bridges, D G Fairchild, W H Gantt, P S Graven, E L Hardy, J A P Millet, P Weiss, W A White, Mr. C K Ogden (London), and Miss C L Williams, for reading the manuscript and/or the proofs as a whole, or in part, and for their invaluable criticism, and suggestions

I also owe much to Doctor C B Bridges and Professor W M Wheeler, not only for their important criticisms and constructive suggestions, but also for their painstaking editorial corrections and interest

Needless to say, I assume full responsibility for the following pages, the more, that I did not always follow the suggestions made.

I wish to express my deep appreciation to Doctor W A White and the staff of St Elizabeth's Hospital, Washington, D C, who, during my two years of study in the hospital, gave me every assistance to facilitate my research work there. I am indebted to Doctor P. S Graven for supplying me with his as yet unpublished experimental clinical material, which was very useful to me

Three important terms have been suggested to me; namely, 'enviro-genetic' by Doctor C B Bridges, 'actional' by Professor P W Bridgman, and 'un-sane' by Doctor P S Graven, which debt I gladly acknowledge

I am also deeply grateful to Professor R D Carmichael for writing Supplement I for this book on the Theory of Einstein, and to Doctor P Weiss for his kind permission to reprint as Supplement II his article on the Theory of Types

I warmly appreciate the kindness of those authors who gave me their permission to utilize their works

During my twelve years of research work in the present subject and preparation of this volume I have been assisted by a number of persons, to whom I wish to express my appreciation My particular appreciation is extended to my secretary, Miss Lily E MaDan who, besides her regular work, made the drawings for the book, to Miss Eunice E Winters for her genuine assistance in reading the proofs and compiling the bibliography, and to Mr Harvey W. Culp for the difficult reading of the physico-mathematical proofs and the equally difficult preparation of the index

The technical efficiency in all departments of the Science Press Printing Company, and the zealous and courteous co-operation of its compositors and officials, have considerably facilitated the publication of this book, and it is my pleasant duty to extend my thanks to them

My heaviest obligations are to my wife, formerly Mira Edgerly This work was difficult, very laborious, and often ungrateful, which involved the renouncing of the life of 'normal' human beings, and we abandoned much which is supposed to make 'life worth living' Without her whole-hearted and steady support, and her relentless encouragement, I neither would have formulated the present system nor written the book which embodies it If this book proves of any value, Mira Edgerly is in fact more to be thanked than the author. Without her interest, no non-aristotelian system, nor theory of sanity would have been produced in 1933.

A. K.

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BOOK I

A GENERAL SURVEY OF NON-ARISTOTELIAN FACTORS

Allow me to express now, once and for all, my deep respect for the work of the experimenter and for his fight to wring significant facts from an inflexible Nature, who says so distinctly "No" and so indistinctly "Yes" to our theories (550) HERMANN WEYL

The firm determination to submit to experiment is not enough, there are still dangerous hypotheses, first, and above all, those which are tacit and unconscious Since we make them without knowing it, we are powerless to abandon them (417) H POINCARÉ

The empiricist . thinks he believes only what he sees, but he is much better at believing than at seeing (461) G SANTAYANA

For a Latin, truth can be expressed only by equations, it must obey laws simple, logical, symmetric and fitted to satisfy minds in love with mathematical elegance

The Anglo-Saxon to depict a phenomenon will first be engrossed in making a *model*, and he will make it with common materials, such as our crude, unaided senses show us them He concludes from the body to the atom

Both therefore make hypotheses, and this indeed is necessary, since no scientist has ever been able to get on without them The essential thing is never to make them unconsciously (417) H POINCARÉ

If a distinction is to be made between men and monkeys, it is largely measurable by the quantity of the subconscious which a higher order of being makes conscious That man really lives who brings the greatest fraction of his daily experience into the realm of the conscious *

MARTIN H FISCHER

The thought of the painter, the musician the geometrician, the tradesman, and the philosopher may take very different forms, still more so the thought of the uncultivated man, which remains rudimentary and revolves for ever in the same circles (411) HENRI PIÉRON

One need only open the eyes to see that the conquests of industry which have enriched so many practical men would never have seen the light, if these practical men alone had existed and if they had not been preceded by unselfish devotees who died poor, who never thought of utility, and yet had a guide far other than caprice (417) H. POINCARÉ

* Spinal Cord Education *Ill Med Jour* Dec., 1928.

The men most disdainful of theory get from it, without suspecting it, their daily bread, deprived of this food, progress would quickly cease, and we should soon congeal into the immobility of old China (417) H POINCARÉ

If one wishes to obtain a definite answer from Nature one must attack the question from a more general and less selfish point of view (415)
M PLANCK

In particular—if we use the word intelligence as a synonym for mental activity, as is often done—we must differentiate between the primitive forms of sensory intelligence, with their ill-developed symbolism beyond which backward children cannot advance, and the forms of verbal intelligence created by social education, abstract and conceptual forms (411)
HENRI PIÉRON

A civilisation which cannot burst through its current abstractions is doomed to sterility after a very limited period of progress (575)
A N WHITEHEAD

almost any idea which jogs you out of your current abstractions may be better than nothing (575) A N WHITEHEAD

That is precisely what common sense is for, to be jarred into uncommon sense One of the chief services which mathematics has rendered the human race in the past century is to put 'common sense' where it belongs, on the topmost shelf next to the dusty canister labeled 'discarded nonsense ' (23)
E T BELL

If you have had your attention directed to the novelties in thought in your own lifetime, you will have observed that almost all really new ideas have a certain aspect of foolishness when they are first produced (575)
A N WHITEHEAD

To know how to criticize is good, to know how to create is better (417)
H POINCARÉ

The explanatory crisis which now confronts us in relativity and quantum phenomena is but a repetition of what has occurred many times in the past Every kitten is confronted with such a crisis at the end of nine days (55)
P W BRIDGMAN

The concept does not exist for the physicist until he has the possibility of discovering whether or not it is fulfilled in an actual case As long as this requirement is not satisfied, I allow myself to be deceived as a physicist (and of course the same applies if I am not a physicist), when I imagine that I am able to attach a meaning to the statement of simultaneity (I would ask the reader not to proceed farther until he is fully convinced on this point) (150) A EINSTEIN

Einstein, in thus analyzing what is involved in making a judgment of simultaneity, and in seizing on the act of the observer as the essence of the situation, is actually adopting a new point of view as to what the concepts of physics should be, namely, the operational view if we had adopted the operational point of view, we would, before the discovery of the actual physical facts, have seen that simultaneity is essentially a relative concept, and would have left room in our thinking for the discovery of such effects as were later found (55) P W BRIDGMAN

Let any one examine in operational terms any popular present-day discussion of religious or moral questions to realize the magnitude of the reformation awaiting us. Wherever we temporize or compromise in applying our theories of conduct to practical life we may suspect a failure of operational thinking. (55) P W BRIDGMAN

I believe that many of the questions asked about social and philosophical subjects will be found to be meaningless when examined from the point of view of operations. It would doubtless conduce greatly to clarity of thought if the operational mode of thinking were adopted in all fields of inquiry as well as in the physical Just as in the physical domain, so in other domains, one is making a significant statement about his subject in stating that a certain question is meaningless (55) P W BRIDGMAN

There is a sharp disagreement among competent men as to what can be proved and what cannot be proved, as well as an irreconcilable divergence of opinion as to what is sense and what is nonsense (22) E. T BELL

Notice the word "nonsense" above It was their inability, among other things, to define this word . that brought to grief the heroic attempt of Russell and Whitehead to put mathematical reasoning on a firm basis (22) E. T. BELL

The structure of all linguistic material is inextricably mixed up with, and dependent upon, the course of the activity in which the utterances are embedded. (332) B MALINOWSKI

To sum up, we can say that the fundamental grammatical categories, universal to all human languages, can be understood only with reference to the pragmatic Weltanshauung of primitive man, and that, through the use of Language, the barbarous primitive categories must have deeply influenced the later philosophies of mankind (332) B MALINOWSKI

Since no two events are identical, every atom, molecule, organism, personality, and society is an emergent and, at least to some extent, a novelty And these emergents are concatenated in such a way as to form vast ramifying systems, only certain ideal sections of which seem to have elicited the attention of philosophers, owing to their avowedly anthropocentric and anthropodoxic interests (555) WILLIAM MORTON WHEELER

The words *is* and *is not*, which imply the agreement or disagreement of two ideas, must exist, explicitly or implicitly, in every assertion (354) AUGUSTUS DE MORGAN

The little word *is* has its tragedies, it marries and identifies different things with the greatest innocence, and yet no two are ever identical, and if therein lies the charm of wedding them and calling them one, therein too lies the danger Whenever I use the word *is*, except in sheer tautology, I deeply misuse it, and when I discover my error, the world seems to fall asunder and the members of my family no longer know one another (461) G SANTAYANA

The complete attempt to deal with the term *is* would go to the form and matter of every thing in *existence*, at least, if not to the possible form and matter of all that does not exist, but might As far as it could be done, it would give the grand Cyclopaedia, and its yearly supplement would be the history of the human race for the time (354) AUGUSTUS DE MORGAN

Consciousness is the feeling of negation in the perception of 'the stone as grey,' such feeling is in barest germ, in the perception of 'the stone as not grey,' such feeling is full development Thus the negative perception is the triumph of consciousness (578) A N WHITEHEAD

But, if we designate as intelligence, quantitatively, the totality of mental functioning, it is evident that the suppression of verbal thought involves a defect, relatively very important among cultivated individuals leading a complex social life the uneducated person from this point of view is a defective (411) HENRI PIÉRON

The philosophy of the common man is an old wife that gives him no pleasure, yet he cannot live without her, and resents any aspersions that strangers may cast on her character (461) G SANTAYANA

It is terrible to see how a single unclear idea, a single formula without meaning, lurking in a young man's head, will sometimes act like an obstruction of inert matter in an artery, hindering the nutrition of the brain, and condemning its victim to pine away in the fullness of his intellectual vigor and in the midst of intellectual plenty. (402) CHARLES S PEIRCE

PART I

PRELIMINARIES

Corpus Errorum Biologicorum

. . . . .

But exactly the distinctive work of science is the modification, the reconstruction, the abandonment of old ideas, the construction of new ones on the basis of observation This however is a distressing operation, and many refuse to undergo it, even many whose work is the practice of scientific investigation The old ideas persist along with the new observations, they form the basis—often unconsciously—for many of the conclusions that are drawn

This is what has occurred in the study of heredity A burden of concepts and definitions has come down from pre-experimental days, the pouring of the new wine of experimental knowledge into these has resulted in confusion And this confusion is worse confounded by the strange and strong propensity of workers in heredity to flout and deny and despise the observations of the workers in environmental action, the equally strange and strong propensity of students of environmental effects to flout and deny and despise the work on inheritance If one accepts the affirmative results of both sets, untroubled by their negations, untroubled by definitions that have come from the past, there results a simple, consistent and useful body of knowledge, though with less pretentious claims than are set forth by either single set

Our first fallacy springs from the situation just described It is

I The fallacy of non-experimental judgments, in matters of heredity and development

Our second general fallacy is one that appears in the interpretation of observational and experimental results, it underlies most of the special fallacies seen in genetic biology This is the fallacy that Morley in his life of Gladstone asserts to be the greatest affliction of politicians, it is indeed a common plague of humanity It is

II. The fallacy of attributing to one cause what is due to many causes

III The fallacy of concluding that because one factor plays a role, another does not, the fallacy of drawing negative conclusions from positive observations . .

IV The fallacy that the characteristics of organisms are divisible into two distinct classes, one due to heredity, the other to environment . .

VII The fallacy of basing conclusions on implied premises that when explicitly stated are rejected

Many premises influencing reasoning are of this hidden, unconscious type Such ghostly premises largely affect biological reasoning on the topics here dealt with, they underlie several of the fallacies already stated, and several to come .

VIII The fallacy that showing a characteristic to be hereditary proves that it is not alterable by the environment

IX. The fallacy that showing a characteristic to be altered by the environment proves that it is not hereditary .

It appears indeed probable, from the present state of knowledge and the trend of discovery, that the following sweeping statements will ultimately turn out to be justified —

(1) All characteristics of organisms may be altered by changing the genes; provided we can learn how to change the proper genes

(2) All characteristics may be altered by changing the environmental conditions under which the organism develops, provided that we learn what conditions to change and how to change them

(3) Any kind of change of characteristics that can be induced by altering genes, can likewise be induced (if we know how) by altering conditions (This statement is open to more doubt than the other two, but it is likely eventually to be found correct) .

X. The fallacy that since all human characteristics are hereditary, heredity is all-important in human affairs, environment therefore unimportant . . .

XI The fallacy that since all important human characteristics are environmental, therefore environment is all-important, heredity unimportant, in human affairs. (247) H. S. JENNINGS

CHAPTER I

AIMS, MEANS AND CONSEQUENCES OF A NON-ARISTOTELIAN REVISION

> The process of intellectualism is not the subject I wish to treat I wish to speak of science, and about it there is no doubt, by definition, so to speak, it will be intellectualistic or it will not be at all Precisely the question is, whether it will be (417) H. POINCARÉ

> The aim of science is to seek the simplest explanations of complex facts . . . Seek simplicity and distrust it (573) A N WHITEHEAD

The present enquiry originated in my attempt to build a science of man. The first task was to define man scientifically in non-elementalistic, functional terms I accomplished that in my book *Manhood of Humanity* (New York, E. P. Dutton & Co), and in it I called the special characteristic which sharply distinguishes man from animal the time-binding characteristic

In the present volume I undertake the investigation of the mechanism of time-binding The results are quite unexpected We discover that there is a sharp difference between the nervous reactions of animal and man, and that judging by this criterion, nearly all of us, even now, copy* animals in our nervous responses, which copying leads to the general state of un-sanity reflected in our private and public lives, institutions and systems By this discovery the whole situation is radically changed If we copy animals in our nervous responses through the lack of knowledge of what the appropriate responses of the human nervous system should be, we can stop doing so, both individually and collectively, and we are thus led to the formulation of a first positive theory of sanity

The old dictum that we *'are'* animals leaves us hopeless, but if we merely *copy* animals in our nervous responses, we can stop it, and the hopeless becomes very hopeful, provided we can discover a *physiological* difference in these reactions Thus we are provided with a definite and promising program for an investigation

Such an investigation is undertaken in the present volume.

The result of this enquiry turned out to be a non-aristotelian system, the first to be formulated, as far as I know, and the first to express the very scientific tendency of our epoch, which produced the non-euclidean and non-newtonian (Einstein's and the newer quantum theories) systems. It seems that these three, the non-aristotelian, non-euclidean and non-newtonian systems are as much interwoven and interdependent

*The use of the term 'copy' is explained in Chapter II

as were the corresponding older systems The aristotelian and the non-aristotelian systems are the more general, the others being only special and technical consequences arising from them

Both the aristotelian and the non-aristotelian systems affect our lives deeply, because of psycho-logical factors and the immediacy of their application Each is the expression of the psycho-logical tendencies of its period Each in its period must produce in the younger generations a psycho-logical background which makes the understanding of its appropriate disciplines 'natural' and simple In an aristotelian human world the euclidean and newtonian systems are 'natural', while the youth educated in the non-aristotelian habits will find the non-euclidean and non-newtonian systems simpler, more 'natural', and the older systems 'unthinkable'

The functioning of the human nervous system is a more generalized affair than that of the animal, with more possibilities The latter is a special case of the former, but not vice versa John Smith, through ignorance of the mechanism, may use his nervous system as a Fido, but Fido cannot copy Smith Hence, the danger for Smith, but not for Fido Fido has many of his own difficulties for survival, but, at least, he has no *self-imposed* conditions, mostly silly and harmful, such as Smith has ignorantly imposed on himself and others The field covered by this enquiry is very wide and involves unexpectedly special suggestive contributions in diverse branches of science To list a few for orientation

1 The formulation of General Semantics, resulting from a General Theory of Time-binding, supplies the scientists and the laymen with a general modern method of orientation, which eliminates the older psychological blockages and reveals the mechanisms of adjustment,

2 The departure from aristotelianism will allow biologists, physiologists, etc, and particularly medical men to 'think' in modern colloidal and quantum terms, instead of the inadequate, antiquated chemical and physiological terms Medicine may then become a science in the 1933 sense;

3 In psychiatry it indicates on colloidal grounds the solution of the 'body-mind' problem,

4 It shows clearly that desirable human characteristics have a definite *psychophysiological* mechanism which, up till now, has been misused, to the detriment of all of us,

5 It gives the first definition of 'consciousness' in simpler physico-chemical terms,

6 A general theory of sanity leads to a general theory of psychotherapy, including all such existing medical schools, as they all deal with

disturbances of the *semantic reactions* (psycho-logical responses to words and other stimuli in connection with their *meanings*),

7 It formulates a physiological foundation for 'mental' hygiene, which turns out to be a most general preventive *psychophysiological* experimental method,

8 It shows the *psychophysiological* foundation of the childhood of humanity as indicated by the *infantilism* in our present private, public, and international lives,

9 In biology it gives a semantic and structural solution of the 'organism-as-a-whole' problem,

10 In physiology and neurology it reformulates to human levels the Pavlov theory of conditional reflexes, suggesting a new scientific field of *psychophysiology* for experiments,

11 In epistemology and semantics it establishes a definite non-elementalistic theory of meanings based not only on definitions but also on *undefined* terms,

12 It introduces a new development and use of 'structure',

13 It establishes structure as the only possible content of knowledge;

14 It discovers the *multiordinality* of the most important terms we have, thus removing the psycho-logical blockage of semantic origin and helping the average man or scientist to become a 'genius', etc,

15 It formulates a new and physiological theory of mathematical types of extreme simplicity and very wide application,

16 It offers a non-aristotelian solution of the problem of mathematical 'infinity',

17 It offers a new non-aristotelian, semantic (from Greek, to signify) definition of *mathematics* and *number*, which clarifies the mysteries about the seemingly uncanny importance of number and measurement and throws a new light on the role, structural significance, meaning, and methods of mathematics and its teaching,

18 In physics, the enquiry explains some fundamental, but as yet disregarded, semantic aspects of physics in general, and of Einstein's and the new quantum theories in particular,

19 It resolves simply the problem of 'indeterminism' of the newer quantum mechanics, etc

I realize that the thoughtful reader may be staggered by such a partial list I am in full sympathy with him in this I also was staggered

As this enquiry claims to be scientific, in the 1933 sense, I must explain how, in spite of great difficulties and handicaps, I was able to accomplish the work. As my work progressed, it turned out to be

'speaking about speaking' Now all scientific works in all fields are written or spoken, and so are ultimately verbal In order to speak about speaking, in any satisfactory and fundamental 1933 sense, I had to become acquainted with the special languages used by scientists in all fields I did not realize beforehand what a very serious undertaking this was It took many years and much hard labour to accomplish it, but, once accomplished, the rest was simple Scientists do not differ from the rest of us They usually disregard entirely structural, linguistic, and semantic issues, simply because no one has, as yet, formulated these problems or shown their importance The structural revision of their language led automatically to new results and new suggestions, and hence the surprising list

The present enquiry is limited and partial, but because it deals with linguistic and semantic issues and their *physiological* and psycho-logical aspects, it is, as far as it goes, *unusually general* I found that, in writing, it is extremely difficult and impracticable always to state explicitly the limitations of a statement It seems most practical to say here that, in general, *all statements here made are limited* by further considerations of the actualities of an analysed problem

Thus, for instance, a 'theory of sanity' deals with the most important semantic issues from limited semantic aspects, and has nothing to do with forms of 'insanity' arising from different organic, or toxic, or other disturbances, which remain as serious as ever The statements made cover just as much as further investigations will allow them to cover—and no more

The reader should be warned against undue generalizations, as they may be unjustified It is impossible, at this stage, to foresee all the ramifications of the present work The verbal issues, which correspond roughly to the older 'mental' issues, seem to pervade all *human* problems to some extent, and so the field of application and influence of any such enquiry must be very large Most of the results of the present work involve factors of unusual security of conclusion, though they may violate canons of our 'philosophical' creeds

The explanation is astonishingly simple and easily verified The present non-aristotelian system is based on fundamental *negative* premises; namely, the complete denial of 'identity', which denial *cannot be denied* without imposing the burden of impossible proof on the person who denies the denial If we start, for instance, with a statement that 'a word is *not* the object spoken about', and some one tries to deny that, he would have to produce an actual physical object which would *be the word,*—impossible of performance, even in asylums for the 'men-

tally' ill. Hence my security, often 'blasphemously cheerful', as one of my friends calls it

This general denial of the 'is' of identity gives the main fundamental non-aristotelian premise, which necessitates a structural treatment The status of negative premises is much more important and secure to start with than that of the positive 'is' of identity, found in the aristotelian system, but easily shown to be false to fact, and involving important delusional factors

Any map or language, to be of maximum usefulness, should, in structure, be similar to the structure of the empirical world Likewise, from the point of view of a theory of sanity, any system or language should, in structure, be similar to the structure of our nervous system. It is easily shown that the aristotelian system differs structurally from these minimal requirements, and that the non-aristotelian system is in accordance with them

This fact turns out to be of *psychophysiological* importance The above considerations, and others impossible to mention in this chapter, have suggested to me the form and structure of the whole work. I have spared no effort to make the presentation as connected, simple, and, particularly, as *workable* as I could As I deal with structure, and similarity of structure, of languages and the empirical world, a definite selection of topics is immediately suggested I must give enough structural data about languages in general, and enough structural data about the empirical world, and then select, or, if necessary, build, my terminology and system of similar structure.

The reader should not be afraid if some parts of the book look technical and mathematical. In reality, they are not so Speaking of the language called mathematics, from a structural point of view, I have had to illustrate what was said, and the few symbols or diagrams are used only for that purpose. Many of the structural points are of genuine importance and interest to professional scientists, teachers, and others, who sometimes, if ever, deal with such structural, linguistic, and semantic problems as are here analysed The layman who will read the book diligently and repeatedly, without skipping any part of it, will get at least a [illegible] or vague notion that *such problems do exist,* which will produce a very important psycho-logical effect or release from the old animalistic unconditionality of responses, whether or not he feels that he has 'understood' them fully

My earnest suggestion, backed by experience, to the reader is to read the book through several times, but not to dwell on points which are not clear to him At each reading the issues will become clearer,

until they will become entirely his own Superficial reading of the book is to be positively discouraged, as it will prove to be so much time wasted Experience teaches me that the number of semantic maladjustments, particularly among the white-collar class, is very large At present, I do not know any case where a thorough *training* in such a non-aristotelian semantic discipline would not give very serious means for better adjustment It will quiet down affective, semantic disturbances, sharpen orientation, judgement, the power of observation, and so forth, it will eliminate different psycho-logical blockages, help to overcome the very annoying and common 'inferiority' feelings, it will assist the outgrowing of the adult *infantile state,* which is a nervous deficiency practically always connected with some pathological sex-reactions or lack of normal and healthy impulses.

After all, we should not be surprised at this Language, as such, represents the highest and latest physiological and neurological function of an organism It is unique with Smith and of uniquely *human* circular structure. to use a logical term—or of spiral structure, to use a four-dimensional or a physico-chemical-aspect term Before we can use the semantic nervous apparatus properly, we must first know how to use it, and so formulate this use

In these processes an 'effect' becomes a *causative* factor for future effects, influencing them in a manner particularly subtle, variable, flexible, and of an endless number of possibilities 'Knowing', if taken as an end-product, must be considered also as a causative psychophysiological factor of the next stage of the semantic response The disregard of this mechanism is potentially of se[illegible]nger, particularly in the rearing of children, as it trains them i[illegible]guistic habits, the more so since the human nervous sys[illegible] at birth This structural and functional circularity [illegible]fficulties in our analysis, disregarded or neglected in the ar[illegible]system. Human life, in its difference from animal life, involves ma[illegible]s and is inherently of different and more complex structure [illegible]an be fully human and, therefore, 'sane', as a 'normal' human [illegible]d be, we must first know how to handle our nervous respo[illegible]cular affair

A non-aristotelian system must not disregard this [illegible]*ral-history structural fact* of the inherent circularity of al[illegible]ical functions which in any form involve human 'knowing' [illegible]sto-telian system differs essentially in structure from its prede[illegible]ch, by necessity, through the lack of knowledge characteristic [illegible]ch,

disregarded these structural semantic issues and so was constructed on cruder *animalistic patterns*

The difficulty in passing from the old system to another of different structure is not in the non-aristotelian system as such, which is really simpler and more in accord with common sense, but the serious difficulty lies rather in the older habits of speech and nervous responses, and in the older semantic reactions which must be overcome These difficulties are, perhaps, more serious than is generally realized Only those who have experienced the passing from euclidean to non-euclidean, and from newtonian to non-newtonian systems can fully appreciate this semantic difficulty; as a rule, it takes a new generation to do it painlessly and with entire success This applies to the general public, but is not an excuse for scientists, educators, and others who are entrusted with the education of, or who otherwise influence, the semantic reactions of children If any reader realizes his difficulties and *seriously wants* to overcome them, another suggestion may be given A structural diagram in the present work, called the Structural Differential, shows the structural difference between the world of animal and the world of man This structural difference is not yet fully realized, neither is its semantic importance understood, as it has never been formulated in a simple way before, yet the permanent and instinctive realization of these structural differences is unconditionally necessary for the mastering of the present theory of sanity This diagram, indeed, involves all the psychophysiological factors necessary for the transition from the old semantic reactions to the new, and it gives in a way a *structural summary* of the whole non-aristotelian system As the diagram is based on the denial of the 'is' of identity, its use is practically indispensable, it has been made in relief and in printed forms, to be kept on the wall or the desk as a permanent visual structural and semantic reminder Without actual handling, pointing the finger or waving the hand at it, seeing the *order,* and so on, it is practically impossible, or very difficult, to become *trained,* or to explain the present system to ourselves or others, because the foundation of all 'knowing' is structural, and the Structural Differential actually shows this structural difference between the world of animal and the world of man

One of the best ways for grown-up persons to train themselves in the present theory of sanity is to try to explain it to others, repeatedly pointing to the Structural Differential In my experience, those who have disregarded this advice have always made very slow progress, and have never got the full semantic benefit of their efforts As regards the verbal side of the training, it is as important to use exclusively the terms

given in this book, which are non-aristotelian and non-elementalistic, as it is to *abandon entirely* the 'is' of identity and some of the elementalistic primitive terms

The reader should be warned from the beginning of a very fundamental semantic innovation; namely, of the discovery of the *multiordinality* of the most important terms we have This leads to a conscious use of these terms in the multiordinal, extremely flexible, full-of-conditionality sense Terms like 'yes', 'no', 'true', 'false', 'fact', 'reality', 'cause,' 'effect', 'agreement', 'disagreement', proposition', 'number', 'relation', 'order', 'structure', 'abstraction', 'characteristic', 'love', 'hate', 'doubt', etc , are such that if they can be applied to a statement they can also be applied to a statement about the first statement, and so, ultimately, to all statements, no matter what their order of abstraction is Terms of such a character I call *multiordinal terms.* The main characteristic of these terms consists of the fact that on different levels of orders of abstractions they may have different meanings, with the result that they have no general meaning , for their meanings are determined solely by the given context, which establishes the different orders of abstractions Psycho-logically, in the realization of the multiordinality of the most important terms, we have paved the way for the specifically *human* full conditionality of our semantic responses This allows us great freedom in the handling of multiordinal terms and eliminates very serious psychological fixities and blockages, which analysis shows to be animalistic in their nature, and, consequently, pathological for man. Once the reader understands this multiordinal characteristic, this semantic freedom does not result in confusion

Accidentally, our vocabulary is enormously enriched without becoming cumbersome, and is made very exact Thus a 'yes' may have an indefinite number of meanings, depending on the context to which it is applied Such a blank 'yes' represents, in reality, 'yes_∞', but this includes 'yes_1', 'yes_2', 'yes_8', etc , all of which are, or may be, different All speculations about such terms *in general*—as, for instance, 'what a fact or reality is?'—are futile, and, in general, illegitimate, as the only correct answer is that 'the terms are multiordinal and devoid of meaning outside of a context' This settles many knotty epistemological and semantic questions, and gives us a most powerful method for promoting human mutual freedom of expression, thus eliminating misunderstandings and blockages and ultimately leading to agreement

I suspect that without the discovery of the multiordinality of terms the present work could not have been written, as I needed a more flexible language, a larger vocabulary, and yet I had to avoid confusion With

the introduction of the multiordinality of terms, which is a *natural* but, as yet, an unnoticed fact, our ordinary vocabulary is enormously enriched, in fact, the number of words in such a vocabulary *natural for man* is infinite The multiordinality of terms is the fundamental mechanism of the *full conditionality* of *human* semantic reactions; it eliminates an unbelievable number of the old animalistic blockages, and is fundamental for sanity

A number of statements in the present work have definite meanings for different specialists, often running entirely counter to the accepted scientific creeds As they followed naturally from the context, I inserted them for the specialist, without warning, for which I have to apologize to the general reader, although they will be useful to him also.

To make issues sharper, some words will be repeated so often that I abbreviate them as follows

Abbreviation	Stands for	Abbreviation	Stands for
A	aristotelian	$\bar{N}$	non-newtonian
$\bar{A}$	non-aristotelian	*el*	elementalistic
E	euclidean	*non-el*	non-elementalistic
$\bar{E}$	non-euclidean	$m\ o$ or $(m\ o)$	multiordinal
N	newtonian	$s\ r$ or $(s\ r)$	semantic reactions, both singular and plural

In some instances, for special emphasis, the words will be spelled in full

A $\bar{A}$-system, being extensional, requires the enumeration of long lists of names, which, in principle, cannot be exhausted Under such conditions, I have to list a few representatives followed by an 'etc', or its equivalents As the extensional method is characteristic of a $\bar{A}$ treatment, the expression 'etc' occurs so often as to necessitate a special $\bar{A}$ extensional punctuation whenever the period does not indicate another abbreviation, as follows

Abbreviation	Stands for
.,	etc ,
,.	,etc
.;	etc ,

Abbreviation	Stands for
.:	etc :
.?	etc ?
!	etc !

This book is intended as a handbook, and I have avoided referring the reader to other books, but have given as much of structural data as I deemed useful for a general orientation In a work of such wide scope and novelty, it seemed desirable to give a general outline rather than to elaborate in detail on some particular points, so that this work is not exhaustive in any field, nor, at present, can it be.

The notes at the end of the book are given for the purposes (among others) of indicating sources of information, as an acknowledgement, and to facilitate the work of the future student. As much as I could, I have avoided direct quotations from other authors, because usually it has seemed more expedient to change the wording slightly. In many instances, I have followed the original wordings very closely, always giving the proper credit

I have not avoided repetitions, because I have found, through sad experience, that many times, when I was reproached for a repetition, the hearer or reader was disregarding quite happily and unconsciously the said 'repetition', as if he had never heard it before For such a work as the present one, the standard literary habits—'avoid repetitions', 'let the reader discover it for himself' , are extremely detrimental to the understanding of a few fundamental issues and to the acquiring of $\bar{A}$ habits and new $s\,r$ To facilitate the student's task, I had no other choice than to write as I did

In 1933, scientific opinion is divided as to whether we need more science or less science Some prominent men even suggest that scientists should take a vacation and let the rest of mankind catch up with their achievements There seems no doubt that the discrepancy between human adjustments and the advances of science is becoming alarming Is, then, such a suggestion justified?

The answer depends on the *assumptions* underlying such opinions If humans, as such, have reached the limit of their nervous development, and if the scientific study of man, as man, should positively disclose these limitations, then such a conclusion would be justified But is this the case?

The present investigation shows most emphatically that this is not the case All sciences have progressed exclusively because they have succeeded in establishing their own $\vec{A}$ languages. For instance, a science of thermodynamics could not have been built on the terms of 'cold' and 'warm'. Another language, one of relations and structure, was needed, and, once this was produced, a science was born and progress secured Could *modern* mathematics be built on the Roman notation for numbers —I, II, III, IV, V ? No, it could not The simplest and most child-like arithmetic was so difficult as to require an expert, and all progress was very effectively hampered by the symbolism adopted History shows that only since the unknown Hindu discovered the most revolutionary and modern principle of *positional notation*—1, 10, 100, 1000 , modern mathematics has become possible Every child today is more skilful in his arithmetics than the experts of those days Incidentally, let us notice that positional notation has a definite *structure*

Have we ever attempted anything similar in the study of man? As-a-whole? In all his activities? Again, most emphatically, No! We have never studied man-as-a-whole scientifically If we make an attempt, such as the present one, for instance, we discover the astonishing, yet simple, fact that, even now, we all copy animals in our nervous responses, although these can be brought to the human level if the difference in the mechanism of responses is discovered and formulated

Once this is understood, we must face another necessity To abolish the discrepancy between the advancement of science and the power of adjustment of man, we must first establish the science of man-as-a-whole, embracing *all* his activities, science, mathematics and 'mental' ills *not* excluded Such an analysis would help us to discover the above-mentioned difference in responses, and the *s* in man would acquire new significance

If the present work has accomplished nothing more than to suggest such possibilities, I am satisfied Others, I hope, will succeed where I may have failed Under such conditions, the only feasible resort is to produce a science of man, and thus have not less, but more, science, ultimately covering all fields of human endeavour, and thereby putting a stop to the animalistic nervous reactions, so vicious in their effects on man

At present, nowhere in the world are there such *psychophysiological* [illegible]ches being made There are large sums of money invested in dif[illegible]nt well-established institutions for scientific research, for 'mental' [illegible]giene, for international peace, and so forth, but not for what is pos[illegible]bly the most important of all lines of research; namely, a general

science of man in all aspects of his behaviour, science, mathematics, and 'mental' ills included

It is to be hoped that, in the not-too-distant future, some individuals and universities will awaken to the fact that language is a fundamental *psychophysiological* function of man, and that a scientific investigation of man in *all* his activities, is a necessary, pressing, very promising, and practical undertaking Then, perhaps, special chairs will be established in universities, and some such researches in *semantic reactions* and *sanity* will command as much interest and public encouragement as other scientific investigations

I, personally, have no doubt that this would mark the beginning of a new era, *the scientific era,* in which all human desirable characteristics would be released from the present animalistic, psychophysiological, *A* semantic blockages, and that sanity would prevail

That this is not a dream, and that such nervous mechanisms producing blockages do exist, has been demonstrated by Pavlov on his dogs, by all psychotherapy, and the experiments now being made on the elimination of the disturbances of the *s r* The abundance of geniuses among younger physicists, since the einsteinian structural revolution and semantic release, is also an important empirical evidence that different man-made verbal systems can stimulate or hamper the functioning of the human nervous system

What has been said here has very solid structural, neurological foundations For our purpose, we may consider a rough structural difference between the nervous systems of man and animal Briefly, we can distinguish in the brain two kinds of nervous fibres, the radiating projection fibres and the tangential correlation and association fibres With the increase of complexities and modifiability of the behaviour, we find an increased number and more complex interrelations of association fibres The main difference, for instance, between the brain of a man and the brain of a higher ape is found not in the projection apparatus, but in the association paths, which are enormously enlarged, more numerous, and more complex in man than in any animal Obviously, if these association paths are blocked to the passage of nervous impulses by some psychophysiological process, the reactions of the individual must be of a lower order, and such blockage must give the effect of the given individual's being organically deficient, and must, therefore, res animalistic behaviour

The present investigation discloses that the *s r* may assume diversified forms, one of which is the production of very powe psychophysiological blockages These, when once we understand th mechanism, can be eliminated by proper education and training in a propriate *s r*

CHAPTER II

TERMINOLOGY AND MEANINGS

The representation of mental phenomena in the form of reactions, conditioned reflexes, Bechterew's 'psycho-reflexes,' leads to a truly physiological schematization . (411) HENRI PIÉRON

Now I claim that the Ethnographer's perspective is the one relevant and real for the formation of fundamental linguistic conceptions and for the study of the life of languages, whereas the Philologist's point of view is fictitious and irrelevant . . To define Meaning, to explain the essential grammatical and lexical characters of language on the material furnished by the study of dead languages, is nothing short of preposterous in the light of our argument (332) B MALINOWSKI

If he contend, as sometimes he will contend, that he has defined all his terms and proved all his propositions, then either he is a performer of logical miracles or he is an ass, and, as you know, logical miracles are impossible (264) CASSIUS J KEYSER

Finally, in semantic aphasia, the full significance of words and phrases is lost Separately, each word or each detail of a drawing can be understood, but the general significance escapes, an act is executed upon command, though the purpose of it is not understood Reading and writing are possible as well as numeration, the correct use of numbers, but the appreciation of arithmetical processes is defective . . A general conception cannot be formulated, but details can be enumerated. (411) HENRI PIÉRON

Moreover, the aphasic patient in his mode of life, in his acts and in all his behaviour may seem biologically and socially normal But he has nevertheless suffered an unquestionable loss, for he no longer has any chance of undergoing further modifications of social origin, and of reacting in his turn as a factor in evolution and progress (411) HENRI PIÉRON

Particularly it expresses that most important step in the treatment, the passing over from a mere intellectual acceptance of the facts of the analysis, whether in interpretation of the underlying complexes or in recognition of the task to be accepted, to an emotional appreciation and appropriation of the same *Intellectual acceptance can work no cure* but may prove seriously misleading to the patient who is attempting to grasp the situation and to the beginner in analysis as well (241) SMITH ELY JELLIFFE

Section A On semantic reactions

The term *semantic reaction* is fundamental for the present work and *non-elementalistic systems* The term 'semantic' is derived from the Greek *semantikos*, 'significant', from *semainein* 'to signify', 'to mean', and was introduced into literature by Michel Bréal in his *Essai de Sémantique* The term has been variously used in a more or less general or restricted sense by different writers Of late, this term has been used by the Polish School of Mathematicians, and particularly L Chwis-

tek (see Supplement III), A. F Bentley[1], and has been given a medical application by Henry Head[2] in the study of different forms of Aphasias 'Aphasia', from the Greek *aphasia*, 'speechlessness', is used to describe disorders in comprehension or expression of written and spoken language which result from lesions of the brain Disturbances of the semantic reactions in connection with faulty education and ignorance must be considered in 1933 as sub-microscopic colloidal lesions

Among the many subdivisions of the symbolic disturbance, we find *semantic aphasia*, to be described (after Head) as the want of recognition or the full significance or intention of words and phrases, combined with the loss of power of appreciating the 'ultimate or non-verbal meaning of words and phrases' to be investigated presently, and the failure to recognize the intention or goal of actions imposed upon the patient

The problems of 'meaning' are very complex and too little investigated, but it seems that 'psychologists' and 'philosophers' are not entirely in sympathy with the attitude of the neurologists It is necessary to show that in a $\bar{A}$-system, which involves a new theory of meanings based on *non-el* semantics, the neurological attitude toward 'meaning' is the only structurally correct and most useful one

The explanation is quite simple We start with the negative $\bar{A}$ premise that words are *not* the un-speakable objective level, such as the actual objects outside of our skin *and* our personal feelings inside our skin It follows that the only link between the objective and the verbal world is exclusively structural, necessitating the conclusion that the only content of all 'knowledge' is structural. Now structure can be considered as a complex of relations, and ultimately as multi-dimensional order

From this point of view, all language can be considered as names either for un-speakable entities on the objective level, be it things or feelings, or as *names for relations* In fact, even objects, as such, *could* be considered as relations between the sub-microscopic events and the human nervous system If we enquire what the last relations represent, we find that an object represents an abstraction of low order produced by our nervous system as the result of the sub-microscopic events acting as stimuli upon the nervous system If the objects represent abstractions of some order, then, obviously, when we come to the enquiry as to language, we find that words are still higher abstractions from objects Under such conditions, a theory of 'meaning' looms up naturally. If the objects, as well as words, represent abstractions of different order, an individual, A, cannot know what B abstracts, unless B tells him, and so the 'meaning' of a word *must* be given by a definition This

would lead to the dictionary meanings of words, provided we could define all our words But this is impossible If we were to attempt to do so, we should soon find that our vocabulary was exhausted, and we should reach a set of terms which could not be any further defined, from lack of words We thus see that all linguistic schemes, if analysed far enough, would depend on a set of undefined terms If we enquire about the 'meaning' of a word, we find that it depends on the 'meaning' of other words used in defining it, and that the eventual new relations posited between them ultimately depend *on the two meanings of the undefined terms*, which, at a given period, cannot be elucidated any further.

Naturally, any fundamental theory of 'meaning' cannot avoid this issue, which must be crucial Here a semantic experiment suggests itself I have performed this experiment repeatedly on myself and others, invariably with similar results Imagine that we are engaged in a friendly serious discussion with some one, and that we decide to enquire into the meanings of words For this special experiment, it is not necessary to be very exacting, as this would enormously and unnecessarily complicate the experiment It is useful to have a piece of paper and a pencil to keep a record of the progress

We begin by asking the 'meaning' of every word uttered, being satisfied for this purpose with the roughest definitions, then we ask the 'meaning' of the words used in the definitions, and this process is continued usually for no more than ten to fifteen minutes, until the victim begins to speak in circles—as, for instance, defining 'space' by 'length' and 'length' by 'space' When this stage is reached, we have come usually to the *undefined* terms of a given individual If we still press, no matter how gently, for definitions a most interesting fact occurs Sooner or later, signs of *affective disturbances* appear Often the face reddens, there is a bodily restlessness, sweat appears—symptoms quite similar to those seen in a schoolboy who has forgotten his lesson, which he 'knows but cannot tell' If the partner in the experiment is capable of self-observation, he invariably finds that he feels an internal *affective pressure*, connected, perhaps, with the rush of blood to the brain and probably best expressed in some such words as 'what he "knows" but cannot tell', or the like Here we have reached the bottom and the foundation of all *non-elementalistic meanings*—the meanings of *undefined terms*, which we 'know' somehow, but cannot tell In fact, we have reached the un-speakable level This 'knowledge' is supplied by the lower nerve centres, it represents affective first order effects, and is interwoven and interlocked with other affective states, such as those called 'wishes',

'intentions', 'intuitions', 'evaluation', and many others It should be noticed that these first order effects have an objective character, as they are un-speakable—are *not* words

'Meaning' must be considered as a multiordinal term, as it applies to all levels of abstractions, and so has no general content We can only speak legitimately of 'meanings' in the plural Perhaps, we can speak of the meanings of meanings, although I suspect that the latter would represent the un-speakable first order effect, the affective, personal raw material, out of which our ordinary meanings are built

The above explains structurally why most of our 'thinking' is to such a large extent 'wishful' and is so strongly coloured by affective factors Creative scientists know very well from observation of themselves, that all creative work starts as a 'feeling', 'inclination', 'suspicion', 'intuition', 'hunch', or some other un-speakable affective state, which only at a later date, after a sort of nursing, takes the shape of a verbal expression, worked out later in a rationalized, coherent, linguistic scheme called a theory In mathematics we have some astonishing examples of intuitively proclaimed theorems, which, at a later date, have been proven to be true, although the original proof was false

The above explanation, as well as the neurological attitude toward 'meaning', as expressed by Head, is *non-elementalistic* We have not illegitimately split organismal processes into 'intellect' and 'emotions' These processes, or the reactions of the organism-as-a-whole, can be contemplated at different neurological stages in terms of order, but must never be split or treated as separate entities This attitude is amply justified structurally and empirically in daily and scientific life For instance, we may assume that educated Anglo-Saxons are familiar with the Oxford Dictionary, although it must be admitted that they are handicapped in the knowledge of their language by being born into it, yet we know from experience how words which have one standard definition carry different meanings to, and produce different affective individual reactions on, different individuals Past experiences, the knowledge , of different individuals are different, and so the *evaluation* (affective) of the terms is different We are accustomed to such expressions as 'it means nothing to me', even in cases when the dictionary wording is accepted, or 'it means a great deal to me', and similar expressions which indicate that the meanings of meanings are somehow closely related to, or perhaps represent, the first order un-speakable affective states or reactions.

Since 'knowledge', then, is not the first order un-speakable objective level, whether an object, a feeling , structure, and so relations, becomes

the only possible content of 'knowledge' *and of meanings* On the lowest level of our analysis, when we explore the objective level (the un-speakable feelings in this case), we must try to define every 'meaning' as a conscious feeling of actual, or assumed, or wished , *relations* which pertain to first order objective entities, psycho-logical included, and which can be evaluated by personal, varied, and racial—again un-speakable first order—psychophysiological effects Because relations can be defined as multi-dimensional order, both of which terms are *non-el,* applying to 'senses' and 'mind', after *naming* the un-speakable entities, all experience can be *described* in terms of relations or multi-dimensional order The meanings of meanings, in a given case, in a given individual at a given moment , represent composite, affective psycho-logical configurations of all relations pertaining to the case, coloured by past experiences, state of health, mood of the moment, and other contingencies

If we consistently apply the organism-as-a-whole principle to any psycho-logical analysis, we must conjointly contemplate at least both aspects, the 'emotional' and the 'intellectual', and so *deliberately ascribe* 'emotional' factors to any 'intellectual' manifestation, and 'intellectual' factors to any 'emotional' occurrence. That is why, on human levels, the *el* term 'psychological' must be abolished and a new term *psycho-logical* introduced, in order that we may construct a science

From what has been said, we see that not only the structure of the world is such that it is made up of absolute individuals, but that meanings in general, and the meanings of meanings in particular—the last representing probably the un-speakable first order effects—also share, in common with ordinary objects, the absolute individuality of the objective level

The above explains why, by the inherent structure of the world, life, and the human nervous system, human relations are so enormously complex and difficult, and why we should leave no stone unturned to discover beneath the varying phenomena more and more general and invariant foundations on which human understanding and agreement may be based In mathematics we find the only model in which we can study the invariance of relations under transformations, and hence the need for future psycho-logicians to study mathematics

It follows from these considerations that any psycho-logical occurrence has a number of aspects, an 'affective', and an 'intellectual', a physiological, a colloidal, and what not For the science of psychophysiology, resulting in a theory of sanity, the above four aspects are of most importance As our actual lives are lived on objective, un-speakable levels, and not on verbal levels, it appears, as a problem of evaluation,

that the objective level, including, of course, our un-speakable feelings, 'emotions' , is the most important, and that the verbal levels are only auxiliary, sometimes useful, but at present often harmful, because of the disregard of the *s r* The role of the auxiliary verbal levels is only fulfilled if these verbal processes are translated back into first order effects Thus, through verbal intercourse, in the main, scientists discover useful first order abstractions (objective), and by verbal intercourse again, *culture* is built, but this only when the verbal processes affect the unspeakable psycho-logical manifestations, such as our feelings, 'emotions',.

Some extraordinary parrot could be taught to repeat all the verbal 'wisdom' of the world, but, if he survived at all, he would be just a parrot The repeated noises would not have affected his first order effects—his affects—these noises would 'mean' nothing to him

Meanings, and the meanings of meanings, with their inseparable affective components, give us, therefore, not only the *non-elementalistic* foundation on which all civilization and culture depends, but a study of the *non-el* mechanisms of meanings, through psychophysiology and general semantics, gives us, also, powerful physiological means to achieve a host of desirable, and to eliminate a large number of undesirable, psycho-logical manifestations

The physiological mechanism is extremely simple and necessitates a breaking away from the older elementalism But it is usually very difficult for any given individual to break away from this older elementalism, as it involves the established *s r*, and to be effective is, by necessity, a little laborious The working tool of psychophysiology is found in the *semantic reaction* This can be described as the psycho-logical reaction of a given individual to words and language and other symbols and events *in connection with their meanings,* and the psycho-logical reactions, which *become meanings and relational configurations* the moment the given individual begins to analyse them or somebody else does that for him It is of great importance to realize that the term 'semantic' is *non-elementalistic,* as it involves conjointly the 'emotional' as well as the 'intellectual' factors

From the *non-el* point of view, any affect, or impulse, or even human instinct, when made conscious acquires *non-el* meanings, and becomes ultimately a psycho-logical configuration of desirable or undesirable to the individual relations, thus revealing a workable *non-el* mechanism Psychotherapy, by making the unconscious conscious, and by verbalization, attempts to discover meanings of which the patient was not aware If the attempt is successful and the individual meanings are revealed, these are usually found to belong to an immature period of

evaluation in the patient's life They are then consciously revised and rejected, and the given patient either improves or is entirely relieved The condition for a successful treatment seems to be that the *processes should be managed in a non-elementalistic* way Mere verbal formalism is not enough, because the full *non-elementalistic* meanings to the patient are not divulged, consequently, in such a case, the *s r* are not affected, and the treatment is a failure

The *non-el* study of the *s r* becomes an extremely general scientific discipline The study of relations, and therefore order, reveals to us the mechanism of *non-el* meanings, and, in the application of an ordinal *physiological* discipline, we gain psychophysiological means by which powerfully to affect, reverse, or even annul, undesirable *s r* In psychophysiology we find a *non-el* physiological theory of meanings and sanity.

From the present point of view, all affective and psycho-logical responses to words and other stimuli *involving meanings* are to be considered as *s r* What the relation between such responses and a corresponding persistent psycho-logical *state* may be, is at present not clear, although a number of facts of observation seem to suggest that the re-education of the *s r* results often in a beneficial change in some of these states But further investigation in this field is needed

The realization of this difference is important in practice, because most of the psycho-logical manifestations may appear as evoked by some event, and so are to be called responses or reflexes Such a response, when lasting, should be called a given *state*, perhaps a semantic state, but not a semantic reflex The term, 'semantic reaction', will be used as covering both semantic reflexes and states In the present work, we are interested in *s r*, from a psychophysiological, theoretical and experimental point of view, which include the corresponding states

If, for instance, a statement or any event evokes some individual's attention, or one train of associations in preference to another, or envy, or anger, or fear, or prejudice , we would have to speak of all such responses on psycho-logical levels as *s r* A stimulus was present, and a response followed, so that, by definition, we should speak of a reaction As the active factor in the stimulus was the individual meanings to the given person, and his response had meanings to him as a first order effect, the reaction must be called a *semantic* reaction

The present work is written entirely from the *s r* point of view, and so the treatment of the material, and the language used, imply, in general, a psycho-logical response to a stimulus in connection with meanings, this response being expressed by a number of such words as 'implies', 'follows', 'becomes', 'evokes', 'results', 'feels', 'reacts', 'evalu-

ates', and many others All data taken from science are selected, and only those which directly enter as factors in *s r* are given in an elementary outline The meanings to the individual are dependent, through the influence of the environment, education, languages and their structure, and other factors, on racial meanings called science, which, to a large extent, because of the structural and relational character of science, become physiological semantic factors of the reactions In fact, science, mathematics, 'logic' , may be considered from a *non-elementalistic* point of view as *generalized* results of *s r* acceptable to the majority of informed and not heavily pathological individuals

To facilitate the writing and the reading of the work, I am compelled to use definite devices As in case of structure, multiordinal terms, so in the case of *s r*, I often employ an ordinary form of expression and use the words 'structur*al*', 'multiordin*al*', 'semantic', as adjectives, or 'structurally', 'semantically' , as adverbs, always implying the full meanings, that under such and such conditions of a given stimulus, the given *s r* would be such and such In many instances, the letters *s r* or (*s r*) will be inserted to remind the reader that we deal with semantic reactions or the psycho-logical reactions in connection with the meanings of the problems analysed It is not only useful, but perhaps essential, that the reader should stop in such places and try to evoke in himself the given *s r* The present work leads to new *s r* which are beneficial to every one of us and fundamental for sanity The casual reading of the present book is not enough Any one who wants the full or partial benefit of the joint labours of the author and the reader must, even in the reading, begin to re-train his *s r*

As the organism works as-a-whole, and as the training is psycho-physiological in terms of order, reversing the reversed pathological order , organism-as-a-whole means *must* be employed For this purpose, the Structural Differential has been developed The reader will later understand that it is practically impossible to achieve, without its help, the maximum beneficial semantic results

From a *non-el* point of view, which makes illegitimate any *el* verbal splitting of 'emotions' and 'intellect' , these processes must be analysed in terms of order, indicating the stages of the psycho-neural process-as-a-whole Empirically, there is a difference between an 'emotion' which becomes 'rationalized' and 'emotions' invoked or produced by 'ideas'. The order is different in each instance, and if, in a given nervous system, at a given moment, or under some special conditions, the lower or higher nerve centres work defectively, the nervous reactions are not well balanced and the manifestations acquire a one-sided character The other

aspect is not abolished, but is simply less prominent or less effective Thus, in morons, imbeciles, and in many forms of infantilism, the 'thinking' is very 'emotional' and of a low grade, in so-called 'moral imbeciles', and perhaps in 'schizophrenia', the 'thinking' may be seemingly 'normal', yet it does not affect the 'feelings', which are deficient

From the *non-el* semantic *human* point of view, any affect only gains meanings when it is conscious, or, in other words, when an actual or assumed set of relations is present In an ideally balanced and efficient human nervous system, the 'emotions' would be translated into 'ideas', and 'ideas' translated into 'emotions', *with equal facility* In other words, the $s\,r$ of a given individual would be under full control and capable of being educated, influenced, transformed quickly and efficiently —the very reverse of the present situation The present enquiry shows that the lack of psychophysiological methods for training and lack of analysis and understanding of the factors involved, are responsible for this deplorable situation

The above processes are quite obvious on *racial* grounds, if we study science and mathematics from the semantic point of view With very few exceptions, we only fail individually For instance, a Euclid and a Newton had 'hunches', 'intuitions' , then they rationalized and verbalized them and so affected the rest of us and established the 'natural' feeling for E geometries, N mechanics, When new $\bar{E}$ or $\bar{N}$ systems were produced, many of the older scientists could 'understand' them, could even master the new symbolic technique, yet their 'feelings' , were seldom affected They 'thought' in the new way, but they continued to 'feel' in the old, their $s\,r$ did not follow fully the transformation of their 'ideas', and this produced a split personality

Any fundamentally new system involves new $s\,r$, and this is the main difficulty which besets us when we try to master a new system We must re-educate, or change, our older $s\,r$ As a rule, the younger generation, which began with the new $s\,r$, has no such difficulties with the new systems Just the opposite—the older $s\,r$ become as difficult or impossible to them as the new were to the older generation To both generations, with their corresponding $s\,r$, the non-habitual $s\,r$ are 'new', no matter what their historical order and how difficult or how simple they are However, there is an important difference The newer systems, as, for instance, the $\bar{E}$, $\bar{N}$, and the present corresponding $\bar{A}$-system, are *more general* which means that the newer systems include the older as particular cases, so that the younger generation has $s\,r$ which are *more flexible, more conditional*, with a broader outlook , semantic conditions absent in the older systems.

The problems connected with the *s r* are not new, because these are inherent in man, no matter on what low or primitive level or on what high level of development he may be, but, up to the undertaking of the present analysis, the problems of *s r* were not formulated, their psychophysiological mechanisms were not discovered, and so, to the detriment of all of us, we have had no workable educational means by which to handle them effectively.

That is why the passing from one era to another is usually so difficult and so painful The new involves new *s r*, while, as a rule, the older generations have enforced their systems, and, through them, by means of controlled education and linguistic structure and habits, the old *s r* This the younger generation, *always* having more racial experience, cannot accept, so that revolutions, scientific or otherwise, happen, and, when successful, the new systems are imposed on the older generation without the older generation's changing their *s r* All of which is painful to all concerned The next generation after such a 'revolution' does not have similar difficulties, because from childhood they are trained in the new *s r*, and all appears as 'natural' to them, and the older as 'unthinkable', 'silly',

As a descriptive fact, the present stage of human development is such that with a very few exceptions our nervous systems do not work properly in accordance with their survival structure In other words, although we have the potentialities for correct functioning in our nervous system, because of the neglect of the physiological control-mechanism of our *s r*, we have semantic blockages in our reactions, and the more beneficial manifestations are very effectively prevented

The present analysis divulges a powerful mechanism for the control and education of *s r*, and, by means of proper evaluation, a great many undesirable manifestations on the psycho-logical level can be very efficiently transformed into highly desirable ones In dealing with such a fundamental experimental issue as the *s r*, which have been with us since the dawn of mankind, it is impossible to say new things all the time. Very often the issues involved become 'common sense'; but what is the use, in practice, of this 'common sense', if it is seldom, if ever, applied, and in fact cannot be applied because of the older lack of workable psychophysiological formulations? For instance, what could be simpler or more 'common sense' than the $\bar{A}$ premise that an object is *not* words, yet, to my knowledge, no one *fully* applies this, or has *fully acquired* the corresponding *s r* Without first acquiring this new *s r*, it is impossible to discover this error and corresponding *s r* in others, but as soon as we have trained ourselves, it becomes so obvious that it is impossible to miss

it We shall see, later, that the older *s r* were due to the lack of structural investigations, to the old structure of language, to the lack of consciousness of abstracting, to the low order conditionality of our conditional reactions (the semantic included), and a long list of other important factors All scientific discoveries involve *s r*, and so, once formulated, and the new reactions acquired, the discoveries become 'common sense', and we often wonder why these discoveries were so slow in coming in spite of their 'obviousness' These explanations are given because they also involve some *s r*, and we must warn the reader that such evaluations (*s r*) 'Oh, a platitude!', 'A baby knows that', are very effective *s r to prevent* the acquisition of the new reactions This is why the 'discovery of the obvious' is often so difficult, it involves very many of semantic factors of new evaluation and meanings

A fuller evaluation is only reached at present on racial grounds in two or more generations, and never on individual grounds, which, of course, for *personal generalized adjustment* and happiness, is very detrimental Similarly, only in the study of racial achievements called science and mathematics can we discover the appropriate *s r* and the nervous mechanism of these so varied, so flexible, and so fundamental reactions.

In fact, without a structural formulation and a $\bar{A}$ revision based on the study of science and mathematics, it is impossible to discover, to control, or to educate these *s r* For this reason it was necessary to analyse the semantic factors in connection with brief and elementary considerations taken from modern science But, when all is said and done, and the important semantic factors discovered, the whole issue becomes extremely simple, and easily applied, even by persons without much education In fact, because the objective levels are *not* words, the only possible aim of science is to discover *structure,* which, when formulated, is *always simple* and easily understood by everyone, with the exception, of course, of very pathological individuals We have already seen that structure is to be considered as a configuration of relations, and that relations appear as the essential factors in meanings, and so of *s r* The present enquiry, because structural, reveals vital factors of *s r* The consequences are extremely simple, yet very important We see that by a simple *structural re-education* of the *s r*, which in the great mass of people are still on the level of copying animals in their nervous reactions, we powerfully affect the *s r*, and so are able to impart very simply, to all, in the most elementary education of the *s r* of the child, *cultural* results at present sometimes acquired unconsciously and painfully in university education

The above considerations have forced upon me the structure of the present work and the selection and presentation of the material Of

course, the reader can skip many parts and at once plunge into Part VII, and discover that it is all 'childishly simple', 'obvious' and 'common sense' Such a reader or a critic with this particular *s r* would miss the point, which can be verified as an *experimental* fact in the meantime, that in spite of its seeming simplicity, *no one,* not even the greatest genius, *fully* applies these 'platitudes' outside of his special work, which *s r*, in his limited field, represent the semantic components *that make up his genius*

The full acquisition of the new *s r* requires special training, but, when acquired, it solves for a given individual, without any outside interference, all important human problems I know of It imparts to him some of the *s r* of so-called 'genius', and thus enlarges his so-called 'intelligence'.

The problems of the structure of a given language are of extreme, and as yet unrealized, semantic importance Thus, for instance, the whole Einstein theory, or any other fundamental scientific theory, must be considered as the building of a new language of similar structure to the empirical facts known at a given date In 1933, the general tendency of science, as made particularly obvious in the works of J Loeb, C. M Child, psychiatry, the Einstein theory, the new quantum mechanics , and the present work, is to build languages which take into consideration the many important invariant relations, a condition made possible only by the use of *non-el* languages In my case, I must construct a *non-el* language in which 'senses' and 'mind', 'emotions' and 'intellect' , are no longer to be verbally split, because a language in which they *are* split is not similar in structure to the known empirical facts, and all speculations in such an *el* language must be misleading

This *non-el* language involves a new *non-el* theory of meanings, as just explained The term 'semantic', 'semantically', 'semantic reactions', 'semantic states' , are *non-el*, as they involve both 'emotions' and 'intellect', since they depend on 'meanings', 'evaluation', 'significance', and the like, based on structure, relations, and ultimately multi-dimensional order All these terms apply equally to 'senses' and to 'mind', to 'emotions' and to 'intellect'—they are not artificially split

It is important to preserve the *non-el* or organism-as-a-whole attitude and terminology throughout, because these represent most important factors in our *s r* Sometimes it is necessary to emphasize the origin, or the relative importance, of a given aspect of the impulse or reaction, or to translate for the reader a language not entirely familiar to him into one to which he is more accustomed In such cases, I use the old *el* terms in quotation marks to indicate that I do not eliminate or disregard the other

aspects—a disregard which otherwise would be implied by the use of the old terms

The term psycho-logical will always be used either with a hyphen to indicate its *non-el* character, or in quotation marks, without a hyphen, when we refer to the old elementalism Similarly, with the terms psychologics, psycho-logicians, for 'psychology' and 'pyschologist'. The terms 'mental ills', 'mental hygiene' are unfortunate ones, since they are used by the majority as *el* Psychiatrists, it is true, use them in the organism-as-a-whole sense to include 'emotions' Because of the great semantic influence of the structure of language on the masses of mankind, leading, as it does, through lack of better understanding and *evaluation* to *speculation on terms,* it seems advisable to abandon completely terms which imply to the *many* the suggested elementalism, although these terms are used in a proper *non-el* way by the *few*

If specialists, to satisfy their *s r,* disregard these issues and persist in the use of *el* terms, or use such expressions as 'man is an animal' and the like, they misunderstand the importance of semantic factors Through lack of appreciation or of proper evaluation of the problems involved, they *artificially* and most effectively prevent the rest of us from following their work without being led astray by the inappropriate structure of their language The harm done through such practices is quite serious, and, at present, mostly disregarded For this reason, I either use quotation marks on the terms 'mental', 'mental' ills, 'mental' hygiene , or else I use the terms psycho-logical, semantic ills, psycho-logical or semantic hygiene,. The above two terms are not only *non-el* but also have an important advantage of being international The terms 'affects', 'affective' are little used outside of scientific literature, where they are used mostly in the *non-el* ordinal sense I use them in a similar way, without quotation marks

All the issues involved in the present work are, of necessity, interconnected Thus, order leads to relations, relations to structure, and these, in turn, to *non-el* meanings and evaluations, which are the fundamental factors of all psycho-logical states and responses, called more specifically semantic reactions, states, and reflexes The reader should be careful to remain at all times aware of these connections and implications. Whenever we find order, or relations, or structure, in the outside world, or in our nervous system, these terms, because of their *non-el* character, imply similar order relations, and structure in our psychological processes, thus establishing meanings, proper evaluations , ultimately leading toward appropriate *s r* The reverse applies also. When-

ever we speak of *s r*, *non-el* meanings, structure, relations, and, finally order, are implied.

The use of *non-el* languages is seriously beneficial, as it is structurally more correct and establishes *s.r* which are more appropriate, more flexible, or of higher order conditionality, a necessity for the optimum working of the human nervous system,—all of which results follow automatically from the structure of the language used.

A *non-el*, structurally correct, but non-formulated attitude is a private benefit Once it is formulated in a *non-el* language, it becomes a public benefit, as it induces in others the *non-el* attitudes, thus transforming the former *s r* In this way, a 'feeling' has been translated structurally into language, which, in turn, through structure, involves other people's attitudes and 'feelings', and so their *s r*

The whole process is extremely simple, elementary, and automatic, yet, before we acquire the new *s r*, we find difficulties because of the fundamental novelty of these reactions Any persistent student will acquire them easily, provided he does not expect too rapid a progress The subject matter of the present analysis is closely related to the 'feelings' of everybody, yet the difficulties in acquiring the new reactions are similar to those the older scientists found in acquiring the *s r* necessary for mastering the $\bar{E}$ and $\bar{N}$ systems

In physics, we often need 'space-like' or 'time-like' intervals, although the *non-el* implications of the term 'interval' remain Similarly, in our problems when we are interested in the 'emotion-like' or 'mind-like' aspects of the *non-el s r*, we shall indicate the special aspects by using the old terms in quotation marks This method prevents wasteful and futile speculations on *el* terms, and serves as a reminder that the other aspects are present, although in a given discussion we do not deem them to be important The above has, by itself, very far-reaching semantic influence on our reactions

From what has already been said, it is clear that the terminology of semantic reactions , covers in a *non-el* way all psycho-logical reactions which were formerly covered by *el* terms of 'emotions' and 'intellect', the reactions themselves always being on the objective levels and un-speakable As *s r* can always be analysed into terms of meanings and evaluation, and the latter into terms of structure, relations, and multidimensional order, which involves physiological factors, the term 'semantic' ultimately appears as a physiological or rather psychophysiological term It suggests workable and simple educational methods which will be explained later The reader should notice that the use of a language

of a new structure has led to new results, which, in turn, directly affect our *s r*

An important point should be stressed, namely, that the issues are fundamentally simple, because they are similar in structure to the structure of human 'knowledge' and to the nervous structure on which so-called 'human nature' depends Because of this similarity, it is unconditionally necessary to become fully acquainted with the new terms of new structure, and to use them habitually Only then will the beneficial results follow All languages have some structure, and so all languages involve automatically the, of necessity, interconnected *s r* Any one who tries to translate the new language into the old while 'thinking' in the older terms is confronted with an inherent neurological difficulty and involves himself in a hopeless confusion of his own doing The reader must be warned against making this mistake

In the present work, I have tried to realize fully my duties toward my reader, and I am certain that the reader who will read the book diligently and repeatedly will be repaid for his labours The realization that some problems *do exist,* even if we do not fully appreciate or understand them, has very serious semantic influence on all of us Realizing my responsibilities toward the reader, I have not spared difficult labour in order to bring these semantic facts to his attention I seriously suggest that no reader ought to disregard Parts VIII, IX, and X, but that he should become at least acquainted with the existence of the problems there discussed If this is conscientiously done, many beneficial *s r* will appear sooner or later.

The present system is an interconnected whole the beginning implies the end, and the end implies the beginning Because of this characteristic, the book should be read *at least twice,* and preferably oftener I wish positively to discourage any reader who intends to give it merely a superficial reading

The problems of *s r* have not, so far, been analysed at all from the point of view of structure, and the present enquiry is, as far as my knowledge goes, the first in existence The problems of meanings are vast, extremely important, and very little analysed The interested reader will find some material in the excellent critical review of the problems of meanings in Ogden's and Richards' *The Meaning of Meaning,* in some parts of Baldwin's *Thought and Things or Genetic Logic,* and in Lady Welby's article in the *Encyclopaedia Britannica* on *Significs* In these three studies, a partial literature of the subject is given

The present work involves issues taken from many and diverse branches of knowledge which have not hitherto been seen to be connected.

What is of importance is that the issues presented should be sound *in the main*, even if not perfect in details, which often have no bearing on the subject Specialists in the fields here analysed should pass their professional judgement as to the soundness of their *special parts* of the system They do not need even to be enthusiastic, it is enough if they approve it The main issue is the building of a $\bar{A}$-system, which *co-ordinates* many disconnected fields of knowledge on the basis of structure, from the special point of view of *non-el s r* If these results have been accomplished, the author is satisfied.

Section B. On the un-speakable objective level

The term 'un-speakable' expresses exactly that which we have up to now practically entirely disregarded, namely, that an object or feeling, say, our toothache, is *not* verbal, is *not* words Whatever we may say will not be the objective level, which remains fundamentally un-speakable Thus, we can sit on the object called 'a chair', but we cannot sit on the noise we made or the name we applied to that object It is of utmost importance for the present $\bar{A}$-system not to confuse the verbal level with the objective level, the more so that all our immediate and direct 'mental' and 'emotional' reactions, and all *s r*, states, and reflexes, belong to the un-speakable objective levels, as these are *not* words This fact is of great, but unrealized, importance for the training of appropriate *s r* We can train these reactions simply and effectively by 'silence on the objective levels', using familiar *objects* called 'a chair' or 'a pencil', and this training automatically affects our 'emotions', 'feelings', as well as other psycho-logical immediate responses difficult to reach, which are also *not* words We can train simply and effectively the *s r* inside our skins by training on purely objective and familiar grounds outside our skins, avoiding unnecessary psycho-logical difficulties, yet achieving the desired semantic results The term 'un-speakable' is used in its strict English meaning The objective level is *not* words, can *not* be reached by words alone, and has nothing to do with 'good' or 'bad', neither can it be understood as 'non-expressible by words' or 'not to be described by words', because the terms 'expressible' or 'described' already presuppose words and symbols Something, therefore, which we call 'a chair' or 'a toothache' may be *expressed* or *described* by words, yet, the situation is not altered, because the given description or expression will *not* be the actual objective level which we call 'a chair' or 'a toothache'.

Semantically, this problem is genuinely crucial Any one who misses that—and it is unfortunately easily missed—will miss one of the most

important psycho-logical factors in all *s r* underlying sanity This omission is facilitated greatly by the older systems, habits of thought, older *s r*, and, above all, by the primitive *structure* of our *A* language and the use of the 'is' of identity Thus, for instance, we *handle* what we call a pencil Whatever we *handle* is un-speakable, yet we *say* 'this *is* a pencil', which statement is unconditionally false to facts, because the object appears as an absolute individual and *is not* words Thus our *s r* are at *once trained in delusional values,* which must be pathological

I shall never forget a dramatic moment in my experience I had a very helpful and friendly contact prolonged over a number of years with a very eminent scientist After many discussions, I asked if some of the special points of my work were clear to him His answer was, 'Yes, it is all right and so on, *but,* how can you expect me to follow your work all through, if I still do not know what an object *is*?' It was a genuine shock to me The use of the little word 'is' as an identity term applied to the objective level had paralysed most effectively a great deal of hard and prolonged work Yet, the semantic blockage which prevented him from acquiring the new *s r* is so simple as to seem trifling, in spite of the semantic harm done The definite answer may be expressed as follows: 'Say whatever you choose *about* the object, and whatever you might say *is not* it' Or, in other words 'Whatever you might *say* the object "is", well it *is not*' This negative statement is *final,* because it is *negative*

I have enlarged upon this subject because of its crucial semantic importance Whoever misses this point is missing one of the most vital factors of practically all *s r* leading toward sanity The above is easily verified In my experience I have never met any one, even among scientists, who would *fully* apply this childish 'wisdom' as an *instinctive* 'feeling' and factor in all his *s r* I want also to show the reader the extreme simplicity of a $\bar{A}$-system based on the denial of the 'is' of identity, and to forewarn him against very real difficulties induced by the primitive structure of our language and the *s r* connected with it Our actual lives are lived entirely on the objective levels, including the un-speakable 'feelings', 'emotions', the verbal levels being only *auxiliary,* and effective only if they are translated back into first order un-speakable effects, such as an object, an action, a 'feeling', all on the silent and un-speakable objective levels In all cases of which I know at present, where the retraining of our *s r* has had beneficial effects, the results were obtained when this 'silence on the objective levels' has been attained, which affects all our psycho-logical reactions and regulates them to the benefit of the organism and of his survival adaptation

Section C. On 'copying' in our nervous reactions

The selection of the term 'copying' was forced upon me after much meditation Its standard meaning implies 'reproduction after a model', applicable even to mechanical processes, and although it does not exclude, it does *not* necessarily include conscious copying. It is not generally realized to what an important extent copying plays its role in higher animals and man

Some characteristics are inborn, some are acquired Long ago, Spalding made experiments with birds Newly hatched birds were enclosed in small boxes which did not allow them to stretch their wings or to see other birds fly At the period when usually flying begins, they were released and began to fly at once with great skill, showing that flying in birds is an inborn function Other experiments were made by Scott to find out if the characteristic song of the oriole was inborn or acquired When orioles, after being hatched, were kept away from their parents, at a given period they began to sing, but the peculiar melody of their songs was different from the songs of their parents Thus, singing is an inborn characteristic, but the special melody is due to copying parents, and so is acquired [3]

In our human reactions, speech in general is an inborn characteristic, but what special language or what special *structure* of language we acquire is due to environment and copying—much too often to unconscious and, therefore, uncritical copying As to the copying of animals in our nervous reactions, this is quite a simple problem Self-analysis, which is rather a difficult affair, necessitating a serious and efficient 'mentality', was impossible in the primitive stage Copying parents in many respects began long before the appearance of man, who has naturally continued this practice until the present day The results, therefore, are intimately connected with reactions of a pre-human stage, transmitted from generation to generation But for our present purpose, the most important form of the copying of animals was, and is, the copying of the comparative unconditionality of their conditional reflexes, or lower order conditionality; the animalistic identification or confusion of orders of abstractions, and the lack of consciousness of abstracting, which, while natural, normal, and necessary with animals, becomes a source of endless semantic disturbances for humans. More about copying will be explained as we proceed

It should be noticed also that because of the structure of the nervous system and the history of its development, the more an organism became 'conscious', the more this copying became a neurological necessity, as

exemplified in parrots and apes With man, owing to the lack of consciousness of abstracting, his copying capacities became also much more pronounced and often harmful Even the primitive man and the child are 'intelligent' enough to observe and copy, but not informed enough in the racial experiences usually called science, which, for him, are non-existent, to discriminate between the reactions on the 'psychological' levels of animals and the typical responses which man with his more complex nervous system should have Only an analysis of *structure* and *semantic reactions,* resulting in consciousness of abstracting, can free us from this unconscious copying of animals, which, let us repeat, must be pathological for man, because it eliminates a most vital regulating factor in human nervous and *s r*, and so vitiates the whole process This factor is not simply additive, so that, when it is introduced and *superimposed* on any response of the human nervous system allowing such superimposition, the whole reaction is *fundamentally changed* in a beneficial way

CHAPTER III

INTRODUCTION

> And so far as the actual, fundamental, biological structure of our society is concerned and notwithstanding its stupendous growth in size and all the tinkering to which it has been subjected, we are still in much the same infantile stage But if the ants are not despondent because they have failed to produce a new social invention or convention in 65 million years, why should we be discouraged because some of our institutions and castes have not been able to evolve a new idea in the past fifty centuries? (553)
>
> WILLIAM MORTON WHEELER

> The ancient who desired to illustrate illustrious virtue throughout the empire, first ordered well their own state Wishing to order well their own state, they first regulated their families Wishing to regulate their families, they first cultivated their own persons Wishing to cultivate their persons, they first rectified their heart Wishing to rectify their hearts, they first sought to be sincere in their thoughts Wishing to be sincere in their thoughts, they extended their knowledge to the utmost, and this extension of knowledge lay in the investigation of things. Things being investigated, knowledge became complete. Their knowledge being complete, their thoughts were sincere Their thoughts being sincere, their hearts were then rectified Their heart being rectified, their persons were cultivated. Their persons being cultivated, their families were regulated Their family being regulated, their states were rightly governed Their states being rightly governed, their whole empire was made tranquil and happy. From the emperor down to the mass of the people, all must consider the cultivation of the person, the root of every thing besides
>
> CONFUCIUS

My service at the front during the World War and an intimate knowledge of life-conditions in Europe and the United States of America have convinced me that a scientific revision of *all* our notions about ourselves is needed Investigation disclosed that all disciplines dealing with the affairs of man either do not have a definition of man, or, if they do, that it is formulated in metaphysical, *el*, subject-predicate languages, which are unscientific and ultimately semantically harmful

As we have, at present, no general science of man embracing *all* his functions, language, mathematics, science and 'mental' ills included, I believed that to originate such a science would be useful This task I began in my *Manhood of Humanity,* and have continued in the present volume The selection of a name for such a science is difficult. The only really appropriate name, 'Anthropology', is already pre-empted to cover a most fundamental and sound discipline, without which even modern psychiatry would be impossible This name, at present, is used in a *restricted* sense to signify the animalistic natural history of man, disregarding the fact that the *natural history of man* must include factors non-existent in the animal world, but which are his *natural* functions,

such as language and its structure, the building of his institutions, laws, doctrines, science, mathematics , which condition his environment, his *s r*, which, in their turn, influence and determine his development.

We see that the 'natural history' of animals differs greatly in structure from a future scientific *'natural history'* of man, a structural difference very seldom fully realized I propose, then, to call the very valuable existing Anthropology the *Restricted Anthropology,* and to call the generalized science of man *General Anthropology,* so as to include *all* his natural functions, of which those covered by the Restricted Anthropology would be a part

Such a definite General Anthropology would be very different from the existing restricted one It would include all disciplines of human interest from a special anthropological and semantic point of view. Very often an anthropological discipline—for instance, anthropological psycho-logics, anthropological sociology, law, history, or 'philosophy'—would turn out to be a *comparative* discipline Such, by necessity, would have to use a language of four-dimensional structure, which would necessitate, as a preliminary, a fundamental revision of the structure of the language they use—a semantic factor which, up to now, has been largely neglected.

It is to be frankly admitted that the present enquiry has led to some quite unexpected and startling results In my *Manhood of Humanity,*[1] I defined man *functionally* as a time-binder, a definition based on a *non-el* functional observation that the human class of life differs from animals in the fact that, in the rough, each generation of humans, at least potentially, can start where the former generation left off—a definition which, in the language of this particular structure, *is sharp,* and corresponds to empirical facts We should notice, also, that in the case of primitive tribes which apparently have not progressed at all for many thousands of years, we always find, among other reasons, some special doctrines or creeds, which proclaim very efficiently, often by killing off individuals (who always are responsible for progress in general), that any progress or departure from 'time honoured' habits or prejudices 'is a mortal sin' or what not Even in our own case we are not free from such semantic tendencies Only the other day, historically speaking, the 'holy inquisition' burned or silenced scientists The discovery of the microscope and telescope, for instance, was delayed for a long time because the inventor, in fear of priestly persecution, was afraid to write his scientific discoveries in plain language He had to write them in cipher—a fact discovered only a few years ago Those afflicted with diseases can easily realize where our science in general, and medical

science in particular, *might* be today if not for the holy zeal of powerful enemies of science who vehemently and ruthlessly sponsored ignorance, old *s r*, and so disease

In some countries, even at present, science is persecuted, and the attempt is made to starve scientists, a device often quite as effective as burning at the stake, of which the Tennessee trial and others are examples But, in spite of all these primitive semantic tendencies, which, unfortunately, are often very efficient, the general time-binding characteristic of man remains unaltered, although its rate can be slowed down by the ignorance of those who control our symbolism—words, money,

The failure to understand these problems is due to the fundamental fact that, until now, we have had no scientific functional *non-el* definition of man, neither have we originated any scientific enquiry into the inherent 'nature of man', which is impossible if we disregard *s r* We should remember that in this commercialized era we offer large incomes to those who preach with great zeal how 'evil' 'human nature is', and who tell us how, without their services, all kinds of dreadful things will happen to a given individual.

In the light of modern enquiry, the above issues come to a very sharp focus Either these apostles *do* know that what they promise has only delusional value, yet they want to retain their incomes, or else they live in *delusional* worlds, and a sane mankind should take care of them In either case, they are *unfit* to be any longer entrusted with the care of the further development of culture and the future of mankind Sooner or later, we must meet this semantic situation squarely, as too many factors of human sanity are at stake

In my *Manhood of Humanity,* it is shown that the canons of what we call 'civilization' or 'civilizations' are based on animalistic generalizations taken from the obvious facts of the lives of cows, horses, dogs, pigs , and applied to man Of course, such generalizations started with *insufficient data* The generalizations had to be primitive, superficial, and when applied in practice, periodical collapses were certain to follow No bridge would stand or could even be built, if we tried to apply rules of surfaces to volumes The rules or generalizations in the two cases are different, and so the results of such primitive semantic confusion must be disastrous to all of us

The present enquiry began with the investigation of the characteristic difference between animal and man, namely, the mechanism of time-binding This analysis, because of the different structure of the language used, had to be carried on independently and anew The results are, in many instances, new, unexpected even by myself, and

they show unmistakably that, to a large extent, even now we nearly all copy animals in our nervous processes Investigation further shows that such nervous reactions *in man* lead to non-survival, pathological states of general *infantilism*, infantile private and public behaviour, infantile institutions, infantile 'civilizations' founded on strife, fights, brute competitions , these being supposedly the 'natural' expression of 'human nature', as different commercialists and their assistants, the militarists and priests, would have us believe

As always in human affairs, in contrast to those of animals, the issues are circular Our rulers, who rule our symbols, and so rule a symbolic class of life, impose their own infantilism on our institutions, educational methods, and doctrines This leads to nervous maladjustment of the incoming generations which, being born into, are forced to develop under the un-natural (for man) semantic conditions imposed on them In turn, they produce leaders afflicted with the old animalistic limitations The vicious circle is completed , it results in a general state of human un-sanity, reflected again in our institutions And so it goes, on and on

At first, such a discovery is shocking On second consideration, however, it seems natural that the human race, being relatively so recent, and having passed through different low levels of development, should misunderstand structurally their human status, should misuse their nervous system , The present work, which began as the 'Manhood of Humanity' turned out to be the 'Adulthood of Humanity', for it discloses a *psychophysiological* mechanism of infantilism, and so points toward its prevention and to adulthood

The term 'infantilism' is often used in psychiatry No one who has had any experience with the 'mentally' ill, and studied them, can miss the fact that they always exhibit some infantile symptoms It is also known that an adult, otherwise considered 'normal', but who exhibits marked infantile semantic characteristics, cannot be a fully adjusted individual, and usually wrecks his own and other persons' lives

In the present investigation, we have discovered and formulated a definite psychophysiological mechanism which is to be found in all cases of 'mental' ills, infantilism, and the so-called 'normal' man The differences between such neural disturbances in different individuals turn out to vary only in degree, and as they resemble closely the nervous responses of animals, which are necessarily regressive for man, we must conclude that, generally, we do not use our nervous system properly, and that we have not, as yet, entirely emerged from a very primitive semantic stage of development, in spite of our technical achievements.

Indeed, experience shows that the more technically developed a nation or race is, the more cruel, ruthless, predatory, and commercialized its systems tend to become These tendencies, in turn, colour and vitiate international, national, capital-labour, and even family, relations

Is, then, the application of science at fault? No, the real difficulty lies in the fact that different primitive, animalistic, un-revised doctrines and creeds with corresponding *s r* have *not* advanced in an equal ratio with the technical achievements When we analyse these creeds semantically, we find them to be based on structural assumptions which are false to facts, but which are strictly connected with the unrevised structure of the primitive language, all of which is the more dangerous because it works unconsciously

When we study comparatively the nervous responses of animals and man, the above issues become quite clear, and we discover a definite psychophysiological mechanism which marks this difference That the above has not been already formulated in a workable way is obviously due to the fact that the *structure* of the old language successfully prevented the discovery of these differences, and, indeed, has been largely responsible for these human semantic disturbances Similarly, in the present $\bar{A}$-system, the language of a new and modern structure, as exemplified by terms such as 'time-binding', 'orders of abstractions', 'multi-ordinal terms', 'semantic reactions' , led automatically to the disclosure of the mechanism, pointing the way toward the means of control of a special therapeutic and preventive character.

The net results are, in the meantime, very promising Investigation shows that, in general, the issues raised are mostly *linguistic,* and that, in particular, they are based on the analysis of the *structure* of languages in connection with *s r* All statements, therefore, which are made in this work are about empirical facts, language and its structure We deal with an obvious and well-known inherent psychophysiological function of the human organism, and, therefore, all statements can be readily verified or eventually corrected and refined, allowing easy application, and automatically eliminating primitive mythologies and *s r*

After all is done and said, one can only wonder why such a simple fact that language represents a very important, unique, and inherent psychophysiological function of the human organism has been neglected so long

The answer seems to be that (1) the daily language is structurally extremely complex, (2) it is humanly impossible to analyse its structure by using the language of A structure, so that before anything can be done at all in this field a $\bar{A}$-system must first be formulated; (3) there is

a general innocence on the part of nearly all specialists, a very few mathematicians excepted, of the structural and semantic role of the simplest—although still inadequate—$\bar{A}$ language called mathematics, (4) all these issues involve most powerful unconscious factors which work automatically against any revision, and (5) the building of a $\bar{A}$-system in 1933 is an extremely laborious enterprise, to say the least, and, in all probability, really beyond the power of any single man to complete

The last point is quite important, and, although I have no intention to apologize or present any alibis, because any thoughtful reader will understand it, I must explain, nevertheless, briefly why the present work has probably fallen far short of what it eventually could be

In the days of Aristotle, we knew extremely little of science in the 1933 sense Aristotle, in his writings, formulated for us a whole scientific program, which we followed until very lately. Whoever, in 1933, attempts to build a $\bar{A}$-system, must, by *internal necessity,* connected with the problems of the *structure of language,* do something similar Obviously, in 1933, with the overwhelming number of most diversified facts known to science, the question is no more to sketch a scientific program for the future, but to build a system which, at least in structure, is similar to the structure of the known facts from all branches of knowledge

Let me repeat the necessity is internal, and connected with the *structure* of language as such, involving new *s r*, and so no one can avoid it, as this whole work shows in detail

Now such structural adjustment requires an immense amount of study of diverse empirical facts, and then it must depend on new generalizations, concerned in the main with structure Many statements of scientists, when even accepted as reliable, still have to be translated into a special language in which structural issues are made quite obvious, divulging factors in *s r* This is a very serious difficulty, particularly when many branches of knowledge are drawn upon, as each uses its own special language, so that such a unitary translation in terms of structure imposes a serious burden on the memory of the translator, and often little details escape attention in the implications of the translation, although they may be well known to the translator. As this is probably the chief difficulty, it is in this field that the main corrections will have to be made

I admit that I started this enquiry without fully realizing its inherent difficulties, or whither it would eventually lead The more I advanced, the more special knowledge was required I had to go to sources, and,

in a way, partially specialize in many branches of science which were never connected before The progress was extremely slow, in fact, it has taken ten years to write this book, but I had to go through the necessary preliminaries or abandon the whole enterprise

Now I present the results of this work to the public It is the best I can do, although I fully realize its limitations and imperfections The unexpected drama of such an enterprise is found, in that a $\bar{A}$-system, like its predecessor, involves full-fledged structural metaphysics of some sort, to be explained later

The A-system involved primitive structural metaphysics; a $\bar{A}$-system, to be of any semantic value at all, must start with the structural metaphysics or structural assumptions as given by science 1933 The first step in building such a system is to study science 1933 and mathematics, and so to know these structural data (and assumptions where we lack data) Such a study is very laborious, slow, and even ungrateful, because the issues with which we are concerned are *structural* Thus, years of patient and sometimes painful labour often result merely in a very few and brief, but important, sentences

The active, and only very lately relaxed, persecution of those scholars who dared to attempt the revision of Aristotle has been very effective in keeping the primitive $s\,r$ There are in this field practically no important works of a critical character, and this fact, naturally, made my own work more difficult

It appears that, during the last few years, most of the physiological functions of the human organism have been investigated, with the exception of psychophysiological *semantic reactions* and their disturbances from the present point of view

The study of aphasia is rather recent, and that of *semantic aphasia* still more so Only since the World War has much new knowledge been accumulated in this field With the 1933 scientific outlook, macroscopic structure becomes a function of the sub-microscopic dynamic structure, and the considerations of colloidal structure and disturbances become extremely important We must, therefore, enlarge the study of semantic aphasia as connected with macroscopic lesions, to include semantic phasic (not only a-phasic) sub-microscopic functional disturbances connected with *order,* natural survival order and its pathological reversal, the disturbances of the *multiordinal semantic reactions*

It is known that 'mental' ills or difficulties often disturb physiological functions of the human organism, and vice versa Something similar appears to be true about the last and little-investigated $s\,r$ In this case, more and special difficulties arise, because of the fact that

these particular reactions are strictly connected with different 'emotional' or affective responses, which are due to the knowledge (or lack of knowledge) of their mechanism They are circular, as all functions connected with knowledge are This difficulty is very serious and closely connected with the *structure of language,* disclosing also a most important fact, that languages *may* have structure This subject could not have been even suggested by the A-system, nor could it have been analysed by A means

The most encouraging feature of this work is the fact that it is *experimental,* and that in cases where it has been applied, it worked remarkably well It appears that all desirable human characteristics, high 'mentality' included, have a definite psychophysiological mechanism, easily understood and easily trained One should not expect this training to be more quickly acquired than the mastering of spelling, or driving a car, or typewriting Practice shows that it requires approximately as much diligence and persistence as learning to spell or to typewrite The results accomplished in the field of 'mental' health, widened horizons, and unlimited possibilities for personal and public adjustment, justify so small a price This applies to adults, but in a different way is true for children From an educational point of view, it is as simple or as complex to train children in the improper use of an important physiological function, such as language, as to train them in the proper use of the nervous system and appropriate $s\,r$ In fact, the new is simpler and easier, if we start with it, because it is in accordance with 'human nature' In theory, it plays a most important role in the prevention of many future eventual break-downs, which the old misuse of the function was certain to involve

The problems of a $\bar{A}$-system are, to the best of my knowledge, novel They are of two kinds (1) scientific, leading to a theoretical, general structural revision of all systems, and (2) purely practical, such as can be grasped and applied by any individual who will spend the time and effort necessary to master this system and acquire the corresponding $s\,r$.

The results are far-reaching They help any individual to solve his problems by himself, to his own and others' satisfaction They also build up an *affective* semantic foundation for personal as well as for national and international agreement and adjustment

Some of the results are quite unexpected For instance, it is shown that the older systems, with their linguistic methods of handling our nervous system, led inevitably to 'universal disagreement' In individual life this led to pathological conflicts with ourselves, in private life, to

family strifes and unhappiness, and so to nervous disturbances, in national life, to political strifes, revolutions , in international affairs, to mutual misunderstanding, suspicion, impossibility to agree, wars, World Wars, 'trade wars' , ultimately ending in slaughter, general unemployment, and an unnecessarily great amount of general unrest, worry, confusion, and suffering in different degrees for all, helping again to disturb the proper working of the human nervous system

The subject of this work is ultimately 'speaking about speaking'. As all human institutions depend upon speaking—even the World War could not have been staged without speaking—and as all science is ultimately verbal, such an analysis must cover a large field. In such an attempt, therefore, we must first understand the speaking of scientists, of different specialists , and so must get acquainted with their languages, and what they are talking *about* This is the semantic reason why I have had to explain to the reader many simple, yet necessary, scientific structural issues

The present book is written on the level of the average intelligent reader, and any such reader will get the full benefit for his labour provided he is willing to put into it the necessary work and persistence Perhaps a word of warning is necessary My own personal experience is that, when once we have acquired a bad habit, let us say in making errors in typewriting, this bad habit is very difficult to eliminate A similar remark applies to the old habits of speech, and of the semantic responses connected with them A re-education is simple in principle, but it requires a great deal of persistent effort to overcome undesirable *s r* My experience convinces me that the self-satisfied, the 'happy' person, who has no problems at all, if there is such a person, should *not* attempt to read this book He will waste just so much effort But I can confidently promise that any one who has any problems to solve,—be they personal difficulties with himself, his family, or his associates—the scientist, the teacher, or the professional person who wants to become more efficient in his own work, will be amply repaid for spending the necessary 'time' in mastering the linguistic, and so neurological problems involved in such a structural semantic re-education

This investigation has turned out to be a general introduction to a theory of sanity, the first ever made, as far as I know When applied, it genuinely works, but, of course, we have to apply it fully. Mere lip-service will not do, because while superficial agreement is quite easy, yet physiologically, on a deeper level, we continue to follow the older harmful *s r* In such a case nothing is actually changed, the old neurologically harmful animalistic responses persist For this the author and

the present work must not be held responsible, the fault will lie in the disregard of fundamental conditions by the reader or the students

From an educational point of view, these problems are particularly important If teachers disregard the structural linguistic semantic issues, they disregard a most powerful and effective educational method If they train in structurally and physiologically harmful A habits, after this mechanism has been disclosed, such teachers, to my understanding, do not honestly perform their very serious social obligations Ignorance is no excuse when once we know that ignorance is the only possible excuse.

The present $\bar{A}$-system is far from perfect Such a work as this has, of necessity, to be altered with the years, as the structure of the language used has to be continually adjusted to newly discovered empirical structural data But the present enquiry at least shows that in the researches in the linguistic and structural semantic fields there are undreamed-of possibilities of tremendous power, and the circularity of human knowledge is made to work with an increasing acceleration in a constructive way toward the adulthood of man

In Chapter I, I have given a tentative list of some results following from the present work Among them we found a new and *semantic definition of number* and mathematics, to be explained in Chapter XVIII. This has very far-reaching consequences, because the existing definition of number is A, in terms of classes, and makes the importance of mathematics still more mysterious With the discovery that the only content of knowledge is structural, understood as a complex of relations and multiordinal and multi-dimensional order, and that the structure of the nervous system is such that only in mathematics do we find a *language of similar structure,* the importance of mathematics, considered as a language, becomes of fundamental semantic significance for a theory of sanity But to show that, and to be able to apply this fact in practice, we must clarify or rather eliminate the mystery which surrounds number and measurement The semantic definition of number is given in terms of relations, and so number and measurement become the most potent factors for supplying us with information about structure, which we know already gives the only content of knowledge

At this point, I feel it essential to refer to the unique and astonishing work of Oswald Spengler, *The Decline of the West* This work is a product of such unusual scholarship and breadth of vision that, in many instances, the details do not matter Its method, its scope, and the complete novelty of its general point of view, combined with such tremendous erudition, are of main importance The work is labeled by the author as a 'philosophy of history', or a morphology of history, or

morphology of cultures The word 'morphology' is used as implying the study of forms, and the term 'form' appears very frequently throughout the book

The main contention of this work—and it is an entirely justified observation—is that the behaviour of the organisms called humans is such that, at different periods, they have produced definite aggregates of achievements, which we dissect and label 'science', 'mathematics', architecture', 'sculpture', 'music' , and that at any given period all these achievements are interconnected by a psycho-logical necessity To this statement I would add the *structure of languages* of a given period which affect the *s r* should not be disregarded

Spengler is a mathematician, an extremely well and generally informed mathematician at that, with a great vision He surveys these aggregates as definite units and shows the necessary psycho-logical connections between all the achievements and the evolution of the notion of number It does not matter whether all his connections are always beyond criticism That some such connections do exist, seems beyond doubt All human achievements have been accomplished in some definite period, and they have been accomplished at a definite period only because of the necessary psycho-logical attitude and *s r* of that period

With regard to the method followed in this work of Spengler, we must notice, first of all, that the attitude of the work is frankly anthropological, in the sense of *General Anthropology*, namely, as the *natural history of man, not* disregarding man's *natural* behaviour, such as building up sciences, mathematics, arts and institutions, and creating new environments, which again influence his development Morphology means 'study of forms', which carries *static* implications Taken from the dynamic point of view 1933, when we know that the dynamic unit, out of which the world and ourselves appear to be built, is found in the dynamic atom of 'action', his 'form' becomes four-dimensional *dynamic structure*, the equivalent of 'function'; and then the whole outlook of Spengler becomes a *structural* enquiry into the world of man, including all his activities.

This 'form', or rudimentary structural point of view, or feeling, or inclination, or tendency, or *s r*—call it what you choose—Spengler, the mathematician and historian, acquires from the deep study of mathematics considered as a *form of human behaviour*, which, in turn, is a part of his behaviour when he was planning and accomplishing his work, a natural expression of the strivings of *his* epoch, which is also our own In my own work, I have attempted to formulate these vague strivings of our epoch in the form of a general *semantic* psychophysiological theory

From this point of view, his achievement is momentous, a great description of the childhood of humanity In spite of the title, there is nothing pessimistic about it, although most of his readers understood it in that way 'The Decline of the West' implies the birth of a new era, perhaps the adulthood of humanity There is no doubt in 1933 that the collapses of the older systems which we witness are probably irrevocable. Sir Auckland Geddes, the British Ambassador to the United States of America, foresaw them when he said in 1920 'In Europe, we know that an age is dying Here it would be easy to miss the signs of coming changes, but I have little doubt that it will come A realization of the *aimlessness* of life lived to labour and to die, having achieved nothing but avoidance of starvation, and the birth of children also doomed to the weary treadmill, has seized the minds of millions'

In 1932 Ambassador Mellon, of the United States of America to Great Britain, said.

'Part of our difficulty arises because we look on the present industrial economic crisis as merely a sporadic illness of the body politic due to conditions in some particular country or section of the world which can be cured by applications of some magic formula Greater difficulty arises because we who are left over from the last century continue to look on the last decade as merely a prolongation of all that is gone before We insist upon trying to make life flow in the same channels as before the war, whereas in the years since the war ended are, in reality, the beginning of a new era, not the end of the old'

To this statement of Ambassador Mellon, the newspapers comment as follows:

'This is an important utterance, since, as far as we know, it is the first admission from the ruling forces in this country that the present panic is not "just another panic"'

No doubt, a period of human development has ended The only sensible way is to look forward to a full understanding of the next phase, get hold of this understanding, keep it under conscious and scientific control, and *avoid this time,* perhaps for the first time in human history, the unnecessary decay, bewilderment, apathy, individual and mass suffering in a *human* life-period, animalistically believed, up to now, to be unavoidable in the passing of an era Instead of being swept down by animalistic resistance to the *humanly* unavoidable change, we must analyse, understand, and so keep conscious control of one change to another, and, as yet, always higher state of human culture

This is no place to analyse these issues in detail Volumes have already been written about the work of Spengler More volumes will

be necessary to analyse the issues raised, and not always solved, in this present volume

I want to make clear only that words are *not* the things spoken about, and that there is *no* such thing as an object in absolute isolation These assertions are negative and experimental and cannot be successfully denied by any one, except by producing positive evidence, which is impossible.

We must realize that *structure, and structure alone*, is *the* only link between languages and the empirical world Starting with undeniable negative premises, we can always translate them into positive terms, but such translation has a new and hitherto unprecedented security In the era which is passing, positive premises were supposed to be important, and we did not know that a whole $\bar{A}$-system can be built on negative premises The new era will have to revaluate these data, and build its systems on *negative premises*, which are of much greater security *A priori*, we cannot know if such systems can be built at all, for in this field the only possible 'proof' is actual performance and the exhibition of a sample.

This has been attempted in my work, and so the possibility of such systems becomes a fact on record

In the new era, the role of mathematics considered as a form of human behaviour and as a language will come to the fore Means can be found, as exemplified in the present volume, to impart mathematical structure to language without any technicalities It is enough to understand the above-mentioned negative premises and the role of structure, and to produce systems from this angle

The role of mathematics has been and, in general, is still misunderstood, perhaps because of the very unsatisfactory definition of number. Even Spengler asserts that 'If mathematics were a mere science, like astronomy or mineralogy, it would be possible to define their object This, man is not, and never has been, able to do' The facts are that mathematicians have been prone to impress us with some religious awe of mathematics, meanwhile, by definition, whatever has symbols and propositions must be considered a *language* All mystery vanishes in this field, and the only question is as to what kind of language mathematics represents From the structural point of view, the answer is simple and obvious. Mathematics, although in daily life it appears as a most insufficient language, seems to be *the only language* ever produced by man, which, *in structure, is similar*, or the most similar known, to the structure of the world *and of our nervous system* To be more explicit,

let me say at once that in this 'similarity of structure' we find *the only* positive 'knowledge' of 1933, and, perhaps, of any date

So far, I am in full agreement with the great work of Spengler More than that, *The Decline of the West* may be considered as a preliminary and preparatory survey of the great cultural spasms which have rocked mankind It may be instructive, in the meantime, to point out some differences, and the eventual difference of conclusions, between the present work and the work of Spengler

The difference, to start with, is in language Spengler announces his work as 'intuitive and depictive through and through, which seeks to present objects and relations illustratively instead of offering an army of ranked concepts'

My own aim is not merely descriptive, but structural and analytical, and so I must use a different language, helping to discover semantic psychophysiological *mechanisms* of the events of which Spengler is giving us a very exceptional *picture*

Spengler missed two points that mathematics must be considered a language, and that the connection which he asserts between the mathematics of each period and other achievements is more general than he suspects and applies to the inherent *structure* of languages, in general, and the *s r* of each period, in particular

Although his analysis is in effect $\bar{A}$, yet the $\bar{A}$ issues are not formulated clearly or consciously, nor does he mention that the present-day accepted definition of number in terms of classes is still A It is true that he considers 'forms' and the use of number as relations, but he does not emphasize that number has not been formally defined as a relation, which is essential in a $\bar{A}$-system His 'form' is still static and not dynamic structure, nor did he discover that the only possible content of knowledge is structural, a fact which is *the* semantic factor responsible for 'cultures', and 'periods', and everything else in human development

This present work is in great sympathy with the momentous work of Spengler, but, as it culminates in a $\bar{A}$-system, it goes further than his, and is more workable and more practical, confirming the general contention of Spengler, that cultures have their periods of growth and development and that, so far, without conscious human intention, they are superseded by others.

We should notice once more in this respect that the issues we deal with, whenever *human* psycho-logical reactions are involved, are circular, as distinguished from animal reactions Human structures, in language or in stone, reflect the psycho-logical status, feelings, intuitions, structural metaphysics, and other *s r*, of their makers and periods, and,

vice versa, once these structural strivings and tendencies are formulated as such, they help to quicken and transform one period into the next one.

To the best of my knowledge, the general analysis of this most fundamental structural semantic problem of human knowledge is here formulated for the first time It will allow, as a result, the making of human progress conscious, it will enable us to control it and so to make it uninterrupted by the painful and wasteful semantic periods of hopelessness and helplessness so characteristic of the older periods of transition

If it is an historical fact and also a psycho-logical fact that a time-binding class of life has to have periods of development, let us have them! Let us investigate the mechanism of time-binding, of $s\,r$, which are the dynamic factors of those changes and developments! Let us direct that development consciously, and this will lead to the elimination of unnecessary and painful panics, unrest, and the often bloody bursting of those animalistic barriers self-imposed on the dynamic class of life called 'man'

When all is said and done, one cannot but see, at least as far as the white race is concerned, that a change from an A to a $\bar{A}$-system must be momentous Such a change will mark the difference between a period when the mystery of 'human knowledge' was not solved and a period when it has been solved This inherent human circular characteristic has, so far been neurologically abused We have not known how to handle our nervous structure We have imposed upon and hampered human development by animalistic methods The solving of the problems of the content of 'human knowledge' will open a new era of man as a *man*, leading toward proper handling of his capacities, and an era scientific in all respects, not merely in a few exact sciences. Psychologically, it will be an era of sanity, and, therefore, of human general adjustment, agreement, and co-operation The dreams of Leibnitz will become sober reality

The only determined attempt made, so far, to deal with the symbolic problems whose importance is emphasized in the present work is that of the Orthological Institute (10 King's Parade, Cambridge, England) This research organization, founded by C K Ogden, editor of 'The International Library of Psychology', is concerned with the influence of language on 'thought' in all its bearings, and it is to be hoped that further endowment may be forthcoming to enable the scope of its enquiries to be extended to include *structure, non-elementalistic semantic reactions,* and *non-aristotelian systems* Reference to International Languages or a Universal Language will be found in the notes [1]

PART II

GENERAL ON STRUCTURE

The relativity theory of physics reduces everything to relations, that is to say, it is structure, not material, which counts The structure cannot be built up without material, but the nature of the material is of no importance (147) A S EDDINGTON

Structure and function are mutually related Function produces structure and structure modifies and determines the character of function (90) CHARLES M. CHILD

These difficulties suggest to my mind some such possibility as this that every language has, as Mr Wittgenstein says, a structure concerning which, *in the language*, nothing can be said, but that there may be another language dealing with the structure of the first language, and having itself a new structure, and that to this hierarchy of languages there may be no limit Mr Wittgenstein would of course reply that his whole theory is applicable unchanged to the totality of such languages. The only retort would be to deny that there is any such totality (456) BERTRAND RUSSELL

CHAPTER IV

ON STRUCTURE

No satisfactory justification has ever been given for connecting in any way the consequences of mathematical reasoning with the physical world. (22) E T. BELL

Any student of science, or of the history of science, can hardly miss two very important tendencies which pervade the work of those who have accomplished most in this field The first tendency is to base science more and more on experiments, the other is toward greater and more critical verbal rigour The one tendency is to devise more and better instruments, and train the experimenters, the other is to invent better verbal forms, better forms of representation and of theories, so as to present a more coherent account of the experimental facts

The second tendency has an importance equal to that of the first, a number of isolated facts does not produce a science any more than a heap of bricks produces a house The isolated facts must be put in order and brought into mutual structural relations in the form of some theory Then, only, do we have a science, something to start from, to analyse, ponder on, criticize, and improve Before this something can be criticized and *improved,* it must first be produced, so the investigator who discovers some fact, or who formulates some scientific theory, does not often waste his time Even his errors may be useful, because they may stimulate other scientists to investigate and improve

Scientists found long ago that the common language in daily use is of little value in science This language gives us a form of representation of very old structure in which we find it impossible to give a full, coherent account of ourselves or of the world around us Each science has to build a special terminology adapted to its own special purposes This problem of a suitable language is of serious importance Too little do we realize what a hindrance a language of antiquated structure is Such a language does not help, but actually prevents, correct analysis through the semantic habits and structural implications embodied in it The last may be of great antiquity and bound up, by necessity, with primitive-made structural implications, or, as we say, metaphysics, involving primitive *s r*

The above explains why the popularization of science is such a difficult and, perhaps, even a semantically dangerous problem We attempt to translate a creative and correct language which has a structure

similar to the structure of the experimental facts into a language of different structure, entirely foreign to the world around us and ourselves Although the popularization of science will probably remain an impossible task, it remains desirable that the *results* of science should be made accessible to the layman, if means could be found which do not, by necessity, involve misleading accounts It seems that such methods are at hand and these involve *structural* and semantic considerations

The term 'structure' is frequently used in modern scientific literature, but, to the best of my knowledge, only Bertrand Russell and Wittgenstein have devoted serious attention to this problem, and much remains to be done These two authors have analysed or spoken about the structure of propositions, but similar notions can be generalized to languages considered as-a-whole To be able to consider the structure of one language of a definite structure, we must produce another language of a *different* structure in which the structure of the first can be analysed This procedure seems to be new when actually performed, although it has been foreseen by Russell [1] If we produce a $\bar{A}$-system based on 'relations', 'order', 'structure' , we shall be able to discuss profitably the A-system, which does not allow asymmetrical relations, and so cannot be analysed by A means

The dictionary meaning of 'structure' is given somewhat as follows· Structure Manner in which a building or organism or other complete whole is constructed, supporting framework or whole of the essential parts of something (the structure of a house, machine, animal, organ, poem, sentence, sentence of loose structure, its structure is ingenious, ornament should emphasize and not disguise the lines of structure), The implications of the term 'structure' are clear, even from its daily sense To have 'structure' we must have a complex of ordered and interrelated parts

'Structure' is analysed in *Principia Mathematica* and is also simply explained in Russell's more popular works [2] The *Tractatus* of Wittgenstein is built on structural considerations, although not much is explained about structure, for the author apparently assumes the reader's acquaintance with the works of Russell [3]

One of the fundamental functions of 'mental' processes is to distinguish We distinguish objects by certain characteristics, which are usually expressed by adjectives If, by a higher order abstraction, we consider individual objects, not in some perfectly *fictitious* 'isolation', but as they appear empirically, as members of some aggregate or collection of objects, we find characteristics which belong to the collection

and not to an 'isolated' object Such characteristics as arise from the fact that the object belongs to a collection are called 'relations'.

In such collections, we have the possibility of *ordering* the objects, and so, for instance, we may discover a relation that one object is 'before' or 'after' the other, or that A is the father of B There are many ways in which we can order a collection, and many relations which we can find It is important to notice that 'order' and 'relations' are, for the most part, empirically present and that, therefore, this language is fit to represent the facts as we know them The structure of the actual world is such that it is *impossible* entirely to isolate an object An *A* subject-predicate language, with its tendency to treat objects as in isolation and to have no place for relations (impossible in complete 'isolation'), obviously has a structure not similar to the structure of the world, in which we deal *only* with collections, of which the members are related

Obviously, under such empirical conditions, only a language originating in the analysis of collections, and, therefore, a language of 'relations', 'order' , would have a *similar structure* to the world around us From the use of a subject-predicate form of language alone, many of our fallacious anti-social and 'individualistic' metaphysics and *s r* follow, which we will not analyse here, except to mention that their structural implications follow the structure of the language they use

If we carry the analysis a step further, we can find relations between relations, as, for instance, the *similarity of relations* We follow the definition of Russell Two relations are said to be similar if there is a *one-one* correspondence between the terms of their fields, which is such that, whenever two terms have the relation P, their correlates have the relation Q, and vice versa For example, two series are similar when their terms can be correlated without change of order an accurate map is similar to the territory it represents, a book spelt phonetically is similar to the sounds when read , [4]

When two relations are similar, we say that they have a *similar structure,* which is defined as the class of all relations similar to the given relation

We see that the terms 'collection', 'aggregate', 'class', 'order', 'relations', 'structure' are interconnected, each implying the others If we decide to face empirical 'reality' boldly, we must accept the Einstein-Minkowski four-dimensional language, for 'space' and 'time' *cannot be separated empirically,* and so we must have a language of *similar structure* and consider the facts of the world as series of *interrelated ordered events,* to which, as above explained, we must ascribe 'structure' Ein-

stein's theory, in contrast to Newton's theory, gives us such a *language, similar in structure* to the empirical facts as revealed by science 1933 *and common experience.*

The above definitions are not entirely satisfactory for our purpose. To begin with, let us give an illustration, and indicate in what direction some reformulation could be made.

Let us take some actual territory in which cities appear in the following order Paris, Dresden, Warsaw, when taken from the West to the East. If we were to build a *map* of this territory and place Paris *between* Dresden and Warsaw thus:

Actual territory *——————*——————*
Paris Dresden Warsaw

Map *——————*——————*
Dresden Paris Warsaw

we should say that the map was wrong, or that it was an incorrect map, or that the map has a *different structure* from the territory. If, speaking roughly, we should try, in our travels, to orient ourselves by such a map, we should find it misleading It would lead us astray, and we might waste a great deal of unnecessary effort In some cases, even, a map of wrong structure would bring actual suffering and disaster, as, for instance, in a war, or in the case of an urgent call for a physician.

Two important characteristics of maps should be noticed. A map *is not* the territory it represents, but, if correct, it has a *similar structure* to the territory, which accounts for its usefulness If the map could be ideally correct it would include, in a reduced scale, the map of the map; the map of the map, of the map, and so on, endlessly, a fact first noticed by Royce

If we reflect upon our languages, we find that at best they must be considered *only as maps* A word *is not* the object it represents, and languages exhibit also this peculiar self-reflexiveness, that we can analyse languages by linguistic means. This self-reflexiveness of languages introduces serious complexities, which can only be solved by the theory of multiordinality given in Part VII The disregard of these complexities is tragically disastrous in daily life and science

It has been mentioned already that the known definitions of structure are not entirely satisfactory. The terms 'relation', 'order', 'structure' are interconnected by implication At present, we usually consider order as a kind of relation. With the new four-dimensional notions taken from mathematics and physics, it may be possible to treat relations and structure as a form of *multi-dimensional order* Perhaps, theoretically, such a change is not so important, but, from a practical, applied,

educational, and semantic point of view, it seems very vital. Order seems *neurologically simpler* and more fundamental than relation. It is a characteristic of the empirical world which we recognize directly by our lower nervous centres ('senses'), and with which we can deal with great accuracy by our higher nervous centres ('thinking'). This term seems most distinctly of the organism-as-a-whole character, applicable both to the activities of the higher, as well as lower, nervous centres, and so *structurally* it must be fundamental

The rest of this volume is devoted to showing that the common, *A*-system and language which we inherited from our primitive ancestors *differ entirely in structure* from the well-known and established 1933 structure of the world, ourselves and our nervous systems included. Such antiquated map-language, by necessity, must lead us to semantic disasters, as it imposes and reflects its *unnatural* structure on the structure of our doctrines and institutions Obviously, under such linguistic conditions, a science of man was impossible, differing in structure from our nervous system, such language must also disorganize the functioning of the latter and lead us away from sanity.

This once understood, we shall see clearly that researches into the structure of language and the adjustment of this structure to the structure of the world and ourselves, as given by science at each date, must lead to new languages, new doctrines, institutions , and, in fine, may result in a new and saner civilization, involving new *s r* which may be called the scientific era.

The introduction of a few new, and the rejection of some old, terms suggests desirable structural changes, and adjusts the structure of the language-map to the known structure of the world, ourselves, and the nervous system, and so leads us to new *s r* and a theory of sanity

s words *are not* the objects which they represent, *structure, and* stru *ure alone,* becomes the only link which connects our verbal processes wit he empirical data. To achieve adjustment and sanity and the condit which follow from them, we must study structural characteristics of world *first,* and, then only, build languages of similar structure, ir of habitually ascribing to the world the primitive structure of o guage All our doctrines, institutions., depend on verbal argu- r If these arguments are conducted in a language of wrong and ı ral structure, our doctrines and institutions must reflect that lin- stic structure and so become unnatural, and inevitably lead to isasters

That languages, as such, all have some structure or other is a new nd, perhaps, unexpected notion Moreover, every language having a

structure, by the very nature of language, reflects in its own structure that of the world as assumed by those who evolved the language In other words, we read unconsciously into the world the structure of the language we use The guessing and ascribing of a fanciful, mostly primitive-assumed, structure to the world is precisely what 'philosophy' and 'metaphysics' do The empirical search for world-structure and the building of new languages (theories), of necessary, or similar, structure, is, on the contrary, what science does Any one who will reflect upon these structural peculiarities of language cannot miss the semantic point that the scientific method uses the only correct language-method It develops in the *natural order,* while metaphysics of every description uses the reversed, and ultimately a pathological, order.

Since Einstein and the newer quantum mechanics, it has become increasingly evident that the only content of 'knowing' is of a *structural* character, and the present theory attempts a formulation of this fact in a generalized way If we build a $\bar{A}$-system by the aid of new terms and of methods excluded by the A-system, and stop some of our primitive habits of 'thought' and *s r*, as, for instance, the confusion of order of abstractions, reverse the reversed order, and so introduce the natural order in our analysis, we shall then find that all human 'knowing' exhibits a structure similar to scientific knowledge, and appears as the *'knowing' of structure.* But, in order to arrive at these results, we must depart completely from the older systems, and must abandon permanently the use of the 'is' of identity.

It would seem that the overwhelming importance *for mankind* of systems based on 'relations', 'order', 'structure' , depends on the fact that such terms allow of an exact and 'logical' treatment, as two relations of similar structure have all their logical characteristics in common It becomes obvious that, as in the A-system we could not deal in such terms, higher rationality and adjustment were impossible. It is not the human 'mind' and its 'finiteness' which is to be blamed, but a primitive language, with a structure foreign to this world, which has wrought havoc with our doctrines and institutions.

The use of the term 'structure' does not represent special difficulties when once we understand its origin and its meanings The main difficulty is found in the old A habits of speech, which do not allow the use of structure, as, indeed, this notion has no place in a complete subject-predicativism

Let us repeat once more the two crucial *negative* premises as established firmly by *all* human experience (1) Words *are not* the thin

we are speaking about, and (2) There *is no* such thing as an object in absolute isolation.

These two most important *negative* statements cannot be denied If any one chooses to deny them, the burden of the proof falls on him He has to establish what he affirms, which is obviously impossible. We see that it is safe to start with such solid *negative* premises, translate them into positive language, and build a $\bar{A}$-system

If words *are not* things, or maps *are not* the actual territory, then, obviously, the only possible link between the objective world and the linguistic world is found in *structure, and structure alone* The only usefulness of a map or a language depends on the *similarity of structure* between the empirical world and the map-languages If the structure is not similar, then the traveller or speaker is led astray, which, in serious human life-problems, must become always eminently harmful, If the structures *are similar,* then the empirical world becomes 'rational' to a potentially rational being, which means no more than that verbal, or map-predicted characteristics, which follow up the linguistic or map-structure, are applicable to the empirical world.

In fact, in structure we find the mystery of rationality, adjustment , and we find that the whole content of knowledge is exclusively structural If we want to be rational and to understand anything at all, we must look for structure, relations, and, ultimately, multi-dimensional order, all of which was impossible in a broader sense in the A-system, as will be explained later on

Having come to such important *positive* results, starting with undeniable *negative* premises, it is interesting to investigate whether these results are *always* possible, or if there are limitations The second *negative* premise; namely, that there *is no* such thing as an object in absolute isolation, gives us the answer If there *is no* such thing as an absolutely isolated object, then, at least, we have two objects, and we shall *always* discover some relation between them, depending on our interest, ingenuity, and what not. Obviously, for a man to speak about anything at all, *always* presupposes *two* objects at least, namely, the object spoken about and the speaker, and so a *relation* between the two is always present Even in delusions, illusions, and hallucinations, the situation is not changed, because our immediate feelings are also un-speakable and *not* words

The semantic importance of the above should not be minimized If we deal with organisms which possess an inherent activity, such as eating, breathing , and if we should *attempt to build for them conditions*

where such activity would be impossible or hampered, these *imposed* conditions would lead to degeneration or death

Similarly with 'rationality' Once we find in this world at least potentially rational organisms, we should not *impose* on them conditions which hamper or prevent the exercise of such an important and inherent function The present analysis shows that, under the all-pervading aristotelianism in daily life, asymmetrical relations, and thus structure and order, have been impossible, and so we have been *linguistically* prevented from supplying the potentially 'rational' being with the means for rationality This resulted in a semi-human so-called 'civilization', based on our copying animals in our nervous process, which, by necessity, involves us in arrested development or regression, and, in general, disturbances of some sort.

Under such conditions, which, after all, may be considered as firmly established, because this investigation is based on undeniable *negative* premises, there is no way out but to carry the analysis through, and to build up a $\bar{A}$-system based on *negative* fundamental premises or the denial of the 'is' of identity with which rationality will be possible

Perhaps an illustration will make it clearer, the more that the old subject-predicate language rather conceals structure If we take a statement, 'This blade of grass is green', and analyse it only as a statement, superficially, we can hardly see how any structure could be implied by it This statement may be analysed into substantives, adjectives, verb ; yet this would not say much about its structure But if we notice that these words can also make a question, 'Is this blade of grass green?', we begin to realize that the *order* of the words plays an important role in some languages connected with the meanings, and so we can immediately speak of the structure of the sentence Further analysis would disclose that the sentence under consideration has the subject-predicate form or structure.

If we went to the objective, silent, un-speakable level, and analysed this objective blade of grass, we should discover various structural characteristics in the blade, but these are not involved in the statement under consideration, and it would be illegitimate to speak about them. However, we can carry our analysis in another direction If we carry it far enough, we shall discover a very intricate, yet definite, relation or complex of relations between the objective blade of grass and the observer. Rays of light impinge upon the blade, are reflected from it, fall on the retina of our eye, and produce within our skins the feeling of 'green'., an extremely complex process which has some definite structure.

We see, thus, that any statement referring to anything objective in this world can always be analysed into terms of relations and structure, and that it involves also definite structural assumptions More than that, as the only possible content of knowledge and science is structural, whether we like it or not, to *know* anything we must search for structure, or posit some structure. Every statement can also be analysed until we come to definite structural issues This applies, however, with certainty only to significant statements, and, perhaps, not to the various noises which we can make with our mouth with the semblance of words, but which are meaningless, as they are not symbols for anything. It must be added that in the older systems we did not discriminate between words (symbols) and noises (not symbols). In a $\bar{A}$-system such a discrimination is essential.

The structure of the world is, in principle, *unknown,* and the only aim of knowledge and science is to discover this structure The structure of languages is potentially *known,* if we pay attention to it Our only possible procedure in advancing our knowledge is to match our verbal structures, often called theories, with empirical structures, and see if our verbal predictions are fulfilled empirically or not, thus indicating that the two structures are either similar or dissimilar.

We see, thus, that in the investigation of structure we find not only means for rationality and for adjustment, and so sanity, but also a most important tool for exploring this world and scientific advance

From the educational point of view, also, the results of such an investigation seem to be unusually important, because they are extremely simple, *automatic* in their working, and can be applied universally in elementary education As the issue is merely one of linguistic structure, it is enough to train children to abandon the 'is' of identity, in the habitual use of a *few new terms,* and to warn them repeatedly against the use of some terms of antiquated structure We shall thus eliminate the pre-human and primitive semantic factors included in the structure of a primitive language The moralizing and combating of primitive-made metaphysics is not effectual, but the habitual use of a language of modern structure, free from identity, produces semantic results where the old failed. Let us repeat again, a most important point, that the new desirable semantic results follow as *automatically* as the old undesirable ones followed

It should be noticed that terms such as 'collection', 'fact', 'reality', unction', 'relation', 'order', 'structure', 'characteristics', 'problem' , iust be considered as *multiordinal terms* (see Part VII), and so, in genral ∞-valued and ambiguous. They become specific and one-valued

only in a given context, or when the orders of abstractions are distinguished.

In the following enquiry an attempt to build a science of man, or a *non-aristotelian system,* or a theory of sanity, is made, and it will be necessary to introduce a few terms of new structure and to abide by them.

Let me be entirely frank about it the main issues are found in the *structure* of language, and readers who are interested in this work will facilitate their task if they make themselves familiar with these new terms and use them habitually. This work will then appear simple, and often self-evident. For those other readers who insist on translating the new terms with *new structural implications* into their old habitual language, and choose to retain *the old terms* with *old structural implications* and old *s r* , this work will not appear simple

Examples illustrating what has just been said abound, here I shall mention only that the $\bar{E}$ geometries, the new revision of mathematics originated by Brouwer and Weyl, the Einstein theory, and the newer quantum mechanics , have similar main aims, namely, to produce *non-el* statements which are structurally closer to the empirical facts than the older theories, and to reject those unwarranted structural assumptions which vitiated the old theories The reader should not be surprised to learn that these new theories are not a passing whim of scientists, but represent lasting advances *in method* Whether these attempts at restatements are finally found to be valid or not, they remain steps in the right direction

It is quite natural that with the advance of experimental science some generalizations should appear to be established from the facts at hand Occasionally, such generalizations, when further analysed, are found to contain serious structural, epistemological and methodological implications and difficulties In the present work one of these empirical generalizations becomes of unusual importance, so important, indeed, that Part III of this work is devoted to it Here, however, it is only possible to mention it, and to show some rather unexpected consequences which it entails

That generalization states · that *any* organism must be treated as-a-whole, in other words, that the organism is not an algebraic sum, a *linear* function of its elements, but always *more* than that It is seemingly little realized, at present, that this simple and innocent-looking statement involves a full structural revision of our language, because that language, of great pre-scientific antiquity, is *elementalistic,* and so singularly inadequate to express *non-elementalistic* notions Such a point

of view involves profound structural, methodological, and semantic changes, vaguely anticipated, but never formulated in a definite theory The problems of structure, 'more', and 'non-additivity' are very important and impossible to analyse in the old way

If this generalization be accepted—and on experimental, structural, and epistemological grounds we cannot deny its complete structural justification—some odd consequences follow, that is to say, odd, as long as we are not accustomed to them For instance, we see that 'emotion' and 'intellect' cannot be divided, that this division structurally violates the organism-as-a-whole generalization We must, then, choose between the two we must either abandon the organism-as-a-whole principle, or abandon accepted speculations couched in *el* verbal terms which create insoluble *verbal* puzzles. Something similar could be said about the distinction of 'body' versus 'soul', and other verbal splittings which have hampered sane advance in the understanding of ourselves, and have filled for thousands of years the libraries and tribunes of the world with hollow reverberations.

The solution of these problems lies in the field of structural, symbolic, linguistic, and semantic research, as well as in the fields of physics, chemistry, biology, psychiatry , because from their very nature these problems are structural

CHAPTER V

GENERAL LINGUISTIC

. . to be an abstraction does not mean that an entity is nothing It merely means that its existence is only one factor of a more concrete element of nature (573) A N WHITEHEAD

In my opinion the answer to this question is briefly, this —As far as the laws of mathematics refer to reality, they are not certain, and as far as they are certain, they do not refer to reality. (151) A EINSTEIN

Thus it would seem that, wherever we infer from perceptions, it is only structure that we can validly infer, and structure is what can be expressed by mathematical logic, which includes mathematics (457) BERTRAND RUSSELL

The current accounts of perception are the stronghold of modern metaphysical difficulties They have their origin in the same misunderstanding which led to the incubus of the substance-quality categories The Greeks looked at a stone, and perceived that it was grey. The Greeks were ignorant of modern physics, but modern philosophers discuss perception in terms of categories derived from the Greeks (574) A N WHITEHEAD

To the biochemist, biophysicist, biologist, and physiological psychologist, however, life and mind are so amazingly complex and comprise so many heterogeneous processes that their blanket designation as two emergent levels cannot seem very illuminating, and to the observer who contemplates the profuse and unabated emergence of idiots, morons, lunatics, criminals, and parasites in our midst, Alexander's prospect of the emergence of deity is about as imminent as the Greek kalends (555) WILLIAM MORTON WHEELER

In speaking of linguistic researches, I do not mean only an analysis of printed 'canned chatter', as Clarence Day would call it, but I mean the behaviour, the performance, *sr* of living Smiths and Browns and the connections between the noises uttered by them and their behaviour No satisfactory analysis has been made, and the reason seems to be in the fact that each existing language really represents a conglomeration of *different* languages with different structures and is, therefore, extremely complex as long as structure is disregarded That 'linguists', 'psychologists', 'logicians' , were, and usually are, very innocent of *mathematics,* a type of language of the greatest simplicity and perfection, with a clear-cut structure, similar to the structure of the world, seems to be responsible for this helplessness Without a study of mathematics, the adjustment of structure seems impossible

We should not be surprised to find that mathematics must be considered a language By definition, whatever has symbols and propositions is called a language, a form of representation for this something-

going-on which we call the world and which is admittedly *not words*. Several interesting statements can be made about mathematics considered as a language. First of all, mathematics appears as a form of human behaviour, as genuine a human activity as eating or walking, a function in which the human nervous system plays a very serious part. Second, from an empirical point of view a curious question arises: why, of all forms of human behaviour, has mathematizing proved to be *at each historical period* the most excellent human activity, producing results of such enormous importance and unexpected validity as not to be comparable with any other musings of man? Briefly, it may be said that the secret of this importance and the validity of mathematics lie in the mathematical *method* and structure, which the mathematizing Smith, Brown, and Jones have used—we may even say, were *forced* to use. It is not necessary to assume that the mathematicians were 'superior' men. We will see later that mathematics is not a very superior activity of the 'human mind', but it is perhaps the *easiest*, or simplest activity, and, therefore, it has been possible to produce a structurally perfect product of this simple kind.

The understanding and proper evaluation of what has been said about the structure and method of mathematics will play a serious semantic role all through this work, and, therefore, it becomes necessary to enlarge upon the subject. We shall have to divide the abstractions we make into two classes: (1) objective or physical abstractions, which include our daily-life notions, and (2) mathematical abstractions, at present taken from pure mathematics, in a restricted sense, and later generalized. As an example of a mathematical abstraction, we may take a mathematical circle. A circle is defined as the locus of all points in a plane at equal distance from a point called the centre. If we enquire whether or not there is such an actual thing as a circle, some readers may be surprised to find that a mathematical circle must be considered a pure fiction, having nowhere any objective existence. In our definition of a mathematical circle, *all particulars* were included, and whatever we may find about this mathematical circle later on will be strictly dependent on this definition, and no new characteristics, not already included in the definition, will ever appear. We see, here, that *mathematical abstractions are characterized by the fact that they have all particulars included.*

If, on the other hand, we draw an objective 'circle' on a blackboard or on a piece of paper, simple reflection will show that what we have drawn is *not* a mathematical circle, but a *ring*. It has colour, temperature, thickness of our chalk or pencil mark, . When we draw a 'circle', it is no longer a mathematical circle with *all particulars included in the definition,*

but it becomes a *physical ring* in which *new characteristics* appear not listed in our definition.

From the above observations, very important consequences follow. Mathematizing represents a very simple and easy human activity, because it deals with fictitious entities with all particulars included, and we proceed by remembering. The structure of mathematics, because of this over-simplicity, yet structural similarity with the external world, makes it possible for man to build verbal systems of remarkable validity

Physical or daily-life abstractions differ considerably from mathematical abstractions. Let us take any actual object, for instance, what we call a pencil Now we may describe or 'define' a 'pencil' in as great detail as we please, yet it is impossible to include *all* the characteristics which we may discover in this actual objective pencil If the reader will try to give a 'complete' description or a 'perfect' definition of any actual physical object, so as to include 'all' particulars, he will be convinced that this task is humanly impossible These would have to describe, not only the numerous rough, macroscopic characteristics, but also the microscopic details, the chemical composition and changes, sub-microscopic characteristics and the endlessly changing relationship of this objective something which we have called pencil to the rest of the universe , an inexhaustible array of characteristics which could never be terminated. In general, physical abstractions, including daily-life abstractions are such that *particulars are left out*—we proceed by a process of forgetting In other words, no description or 'definition' will ever include all particulars

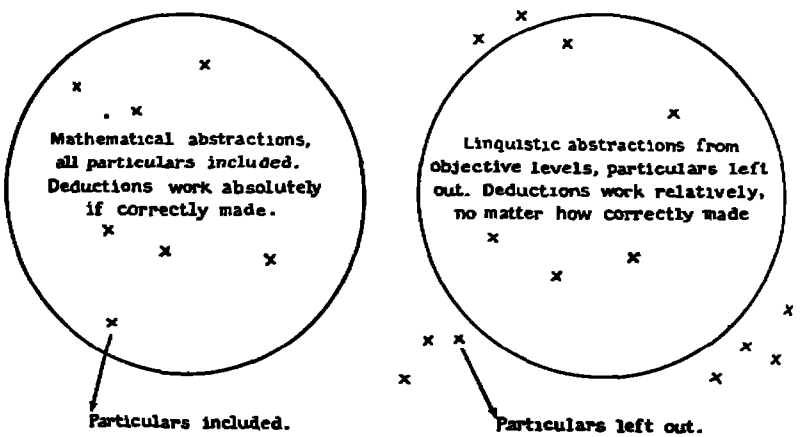


FIG. 1.

Only and exclusively in mathematics does deduction, if correct, work absolutely, for no particulars are left out which may later be discovered and force us to modify our deductions

Not so in abstracting from physical objects Here, particulars are left out, we proceed by forgetting, our deductions work only relatively, and must be revised continuously whenever new particulars are discovered In mathematics, however, we build for ourselves a fictitious and *over-simplified* verbal world, with abstractions which have all particulars included If we compare mathematics, taken as a language, with our daily language, we see readily that in both verbal activities we are building for ourselves forms of representation for this something-going-on, which is *not* words

Considered as a language, mathematics appears as a language of the highest perfection, but at its lowest development Perfect, because the structure of mathematics makes it possible to be so (all characteristics included, and no physical content), and because it is a language of *relations* which are also found in this world At the lowest development, because we can speak in it as yet about very little and that in a very narrow, restricted field, and with limited aspects

Our other languages would appear, then, as the other extreme, as the highest mathematics, but also at their lowest development—highest mathematics, because in them we can speak about everything, at their lowest development because they are still A and not based on asymmetrical relations Between the two languages there exists as yet a large unbridged structural gap The bridging of this gap is the problem of the workers of the future. Some will work in the direction of inventing new mathematical methods and systems, bringing mathematics closer in scope and adaptability to ordinary language (for instance, the tensor calculus, the theory of groups, the theory of sets the algebra of states and observables,). Others will undertake linguistic researches designed to bring ordinary language closer to mathematics (for instance, the present work) When the two forms of representation meet on relational grounds, we shall probably have a simple language of mathematical structure, and mathematics, as such, might then even become obsolete

It is not desirable that the reader should be under the impression that all mathematical 'thinking' is low-grade 'thinking' The mathematicians who discover or invent new *methods* for relating and structures are the biggest 'mental' giants we have had, or ever shall have. Only the technical interplay of symbols, to find out some new possible combination, can be considered as low-grade 'thinking'.

From what has now been said, it is probably already obvious that if any one wants to work scientifically on problems of such enormous complexity that they have so far defied analysis, he would be helped enormously if he would train his *s r* in the simplest forms of correct 'thinking', that is, become acquainted with mathematical methods The continued application of this relational method should finally throw some light on the greatest complexities, such as life and man In contrast to enormous advances in all technical fields, our knowledge of 'human nature' has advanced very little beyond what primitives knew about themselves We have tried to analyse the most baffling phenomena while disregarding structural peculiarities of languages and thus failing to provide sufficient fundamental training in new *s r* In practically all universities at present, the mathematical requirements, even for scientists, are extremely low, much lower, indeed, than is necessary for the progress of these scientists themselves Only those who specialize in mathematics receive an advanced training, but, even with them, little attention is devoted to *method* and *structure* of languages *as such* Until lately, mathematicians themselves were not without responsibility for this. They treated mathematics as some kind of 'eternal verity', and made a sort of religion out of it, forgetting, or not knowing, that these 'eternal verities' last only so long as the nervous systems of Smiths and Browns are not altered Besides, many, even now, disclaim any possible connection between mathematics and human affairs Some of them seem, indeed, in their religious zeal, to try to make their subjects as difficult, unattractive, and mysterious as possible, to overawe the student Fortunately, a strong reaction against such an attitude is beginning to take place among the members of the younger mathematical generation This is a very hopeful sign, as there is little doubt that, without the help of professional mathematicians who will understand the general importance of *structure* and *mathematical methods,* we shall not be able to solve our human problems in time to prevent quite serious break-downs, since these solutions ultimately depend on structural and semantic considerations

The moment we abandon the older theological attitude toward mathematics, and summon the courage to consider it as a form of human behaviour and the expression of *generalized s r,* some quite interesting problems loom up Terms like 'logic' or 'psychology' are applied in many different senses, but, among others, they are used as labels for certain disciplines called sciences 'Logic' is defined as the 'science of the laws of thought' Obviously, then, to produce 'logic' we should have to study *all* forms of human behaviour connected directly with mentation, we should have to study not only the mentations in the daily life of

the average Smiths, Browns., but we should have to study the mentations of Joneses and Whites when they use their 'mind' at its best; namely, when they mathematize, scientize , and we should also have to study the mentations of those whom we call 'insane', when they use their 'mind' at its worst It is not our aim to give a detailed list of these forms of human behaviour which we should study, since all should be studied It is enough for our purpose to emphasize the two main omissions, namely, the study of mathematics and the study of 'insanity'

As a similar reasoning applies to 'psychology', we must sadly admit that we have as yet no general theory which deserves the name of 'logic' or psycho-logics. What has passed under the name of 'logic', for instance, is not 'logic' according to its own definition, but represents a philosophical grammar of a primitive-made language, of a structure different from the structure of the world, unfit for serious use. If we try to apply the rules of the old 'logic', we find ourselves blocked by ridiculous impasses So, naturally, we discover that we have no use for such a 'logic'

It follows also that any one who has any serious intention of becoming a 'logician' or a psycho-logician must, first of all, be a thorough mathematician and must also study 'insanity' Only with such preparation is there any possibility of becoming a psycho-logician or semantician Sometimes it is useful to stop deceiving ourselves; and it is deceiving ourselves if we claim to be studying *human* psycho-logics, or *human* 'logic', when we are generalizing only from those forms of human behaviour which we have in common with the animals and neglect other forms, especially the most characteristic forms of human behaviour, such as mathematics, science, and 'insanity'. If, as psycho-logicians, we want to be 'behaviourists', it is clear that we must study *all* known forms of human behaviour But it seems never to have occurred to the 'behaviourists' that mathematics and 'insanity' are very characteristic forms of human behaviour.

Some readers may be puzzled by my calling the daily forms of representation we use 'primitive-made' Let me illustrate what I mean by a classical example For more than two thousand years the famous paradox of Zeno has puzzled 'philosophers', without any solution, and only in our own day has it been solved by mathematicians The paradox reads Achilles was supposed to be a very swift runner, and in a race with a tortoise, which was given the benefit of starting first, Achilles could never overtake his slow competitor, because, the argument runs, before he could overtake the tortoise he would have to halve the distance between them, and again halve the remaining half, and so on No matter how long this might last, there still would be some distance to halve, and so

it was concluded he could never pass the tortoise Now any child knows that this conclusion is not true, yet the *verbal* argument for the untrue conclusion remained, in the hands of 'philosophers' and 'logicians', perfectly valid for more than two thousand years This instance throws light on the stage of development which we have reached and of which we often boast

Having, then, no scientific *general* theory of 'logic' and psycho-logics to guide us, the task of an enquiry like the present is very much handicapped We must merely go ahead groping and pioneering, and this is always a difficult, blundering task

It is indeed very important that not only the scientists but also the intelligent public, as a whole, should understand that at present we have no general theory which may be called 'logic' or psycho-logics Perhaps an illustration will help to bring home this really shocking state of affairs Imagine, for example, that we should try to study dinosaurs exhaustively The standard methods of study would centre about the actual fossil remains when such are available, but, in the case of those extinct forms of which the fossil remains are very meagre, or entirely lacking, much information is obtained from the study of the tracks which have been left on the mud flats that have become rocks It seems undeniable that such a study of fossil tracks would contribute a large share to the formulation of any 'general theory' of the characteristics of dinosaurs We could go further and say that no 'general theory' could be complete if such study were entirely neglected

Now, that is precisely the situation in which 'psychologists' and 'logicians' find themselves, they have made many studies, and gathered some facts, but they have entirely disregarded as yet these unique and peculiar black tracks which the mathematicians and others have left on white paper when they mathematized or scientized The old 'psychological' generalizations were made from insufficient data, in spite of the fact that *sufficient* data, namely, these black marks on white paper, exist, and have existed for a long time But these marks the 'psychologists' and 'logicians' were not able properly to read, analyse, and interpret

Under such circumstances, it should not be surprising to find that, in the study of animals, we have vitiated our researches by reading into the animals our own activities, and that we have vitiated our own understanding of ourselves by faulty generalizations from a few data taken mostly from those activities which we have in common with animals Thus we measure ourselves by animalistic standards This error is mainly due to the ignorance of mathematical method and the disregard of structural problems by those who deal with human affairs. Indeed, as I have

already shown in my *Manhood of Humanity,* what we call 'civilization' rests upon faulty generalizations taken from the lives of cows, horses, cats, dogs, pigs , and self-imposed upon Smith and Brown

The main thesis of this $\bar{A}$-system is that *as yet we all (with extremely few exceptions) copy animals in our nervous processes,* and that practically *all* human difficulties, 'mental' ills of all degrees included, have this characteristic as a component. I am glad to be able to report that a number of experiments undertaken with 'mentally' or nervously ill individuals have shown decided benefit in cases where it proved possible to re-educate them to appropriate human *s r*

Here, perhaps, it may be advisable to interpolate a short explanation When we deal with human affairs and man, we sometimes use the term 'ought', which is very often used arbitrarily, dogmatically, and absolutistically, and so its use has become discredited In many quarters, this term is very unpopular, and, it must be admitted, justly so My use of it is that of the engineer, who undertakes to study a machine entirely unknown to him—let us say, a motorcycle He would study and analyse *its structure,* and, finally, would give a verdict that with such a structure, under certain circumstances, this machine *ought* to work in a particular way

In the present volume, this engineering attitude is preserved We shall investigate the structure of human knowledge, and we shall conclude that with such a structure it should work in this particular way In the motorcycle example, the proof of the correctness of the reasoning of the engineer would be to fill the tank with gasoline and make the motorcycle go In our analogous task, we have to *apply* the information we get and see if it works In the experiments mentioned above, the $\bar{A}$-system actually has worked, and so there is some hope that it is correct Further investigations will, of course, add to, or modify, the details, but this is true of all theories

Another reason why a non-mathematician cannot study psychological phenomena adequately is that mathematics is the only science which has *no physical content* and, therefore, when we study the performances of Smiths and Browns when they mathematize, we study the *only* available working of 'pure mind'. Moreover, mathematics is the only language which at present has a structure similar to that of the world and the nervous system It must be obvious that from such a study we should learn more than by the study of any other 'mental' activity In some quarters it is believed, I think erroneously, that 'psychology' and 'logic' have no 'physical content' 'Psychology' and 'logic' have a very definite content—Smith, Brown . ,—and we should treat these

disciplines in relation to the living organism Quite probably, when the above issues are fully realized, these specialists, future psycho-logicians and semanticians, will begin to study mathematical methods and pay attention to structure, and a number of mathematicians, in their turn, will become psycho-logicians, psychiatrists, semanticians, When this happens, we may expect marked advance in these lines of endeavour *

In the course of this book, it will be shown that the structure of human knowledge precludes any serious study of 'mental' problems without a thorough mathematical training We shall take for granted all the partial light thrown on man by existing disciplines and shall make some *observations* from the study of the *neglected* forms of human behaviour, such as mathematics, exact sciences, and 'insanity', and with these new data re-formulate, in the rough, all available data at hand in 1933

At the present early stage of our enquiry, we must, of necessity, be often vague Before we give the new data, it is impossible to speak in a more definite way Besides, in such a general survey, we shall have to use what I call *multiordinal* terms At present, all the most humanly important and interesting terms are multiordinal, and no one can evade the use of such terms Multiordinality is inherent in the structure of 'human knowledge' This multiordinal mechanism gives the key to many seemingly insoluble contradictions, and explains why we have scarcely progressed at all in the solution of many human affairs.

The main characteristic of these multiordinal terms is found in that they have *different meanings* in general, depending on the order of abstractions Without the level of abstraction being specified, a *m o* term is only ambiguous, its use involves shifting meanings, variables, and therefore generates, not propositions, but propositional functions It may not be an exaggeration to say that the larger number of human tragedies, private, social, racial , are intimately connected with the non-realization of this multiordinality of the most important terms we use

A similar confusion between orders of abstractions is to be found in all forms of 'insanity', from the mildest, which afflicts practically

*There are already signs that the more serious workers, as, for instance, the Gestalt 'psychologists', begin to feel their handicaps Others, as yet, do not seem to realize the hopelessness of their endeavours—as best exemplified by the American school of Behaviourists, who seem to think that the splendid name they have selected will solve their problems It would be very interesting to see the Behaviourists *deny* that the writing of a mathematical treatise, or of some new theory of quantum mechanics represents a form of *human behaviour* which they should study Some day they must face the fact that they have neglected to consider a great many forms of human behaviour—the *most characteristic* forms at that—and that, therefore, they could not produce an adequate theory of the nature of the 'human mind'

every one of us, to the most pronounced and violent Indeed, the discovery of this mechanism leads conversely to a *theory of sanity* Imperfect as this theory of sanity probably is, it opens a wide field of possibilities which I myself, at this stage, am unable fully to appreciate

There seems one thing certain, at present, namely, that the old theories and methods tended strongly to produce morons and 'insane' persons, while 'geniuses' were only born in spite of these handicaps. Perhaps in the future we shall be able to produce 'geniuses', while morons and 'insane' persons will be born only in spite of our precautions If this should actually prove to be true, and the experimental results seem to give some hope in this direction, this world would then become quite a different place in which to live.

CHAPTER VI

ON SYMBOLISM

Philosophers have worried themselves about remote consequences, and the inductive formulations of science They should confine attention to the rush of immediate transition Their explanations would then be seen in their native absurdity. (578) A N. WHITEHEAD

It is often said experiments must be made without a preconceived idea. That is impossible Not only would it make all experiment barren, but that would be attempted which could not be done Every one carries in his mind his own conception of the world, of which he can not so easily rid himself. We must, for instance, use language, and our language is made up only of preconceived ideas and can not be otherwise Only these are unconscious preconceived ideas, a thousand times more dangerous than the others (417) H. POINCARÉ

. the patriotic archbishop of Canterbury, found it advisable—' "
"Found *what?*" said the Duck
"Found *it*," the Mouse replied, rather crossly "of course you know what 'it' means "
"I know what 'it' means well enough, when *I* find a thing," said the Duck "it's generally a frog, or a worm "* LEWIS CARROLL

. . psychiatry works specifically on the social organ of man itself—the person's assets and behavior, that which we must adjust before we can expect the individual to make proper use of most of our help **
ADOLF MEYER

Perhaps, as has often been said, the trouble with people is not so much with their ignorance as it is with their knowing so many things that are not so . So that it is always important to find out about these fears, and if they are based upon the knowledge of something that is not so, they may perhaps be corrected (568) WILLIAM A. WHITE

The affairs of man are conducted by our own, man-made rules and according to man-made theories Man's achievements rest upon the use of symbols For this reason, we must consider ourselves as a symbolic, semantic class of life, and those who rule the symbols, rule us Now, the term 'symbol' applies to a variety of things, words and money included A piece of paper, called a dollar or a pound, has very little value if the other fellow refuses to take it, so we see that money must be considered as a symbol for human agreement, as well as deeds to property, stocks, bonds, The *reality* behind the money-symbol is doctrinal, 'mental', and one of the most precious characteristics of mankind But it must be used properly, that is, with the proper understanding of

Alice in Wonderland
**Historical Sketch and Outlook of Psychiatric Social Work *Hosp Soc Serv* V, 1922, 221.

its structure and ways of functioning It constitutes a grave danger when misused

When we say 'our rulers', we mean those who are engaged in the manipulation of symbols There is no escape from the fact that they do, and that they always will, rule mankind, because we constitute a symbolic class of life, and we cannot cease from being so, except by regressing to the animal level

The hope for the future consists in the understanding of this fact; namely, that we shall always be ruled by those who rule symbols, which will lead to scientific researches in the field of symbolism and *s r* We would then *demand* that our rulers should be *enlightened* and *carefully selected* Paradoxical as it may seem, such researches as the present work attempts, will ultimately do more for the stabilization of human affairs than legions of policemen with machine guns, and bombs, and jails, and asylums for the maladjusted

A complete list of our rulers is difficult to give, yet, a few classes of them are quite obvious. Bankers, priests, lawyers and politicians constitute one class and work together They do not *produce* any values, but manipulate values produced by others, and often pass signs for no values at all Scientists and teachers also comprise a ruling class They produce the main values mankind has, but, at present, they do not realize this They are, in the main, themselves ruled by the cunning methods of the first class

In this analysis the 'philosophers' have been omitted This is because they require a special treatment As an historical fact, many 'philosophers' have played an important and, to be frank, sinister role in history At the bottom of any historical trend, we find a certain 'philosophy', a structural implication cleverly formulated by some 'philosopher'. The reader of this work will later find that most 'philosophers' gamble on multiordinal and *el* terms, which have *no definite single (one-valued) meaning,* and so, by cleverness in twisting, can be made to appear to mean anything desired It is now no mystery that some quite influential 'philosophers' were 'mentally' ill Some 'mentally' ill persons are tremendously clever in the manipulation of words and can sometimes deceive even trained specialists Among the clever concoctions which appear in history as 'philosophic' systems, we can find flatly opposing doctrines. Therefore, it has not been difficult at any period for the rulers to select a cleverly constructed doctrine perfectly fitting the ends they desired

One of the main characteristics of such 'philosophers' is found in the delusion of grandeur, the 'Jehovah complex' Their problems have

appeared to them to be above criticism or assistance by other human beings, and the correct procedure known only to super-men like themselves So quite naturally they have usually refused to make enquiries. They have refused even to be informed about scientific researches carried on outside the realms of their 'philosophy' Because of this ignorance, they have, in the main, not even suspected the importance of the problems of structure

In all fairness, it must be said that not all so-called 'philosophy' represents an episode of semantic illness, and that a few 'philosophers' really do important work. This applies to the so-called 'critical philosophy' and to the *theory of knowledge* or *epistemology* This class of workers I call epistemologists, to avoid the disagreeable implications of the term 'philosopher' Unfortunately, epistemological researches are most difficult, owing mainly to the lack of scientific psycho-logics, general semantics, and investigations of structure and *s r*. We find only a very few men doing this work, which, in the main, is still little known and unapplied It must be granted that their works do not make easy reading They do not command headlines, nor are they aided and stimulated by public interest and help

It must be emphasized again that as long as we remain humans (which means a symbolic class of life), the rulers of symbols will rule us, and that no amount of revolution will ever change this But what mankind has a right to ask—and the sooner the better—is that our rulers should not be so shamelessly ignorant and, therefore, pathological in their reactions If a psychiatrical and scientific enquiry were to be made upon our rulers, mankind would be appalled at the disclosures

We have been speaking about 'symbols', but we have not yet discovered any general theory concerning symbols and symbolism. Usually, we take terms lightly and never 'think' what kind of implication and *s r* one single important term may involve 'Symbol' is one of those important terms, weighty in meanings If we use the term 'food', for instance, the presupposition is that we take for granted the existence of living beings able to eat, and, similarly, the term 'symbol' implies the existence of intelligent beings The solution of the problem of symbolism, therefore, presupposes the solution of the problem of 'intelligence' and structure So, we see that the issues are not only serious and difficult, but, also, that we must investigate a semantic field in which very little has been done.

In the rough, a symbol is defined as a sign which stands for something Any sign is not necessarily a symbol If it stands for something, it becomes a symbol for this something If it does not stand for some-

thing, then it becomes not a symbol *but* a *meaningless* sign This applies to words just as it does to bank cheques If one has a zero balance in the bank, but still has a cheque-book and issues a cheque, he issues a sign but not a symbol, because it does not stand for anything The penalty for such use of these particular signs as symbols is usually jailing. This analogy applies to the oral noises we make, which occasionally become symbols and at other times do not, as yet, no penalty is exacted for such a fraud

Before a noise, may become a symbol, something must exist for the symbol to symbolize So the first problem of symbolism should be to investigate the problem of 'existence' To define 'existence', we have to state the standards by which we judge existence At present, the use of this term is not uniform and is largely a matter of convenience Of late, mathematicians have discovered a great deal about this term For our present purposes, we may accept two kinds of existence (1) the physical existence, roughly connected with our 'senses' and persistence, and (2) 'logical' existence The new researches in the foundations of mathematics, originated by Brouwer and Weyl, seem to lead to a curtailment of the meaning of 'logical' existence in quite a sound direction, but we may provisionally accept the most general meaning, as introduced by Poincaré He defines 'logical' existence as a statement free from self-contradictions Thus, we may say that a 'thought' to be a 'thought' must not be self-contradictory A self-contradictory statement is meaningless, we can argue either way without reaching any valid results We say, then, that a self-contradictory statement has no 'logical' existence As an example, let us take a statement about a square circle This is called a contradiction in terms, a non-sense, a meaningless statement, which has no 'logical' existence Let us label this 'word salad' by a special noise—let us say, 'blah-blah' Will such a noise become a word, a symbol? Obviously not—it stands for nothing, it remains a mere noise , no matter if volumes should be written about it.

It is extremely important, semantically, to notice that not all the noises , we humans make should be considered as symbols or valid words Such empty noises , can occur not only in direct 'statements', but also in 'questions' Quite obviously, 'questions' which employ noises , instead of words, are not significant questions They ask nothing, and cannot be answered. They are, perhaps, best treated by 'mental' pathologists as symptoms of delusions, illusions, or hallucinations In asylums the noises., patients make are predominantly meaningless, as far as the external world is concerned, but *become symbols in the illness of the patient.*

A complicated and difficult problem is found in connection with those symbols which have meaning in one context and have no meaning in another context Here we approach the question of the application of 'correct symbolism to facts' We will not now enlarge upon this subject, but will only give, in a different wording, an illustration borrowed from Einstein' Let us take anything, for example, a pencil Let us assume that this physical object has a temperature of 60 degrees Then the 'question' may be asked 'What is the temperature of an "electron" which goes to make up this pencil?' Different people, many scientists and mathematicians included, would say: '60 degrees', or any other number And, finally, some would say: 'I do not know'. All these answers have one common characteristic, namely, that they are senseless, for they try to answer a meaningless question Even the answer, 'I do not know', does not escape this classification, as there *is nothing to know about a meaningless question* The only correct answer is to explain that the 'question' has no meaning This is an example of a symbol which has no application to an 'electron' Temperature by *definition* is the vibration of molecules (atoms are considered as mon-atomic molecules), so to have temperature at all, we must have at least two molecules Thus, when we take one molecule and split it into atoms and electrons, the term 'temperature' does not apply by definition to an electron at all Although the term 'temperature' represents a perfectly good symbol in one context, it becomes a meaningless noise in another The reader should not miss the plausibility of such gambling on words, for there is a very real semantic danger in it.'

In the study of symbolism, it is unwise to disregard the knowledge we gather from psychiatry The so-called 'mentally' ill have often a very obvious and well-known semantic mechanism of projection They project their own feelings, moods, and other structural implications on the outside world, and so build up delusions, illusions, and hallucinations, believing that what is going on *in* them is going on *outside* of them. Usually, it is impossible to convince the patient of this error, for his whole illness is found in the semantic disturbance which leads to such projections

In daily life we find endless examples of such semantic projections, of differing affective intensity, which projections invariably lead to consequences more or less grave' The structure of such affective projections will be dealt with extensively later on Here we need only point out that the problems of 'existence' are serious, and that any one who claims that something 'exists' outside of his skin must show it Otherwise, the 'existence' is found only inside of his skin—a psycho-logical state of

affairs which becomes pathological the moment he projects it on the outside world If one should claim that the term 'unicorn' is a symbol, he must state what this symbol stands for It might be said that 'unicorn', as a symbol, stands for a *fanciful* animal in heraldry, a statement which happens to be true In such a sense the term 'unicorn' becomes a symbol for a fancy, and rightly belongs to psycho-logics, which deals with human fancies, but does not belong to zoology, which deals with actual animals But if one should believe firmly and intensely that the 'unicorn' represents an actual animal which has an external existence, he would be either mistaken or ignorant, and could be convinced or enlightened, or, if not, he would be seriously ill We see that in this case, as in many others, all depends to what 'ology' our semantic impulses assign some 'existence' If we assign the 'unicorn' to psycho-logics, or to heraldry, such an assignment is correct, and no semantic harm is done, but if we assign a 'unicorn' to zoology, that is to say, if we believe that a 'unicorn' has an objective and not a fictitious existence, this *s r* might be either a mistake, or ignorance, and, in such a case, it could be corrected, otherwise, it becomes a semantic illness If, in spite of all contrary evidence, or of the lack of all positive evidence, we hold persistently to the belief, then the affective components of our *s r* are so strong that they are beyond normal control Usually a person holding such affective beliefs is seriously ill, and, therefore, no amount of evidence can convince him

We see, then, that it is not a matter of indifference to what 'ology' we assign terms, and some assignments may be of a pathological character, if they identify psycho-logical entities with the outside world Life is full of such dramatic identifications, and it would be a great step forward in semantic hygiene if some 'ologies'—e g, demonologies of different brands, should be abolished as such, and their subject-matter transferred to another 'ology', namely, to psycho-logics, where it belongs

The projection mechanism is one fraught with serious dangers, and it is very dangerous to develop it The danger is greatest in childhood, when silly teachings help to develop this semantic mechanism, and so to affect, in a pathological way, the physically undeveloped nervous system of the human child Here we meet an important fact which will become prominent later—that ignorance, identification, and pathological delusions, illusions, and hallucinations, are dangerously akin, and differentiated *only* by the 'emotional' background or intensity

An important aspect of the problem of existence can be made clear by some examples Let us recall that a noise or written sign, to become a symbol, must stand for *something* Let us imagine that you, my

reader, and myself are engaged in an argument Before us, on the table, lies something which we usually call a box of matches you argue that there are matches in this box, I say that there are no matches in it Our argument can be settled We open the box and look, and both become convinced It must be noticed that in our argument we used *words,* because they stood for something, so when we began to argue, the argument could be solved to our mutual satisfaction, since there was a *third* factor, the object, which corresponded to the symbol used, and this settled the dispute A third factor was present, and agreement became possible Let us take another example Let us try to settle the problem 'Is blah-blah a case of tra-tra?' Let us assume that you say 'yes', and that I say 'no'. Can we reach any agreement? It is a real tragedy, of which life is full, that such an argument cannot be solved at all We used noises, not words There was *no third* factor for which these noises stood as symbols, and so we could argue endlessly without any possibility of agreement That the noises may have stood for some *semantic disturbance* is quite a different problem, and in such a case a psycho-pathologist should be consulted, but arguments should stop The reader will have no difficulty in gathering from daily life other examples, many of them of highly tragic character

We see that we can reach, even here, an important conclusion, namely, that, first of all, we must distinguish between words, symbols which symbolize something, and noises, not symbols, which have no meaning (unless with a pathological meaning for the physician), and, second, that if we use words (symbols for something), all disputes can be solved sooner or later But, in cases in which we use noises as if they were words, such disputes can *never* be settled Arguments about the 'truth' or 'falsehood' of statements containing noises are useless, as the terms 'truth' or 'falsehood' do not apply to them There is one characteristic about noises which is very hopeful If we use words, symbols, not-noises, the problems may be complicated and difficult, we may have to wait for a long time for a solution, but we know that a solution will be forthcoming In cases where we make noises, and treat them as words, and this fact is exposed, then the 'problems' are correctly recognized at once as 'no-problems', and such solutions remain valid Thus, we see that one of the obvious origins of human disagreement lies in the use of noises for words, and so, after all, this important root of human dissension might be abolished by proper education of *s r* within a single generation Indeed, researches in symbolism and *s r* hold great possibilities We should not be surprised that we find meaningless noises in the foundation of many old 'philosophies', and that from them arise

most of the old 'philosophical' fights and arguments. Bitterness and tragedies follow, because many 'problems' become 'no-problems', and the discussion leads nowhere But, as material for psychiatrical studies, these old debates may be scientifically considered, to the great benefit of our understanding.

We have already mentioned the analogy between the noises we make when these noises do not symbolize anything which exists, and the worthless 'cheques' we give when our bank balance is zero This analogy could be enlarged and compared with the sale of gold bricks, or any other commercial deal in which we try to make the other fellow accept something by a representation which is contrary to fact But we do not realize that when we make noises which are not words, because they are not symbols, and give them to the other fellow as if they were to be considered as words or symbols, we commit a similar kind of action In the concise *Oxford Dictionary of Current English,* there is a word, 'fraud', the definition of which it will be useful for us to consider Its standard definition reads 'Fraud, n Deceitfulness (rare), criminal deception, *use of false representations* (in Law,), dishonest artifice or trick (*pious* fraud, deception intended to benefit deceived, and especially to strengthen religious belief), person or thing not fulfilling expectation or description '* Commercialism has taken good care to prevent one kind of symbolic fraud, as in the instances of spurious cheques and selling gold bricks or passing counterfeit money. But, as yet, we have not become intelligent enough to realize that another most important and similar kind of fraud is continually going on So, up to the present, we have done nothing about it

No reflecting reader can deny that the passing off, on an unsuspecting listener, of noises for words, or symbols, must be classified as a fraud, or that we pass to the other fellow contagious semantic disturbances This brief remark shows, at once, what serious ethical and social results would follow from investigation of correct symbolism.

On one side, as we have already seen, and as will become increasingly evident as we proceed, our *sanity* is connected with correct symbolism And, naturally, with the increase of sanity, our 'moral' and 'ethical' standards would rise It seems useless to preach metaphysical 'ethics' and 'morals' if we have no standards for sanity. A fundamentally *un*-sound person cannot, in spite of any amount of preaching, be either 'moral' or 'ethical' It is well known that even the most good-natured person becomes grouchy or irritable when ill, and his other

*The first italics are mine—A. K.

semantic characteristics change in a similar way. The abuse of symbolism is like the abuse of food or drink it makes people ill, and so their reactions become deranged.

But, besides the moral and ethical gains to be obtained from the use of correct symbolism, our economic system, which is based on symbolism and which, with ignorant commercialism ruling, has mostly degenerated into an abuse of symbolism (secrecy, conspiracy, advertisements, bluff, 'live-wire agents' ,), would also gain enormously and become stable Such an application of correct symbolism would conserve a tremendous amount of nervous energy now wasted in worries, uncertainties , which we are all the time piling upon ourselves, as if bent upon testing our endurance We ought not to wonder that we break down individually and socially Indeed, if we do not become more intelligent in this field, we shall inevitably break down racially

The semantic problems of correct symbolism underlie *all human* life Incorrect symbolism, similarly, has also tremendous semantic ramifications and is bound to undermine any possibility of our building a structurally *human* civilization Bridges cannot be built and be expected to endure if the cubic masses of their anchorages and abutments are built according to formulae applying to *surfaces* These formulae are structurally different, and their confusion with the formulae of volumes must lead to disasters Similarly, we cannot apply generalizations taken from cows, dogs, and other animals to man, and expect the resultant social structures to endure

Of late, the problems of meaninglessness are beginning to intrigue a number of writers, who, however, treat the subject without the realization of the multiordinal, ∞-valued, and *non-el* character of meanings They assume that 'meaningless' has or may have a definite general content or unique, one-valued 'meaning' What has been already said on *non-el* meanings, and the example of the unicorn given above, establish a most important semantic issue, namely, that what is 'meaningless' in a given context on one level of analysis, may become full of sinister meanings on another level when it becomes a symbol *for a semantic disturbance.* This realization, in itself, is a most fundamental semantic factor of our reactions, without which the solution of the problems of sanity becomes extremely difficult, if at all possible

CHAPTER VII

LINGUISTIC REVISION

This would appear to put at least part of the Theory of Demonstration in a category with the efforts of beginners in Geometry· To prove that A equals B let A equal B, therefore A equals B. (22) E T BELL

To what final conclusions are we then led respecting the nature and extent of the scholastic logic? I think to the following that it is not a science, but a collection of scientific truths, too incomplete to form a system of themselves, and not sufficiently fundamental to serve as the foundation upon which a perfect system may rest (44) GEORGE BOOLE

. . the subject-predicate habits of thought had been impressed on the European mind by the overemphasis on Aristotle's logic during the long mediaeval period. In reference to this twist of mind, probably Aristotle was not an Aristotelian (578) A N WHITEHEAD

The Euclidean space alone is one which at the same time is free of electricity and of gravitation (551) HERMANN WEYL

To imagine that Newton's great scientific reputation is tossing up and down in these latter-day revolutions is to confuse science with omniscience (149) A S EDDINGTON

This latter objection was sanctioned by Newton, who was not a strict Newtonian (457) BERTRAND RUSSELL

The evil produced by the Aristotelian 'primary substance' is exactly this habit of metaphysical emphasis upon the 'subject-predicate' form of proposition (578) A. N WHITEHEAD

The belief or unconscious conviction that all propositions are of the subject-predicate form—in other words, that every fact consists in some thing having some quality—has rendered most philosophers incapable of giving any account of the world of science and daily life (153) BERTRAND RUSSELL

The alternative philosophic position must commence with denouncing the whole idea of 'Subject qualified by predicate' as a trap set for philosophers by the syntax of language (574) A N WHITEHEAD

And a well-made language is no indifferent thing; not to go beyond physics, the unknown man who invented the word *heat* devoted many generations to error Heat has been treated as a substance, simply because it was designated by a substantive, and it has been thought indestructible. (417) H. POINCARÉ

Aristotle was almost entirely concerned with establishing what had been conceived already or of refuting error, but not with solving the problem of the discovery of truth Now and then, in reading his organon, one feels that he has almost sensed the nature of this problem, only to find that he lapses immediately into a discussion of the logic of demonstration He thinks of confirming truth rather than of finding it (82) R D CARMICHAEL

It is necessary here to give a short account of the great scientific revolution which started some years ago, but which is still going on with very beneficial results This scientific revolution started in geometry, and, in a deeper sense, is carried on by geometry Until the work of Gauss, Lobatchevski, Bolyai, Riemann , the *E* geometry, being *unique,* was believed to be *the* geometry of *the* 'space'. The moment a second geometry was produced, just as good, self-consistent, yet contradictory to the old one, *the* geometry became *a* geometry None was unique One absolute was dead Until Einstein (roughly), *the* universe of Newton was, for us, *the* universe With Einstein, it became *a* universe Something similar happened to man * A new 'man' was produced, just as good, certainly contradictory to the old one. *The* man became *a* man, otherwise a 'conceptual construction', one among the infinity of possible ones

It is not difficult to see that in all these advances there is a common characteristic, which can be put simply in that it consists in a little change from a 'the' into an 'a' Some people insist upon sentences in one-syllable words, here we could indeed satisfy them! The change, no doubt, can be expressed by the exchange of one syllable for another But the problems, in spite of this apparent simplicity, are quite important; and the rest of this volume will be devoted to the examination of this change and of what it structurally involves

In mentioning the above names, a very important one was omitted, that of Aristotle I merely mentioned these names as representative of certain trends Otherwise, of course, it would have been necessary to mention additional names, including sometimes those of their predecessors and the followers who have carried their work further It would have been particularly necessary in the case of Aristotle, who was not only a most gifted man, but who, also, because of the character of his work, has semantically affected perhaps the largest number of people ever influenced by a single man, and so his work has undergone a most marked elaboration Because of this, his name, in this book, will usually stand for the body of doctrines known as aristotelianism It is important to keep this in consideration, because it is becoming more and more evident that the work of Aristotle and his followers has had an unprecedented influence upon the development of the Aryan race, and so the study of aristotelianism may help us to understand ourselves In using the name of the founder of the school as a synonym for the school itself,

*See my *Manhood of Humanity, The Science and Art of Human Engineering,* E P Dutton & Co, N Y. C

we make our statements less cumbersome Some of the statements may not be true about the founder of the school, yet they remain true about the school.

Aristotle (384-322 B C.) was born in Stagira, Greece He was the son of a physician and had marked predilection for natural history and a distinct dislike for mathematics Plato, who is considered the 'father of mathematicians', was his teacher Early in his career Aristotle reacted strongly against the mathematical philosophy of his teacher, and began to build up his own system, which had a strongly biological bias and character Psycho-logically, Aristotle was a typical extrovert, who projects all his internal processes on the outside world and objectifies them: so his reaction against Plato, the typical introvert, for whom 'reality' was all inside, was a natural and rather an inevitable consequence The struggle between these two giants was typical of the two *extreme* tendencies which we find in practically all of us, as they represent two most diverse, and yet fundamental psycho-logical tendencies In 1933 we know that either of these extremes in our make-up is undesirable and un-sound, in science as well as in life In science, the extreme extroverts have introduced what might be called gross empiricism, which, as such, is a mere *el* fiction—practically a delusion For no 'facts' are ever free from 'doctrines' so whoever fancies he can free himself from 'doctrines', as expressed in the structure of the language he uses , simply cherishes a delusion, usually with strong affective components The extreme introverts, on the other hand, originated what might be called the 'idealistic philosophies', which in their turn become *el* delusions We should not overlook the fact that both these tendencies are *el* and structurally fallacious Belief in the separate existence of *el*, and, therefore, fictitious, entities must be considered as a structurally un-sound *s r* and accounts in a large degree for many bitter fights in science and life

In asylums, these two tendencies are sometimes very obvious The extreme extrovert is found mostly among the paranoiacs, the extreme introvert among cases of schizophrenia (dementia praecox) Between the two extremes we find all possible shades and degrees represented in daily life as well as in asylums Both extreme tendencies involve harmful *s r*, because both produce delusions of some elementalism which, as such, is always *fictitious* and *impossible* 'Mentally' ill are often characterized by *s r* involving this capacity for building for themselves fictitious worlds in which they can find refuge from actual life. If we, who live outside of asylums, *act* as if we lived in a fictitious world—that is to say, if we are consistent with our beliefs—we cannot adjust ourselves to actual conditions, and so fall into many *avoidable* semantic difficulties

But the so-called normal person practically never abides by his beliefs, and when his beliefs are building for him a fictitious world, he saves his neck by *not* abiding by them A so-called 'insane' person *acts* upon his beliefs, and so cannot adjust himself to a world which is quite different from his fancy.

Let me repeat that the nervous system of the human child is not physically finished at birth. and, therefore, it is easy to give it quite harmful semantic twists, by wrong doctrines To eliminate the vicious and fictitious *el* outlook and *s r*, it is of paramount importance to try to educate a child to be neither an extreme extrovert nor an extreme introvert, but a balanced extroverted-introvert.

In psychotherapy, the attempt is often made to re-educate these tendencies The physician usually tries to make an extrovert more introverted, and an introvert more extroverted In case of success, the patient either recovers altogether or improves considerably

In practice there is a considerable difference between the re-education of an extrovert to an introvert and that of an introvert to an extrovert We have already seen that the balanced person should be both In daily *el* language, the introvert is 'all thought' and has not much use for the external world, while the extrovert is 'all senses' and has little use for 'thought' It often happens that it is easier to re-educate an introvert, because at least he 'thinks', but difficult to re-educate an extrovert, as he has not cultivated his capacity to 'think' He may be a remarkable player on words, but all his verbal plays, though clever, are shallow.

Now we shall be able to understand why Aristotle, the extrovert, and his doctrines have appealed, and still appeal, to those who can 'think' but feebly The fact that the fuller linguistic system of the extrovert Aristotle was accepted in preference to the work of the introvert, Plato, is of serious semantic consequence to us It is evident that mankind, in its evolution, had to pass through a low period of development, but this fact is not the only reason why the *A* doctrines have had such a tremendous influence upon the Aryan race The reason is much more deeply rooted and pernicious In his day, over two thousand years ago, Aristotle inherited a structurally primitive-made *language* He, as well as the enormous majority of us at present, never realized that what is going on outside of our skins is certainly *not* words. We never 'think' about this distinction, but we all take over semantically from our parents and associates their habitual forms of representation involving structure as *the* language in which to talk about this world, not knowing, or else forgetting, that a language to be fit to represent this world should at least have the *structure* of this world

Let me illustrate this by a structural example: let us take a man-made green leaf We see that in it *green colour was added* Now let us take a natural green leaf We see that the green colour was *not added* to it, but that the natural green leaf must be considered a process, a *functional* affair which *became* green without anybody's adding green colour. In the old savage mythologies, there were always demons in *human* shape, who actually made everything with *their hands* This primitive mythology built up a 'plus' or additive language which attributed to the world an anthropomorphic structure This false notion of the world's structure was, in turn, reflected in the language. It was a subject-predicate, 'plus' language, and not as it should be, to fit the structure of the world, a *functional* language

Here we come across a tremendous fact, namely, that a language, any language, has at its bottom certain metaphysics, which ascribe, consciously or unconsciously, some sort of structure to this world Our old mythologies ascribed an anthropomorphic structure to the world, and, of course, under such a delusion, the primitives built up a language to picture such a world and gave it a subject-predicate form This subject-predicate form also was closely related to our 'senses', taken in a very *el*, primitive form

This 'plus' tendency not only shaped our language, but even in mathematics and in physics we are still much more at home with linear ('plus') equations Only since Einstein have we begun to work seriously at new forms of representation which are no longer expressed by linear (or 'plus') equations At present, we have serious difficulties in this field It must be admitted that linear equations are much simpler than non-linear equations I will explain later that the notion of two-valued causality is strictly connected with this linearity or *additivity*

Neither Aristotle nor his immediate followers realized or could realize what has been said here They took the structure of the primitive-made language for granted, and went ahead formulating a philosophical grammar of this primitive language, which grammar—to our great semantic detriment—they called 'logic', defining it as the 'laws of thought' Because of this formulation in a general theory, we are accustomed even today to inflict this 'philosophical grammar' of primitive language upon our children, and so from childhood up imprison them unconsciously by *the structure* of the language and the so-called 'logic', in an anthropomorphic, structurally primitive universe.

Investigation shows that three great names in our history have been very closely interconnected: Aristotle, who formulated a general theory of a primitive language, a kind of 'philosophical grammar' of this lan-

guage, and called it 'logic'; Euclid, who built the first nearly autonomous 'logical' system, which we call 'geometry', and, finally, Newton, who rounded up these structural systems by formulating the foundations of macroscopic mechanics These three systems happen to have one underlying structural metaphysics, in spite of the fact that Newton corrected some of the most glaring errors of Aristotle Such first systems are never structurally satisfactory, and, in time, it was found that these systems contained unjustified structural assumptions which their followers tried to evade It was natural that the innovators should meet with a strong resistance, as these old systems had become so elaborated as to impress the 'thoughtless' with their finality So the revisions went very slowly and very shyly In the case of Aristotle, revision was still more difficult because the current religious 'philosophies' of the Western world were inextricably bound up with the *A*-system The religious leaders took a strong stand, and as late as the seventeenth century threatened death to the critics of Aristotle

Even today a revision of Aristotle is extremely difficult, for these three systems have a tremendous semantic hold upon us Many semantic factors have contributed to this hold First, they were established by men who were really very gifted Second, they were not wise epigrams but were genuine systems with definite structure, and, as such, extremely difficult to replace Obviously, it was not enough to pick some weak spot in one of these systems, the new system-builder would have to replace the old structure by an equally full-fledged structure, and this was a very laborious and difficult task Third, these systems were strictly united by one structural metaphysics and *s r*, they collaborated with each other, and gave each other assistance Finally, the interdependence of these systems rested to a large degree on the structure of the primitive language, upon which Aristotle had legislated, and which was accepted by practically all Aryans, and so was inherently bound up with our daily habits of speech and *s r* Together, these four factors constituted a tremendous power, working against any attempts at revision

We do not realize what tremendous power the structure of an habitual language has It is not an exaggeration to say that it enslaves us through the mechanism of *s r* and that the structure which a language exhibits, and impresses upon us unconsciously, is *automatically projected* upon the world around us This semantic power is indeed so unbelievable that I do not know any one, even among well-trained scientists, who, after having admitted some argument as correct, does not the next minute deny or disregard (usually unconsciously) practically every word he

had admitted, being carried away again by the structural implications of the old language and his *s r*

This linguistic slavery makes criticism very difficult, for the majority of critics with their *s r* defend unconsciously structural and linguistic implications, instead of analysing open-mindedly the structure of the facts at hand All our advances are going very slowly, very painfully and haltingly, because the new work in science, the Einstein and the new quantum theories included, is all of a *non-el* structure, while our daily languages are *el* and absolutistic and twist pathologically our habits of 'thought' and *s r* No help is forthcoming from the so-called 'psychologists' Not to keep the reader guessing too long, let me say here—although this will be explained at length later on—that the main achievement of Einstein was precisely in the fact that he refused to divide *verbally* 'space' *and* 'time', which experimentally cannot be so divided This was accomplished by the help of the mathematician Minkowski, who invented a language of *new* structure, namely, the four-dimensional 'space-time', in which to talk about events This device made the Einstein General Theory possible, and affected the new quantum theories In the present work, in order to be able to talk about the organism-as-a-whole, we must introduce this *non-el* principle as fundamental and apply it.

The first science to break the traditional structural ring was geometry Full-fledged $\bar{E}$ systems were built Following these $\bar{E}$ systems, $\bar{N}$ systems were built (Einstein, quantum), and the 'time' is ripe to build a $\bar{A}$-system, which the present writer originated in his *Manhood of Humanity,* and which is formulated as a structural outline of a general theory in the present volume

As soon as this new $\bar{A}$-system was definitely formulated, a most curious, natural, and yet unexpected result became apparent, namely, that the three new systems, the $\bar{A}$, $\bar{E}$, and the $\bar{N}$ have *also* one underlying structure and metaphysics This fact adds to the importance of the situation All these three new systems have been produced independently They express between them the structural and semantic urge and longing of all modern science Their mutual interdependence, mutual structure, mutual metaphysics, mutual method are helpful, for when the vital nature of the issues at hand is clearly seen, it will be found expedient to *start* from this interdependence as a basis, although, historically speaking, it was not a factor in the production of these systems

This does not seem to be clearly understood by all scientists. I have read, for instance, scientific papers in which Einstein is reproached that he did not *start* with $\bar{E}$ geometries, but only at a later stage incorporated them into his system This argument, of course, is not against

Einstein but for Einstein. Similar remarks could be made about this present work, and again this would not be an argument against this work, but for it All these new systems represent methodological and structural advances, and will have played their semantic roles even if some day they should be dismissed and systems of different structure take their place

Historically, attempts in the direction of a $\bar{A}$ discipline have been very numerous Indeed, the invention of any new important term of a non-subject-predicate character, or of a functional character, was, in itself, an attempt in the $\bar{A}$ direction All sciences have had to abandon the common vocabularies and build their own terminologies, many of which are also $\bar{A}$ Although all these attempts have been made, and have quite often been successful in their fields, to the best of my knowledge, they were not made consciously. The term accepted here, namely, 'non-aristotelian' is very useful, not only because it is appropriate and illustrates very well what we have to contend with, but also because it places the emphasis properly and makes us conscious of the structural issues. The fact that the three new non-systems have as much in common as the older three had, recommends and justifies the use of the term The new problem which looms up, namely, the validity or non-validity of the A law of the excluded third, leads automatically to the non-chrysippian and $\bar{A}$ ∞-valued 'logics', which merge with the theory of probability[1] According to the accepted use, it is enough to build a system differing from an older system by *one single postulate,* to justify (for instance) the name 'non-euclidean'

The scope of this particular chapter does not permit me to enlarge upon this difficult and important problem as to the differences between the A and $\bar{A}$ systems, but for orientation, a short list of structural differences is given here, all of which involves new semantic factors

The primitive form of representation which Aristotle inherited, together with its structural implications and his 'philosophical grammar', which was called 'logic', are strictly interconnected, so much so that one leads to the other

In the present $\bar{A}$-system, I reject Aristotle's assumed structure, usually called 'metaphysics' (*circa* 350 B C), and accept modern science (1933) as my 'metaphysics'

I reject the following structurally and semantically important aspects of the A-system, which I shall call postulates, and which underlie the A-system-function:

1) The postulate of uniqueness of subject-predicate representation

2) The two-valued *el* 'logic', as expressed in the law of 'excluded third'.

3) The necessary confusion through the lack of discrimination between the 'is' of identity, which I reject completely, and the 'is' of predication, the 'is' of existence, and the 'is' used as an auxiliary verb

4) The elementalism, as exemplified by the assumed sharp division of 'senses' *and* 'mind', 'percept' *and* 'concept', 'emotions' *and* 'intellect',.

5) The *el* theory of 'meaning'

6) The *el* postulate of two-valued 'cause-effect'.

7) The *el* theory of definitions, which disregards the undefined terms.

8) The three-dimensional theory of propositions and language

9) The assumption of the cosmic validity of grammar

10) The preference for intensional methods

11) The additive and *el* definition of 'man'.

This list is not complete but sufficient for my purpose and for orientation

I reject the use of the 'is' of identity entirely, because identity is never found in this world, and devise methods to make such a rejection possible

I base the $\bar{A}$-system-function and system all through on negative *'is not'*, premises which cannot be denied without the production of impossible data, and so accept 'difference', 'differentiation' , as fundamental

I accept relations, structure, and order as fundamental

I accept the many-valued, more general, structurally more correct 'logic of probability' of Łukasiewicz and Tarski, which in my *non-el* system becomes infinite-valued (∞-valued) semantics *

I accept functional representation whenever possible

I introduce the *principle of non-elementalism* and apply it all through, which leads to (*a*) A *non-el* theory of *meanings;* (*b*) A *non-el* theory of *definitions* based on *undefined terms;* (*c*) A *psycho-physiological* theory of *semantic reactions*

I accept the absolute individuality of events on the un-speakable objective levels, which necessitates the conclusion that *all statements* about them are only probable in various degrees, introducing a *general principle of uncertainty* in *all statements*

I accept 'logical existence' as fundamental

I introduce differential and four-dimensional methods

*I use the term infinite-, or ∞-valued in the sense of Cantor as a *variable finite.*

I accept the propositional function of Russell

I accept the doctrinal function of Keyser, and generalize the system function of Sheffer

I introduce the four-dimensional theory of propositions and language.

I establish the *multiordinality* of terms

I introduce and apply psychophysiological considerations of *non-el* orders of abstractions.

I expand the two-term 'cause-effect' relation into an ∞-valued causality

I accept the ∞-valued determinism of maximum probability instead of the less general two-valued one

I base the $\bar{A}$-system on extensional methods, which necessitates the introduction of a new punctuation indicating the 'etc' in a great many statements.

I define 'man' in *non-el* and functional terms

This list is also not complete and is given for orientation and justification of the name of a *non-aristotelian system*

In the rough, all science is developing in the $\bar{A}$ direction The more it succeeds in overcoming the old structural implications of speech, and the more successful it is in building new vocabularies, the further and more rapidly it will progress

Our human relations at present are still mostly based on the A-system-function The issues are definite Either we shall have a science of man, and, therefore, have to part company with the structural implications of our old language and corresponding $s\,r$—and this means we shall have to build up a new terminology, which is $\bar{A}$ in structure, and use different methods,—or we shall remain in A semantic clutches, use A language and methods, involving older $s.r$, and have no science of man As I am engaged in building up a science of man, all departures I am forced to make from accepted methods are necessary semantic preliminaries to the building of my system and need no apology

It is no exaggeration to say that the A, E, and N systems have one most interesting structural and semantic characteristic in common, namely, that they have a few unjustified 'infinities' too many The modern $\bar{E}$, $\bar{N}$, and, finally, $\bar{A}$ systems, after analysis, eliminate these unjustified notions New systems arise, quite different from the old ones, which again have this structural characteristic in common, that they have a few 'infinities' less—an important semantic factor, especially in the $\bar{A}$-system, as it helps to eliminate our older delusional mythologies In the mathematical reconstruction of Brouwer, Weyl, and the Polish School, a similar

tendency is apparent, leading to revision of the mathematical notions of infinity For instance, the E-system involves several structural 'infinity' assumptions In it, a line has infinite length, the space constant is infinite, and the natural unit of length is also infinite. In the N-system, the velocity of light is assumed unconsciously to be infinite, a structural assumption false to facts The A-system involves also false to facts infinity assumptions, explained later It is extremely interesting to note that in any system a similar result follows from the introduction of these different 'infinities', namely, when such an 'infinity' is introduced in the denominator, it makes the whole expression vanish When, in the observation of actual facts, we *miss* some characteristic entirely, for instance, order, it leads to the introduction of some 'infinity' somewhere In other words, faulty, insufficient observation leads to the introduction somewhere in our systems of some fanciful 'infinities'.

I must emphasize again the semantic difficulties which beset us, in the formation of a new and $\bar{A}$-system, mainly because of the lack of scientific *non-el* psycho-logics and general semantics Having no general theories to guide us in our researches, we must select some other devices We can survey those achievements of mankind which have proved to be the most beneficial and of most lasting value, *study* their structure and try to train ourselves, and our *s r*, in repeating the psycho-logical processes and methods which have made them In this way, we are led to the study of the structure of mathematics and science, and acquire the habit of rigorous and critical 'thought' and acquire new *s r* Naturally, such a method is wasteful, it would be simpler to have general *non-el* theories, which I have proposed to call general semantics and psychologics, replacing the older *el* 'logic' and 'psychology', and study these short, structurally correct, ready-made formulations to train our *s r* rather than to study the actual performance of scientists and mathematicians, and formulate these generalizations for ourselves But, until the present work, this could not be done

For these reasons, we shall have to make, in the following chapters, a short survey of different scientific achievements without going into technical details, but giving enough of these details to indicate structure and its bearing on *s r* Every thing given will be strictly of an elementary character, and the intelligent reader will find no special difficulties in following the survey

The selection of suitable material presented a very serious problem I consulted with many friends and used my best judgement, backed by some experience An important factor was the class of readers for whom this book is written Sooner or later a new branch of science must be—

and will be—established for the pursuit of this $\bar{A}$ enquiry, so the future student and teacher must have at least an outline of the main problems. It seemed more advisable to outline main issues relevant to the subject, than to work out some of them in more detail A great deal of new scientific literature on structure and *s r* must be produced by mathematicians, psychiatrists, linguists, psychophysiologists, In this field, experience has taught me that very little has been done and that much of what has been done cannot be accepted without a *non-el* revision It seems to be more convenient that the reader shall not be referred to too many books, and more expedient that the writer should not take too much for granted, so most of the structural and semantic informations which are necessary for an intelligent reading are given, together with additional references for students who wish to go deeper into the subject

The reader will find that the *non-el* principle has been emphasized In the meantime, in the writing I have had to use some *el* terms In such cases, I used the old terms in quotation marks The reason for this is that before the full general theory is developed, it is impossible to do otherwise. Besides, even if organism-as-a-whole terms were used from the beginning, this also would not be entirely adequate, for the organism-as-a-whole cannot and should not be structurally separated from its environment, and so the terms should be enlarged to cover, by implication, the environment

Later we shall see that all languages have some characteristics similar to mathematical languages For instance, the A word, 'apple', as it has no individual subscripts or date, is *not* a name for a definite object or stage of a process *which are all different,* but a name *for a definition,* which, in principle, is one-valued, while the objective processes are ∞-valued If this mechanism is not clearly understood, we are bound in dealing with actual ∞-valued stages of processes, to identify the ∞ values into one or a few values The above considerations necessitate a *non-el* new theory of meanings in accordance with the structure of the world and our nervous system

The distinction between mathematical and physical languages is structurally most important, although once identification is entirely eliminated, we discover that all possible characteristics found in this world are due to *structure*, and so can be expressed in terms of structure, relations, and multi-dimensional order

Several similar difficulties will appear later on, all having a similar general characteristic, namely, that we seem to reach an impasse, from which there is no way out Yet escape can be found, not by solution in the old way, but by reformulating the problem so as to make a solution

possible This method is of extreme usefulness in mathematics, and seemingly can be applied to life also.

If we compare the three systems of Aristotle, Euclid, and Newton, designated, A, E, N, respectively, in Fig 1, with the non-aristotelian, non-euclidean and non-newtonian systems, designated $\bar{A}$, $\bar{E}$, $\bar{N}$, a very important fact should be noticed, namely, that the $\bar{A}\bar{E}\bar{N}$ trilogy is *more general* than AEN. This fact has far-reaching semantic and practical consequences and perhaps can be best explained by the aid of a diagram We see that the $\bar{A}\bar{E}\bar{N}$ trilogy includes the AEN trilogy as a particular case, from which it follows that all those readers who are already re-educated to the new $\bar{A}\bar{E}\bar{N}$ s r, have less difficulty in understanding the older AEN, simply because the older systems are only particular cases of the new $\bar{A}\bar{E}\bar{N}$ But this is not so with those readers who still have tr[illegible] old AEN s r, they have to enlarge their limited point of view, grasp [illegible]ore than they knew before, and so will have serious semantic difficulties for a while, and, perhaps, become impatient or even angry With the understanding of this larger generality of the new $\bar{A}\bar{E}\bar{N}$, perhaps a great deal of this semantic futile unpleasantness can be eliminated

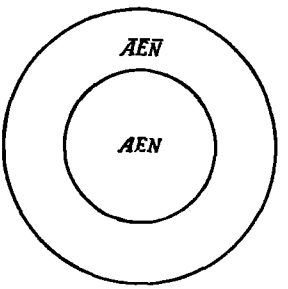


FIG 1

I know of no better example to illustrate this than to refer the reader to a little elementary book, *Debate on the Theory of Relativity*, published by the Open Court Co, Chicago [2] It is really interesting to watch how good-natured the einsteinists are as compared with the newtonians This book is suggested because it is elementary, extremely instructive, and very well worth reading But the whole literature of euclideanism, non-euclideanism, newtonianism and non-newtonianism gives ample proof of the above statements What kind of verbal flowers the aristotelians will throw to the non-aristotelians remains to be seen, but some verbal and semantic uproar can be expected

It should be expected that this widening of horizons can only be attained, after all, with difficulty, because it requires an alteration of habitual reactions, from one-, two-, and three-valued to ∞-valued new s r—usually not easy to achieve But there seems little doubt that the future depends on it, and so we shall not be able to escape it indefinitely.

As we usually fail to make allowances for the 'emotional' aspects of 'intellectual' pursuits, let me once more point to the fact that even purely 'intellectual' achievements have their 'emotional' components and these

are included in the *non-el s r* It seems that broader ∞-valued understanding has beneficial effect on our *s r*, a result which should be expected, if, as at present, we have no reason to doubt that the organism-as-a-whole is a dependable structural *non-el* generalization.

PART III

NON-ELEMENTALISTIC STRUCTURES

The history of human thought may be roughly divided into three periods, each period has gradually evolved from its predecessor The beginning of one period overlaps the other As a base for my classification I shall take the relationship between the observer and the observed .

The first period may be called the Greek, or Metaphysical, or Pre-Scientific Period In this period the observer was everything, the observed did not matter.

The second period may be called the Classical or Semi-Scientific—still reigning in most fields—where the observer was almost nothing and the only thing that mattered was the observed This tendency gave rise to that which we may call *gross* empiricism and *gross* materialism

The third period may be called the Mathematical, or Scientific Period.

In this period mankind will understand (some understand it already) that all that man can know is a joint phenomenon of the observer and the observed

Someone may ask, How about "intuitions," "emotions," etc ? The answer is simple and positive It is a fallacy of the old schools to divide man into parcels, elements, all human faculties consist of an inter-connected whole . . (280) A K

The organism is inexplicable without environment Every characteristic of it has some relation to environmental factors And particularly the organism as a whole, *i e* , the unity and order, the physiological differences, relations and harmonies between its parts, are entirely meaningless except in relation to an external world (92) CHARLES M CHILD

In reality it is the brain as a whole which is the centre of association, and the association is the very raison d'être of the nervous system as a whole (411) HENRI PIÉRON

The views of space and time which I wish to lay before you have sprung from the soil of experimental physics, and therein lies their strength They are radical Henceforth space by itself, and time by itself, are doomed to fade away into mere shadows, and only a kind of union of the two will preserve an independent reality (352) H MINKOWSKI

This assumption is not permissible in atomic physics, the interaction between observer and object causes uncontrollable and large changes in the system being observed, because of the discontinuous changes characteristic of atomic processes (215) W HEISENBERG

Well, this is one of the characteristics by which we recognize the facts which yield great results They are those which allow of these happy innovations of language The crude fact then is often of no great interest, we may point it out many times without having rendered great services to science. It takes value only when a wiser thinker perceives the relation for which it stands, and symbolizes it by a word (417) H. POINCARÉ

CHAPTER VIII

GENERAL EPISTEMOLOGICAL

> The physiological gradient is a case of protoplasmic memory since it represents the persistence of the effects of environmental action The establishment of a gradient in a protoplasm may be regarded as a process of learning. CHARLES M CHILD

In what has already been said, we have emphasized repeatedly the 'organism-as-a-whole' principle The principle is structural, involving most important semantic factors and so deserves a more detailed consideration.

Since the days of Aristotle, more than two thousand years ago, this principle has been often emphasized, often belittled, but, withal, seldom applied That all we know about life and organisms seems to justify such a principle seems obvious.

The arguments of those experimentalists who belittle or object to such a principle seem to be all of a similar type, and are, perhaps, best expressed by Professor H S Jennings, who, in his friendly review of Ritter's book on the *Organismal Conception of Life,* concludes that such an 'organismal conception' is quite justified, but is entirely sterile and does not help laboratory workers

It must be granted that at the date when the book of Ritter and the review of Jennings were written such a statement was *seemingly* justified. The principle is usually treated as a rough generalization from experience and is not analysed further, the *structural,* epistemological, psycho-logical and semantic consequences were not known, and so the laboratory workers actually did not realize that they *have much help*

As we have already seen, the main semantic issues were, and are, *structural* How can we apply the organism-as-a-whole principle if we insist on keeping an *el* language and attitude? Naturally, if the principle is *not* applied, it is futile to look for semantic consequences of a non-applied principle But once the principle *is* applied, a new language has to be built, of different structure and, *therefore, new implications,* which suggest a long series of new experiments

A new and structurally different theory may be summarized in a single term—as, for instance, 'tropism' or 'dynamic gradient', a fact which not only revolutionizes our knowledge but which leads also to entirely new experiments and further knowledge. Experiments, as such,

always give relational, structural data, that, under such and such conditions, such and such results follow The *non-el* attitude and language, as opposed to the old elementalism, is a part of a broader and more fundamental semantic problem, namely, *similarity of structure* between language and the external world Such similarity leads to similarity of 'logical' relations, predictability, and so forth, and, in general, to the understanding of the structure of the world and *new s r*

There are many examples of such organism-as-a-whole terms, but for the present we will mention only the terms 'tropism' in the generalized sense of Loeb, and the 'dynamic or physiological gradients' of Professor Child The term 'tropism' means the response of the organism-as-a-whole to special external stimuli For instance, the term 'heliotropism' is applied in cases when the organism responds to the influence of light, 'chemotropism', when it reacts to chemical stimuli, 'galvanotropism', when the organism responds to galvanic (electrical) stimulation,

The term 'dynamic or physiological gradient' is the foundation of the $\bar{A}$ biological system of Professor Child Because of its importance, I shall explain the meaning of this term in some detail [1]

All protoplasm exhibits empirically a structural characteristic which may be called 'irritability', which appears as a reaction of living protoplasm to external dynamic influences That 'irritability', as a structural characteristic, becomes obvious when we consider that structurally disintegrated protoplasm is colloidally inactive and becomes 'dead' Many of the most important characteristics of living protoplasm are strictly bound up with structural integrity.

This 'irritability' occurs in a *structural plenum* and is transmitted to other regions of the protoplasm with differing yet *finite* velocities, and not in 'no time', as Alice would say. Let us imagine a non-differentiated, except for the limiting surface (A), and living bit of protoplasm This limiting surface represents that part of the protoplasm which is in direct contact with the environment If the external dynamic factor (S) excites this living bit of protoplasm at a point (B), this stimulus will be the strongest at (B), and it will spread to the further removed portions of (A) in a diminishing gradient If the decrement is not too sharp, the stimulus will reach the furthest regions of (A), namely, (C), (D), (E), (F),

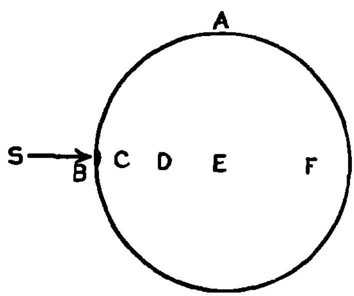


FIG 1.

The presence or absence of the decrement or its steepness and the intensity of the excitation during transmission depends on the specific character of the protoplasm, and varies from individual to individual, and in different regions and under different conditions varies in one individual.

Thus, we see that a living cell has a necessary relationship with the environment and with external energies because of its limiting surface The difference between the 'inside of the skin' and the 'outside of the skin' establishes the organism-as-a-whole The interplay between the inside and the outside is *structural* and supplies the energies which activate the organism The membrane formation is mostly not dependent upon the constitution of any particular protoplasm, but is rather a general reaction of all protoplasm to environmental influences

The evidence we have seems to show that in all protoplasm in which we find no specialized conducting paths a certain decrement appears, so that the effectiveness of transmission is limited In a primitive non-differentiated protoplasm different points further removed from (B) will show different degrees of excitatory changes decreasing from (B) At a certain point the transmission may cease altogether

The result, then, becomes an excitation-transmission gradient of greater or lesser length, the different levels of which represent various degrees or intensities of excitation

The primary region of excitation (B) is physiologically more affected and dominant over the other regions to which the excitation is transmitted, because it has more effect upon them than they have upon it The effect of such conditions gives rise to a temporary structural organismal pattern The region of primary excitation (B) becomes the dominant region, and the other regions become subordinate to it

The potentiality for the excitation and the transmission was structurally present in the protoplasm, but this could not produce the pattern which resulted from the external excitation We see that the action of the external factor was necessary for the realization of the definite physiological pattern whose potentialities were in the protoplasm.

These new excitation-transmission patterns exhibit all the characteristics of new structural patterns in the protoplasmic mass They determine localized differences at different points, (C), (D), (E), These differences and *relations* with the dominant region (B) constitute a physiological axis with (B) at one pole This new pattern constitutes a new structural integration, which is a joint phenomenon of the potentialities of the protoplasm and the environmental action This relation is of a functional and not merely of a 'plus' character. Child shows that

the physiological axes in their simpler forms are similar to, if not the result of, such excitation-transmission gradients

For the organism to work as-a-whole, some sort of integrating pattern is necessary. The behaviour of the organism-as-a-whole results, first, from patterns already present, and, second, from the possibilities of further development and integration in response to particular external factors The physiological gradients give such means

The development of our nervous system is strictly connected with the above principles discovered by Child [2] In axiate animals and man the chief aggregation of nervous tissues is localized in the apical (head) end, which region is characterized primarily by a higher rate of metabolism in the early stages Physiological gradients originate as simple protoplasmic reactions to external stimuli, and so the nervous system originates in protoplasmic behaviour Nerves then become simply *structuralized* and permanent physiological gradients, and so exert a physiological dominance over other tissues

From an epistemological point of view, we should notice that the gradients are primarily quantitative and that we do not need specific factors to determine them Any factor that will determine a more or less persistent quantitative differential in the protoplasm ought to be effective The above theory is structurally supported by a large number of experiments For instance, we can experimentally obliterate or determine new gradients [3] The organism appears in this new light as a behaviour reaction-pattern, and substantiates the old saying that the function builds the organ Not only should the organism be treated as-a-whole, but it is impossible to isolate the organism from its environment A functional interrelationship is established between the two

This theory appears, also, to be fundamental for psychiatry and for psycho-logics, for it establishes the head as a dominant region on the base of an experimentally proven higher rate of metabolism From Child's point of view, as suggested by Dr William A White, the main dynamic gradient, the central nervous axis, gives the *structuralized* evidence of the degree of *correlation* of the other organs and of the degree that the body is under the control of the head-end of this gradient The failure to keep in touch with this centre of control leads to the disintegration of the individual[4] The head-end is also the most modifiable point in the axis of control, a conclusion which is of the utmost significance in psychotherapy It is known that the metabolism of organs can be affected by 'psychic' stimuli, and it is only one step further to understand, as White says, why we may have other structuralized functions, such as structuralized anti-social feelings, structuralized greed, structur-

alized hate., facts which are observed daily in ordinary life and in asylums From the point of view of the theory of Child, the nervous system appears not only as a structuralized conducting gradient, but it also explains how specific conducting tissues could have evolved from non-specific living protoplasm It is important to notice the dominance which the primary region of excitation exerts over the others, since, with the great complexities of the human brain, we understand better why so-called 'mental' and semantic issues, which are phylogenetically the youngest, are of such importance.

In our daily life we deal with different people, some of whom are seriously ill 'mentally' and who, under favorable conditions, would be under medical attendance The majority of us—some specialists consider it to run even as high as ninety per cent of the whole population—would be better off if taken care of by some psychiatrist, or, at least, if under consultation from time to time

Owing to old religious prejudices, often unconscious, it is still believed that those 'mentally' ill are either obsessed by 'demons' or are being punished for some 'evil', The majority even of enlightened people have a kind of semantic horror or fright at 'mental' ills, not realizing that under the *animalistic conditions* which prevail at present in our theories, 'ethical', social, economic , those only with the least human traits are favored, while those most human cannot stand such animalistic conditions and often break down It is not a novelty that a moron cannot be 'insane' A moron lacks something, only the more gifted individuals, the more human (as compared with animals), break down I know of many psychiatrists who say that 'it takes a "good mind" to be "insane" '

Now, 'mental' and semantic excitation, which phylogenetically appeared so recently, naturally plays, in many instances, a dominant part, a fact which science, until very lately, has completely disregarded The present theory makes it quite obvious that with animalistic theories in existence, and un-sanity (lack of consciousness of abstracting, confusion of orders of abstractions resulting from identifications ,) practically universally operating in every one of us, a seriously unbalanced race must be produced

There can be no doubt that the consistent application of a *non-el* language in the analysis of animal behaviour has suggested new experiments and that, as a result, the use of such terms had its influence on laboratory workers It does not matter to what extent these terms, or the theories which they represented, were 'right' or 'wrong', they were terms of the *non-el* type, and they expressed in one term entirely *struc-*

turally new and far-reaching theories In testing these theories, new series of experiments were required Even when the new experiments were devised to verify the older experiments, again the laboratory workers got direct benefit of the structurally new terms But these benefits were largely unconscious, and so biologists *could* believe in the older days that they had no laboratory benefits from the use of such terms, however, this belief is now entirely unjustified

Since the *non-el* principle is not only a structurally justified empirical generalization, but also involves for its application the structural rebuilding of our language and old theories, the semantic issues are far-reaching and of great practical value.

The application of the principle means the rejection of the old elementalism which results and leads to identifications and to blinding semantic disturbances, which, in turn, prevent clear vision and unbiased creative freedom.

According to the modern theory of materials, as given in Part X, the mutual interdependence, the mutual action and reaction of everything in this world upon everything else appears as a *structural* fact and a necessity, and so *el* languages cannot be expected to lead to satisfactory semantic solutions We should not be surprised to find that the struggle against identification and elementalism appears at some stage in every science.

Some of the most prominent examples of this tendency outside of biology, psychiatry , can be found in modern physics From a structural point of view the whole theory of Einstein is nothing else than an attempt to reformulate physics on a *structurally new non-el* and $\bar{A}$ foundation—an exact structural parallel of the biological organism-as-a-whole principle

Einstein realized that the empirical structure of 'space' and 'time' with which the physicist and the average man deals is such that it cannot be empirically divided, and that we actually deal with a blend which we have split only elementalistically and verbally into these fictitious entities He decided to build a verbal system closer in structure to the facts of experience and, with the help of the mathematician Minkowski, he formulated a system of new structure which employed a *non-el language* of space-time As we know from physics and astronomy, this *non-el* language *suggested experiments,* and so it had beneficial laboratory application But, in fact, the influence goes still deeper, as the present work will show, for such structural advances carry with them profound psycho-logical, semantic effects Although, at present, these

beneficial influences operate unconsciously, they, nevertheless, tend to counteract the *el* and absolutistic semantic effects of identification.

It is interesting to note that the Einstein theory, because structural, has had the effect upon the younger physicists of a semantic release from the old structural elementalism and has prepared the semantic ground for the crop of young geniuses which has sprung up lately in the quantum field It was found that the *el* 'absolute' division of the 'observer' and the 'observed' was false to facts, because every observation in this field disturbs the observed. The elimination of this elementalism in the quantum field led to the most revolutionary restricted 'uncertainty principle' of Heisenberg, which, without abolishing determinism, requires the transforming of the two-valued A 'logic' into the ∞-valued semantics of probability Again, this advance in quantum formulations has suggested new experiments

The $\bar{A}$-system, as originated by the writer in his *Manhood of Humanity* and other writings, is also the result of the structurally *non-el* tendency In *Manhood of Humanity,* I introduced a *non-el* term, 'time-binding', by which is meant *all* the factors *which as-a-whole* make man a man, and which differentiate him from animals In carrying the system further in the present book, I reject the structurally *el* separation involved in such terms as 'senses' and 'mind' , and introduce, instead, *non-el* terms, such as 'different orders of abstractions' , where 'mind' and 'senses' , are no longer divided Curiously enough, even in such a field, the method has suggested experiments, and so again the new language has laboratory importance

What has been said above about the organism-as-a-whole, and illustrated by particular cases, seems to show a general characteristic of all our abstracting capacities We usually disregard, or fail to appreciate, the fact that a single structurally important new term might lead to the re-postulation of the whole structure of the language in the given field In science we search for structure, so any structurally new term is useful, because, when tested, it always gives structural information, whether positive or negative In our human affairs, it is different All our human institutions follow the structure of the language used, but we never 'think' of that, and, when the silly institutions do not work, we blame it all on 'human nature', without any scientific justification

Poincaré, in one of his essays, speaks about the harmful effect which the term 'heat' had on physics Grammatically, the term 'heat' is classified as a substantive, and so physics was labouring for centuries looking for some 'substance' which would correspond to the substantive name 'heat' We know by now that there is no such thing, but that 'heat' must

be considered as a manifestation of 'energy'. If we choose to carry this analysis further, we should find that 'energy' is also not a very satisfactory term, but that 'action', perhaps, is more fundamental

In dealing with ourselves and the world around us, we must take into account the structural fact that everything in this world is strictly interrelated with everything else, and so we must make efforts to discard primitive *el* terms, which imply structurally a *non-existing isolation*

The moment this is realized, we shall have to treat the *non-el* principle seriously As the new terms have, also, their *non-el* implications, such terms throw new light on old problems

In practice, it is difficult, at first, to avoid the use of old terms When we want to digest fully a new and important work based on new structural terms and acquire corresponding *s r*, the best way to train oneself in the use of the new terms is by gradually dropping the old terms If we *have* to use the old terms, then we should train ourselves to be aware of their *insufficiency* and of their *fallacious* structural *implications*, and so be free from the old *s r*

The use of the new terms should be deliberate We should put the problem to ourselves somewhat as follows The old language is structurally, and, therefore, by implication, semantically unsatisfactory, the new terms seem to correspond closer to facts, let us test the new terms Are the new terms always structurally satisfactory? Probably not, but in science experiments check predictions, and so new structural issues become clarified

We have been speaking about new and old terms quite simply, yet the issues are not so simple The invention of a single structurally new term always involves new structural and relational notions, which, again, involve *s r* For instance, if we study any event, and in that study use the terms 'tropism', or 'dynamic gradient', or 'time-binding', or 'order of abstractions', or 'space-time', or 'wave-packets', we must use all structural and semantic implications the terms involve

Using the first four terms, we are bound to treat the organism-as-a-whole, for the terms are not *el* They are not based on the notion of, nor do they postulate, some fictitious 'isolated' elements In using space-time, we introduce the individuality of events, as every 'point of space' carries with itself a *date*, which, by necessity, makes every 'point' in space-time unique and individual In using the term 'wave-packet', we re-interpret the older objectified and, perhaps, fictitious 'electron',

The consistent and permanent use of such terms naturally involves, structurally, a new world-outlook, new *s r*, more justified by our scientific and daily experience But the greatest gain is usually in getting

away from primitive structural notions and metaphysics, with their vicious semantic disturbances In creative work, semantic *limitations* hamper a clear understanding, and prevent scientists from inventing or formulating better, simpler, and more effective theories of different structure

As soon as we possess 'knowledge', then we shall 'know' all that there is to be known By definition, there cannot be any *unknowable* There is a place for the unknown structure The unknown is rather extensive, partly because science has been, and still is, persecuted, as has already been pointed out

The so-called 'unknowable' was the semantic result of identification, of a semantic unbalance, which posits for knowledge something 'beyond' knowledge But has such a postulation any meanings outside of psychopathology? Of course not, as it starts with a self-contradictory assumption, which, being senseless, must lead to senseless results

We have dwelt on the problems of the structure of terms at such length, because they are generally disregarded, but they are, for semantic purposes, fundamental The reader will get the main benefit of this book and will receive help in understanding modern scientific issues if he becomes entirely convinced of the seriousness of structural and semantic problems

Terms are artifices of humans which are necessary to economize effort in the field of 'experience' and experimentation They are useful in reducing the actual amount of experience necessary, by allowing verbal experimentation The human rate of progress is swifter than that of the animals, and this is due mainly to the fact that we can summarize and transmit past experiences to the young generation in a degree far more effective than that of the animals We have also extra-neural means for recording experiences, which the animals lack entirely

That such verbal experimentation is possible at all is conditioned by the fact that languages have *structure,* and that our knowledge of the world is *structural* knowledge Let us repeat once more that if two relations have similar structure, all of their 'logical' characteristics are similar; therefore, once structure is discovered, such a process of verbal experimentation becomes extremely effective, and an accelerating cultural device The use of an antiquated language in our human affairs, in addition to other drawbacks, prevents our being more intelligent in those affairs

The natural order of investigation is indicated thus (1) Empirical search for structure in the sciences. (2) Once this structure is discovered, at each date, the structure of our language is adjusted to it and

our new *s r* trained Historically, we have partially followed the reversed, and ultimately pre-human, and so pathological, order Without science, and with extremely meagre and primitive knowledge of the structure of the world, we have produced grunts and languages of primitive false structure, reflecting, of necessity, its implications as to the assumed structure of the world We have made out of it primitive dogmas which are still in full sway and embodied in the structure of the old language This is also the reason why, outside of technical achievements, we are still on such primitive levels It is easy to understand why experimental science is of such importance and why theoretical (verbal) predictions must be tested experimentally The above also gives a deeper and a new justification for what is called 'pragmatism'

Experiments constitute a search for relations and structure in the empirical world Theories produce languages of some structure If the two structures are similar, the 'theories work', otherwise, they do not, and suggest further search and structural adjustments

It should be mentioned, perhaps, that the main epistemological principle which has led to the writing of the works of the present author was a definite inclination to abandon identification and the resulting structurally unsatisfactory *el* language in general use, and to produce a *non-el* system, which, in structure, would be similar to the world around us, ourselves and our nervous system included This structural novelty was the foundation on which the $\bar{A}$-system has been gradually built

CHAPTER IX

COLLOIDAL BEHAVIOUR

> In fact, to-day colloids may be regarded as an important, perhaps the most important connecting link between the organic and the inorganic world (7) WOLFGANG PAULI

In our researches, let us follow the natural order and give a brief structural account of what we know, empirically, about the medium in which life is found, namely, about the colloids The following few elementary particulars show the empirical importance of structure, and so are fundamental in the present work

At present, physicians are usually too innocent of psychiatry, and psychiatrists, although they often complain about this innocence of their colleagues, seldom, if ever, themselves pay any attention to the colloidal structure of life, and their arguments about the 'body-mind' problem are still scientifically incomplete and unconvincing, though the 'body-mind' problem has been present with us for thousands of years It is a very important semantic problem, and, as yet, not solved scientifically, although there is a simple solution of it to be found in the *colloidal* structure of life

The reader should not ascribe any uniqueness of the 'cause-effect' character to the statements which follow, as they may not be true when generalized Colloidal science is young and little known Science has accumulated a maze of facts, but we do not have, as yet, a general theory of colloidal behaviour. Statements, therefore, should not be unduly generalized

We shall only indicate a few structural and relational connections important for our purpose.

When we take a piece of some material and subdivide it into smaller pieces, we cannot carry on this process indefinitely At some stage of this process the bits become so small that they cannot be seen with the most powerful microscope At a further stage, we should reach a limit of the subdivision that the particles can undergo without losing their chemical character Such a limit is called the molecule * The smallest particle visible in the microscope is still about one thousand times larger than the largest molecule So we see that between the molecule and the smallest visible particle there is a wide range of sizes

*This statement is only approximate, because there is evidence that chemical characteristics change as the molecule is approached

Findlay calls these the 'twilight zone of matter', and it was Oswald, I believe, who called it the 'world of neglected dimensions'.

This 'world of neglected dimensions' is of particular interest to us, because in this range of subdivision or smallness we find very peculiar forms of behaviour—life included—which are called 'colloidal behaviour'

The term 'colloid' was proposed in 1861 by Thomas Graham to describe the distinction between the behaviour of those materials which readily crystallize and diffuse through animal membranes and those which form 'amorphous' or gelatinous masses and do not diffuse readily or at all through animal membranes Graham called the first class 'crystalloids' and the second 'colloids', from the Greek word for glue

In the beginning colloids were regarded as special 'substances', but it was found that this point of view was not correct. For instance, NaCl may behave in solution either as a crystalloid or as a colloid, so we began to speak about the *colloidal state* Of late, even this term became unsatisfactory and is often supplanted by the term *'colloidal behaviour'*

In general, a colloid may be described as a 'system' consisting of two or more 'phases'. The commonest represent emulsions or suspensions of fine particles in a gaseous, liquid, or other medium, the size of the particles grading from those barely visible microscopically to those of molecular dimensions These particles may be either homogeneous solids or liquids, or solutions themselves of a small percentage of the medium in an otherwise homogeneous complex Such solutions have one characteristic in common, namely, that the suspended materials may remain almost indefinitely in suspension, because the tendency to settle, due to gravity, is counteracted by some other factor tending to keep the particles suspended In the main, colloidal behaviour is not dependent upon the physical state or chemistry of the finely subdivided materials or of the medium We find colloidal behaviour exhibited not only by colloidal suspensions and emulsions where solid particles or liquid droplets are in a liquid medium, but also when solid particles are dispersed in gaseous medium (smokes), or liquid droplets in gaseous media (mists),

Materials which exhibit this special colloidal behaviour are always in a very fine state of subdivision, so that the ratio of *surface exposed* to *volume of material* is very large. A sphere containing only 10 cubic centimetres, if composed of fine particles 0 00000025 cm in diameter, would have a total area of all the surfaces of the particles nearly equal to half an acre [1] It is easy to understand that under such *structural* conditions the *surface forces* become important and play a prominent role in colloidal behaviour

The smaller the colloidal particles, the closer we come to molecular and atomic sizes Since we know atoms represent electrical *structures,* we should not be surprised to find that, in colloids, surface energies and electrical charges become of fundamental importance, as by necessity all surfaces are made up of electrical charges The surface energies operating in finely grained and dispersed systems are large, and in their tendency for a minimum, every two particles or drops tend to become one; because, while the mass is not altered by this change, the surface of one larger particle or drop is less than the surface of two smaller ones—an elementary geometrical fact Electrical charges have the well-known characteristic that like repels like and attracts the unlike In colloids, the effect of these factors is of a fundamental, yet opposite, character The surface energies tend to unite the particles, to coagulate, flocculate or precipitate them In the meanwhile the electrical charges tend to preserve the state of suspension by repelling the particles from each other On the predominance or intensity of one or other of these factors, the instability or the stability of a suspension depends

In general, if 'time' limits are not taken into consideration, colloids are *unstable* complexes, in which continuous transformation takes place, which is induced by light, heat, electric fields, electronic discharges, and other forms of energy. These transformations result in a great variation of the characteristics of the system The dispersed phase alters its characteristics and the system begins to coagulate, reaching a *stable* state when the coagulation is complete This process of transformation of the characteristics of the system which define the colloid, and which ends in coagulation, is called the 'ageing' of the colloid With the coagulation complete, the system loses its colloidal behaviour—it is 'dead'. Both of these terms apply to inorganic as well as to organic systems.

Some of the coagulating processes are partial and reversible, and take the form of change in viscosity, some are not. Some are slow, some extremely rapid, particularly when produced by external agencies which alter the colloidal equilibrium

From what has been said already, it is obvious that colloids, particularly in organisms, are extremely sensitive and complex structures with enormous possibilities as to degree of stability, reversibility , and allow a wide range of variation of behaviour When we speak of 'chemistry', we are concerned with a science which deals with certain materials which preserve or alter certain of their characteristics In 'physics', we go beyond the obvious characteristics and try to discover the *structure* underlying these characteristics Modern researches show clearly that atoms have a very complex structure and that the macroscopic character-

istics are directly connected with sub-microscopic structure If we can alter this structure, we usually can alter also the chemical or other characteristics As the processes in colloids are largely structural and physical, anything which tends to have a structural effect usually also disturbs the colloidal equilibrium, and then different macroscopic effects appear. As these changes occur as series of interrelated events, the best way is to consider colloidal behaviour as a physico-electro-chemical occurrence. But once the word 'physical' enters, structural implications are involved This explains also why all known forms of radiant energy, being structures, can affect or alter colloidal structures, and so have marked effect on colloids

As all life is found in the colloidal form and has many characteristics found also in inorganic colloids, it appears that colloids supply us with the most important known link between the inorganic and the organic This fact also suggests entirely new fields for the study of the living cells and of the *optimum conditions for their development, sanity included.*

Many writers are not agreed as to the use of the terms 'film', 'membrane', and the like Empirically discovered structure shows clearly, however, that we deal with surfaces and *surface energies* and that a 'surface tension film' behaves as a membrane In the present work, we accept the obvious fact that organized systems are film-partitioned systems

One of the most baffling problems has been the peculiar periodicity or rhythmicity which we find in life Lately, Lillie and others have shown that this rhythmicity could not be explained by purely physical nor purely chemical means, but that it is satisfactorily explained when treated as a *physico-electro-chemical structural occurrence* The famous experiments of Lillie, who used an iron wire immersed in nitric acid and reproduced, experimentally, a beautiful periodicity resembling closely some of the activities of protoplasm and the nervous system, show conclusively that both the living and the non-living systems depend for their rhythmic behaviour on the chemically alterable film, which divides the electrically conducting phases In the iron wire and nitric acid experiment, the metal and the acid represent the two phases, and between the two there is found a thin film of oxide In protoplasmic structures, such as a nerve fibre, the internal protoplasm and the surrounding medium are the two phases, separated by a surface film of modified plasm membrane In both systems, the electromotive characteristics of the surfaces are determined by the character of the film [2]

That living organisms are film-bounded and partitioned systems accounts also for irritability It appears that irritability manifests itself as sensitiveness to electrical currents. These currents seem to depend on polarizability or resistance to the passage of ions, owing to the presence of semi-permeable boundary films or surfaces enclosing or partitioning the system It is obvious that we are here dealing with complex *structures* which are intimately connected with the characteristics of life Living protoplasm is electrically sensitive only as long as its structure is intact With death, semi-permeability and polarizability are lost, together with electrical sensitivity.

One of the baffling peculiarities of organisms is the rapidity with which the chemical and metabolic processes spread Indeed, it is impossible to explain this by the transportation of material All evidence shows that electrical and, perhaps, other energy factors play an important role, and that this activity again depends on the presence of surfaces of protoplasmic structures with electrode-like characteristics which form circuits.

The great importance of the electrical charges of the colloidal particles arises out of the fact that they prevent particles from coalescing; and when these charges are neutralized, the particles tend to form larger aggregates and settle out of the solution Because of these charges, when an electrical current is sent through a colloidal solution, the differently charged particles wander to one or the other electrode This process is called cataphoresis There is an important difference in behaviour in inorganic and organic colloids under the influence of electrical currents, and this is due to the difference in structure In inorganic colloids, an electrical current does not coagulate the whole, but only that portion of it in the immediate vicinity of the electrodes Not so in living protoplasm Even a weak current usually coagulates the entire protoplasm, because the inter-cellular films probably play the role of electrodes and so the entire protoplasm structurally represents the 'immediate vicinity' of the electrodes Similarly, structure also accounts for the extremely rapid spread of some effects upon the whole of the organism

Electrical phenomena in living tissue are mainly of two more or less distinct characters The first include electromotive energy which produces electrical currents in nerve tissue, the membrane potentials, The second are called, by Freundlich, electrokinetic, and include cataphoresis, agglutination, There is much evidence that the mechanical work of the muscles, the secretory action of the glands, and the electrical work of the nerve cells are closely connected with the colloidal structure of these tissues This would explain why *any factor* (semantic reactions included)

capable of altering the colloidal structure of the living protoplasm must have a marked effect on the behaviour and welfare of the organism

Experiments show that there are four main factors which are able to disturb the colloidal equilibrium. (1) Physical, as, for instance, X-rays, radium, light, ultra-violet rays, cathode rays , (2) Mechanical, such as friction, puncture.; (3) Chemical, such as tar, paraffin, arsenic ; and, finally, (4) Biological, such as microbes, parasites, spermatozoa, *In man, another (fifth) potent factor, namely, the semantic reactions,* enters, but about this factor, I shall speak later.

For our purpose, the effects produced by the physical factors, because obviously structural, are of main interest, and we shall, therefore, summarize some of the experimental structural results Electrical currents of different strength and duration, as well as acids of different concentration, or addition of metallic salts, which produce marked acidity, usually coagulate the protoplasm, these effects being structurally interrelated Slow coagulation involves changes in viscosity, all of which, under certain conditions, may be reversible [3] When cells are active, their fluidity often changes in a sharp and rapid manner [4]

Fat solvents are called surface-active materials; when diluted, they decrease protoplasmic viscosity, but more concentrated solutions produce increased viscosity or coagulation [5] The anaesthetics, which always are fat solvents and surface-active materials, are very instructive in their action for our purpose, as they affect very diversified types of protoplasm similarly, this similarity of action being due to the similarity of colloidal structure Thus, ether of equal concentration will make a man unconscious, will prevent the movement of a fish and the wriggling of a worm, or stop the activity of a plant cell, without permanently injuring the cells [6] In fact, the action of all drugs is based on their effect upon the colloidal equilibrium, without which action a drug would not be effective It is well known that various acids or alkalis always change the electrical resistance of the protoplasm [7]

The working of the organism involves mostly a structural and very important 'vicious circle', which makes the character of colloidal changes *non-additive* If, for instance, the heart, for any reason, slows down the circulation, this produces an accumulation of carbonic acid in the blood, which again increases the viscosity of the blood and so throws more work on the already weakened heart [8] Under such structural conditions, the results may accumulate very rapidly, even at a rate which can be expressed as an exponential function of higher degree

Different regions of the organism have different charges, but, in the main, an injured, or excited, or cooler part is electro-negative (which

is connected with acid formation), and the electro-positive particles rush to those parts and supply the material for whatever physiological need there may be [9]

The effects of different forms of radiant energy on colloids and protoplasm are being extensively studied, and the results are very startling The different forms of radiant energy differ in wave-length, frequency ,—that is to say, generally in *structure,*—and, as such, may produce structural effects on colloids and organisms, which effects may appear on the gross macroscopic level in many different forms

Electrical currents, for instance, retard reversibly the growth of roots, may activate some eggs into larval stages without fertilization , which makes it possible to understand why, in some cases, a mere puncturing of the egg may disturb the equilibrium and produce the effects of fertilization [10]

The X-, or Rontgen-rays have been shown to accelerate 150 times the process of mutation Muller, in his experiments with several thousand cultures of the fruit fly, has established the above ratio of induced mutations, which become hereditary [11] 'Cosmic rays' in the form of radiation from the earth, in tunnels, for instance, show similar results, except that mutation occurs only twice as often as under the usual laboratory conditions Under the influence of X-rays, mice change their colour of hair, gray mice become white, and white ones darker. Sometimes further additional bodily changes appear, as, for instance, one or no kidneys, abnormal eyes or legs, occur more often than under ordinary conditions Some animals lose their power of reproduction, although the body is not obviously changed Plants respond also to the X-ray treatment They grow faster, flower more, and produce new forms more readily In humans the effect of X-ray irradiation has often proven disastrous to the health of experimenters There are even data that the irradiation of pregnant mothers may result in deformation of the head and limbs of the unborn child and, in one-third of the cases, feeble-mindedness of the children has resulted [12]

Ultra-violet rays also show a marked effect In some instances, they slow down or stop the streaming of protoplasm, because of increased viscosity or coagulation, plants grow slowly or rapidly; certain valuable ingredients in plants are increased, certain animals, as, for instance, small crustacea or bacteria are killed, eggs of Nereis (a kind of sea worm), which usually have 28 chromosomes, after irradiation have 70; certain bone malformations in children are cured, the toxin in the blood serum of pernicious anaemia patients is destroyed, [13] In this respect, we should notice again that ultra-violet irradiation produces curative effects

like those of cod-liver oil, which shows that the effect of both factors is ultimately colloidal and structural

Extensive experimentation with cathode rays is very recent, but already we have a most astonishing array of structural facts Moist air is converted into nitric acid, synthetic rubber is produced rapidly, the milk from rubber trees is made solid and insoluble without the use of sulphur, liquid forms of bakelite are solidified without heating, linseed oil becomes dry to the touch in three hours and hard in six hours, certain materials, like cholesterol, yeast, starch, cottonseed oil, after exposure for thirty seconds, heal rickets, and similar unexpected results What are usually called 'vitamins' do not only represent 'special substances', but become structurally active factors, and this is why ultra-violet rays may produce results like those of some 'substance' It seems that in 'vitamins' the surface activities are important, the parallelism shown by von Hahn between the surface activities of different materials and the Funk table of vitamin content is quite suggestive Some data seem to show that, in some instances, surface-active materials, such as coffee or alcohol, produce beneficial surface activities similar to the 'vitamins' [14]

The above short list gives only an approximate picture of the overwhelming importance of the roles which structure in general, and colloids in particular, play in our lives We see about us many human types Some are delicate, some are heavy-set, some flabby, some puffy, all of which indicates a difference in their colloidal structure Paired with these physical colloidal states are also nervous, 'mental', and other characteristics, which vary from weak and nervous to the extreme limitation of nervous activities, as in idiocy, which is a negation of activity

It is curious that in all illnesses, whether 'physical' or 'mental', the symptoms are very few, and fundamentally of a standard type In 'physical' illness we find the following common characteristics. fever, chills, headaches, convulsions, vomiting, diarrhoea, In 'mental' ills, identifications, illusions, delusions, and hallucinations—in general, the reversed pathological order—are found It is not difficult to understand the reason Because of the general colloidal background of life, different disturbances of colloidal equilibrium *should* produce similar symptoms In fact, many of these symptoms have been reproduced experimentally by injecting inert precipitates incapable of chemical reactions, which have induced artificial colloidal disturbances Thus, if the serum from an epileptic patient is injected into a guinea pig, it results in an attack of convulsions, often ending in death But, if the guinea pig is previously made immune by an injection of some colloid which accustoms the nerve-endings to the colloidal flocculation, then, for a few hours following, we

can, with impunity, introduce into the circulation otherwise fatal doses of epileptic serum Epileptic serum can also be made immune by filtration, or by strong centrifugation, or by long standing, which frees it from colloidal precipitates [15]

Death through blood transfusion or the injection of *any* colloid into the circulation has also, in the main, similar symptoms, regardless of the chemical character of the colloid, indicating once more the importance and fundamental character of structure.[16]

That illnesses are *somehow* connected with colloidal disturbances (note the wording of this statement) becomes quite obvious when we consider catarrhal diseases, inflammations, swellings, tumours, cancer, blood thrombi , which involve colloidal injuries, resulting in extreme cases in complete coagulation or fluidification, the variation between 'gel' and 'sol' appearing in a most diversified manner [17] Other illnesses are connected with precipitation or deposits of various materials Gout, for instance, results from a morbid deposit of uric acid, and different concretions, such as the 'stones', are very often found in different fluids of the organism We have, thus, concretions in the intestines, the bile, the urine, the pancreas, the salivary glands, lime deposits in old softened tissues, 'rice bodies' in the joints, 'brain sand', [18]

In bacterial diseases, the micro-organisms rapidly produce acids and bases which tend to destroy the colloidal equilibrium Lately, it has been found that even tuberculosis is more than a mere chapter in bacteriology All the main tubercular symptoms can be reproduced, experimentally, by means of colloidal disturbances without the intervention of a single bacterium [19] This would explain also why, in some instances, psychotherapy is effective in diseases with tubercular symptoms [20]

By structural necessity, every expression of cellular activity involves some sort of colloidal behaviour, and any factor disturbing the colloidal structure must be disturbing to the welfare of the organism Vice versa, a factor which is beneficial to the organism must reach and affect the colloids.

After this brief account of the structural peculiarities of the domain in which life is found, we can understand the baffling 'body-mind' problem We do not yet know as many details as we could wish, but these will accumulate the moment a general solution is clearly formulated It is a well-established *experimental* fact that all nervous and 'mental' activities are connected with, or actually generate, electrical currents, which of late are scrupulously studied by the aid of an instrument called the psychogalvanometer [21] It is not suggested that electrical currents are the only ones which are involved There may be many different forms

of radiant energy produced or effective, which we have not yet the instruments to record Experiments suggest such a possibility. Thus, for instance, the apex of a certain rapidly growing vegetable or animal tissue emits some sort of invisible radiation which stimulates the growth of living tissue with which it is not in contact The tip of a turnip or onion root, if placed at right angles to another root, at a distance of a quarter of an inch, so stimulates the growth of the latter that the increase of the number of cells, on its side nearest the point of stimulation, is as high as seventy per cent These radiations accelerate the growth of some bacteria Other examples could be given [22]

A classical example of the effect left on protoplasm by energetic factors is given by Bovie [23]

As yet, we have not assumed that the protoplasm of plants also shows lasting structural and functional results of stimulation, some sort of 'learning' or 'habit-formation' characteristics But such is the case, and further experimentation along these lines will help greatly to understand the mechanism of 'mental' processes in ourselves

If we take the seed of a plant, for instance, of a squash, and keep it in a moist tropism chamber in the dark, it will grow a root When the root is about one inch long, we begin our experiment Originally, under the influence of gravitation, the root grows vertically downwards (A) If we rotate the tropism chamber 90° so that the root is horizontal (B), the root will soon bend downwards under the influence of positive geotropism But the bending does not occur at once There is a latent period—in the case of the squash seed, about ten minutes—after which pause the root is bent downwards When we have determined this latent period for a given seedling, we then rotate the chamber to the positions (B), (C), (A), (B), (C) , just within the 'time' limit before the bending would occur We repeat such procedure several times When we set the root again in its vertical downward position (A), we notice that the root, without any more changes of position, will wag backwards and forward with the period as was used in the experiment This unexpected behaviour will last for several days It shows that the alternating stimulus of gravitation, as applied to the root, has produced some structural changes in the protoplasm which persist for a comparatively long period after the stimulus has ceased to act It be-

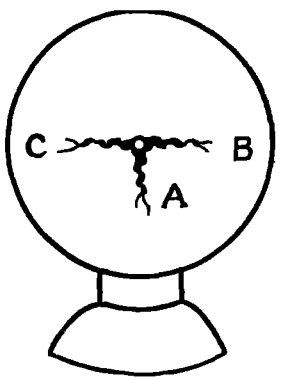


Fig 1

comes obvious that teachability and the structural tendency for forming engrams is a general characteristic of protoplasm

All the examples given above show clearly that *structure* in general, and of colloids in particular, gives us a satisfactory basis for the understanding of the *equivalence* between occurrences which belonged formerly to 'chemistry' and those classified as 'physical', and ultimately between these and those we call 'mental' Structure, and structure alone, gives not only the *unique* content of what we call 'knowledge', but also the bridge between the different classes of occurrences—a fact which, as yet, has not been fully understood.

To sum up It is known that colloidal behaviour is exhibited by materials of very fine subdivision, the 'world of neglected dimensions', which involves surface activities and electrical characters of manifold and complex structure, and therefore the flexibility of gross macroscopic characteristics It is well known that all life-processes, 'feelings', 'emotions', 'thought', semantic reactions, and so forth, involve *at least* electrical currents As electrical currents and other forms of energy are able to affect the colloidal structure on which our physical characteristics depend, obviously 'feelings', 'emotions', 'thought' , in general, *s r*, which are connected with manifestations of energy, will also have some effect on our bodies, and vice versa Colloidal structure supplies us with an extremely flexible mechanism with endless possibilities

When we analyse the known empirical facts from a structural point of view, we find not only the equivalence which was mentioned before, but we must, also, legitimately consider the so-called 'mental', 'emotional', and other semantic and nervous occurrences in connection with manifestations of energy which have a powerful influence on the colloidal behaviour, and so ultimately on the behaviour of our organisms as-a-whole Under such environmental conditions, we must take into account all energies which have been discovered, *semantic reactions not excluded,* as all such energies have structural effect As language is one of the expressions of one of these energies, we ought to find it quite natural that the structure of language finds its reflection in the structure of the environmental conditions which are dependent on it

Until lately, the disregard of colloidal science and of structure in general has greatly retarded advance in biology, psychiatry, and other sciences Biology, for instance, has mostly studied 'life' where none existed, namely, in death If we study corpses, we study death, not life, and life is a function of living cells The living cell is semi-fluid, and all the forces which act in colloidal solutions and constitute colloidal

behaviour are acting because they *can act,* while a dead cell is *coagulated* and so a different set of energies is operating there [24] v

Should we wonder that life, being a form of colloidal behaviour on microscopic and sub-microscopic levels, conditioned by little colloidal 'wholes', and structures separated from their environment by surfaces, preserves a similar character on macroscopic levels? We should, instead, be surprised if this did not turn out to be the case.

CHAPTER X

THE 'ORGANISM-AS-A-WHOLE'

. . . in hypnotized children real colours and suggested colours are blended to form the complementary colour (189) W. HORSLEY GANTT

Section A Illustrations from biology

Because of the semantic importance of the structural non-elementalistic principle, and the weighty, yet in the beginning odd, consequences which follow the consistent application of this principle in practice, we will give a short account of some other experimental structural facts taken from widely separated fields

A worm, a marine planarian, called a *Thysanozoon (Brochii),* is common in the bay of Naples If we put a normal *Thysanozoon* on its back, it soon will right itself When the brain of the worm has been removed, under similar conditions of the experiment, the worm will right itself, but *more slowly* In this case, we see a general tendency of the organism-as-a-whole, the nervous system only facilitated a quicker action. If we cut the worm partly in two, so that the longitudinal nerves are severed, but a thin piece of tissue keeps the two parts together, the two parts move in a co-ordinated way, as if not cut The organism still works as-a-whole, although the conditions seem not favourable [1]

If we cut a fresh-water planarian (*Planaria torva*) in two, transversely, the posterior part, which has no brain, moves about as well as the anterior part, which has the brain If we try to find the effect of light on the part devoid of brain and eyes, we see that the effect of light is not changed, and that the posterior part crawls away from light into dark corners as a normal animal would, except that the action takes place at a slower rate In normal animals, the reaction usually begins in about one minute after the exposure, in the brainless part, it takes nearly five minutes of exposure [2]

How chemical conditions affect the activities of the organism-as-a-whole can be well illustrated by the following examples In a jellyfish, we can increase or decrease the locomotor activities by simply changing the chemical constitution of the water If we increase the number of Na ions in the sea-water, the rhythmical contractions increase and the animal becomes restless If we increase the number of Ca ions, the contractions decrease In a similar way, we can change the orientation toward light in a number of marine animals by changing the constitution

of the medium. The larvae of *Polygordius,* which usually go away from light into dark corners, can be compelled to go toward light by two methods: either by lowering the temperature of the sea-water, or else by increasing the concentration of the salts in the sea-water This behaviour can be reversed by raising the temperature or lowering the concentration of the salts [3]

An extremely instructive group of experiments has been performed in artificial fertilization of the eggs of a large number of marine animals, such as starfish, molluscs, and others

Under usual conditions, these eggs cannot develop unless a spermatozoon enters the egg, which results in a thickening of the membrane called the 'fertilization membrane' Experiments show that such a transformation can be produced artificially in an unfertilized egg, with resulting 'fertilization', by several artificial means, as, for instance, by the treatment of the eggs with special chemicals, and, in some instances, by merely puncturing the egg with a needle The late Jacques Loeb succeeded in producing in this way parthenogenetic frogs, which lived a normal life [4]

Under normal conditions, the eggs of different sea animals can be fertilized only by their proper sperm But, if we raise the alkalinity of the sea-water slightly, we find that the eggs can be fertilized by different sperms, often of widely separated kinds of animals [5] If we put unfertilized eggs of a sea-urchin into sea-water which contains a trace of saponin, we find that the eggs acquire the characteristic 'membrane of fertilization' If the eggs are taken out, washed carefully and put back into sea-water, they develop into larvae [6] The change in the chemical constitution of sea-water will also often produce twins from one egg Change in temperature may change the colour of butterflies, [7]

A very large class of such organism-as-a-whole reactions is given in the works of Professor C M Child on regeneration I suggest these works, not only because they are particularly interesting, even to the layman, but mainly because Professor Child has formulated a $\bar{A}$ biological system, the importance of which is becoming paramount, and is beginning to be applied even in psychiatry by Dr Wm A White and others

We find the characteristic of profiting by past experiences and acquiring negative reactions very low in the scale of life Thus, even infusoria, which ingest a grain of carmine, soon learn to refuse it [8] Most interesting experiments were performed on worms by Yerkes in 1912 and verified repeatedly Yerkes built a T-shaped maze In one arm (C) he placed a piece of sand-paper (S), beyond which there was an elec-

trical device (E) which could give an electrical shock. The animal used for experimenting was an earthworm The worm was admitted through the entrance (A) If he selected his way through (B), he got out without disagreeable consequences If he selected (C), he received, first, a fair warning through the sand-paper (S) and, if this was not enough, he received an electrical shock at (E) After a number of experiences, the worm learned his lesson and avoided the path (C) After this habit was acquired, the five anterior segments of the worm were cut off The beheaded worm retained the habit, although it reacted more slowly During the following two months, the worm grew a new brain and the habit disappeared When trained again, he partially reacquired the above habit Further experiments established that normal worms acquire the avoiding habit in approximately two hundred trials; and when the electrical device was put in the other arm, the worm learned how to reverse his habit in about sixty-five trials Once the habit was acquired, the removal of the brain did not alter it Worms with removed brains were also able to acquire a similar habit Since the brain of an earthworm is a very small part of his whole nervous system, it has only a small dominance, and the neuro-muscular habits are acquired by the whole system and not simply by the brain But, when a new brain began to operate, its dominance was seemingly sufficient to eliminate the habit [9]

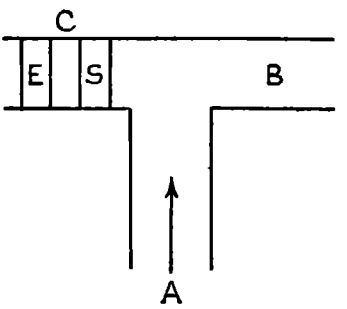


FIG 1

Experiments of McCracken with silkworm moths have shown that a beheaded moth can live as long as a normal one It can be mated and will lay the normal number of fertile eggs arranged in the usual way But it will not lay eggs spontaneously, and cannot select the proper kind of leaves on which to deposit them If the head and the thorax were cut off, the females were unable to mate and their life was shortened to about five days If mated before the operation, they would still lay eggs when stimulated

In these more complicated cases, the brain is necessary for the more complicated behaviour, as, for instance, the selection of a mulberry leaf [10] Although the organism works as-a-whole, the differentiation and relative importance (domination) of different organs becomes more accentuated, the higher we go in the scale of life.

Section B Illustrations from nutrition experiments

We find striking illustrations of the *non-el* principle in the study of 'vitamins' A few years ago it was discovered that certain widely spread and pernicious diseases were due to deficiencies of some factors in diet These factors, which normally are present in very minute amounts, were called 'vitamins' by the Polish biologist, Funk The most important vitamin-deficiency diseases are called Rickets, Scurvy, Beri-Beri, and Pellagra In all these cases, it is important to notice that the lack of a minute amount of some factor may have the most varied, pronounced, and seemingly unrelated consequences The symptoms can now be produced deliberately on experimental animals, by diets free from the particular 'vitamins' and can also be cured at will by feeding them with the proper 'vitamins' [11]

Rickets appears essentially as a disease of infancy or childhood In mild cases, the disease may only be discovered after the death of the adult In these cases, the lesions have not become pronounced enough during life to attract attention

The diagnosis usually depends on manifestations in the bones, but rickets affects the whole organism and not merely the skeleton The children are nervous and irritable, but apathetic They sleep poorly and perspire excessively The muscles become wasted and weak Often a secondary anaemia occurs The children sit, stand, and walk later than usual, the teeth appear later in life and decay sooner The bones usually become much affected Areas of softening appear in the long bones, which become bent In more severe cases, the bones may even become fractured and the head of the bone may separate from the shaft The general resistance of the children to other diseases is lowered and mortality increases

Cod liver oil *or* sunshine usually effects a cure We should notice the little word 'or', for quite different 'causes' produce similar 'effects'—an example illustrating that in life 'cause' and 'effect' do not correspond in a one-to-one relation, but in a many-to-one relation

Experiments have shown that not less than three primary dietary factors are concerned with the development of skeletal tissue These are phosphorus, calcium, and at least one organic compound which is known as antirachitic vitamin The work of Professor E V McCollum and his co-workers seems to show an interesting point, namely, that the ratio between the concentrations of calcium and of phosphorus in the food may be more important than the absolute amounts of these substances

Scurvy develops gradually The patient loses weight, appears anaemic, pale, weak, and short of breath The gums become swollen, bleed easily, and often develop ulcers The teeth loosen and may fall out. Hemorrhages between the mucous membranes and the skin often occur. Blue-black spots in the skin are very easily produced, or even occur spontaneously. The ankles become swollen, and, in severe cases, the skin becomes hard Nervous symptoms of a varied character appear, some of which are due to the rupture of blood vessels. In later stages of the disease, delirium and convulsions may occur Autopsy reveals significant data, namely, hemorrhages and fragility of the bones Scurvy appears also as a deficiency disease, produced mainly by the lack in food of the so-called 'anti-scorbutic vitamin'

Beri-Beri labels a form of inflammation of the peripheral nerves, the nerves of motion and sensation being equally affected In the beginning of the disease, the patient feels fatigue, depression, and stiffness of the legs We distinguish two forms, the wet and the dry In the dry form, wasting, anaesthesia and paralysis are the chief manifestations The most marked manifestation in the wet form is the accumulation of serum in the cellular tissue affecting the trunks, limbs and extremities Usually, in both forms, there appear tenderness of the calf muscles and a tingling or burning in the feet, legs, and arms The mortality is high.

Pellagra involves the nervous system, the digestive tract, and skin. Normally, one of the first symptoms to appear is soreness and inflammation of the mouth. Symmetrical redness of the skin occurs on parts of the body The nervous symptoms become more pronounced as the disease advances The spinal cord is particularly involved, but the central nervous system is also often affected

Speaking about 'vitamins' and how their absence affects the organism-as-a-whole, we should mention that sterility in females may be connected with lack of vitamins Astonishing experiments by Professor McCollum showed that such diverse phenomena as loss of weight, premature old age, high infant mortality , are largely due to diet, and that even such fundamental instincts as the motherly instinct are also affected. The normally nourished rat very seldom destroys its young and, as a rule, rats are good mothers If we put such a mother rat on an abundant diet that is deficient in some vitamins, the mother reacts quite differently toward her young and destroys them soon after their birth This characteristic has been controlled experimentally, and reversed at will by proper diets Nervousness and irritability in rats can also be controlled experimentally by means of the vitamins they receive, or lack in food.

Section C Illustrations from 'mental' and nervous diseases

Simple and striking examples of what the *non-el* principle means can also be given from psychiatry

White quotes the report of Prince that a patient was subject to severe attacks of hay fever when exposed to roses On one occasion, a bunch of roses was unexpectedly produced from behind a screen. The patient started a severe attack with all the usual symptoms, lachrymation, congestion of the mucosa , although the roses were *made of paper*. This interesting case shows clearly how 'mental' factors (the belief that the roses were genuine) produce a series of reactions involving sensory, motor, vasomotor disturbances, and secretory disturbances of a definitely 'physical' character [12]

Migraine labels a disturbance in the tension of blood vessels (vasomotor), which is due to a great variety of possible stimuli acting on the vegetative nervous system In some instances, the stimuli may be purely physical, as severe blows, falls, fast movements, sudden alteration in temperature, of pressure , or they may be chemical, and due to nicotine, alcohol, morphine, or to some endocrinal disturbances (adrenals, thyroid), toxins , They may be of a purely somatic reflex character, due to fatigue, tumour formations , They may also be of a semantic character, due to anger, fear, disappointment, worry, and other semantic states, which may act by disturbing the metabolism

Migraine appears usually as a periodical abnormal state, in which the patient suffers from an oppressive pain in the head which gradually passes from heaviness and dullness to splitting intensity Often characteristic visual signs also appear The patient sees dark spots in the visual field, flying specks, and may become even partially blind Chilliness, depression, sensory disturbances, particularly in the stomach, with vomiting, are often present An attack may last a few hours or even several days [13]

Cretinism labels a physical and 'mental' disturbance due mainly to the loss or diminution of the function of the thyroid gland The patient (child) falls behind in his physical development, which often results in dwarfism, except for the skull, which grows larger in proportion to the rest of the body The bone defects give rise to widely separated eyes, pug nose , The bony tissue becomes unusually hard, and there is also a marked dental deficiency The neck is usually thick and short, the abdomen puffy, the navel sunken The hair line begins low on the forehead, the nose is sunken, the eyelids swollen, the face puffy, the tongue protruding The liver is usually enlarged, respiration is slow, and

changes in the blood can be detected. The nervous system is affected: we also find defects in sensory and motor nerve structure On the 'mental' level, we find different degrees of stupidity, 'mental' weakness (morons), imbecility, and even idiocy Smell, eyesight, and hearing are often poor, speech disturbed, so that we often find the patients deaf and dumb The patients have an unsteady gait, with wobbling of the head. Over-activity of the thyroid gland results in the well-known goitre.

Hyperpituitarism results in acromegaly, characterized by the gradual enlargement of the bones of the nose, jaw, hands and feet, gigantism, often connected with profound disturbances Hypopituitarism, or deficiency of the pituitary hormones, gives rise to a group of diseases characterized by a progressive accumulation of fat, and is connected with other abnormalities and disturbances

From the field of the psychoneuroses, I shall mention only hysteria. It is very interesting to note that the many and various physical and somatic symptoms are of a purely semantic origin The symptoms of hysteria are many and very complex, but they group themselves mainly in disturbances of motion and 'sensation' We find every kind of paralysis and anaesthesia Paralysis of the limbs is frequent, anaesthesia may be distributed in many ways, involving the superficies or the various 'sense-organs' It is interesting to note that the distribution of these symptoms does not follow the anatomical areas of nerve distribution, but shows a symbolic (psycho-logical) grouping The disturbances of motility are usually in the form of paralysis Tremors, muscular debility, fatigability, involuntary muscular twitching, tics and spasms are often hysterical in origin Speech is often involved, sometimes patients can only whisper, although their vocal organs are healthy Stuttering is often hysterical, and analysis shows that the words which give difficulties usually have special semantic significance for the patient Respiratory disturbances of an asthmatic character and disturbances of the gastro-intestinal tract are also often hysterical

It should be emphasized that since non-elementalism has a physico-chemical structural base in colloidal behaviour, all life and all organisms give ample material for illustration We have given here only a very few examples, selected mainly because of their simple and spectacular empirical character, but not generally too well known Empirical data show clearly that the most diversified factors, acting as partial stimuli, ultimately affect or result in the response of the whole

The handling of such empirical, structural, fundamental problems involves serious structural, linguistic and semantic difficulties which have to be solved *entirely* by adjusting the structure of the language used But

such adjustment requires a full understanding of the structural issues at hand and a fundamental structural departure from *A* methods and *means*. These structural issues and means of departures from *A* methods are explained in the following chapters

To sum up The *non-el* principle formulates a structural character inherently found in the structure of the world, ourselves, and our nervous system on all levels, the knowledge and application of which is unconditionally necessary for adjustment on all levels, and, therefore, in humans, for *sanity*

As 'knowledge', 'understanding', and such functions are *solely* relational, and, therefore, structural, the unconditional and inherent condition for adjustment on all human levels depends on building languages of similar structure to the experimental facts. Once this is accomplished, all the former desirable semantic consequences follow *automatically*

For simplicity, we have considered only examples of the 'organism-as-a-whole', but, as a matter of fact, such a detached consideration cannot be considered entirely satisfactory, as, *structurally,* every organism depends on its environment, and, therefore, in building our languages. we ought to coin terms which also involve the latter by implication Fortunately, this condition does not involve us in serious difficulties. when once identity is eliminated and the fundamental problems of structure are grasped Indeed, the terms which we have already used, or which will be used as we proceed, are all of such a *non-el* structure as to involve the environment by implication

In dealing with 'Smith', the difficulties are particularly serious because his nervous system is the most complex known It is stratified four-dimensionally (in space-time), and the dominance of some centres introduces prodigious and manifold interrelations non-existent in nervous systems of simpler structure, and we still have to learn how to handle the former Fortunately, mathematical methods and psychiatry explain a good deal about this question, and give us the desired means to apply what we have learned.

Obviously, to 'know' something is quite different from the *habitual* application of what we have learned This semantic difference is particularly acute in the case of language, as it involves *structural* implications which work *unconsciously*. It is not enough to 'understand' and 'know' the content of the present work; one must *train* oneself in *the use* of the new terms. Then only can he expect the maximum semantic results

PART IV

STRUCTURAL FACTORS IN NON-ARISTOTELIAN LANGUAGES

Without objects conceived as unique individuals, we can have *no Classes* Without classes we can, as we have seen, define *no Relations*, without relations we can have *no Order* *But to be reasonable is to conceive of order-systems, real or ideal. Therefore, we have an absolute logical need to conceive of individual objects as the elements of our ideal order systems* This postulate is the condition of defining clearly any theoretical conception whatever The further metaphysical aspects of the concept of an individual we may here ignore *To conceive of individual objects is a necessary presupposition of all orderly activity* (449) JOSIAH ROYCE

The connections shown by these particular examples hold in general given a transformation, you have a function and a relation, given a function, you have a relation and a transformation, given a relation, you have a transformation and a function· *one* thing—*three* aspects, and the fact is exceedingly interesting and weighty (264) CASSIUS J KEYSER

It can, you see, be said, with the same approximation to truth, that the whole of science, including mathematics, consists in the study of transformations or in the study of relations (264) CASSIUS J KEYSER

Science is never merely knowledge, it is orderly knowledge (449) JOSIAH ROYCE

Philosophers have, as a rule, failed to notice more than two types of sentence, exemplified by the two statements "this is yellow" and "buttercups are yellow" They mistakenly suppose that these two were one and the same type, and also that all propositions were of this type. The former error was exposed by Frege and Peano, the latter was found to make the explanation of order impossible Consequently the traditional view that all propositions ascribe a predicate to a subject collapsed, and with it the metaphysical systems which were based upon it, consciously or unconsciously. (457) BERTRAND RUSSELL

Interesting analyses by Van Woerkom have shown a general incapacity in aphasics for grasping relations, realizing ordered syntheses, etc , all of them are operations which are based, in the normal individual, on the use of verbal symbolization When confronted by groups of figures or of geometrical forms, the aphasic, even though he may perceive them correctly, is unable to analyse or to order the elements, to grasp their succession (411) HENRI PIÉRON

CHAPTER XI

ON FUNCTION

> The whole science of mathematics rests upon the notion of function, that is to say, of dependence between two or more magnitudes, whose study constitutes the principal object of analysis C E PICARD

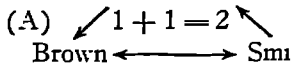
> Every one is familiar with the *ordinary* notion of a function—with the notion, that is, of the lawful dependence of one or more variable things upon other variable things, as the area of a rectangle upon the lengths of its sides, as the distance traveled upon the rate of going, as the volume of a gas upon temperature and pressure, as the prosperity of a throat specialist upon the moisture of the climate, as the attraction of material particles upon their distance asunder, as prohibitionary zeal upon intellectual distinction and moral elevation, as rate of chemical change upon the amount or the mass of the substance involved, as the turbulence of labor upon the lust of capital, and so on and on without end (264) CASSIUS J. KEYSER

> The infinite which it superficially gets rid of is concealed in the notion of "any," which is but one of the protean disguises of mathematical generality (22) E T BELL

The famous mathematician, Heaviside, mentions the definition of quaternions given by an American schoolgirl She defined quaternions as 'an ancient religious ceremony'. Unfortunately, the attitude of many mathematicians justified such a definition The present work departs widely from this religious attitude and treats mathematics simply as a most important and unique form of human behaviour There is nothing sacred about any single verbal formulation, and even those that now seem most fundamental should be held subject to structural revision if need should arise The few mathematicians who have produced epoch-making innovations in mathematical method had this behaviouristic attitude *unconsciously,* as will be shown later The majority of mathematicians take mathematics as a clear-cut entity, 'by itself' This is due, first, to a confusion of orders of abstractions and to identification, as will be explained later, and, second, to its seeming simplicity In reality, such an attitude introduces quite unexpected complications, leading to mathematical revolutions, which are always bewildering The mathematical revolutions occur only because of this *over-simplified,* and thus fallacious, attitude of the mathematicians toward their work Had all mathematicians the semantic freedom of those who make the mathematical 'revolutions', there would be *no* mathematical 'revolutions', but an extremely swift and constructive progress To re-educate the *s r* of such mathematicians, the problem of the psycho-logics of mathematics must receive more attention This means that some mathematicians must

become psycho-logicians also, or that psycho-logicians must study mathematics.

For, let us take a formula which exemplifies mathematics at its best, namely, one and one make two $(1+1=2)$ We see clearly that this human product involves a threefold relation. between the man who made it,



let us say, Smith, and the black-on-white marks (A), between these marks and Brown, and between Brown and Smith This last relationship is the only *important* one The marks (A) are only auxiliary and are *meaningless by 'themselves'* They would never occur if there were no Smiths to make them, and would be of no value if there were no understanding Browns to use and to appreciate them It is true that when we take into account this threefold relation the analysis becomes more difficult and must involve a revision of the foundations of mathematics. Although it is impossible to attempt in this book a deeper analysis of these problems in a general way, yet this behaviouristic attitude follows the rejection of the 'is' of identity, and is applied all through this work

The notion of 'function' has played a very great role in the development of modern science, and is structurally and semantically fundamental. This notion was apparently first introduced into mathematical literature by Descartes. Leibnitz introduced the term The notion of a 'function' is based on that of a *variable*. In mathematics, a variable is used as an ∞-valued symbol that can represent *any one* of a series of numerical elements.

It is useful to enlarge the mathematical meaning of a variable to include any ∞-valued symbol of which the value is not determined The various determinations which may be assigned to the variable we call the *value* of the variable. It is important to realize that a mathematical variable does not vary or change in itself, but can take *any* value within its range. If a particular value is selected for a variable, then this value, and, therefore, the variable, becomes fixed—a one-valued constant In the use of these terms, we should take into account the behaviour of the mathematizer. His 'x' is like a container, into which he may pour any or many liquids, but once the selection has been made, the content of the container is one or a constant So 'change' is not inherent in a variable, it is due only to the volition of the mathematizer, who can change one value for another Thus, the value changes by quanta, in definite lots, according to the pleasure of the operator This

quantum character of the variable has serious structural and semantic consequences, which will become clearer further on It allows us, without stretching our definitions, to apply the new vocabulary to any problem whatsoever It is in structural accord with the trend of the quantum theory, and, therefore, with the *structure* of this world, as we know it at present.

The notion of a variable originated in mathematics, and, in the beginning, dealt only with numbers Now numbers, when given, represent, structurally, a manifold or aggregate which is *not* supposed to change So, when we consider a variable, we should 'think' *not* of a changing entity, but of *any* element we choose out of our perfectly constant collection (when given) Let me repeat that the notion of *change* enters in, only in connection with the volition and the *s r* of the one who operates these unchanging entities The notion of a variable is taken always in an extensional ∞-valued sense, to be explained later, as it always implies structurally a collection of many individuals, out of which collection a selection of one can be made. The notion of a variable is general and, in principle, ∞-valued, a constant is a special one-valued case of a variable in which the collection contains a single element, making alternative selection impossible

Variables are usually symbolized by the end letters of the alphabet, x, y, z, The supply is increased as desired by the use of indices, for instance, x', y', z' , x'', y'', z''., or x_1, y_1, z_1 , x_2, y_2, z_2 , This gives a flexible means of denoting numerous individuals, and so manufacturing them indefinitely, as the extensional method of mathematics requires. Another method, introduced not long ago, has proven useful in dealing with a definite selection of variables in a simplified manner One letter or one equation can be used instead of many The variable sign x is modified by another letter which may have different values, in a given range, for instance, x_i, x_k, The modifying letter i or k can take the serial values, let us say i or $k = 1, 2, 3$, Since the one symbol x_k stands for the array of many *different* variables x_1, x_2, x_3 , statements can be greatly simplified, and yet preserve structurally the *extensional* individuality

It is important that the non-mathematical reader should become acquainted with the above methods and notations, as they involve a profound and far-reaching structural and *psycho-logical* attitude, useful to *everybody,* involving most fundamental *s r.*

The *extensional* method means dealing structurally with many *definite individuals,* as, for instance, with 1, 2, 3 , a series in which each individual has a special and *unique* name or symbol. This extensional

method is structurally the *only* one by which we may expect to acquire $\bar{A}$ ∞-valued *s r* In a strict sense, the problems in life and the sciences do not differ structurally from this mathematical problem. In life and science, one deals with many, actual, unique individuals, and all *speaking* is using abstractions of a very high order (abstractions from abstraction from abstraction,) So, whenever we speak, the individual is never completely covered, and some characteristics are left out

A rough definition of a function is simple. y is said to be a function of x, if, when x is given, y is determined Let us start with a simple mathematical illustration. $y = x + 3$ If we select the value 1 for x our $y = 1 + 3 = 4$. If we select $x = 2$, then $y = 2 + 3 = 5$, Let us take a more complicated example, for instance. $y = x^2 - x + 2$ We see that for $x = 1$, $y = 1 - 1 + 2 = 2$, for $x = 2$, $y = 4 - 2 + 2 = 4$, for $x = 3$, $y = 9 - 3 + 2 = 8$,

In general, y is determined when we fulfill all the indicated *operations* upon the variable x, and so get the final results of these operations In symbols, $y = f(x)$, which is read, y equals function of x, or y equals f of x.

In our example, we may call x the independent variable, meaning that it is the one to which we may assign any value at our pleasure, if not limited by the conditions of our problem, and y would then be the dependent variable, which means that its value is no longer dependent on our pleasure, but is determined by the selection of the value of x The terms dependent and independent variables are not absolute, for the dependence is mutual, and we could select either variable as the independent one, according to our wishes

The notion of a 'function' has been generalized by Bertrand Russell to the very important notion of a 'propositional function' [1] For my purpose, a rough definition will be sufficient By a propositional function, I mean an *∞-valued* statement, containing one or more variables, such that when single values are assigned to these variables the expression becomes, in principle, a *one-valued* proposition The ∞-valued character of propositional functions seems essential, because we may have a one-valued descriptive function with variables, or a one-valued expression formulating a semantic relational law expressed in variable terms , yet these would be propositions Thus, the *∞-valued* statement, 'x is black', would exemplify a propositional function, but the one-valued relation 'if x is more than y, and y is more than z, then x is more than z' exemplifies a proposition This extended *m o* notion of a propositional function becomes of crucial importance in a $\bar{A}$-system, because most of our speaking is conducted in ∞-valued languages to which we mostly

and delusionally ascribe single values, entirely preventing proper evaluation

An important characteristic of a propositional function, for instance, 'x is black', is that such a statement is neither true nor false, but ambiguous. It is useless to discuss the truth or falsehood of propositional functions, since the terms true or false cannot be applied to them But if a definite, single value is assigned to the variable x, then the propositional function becomes a proposition which may be true or false For instance, if we assign to x the value 'coal', and say 'coal is black', the x-valued propositional function has become a one-valued true proposition If we should assign to x the value 'milk', and say 'milk is black', this also would make a proposition, but, in this case false If we should assign to x the value 'blah-blah' and say 'blah-blah is black', such a statement may be considered as meaningless, since it contains sounds which have *no* meaning, or we *may* say, 'the statement blah-blah is *not* black but meaningless', and, therefore, the proposition 'blah-blah is black', is *not* meaningless but false

We should notice—a fact disregarded in the *Principia Mathematica* —that there is no hard and fast rule by which we can distinguish between meaningless and false statements in general, but that such discrimination depends on many factors in each specific case A propositional function, 'x is black', cannot be its own argument for instance, if we substitute the whole propositional function, 'x is black', for the variable x in the original propositional function, and then consider the expression, 'x is black is black', which Whitehead and Russell classify as *meaningless* this expression is *not* necessarily meaningless, but *may* be considered *false*. For, the statement 'x is black', is defined as a *propositional function,* and, therefore, the statement, 'x is black, is black', *may* be considered *false*

The problems of 'meaning' and 'meaningless' are of great semantic importance in daily life, but, as yet, little has been done, and little research made, to establish or discover valid criteria To prove a given statement false is often laborious, and sometimes impossible to do so, because of the undeveloped state of knowledge in that field But with meaningless *verbal* forms, when their meaninglessness is exposed in a given case the non-sense is exploded for good

From this point of view, it is desirable to investigate more fully the mechanism of our symbolism so as to be able to distinguish between statements which are false and verbal forms which have no meanings. The reader should recall what was said about the term 'unicorn', used as a symbol in heraldry and, eventually, in 'psychology', since it stands for

a human *fancy,* but, in zoology, it becomes a noise and not a symbol, since it does not stand for any actual animal whatsoever

A very curious semantic characteristic is shared in common by a propositional function and a statement containing meaningless noises, namely, that neither of them can be true or false In the old A way all sounds man made, which could be written down and looked like words, were considered words, and so every 'question' was expected to have an answer When spell-marks (noises which can be spelled) were put together in a specified way, each combination was supposed to say something, and this statement was supposed to be true or false We see clearly that this view is not correct, that, in addition to words, we make noises (spell-marks) which may have the appearance of being words, but should *not* be considered as words, as they say nothing in a given context Propositional functions, also, cannot be classified under the simple two opposites of true and false

The above facts have immense semantic importance, as they are directly connected with the possibility of human agreement and adjustment For upon statements which are neither true nor false we can always disagree, if we insist in applying criteria which have no application in such cases

In *human* life the semantic problems of 'meaninglessness' are fundamental for sanity, because the evaluation of noises, which do not constitute symbols in a given context as symbols in that context, must, of necessity, involve delusions or other morbid manifestations

The solution of this problem is simple Any noises or signs, when used semantically as symbols, *always* represent *some symbolism,* but we must find out to what field the given symbolism applies We find only three possible fields If we apply a symbol belonging to one field to another field, it has very often no meaning in this latter In the following considerations, the theory of errors is disregarded

A symbol may stand for: (1) Events outside our skin, or inside our skin in the fields belonging to physics, chemistry, physiology, (2) Psycho-logical events inside our skin, or, in other words, for $s\,r$ which may be considered 'sane', covering a field belonging to psycho-logics (3) Semantic disturbances covering a pathological field belonging to psychiatry

As the above divisions, together with their interconnections, cover the field of human symbolism, which, in 1933, have become, or are rapidly becoming, *experimental* sciences, it appears obvious that older 'metaphysics' of every description become illegitimate, affording only a very fertile field for study in psychiatry

Because of *structural* and the above *symbolic* considerations based on $\bar{A}$ negative, non-identity premises, these conclusions appear as *final;* and, perhaps, for the first time bring to a focus the age-long problem of the subject-matter, character, value, and, in general, the status of the older 'metaphysics' in human economy From the *non-el,* structural, and semantic point of view, the problems with which the older 'metaphysics' and 'philosophy' dealt, should be divided into two quite definite groups One would include 'epistemology', or the theory of knowledge, which would ultimately merge with scientific and *non-el* psycho-logics, based on general semantics, structure, relations, multi-dimensional order, *and* the quantum mechanics of a given date, and the rest would represent semantic disturbances, to be studied by a generalized up-to-date psychiatry

Obviously, considerations of structure, symbolism, sanity , involve the solutions of such weighty problems as those of 'fact', 'reality', 'true', 'false' , which are completely solved only by the consciousness of abstracting, the multiordinality of terms ,—in general, a $\bar{A}$-system

Let me repeat the rough definition of a propositional function—as an ∞-valued statement containing variables and characterized by the fact that it is ambiguous, neither true nor false

How about the terms we deal with in life? Are they all used as one-valued terms for constants of some sort, or do we have terms which are inherently ∞-valued or variable? How about terms like 'mankind', 'science', 'mathematics', 'man', 'education', 'ethics', 'politics', 'religion', 'sanity', 'insanity', 'iron', 'wood', 'apple', 'object', and a host of other terms? Are they labels for one-valued constants or labels for ∞-valued stages of processes Fortunately, here we have no doubt

We see that a large majority of the terms we use are names for ∞-valued stages of processes with a *changing content* When such terms are used, they generally carry different or many contents The terms represent ∞-valued variables, and so the statements represent ∞-valued propositional functions, not one-valued propositions, and, therefore, in principle, are neither true nor false, but ambiguous

Obviously, before such propositional functions can become propositions, and be true or false, single values must be assigned to the variables by some method Here we must select, at least, the use of co-ordinates In the above cases, the 'time' co-ordinate is sufficient Obviously, 'science 1933' is quite different from 'science 1800' or 'science 300 B C'.

The objection may be made that it would be difficult to establish means by which the use of co-ordinates could be made workable. It

seems that this might involve us in complex difficulties But, no matter how simple or how complex the means we devise, the details are *immaterial,* and, therefore, we can accept the roughest and simplest, let us say, the year, and usually no spatial co-ordinates The invaluable semantic effect of such an innovation is *structural,* one-, versus ∞-valued, *psycho-logical* and methodological, and affects deeply our *s r*

From time immemorial, some men were supposed to deal in one-valued 'eternal verities' We called such men 'philosophers' or 'metaphysicians' But they seldom realized that all their 'eternal verities' consisted only of *words,* and words which, for the most part, belonged to a primitive language, reflecting in its structure the assumed structure of the world of remote antiquity Besides, they did not realize that these 'eternal verities' last only so long as the human nervous system is not altered Under the influence of these 'philosophers', two-valued 'logic', and confusion of orders of abstractions, nearly all of us contracted a firmly rooted predilection for 'general' statements—'universals', as they were called—which, in most cases, inherently involved the semantic one-valued conviction of validity for all 'time' to come

If we use our statements with a date, let us say 'science 1933', such statements have a profoundly modified structural and psycho-logical character, different from the old general legislative semantic mood A statement concerning 'science 1933', whether correct or not, has no element of semantic conviction concerning 1934

We see, further, that a statement about 'science 1933' might be quite a definite statement, and that if the person is properly informed, it probably would be true Here we come in contact with the structure of one of those human semantic impasses which we have pointed out We humans, through old habits, and because of the inherent structure of human knowledge, have a tendency to make static, definite, and, in a way, absolutistic one-valued statements But when we fight absolutism, we quite often establish, instead, some other dogma equally silly and harmful 'For instance, an active atheist is psycho-logically as unsound as a rabid theist'

A similar remark applies to practically all these opposites we are constantly establishing or fighting for or against The present structure of human knowledge is such, as will be shown later, that we tend to make definite statements, static and one-valued in character, which, when we take into account the present pre-, and A one-, two-, three-valued affective components, inevitably become absolutistic and dogmatic and extremely harmful

It is a genuine and fundamental semantic impasse These static statements are very harmful, and yet they cannot be abolished, for the present There are even weighty reasons why, without the formulation and application of ∞-valued semantics, it is not possible (1933) to abolish them What can be done under such structural circumstances? Give up hope, or endeavour to invent methods which cover the discrepancy in a satisfactory (1933) way? The analysis of the psycho-logics of the mathematical propositional function and $\bar{A}$ semantics gives us a most satisfactory structural solution, necessitating, among others, a four-dimensional theory of propositions

We see (1933) that we can make definite and *static* statements, and yet make them semantically *harmless* Here we have an example of abolishing one of the old A tacitly-assumed 'infinities' The old 'general' statements were supposed to be true for 'all time', in quantitative language it would mean for 'infinite numbers of years' When we use the date, we reject the fanciful tacit A 'infinity' of years of validity, and *limit* the validity of our statement by the date we affix to it. Any reader who becomes accustomed to the use of this structural device will see what a tremendous semantic difference it makes psycho-logically

But the above does not exhaust the question structurally We have seen that when we speak about ∞-valued processes, and stages of processes, we use variables in our statements, and so our statements are not propositions but propositional functions which are not true or false, but are ambiguous But, by assigning single values to the variables, we make propositions, which might be true or false, and so investigation and agreement become possible, as we then have something definite to talk about

A fundamental structural issue arises in this connection, namely, that in doing this (assigning single values to the variables), our attitude has automatically changed to an extensional one By using our statements with a date, we deal with definite issues, on record, which we can study, analyse, evaluate , and so we make our statements of an extensional character, with all cards on the table, so to say, at a given date Under such extensional and limited conditions, our statements then become, eventually, propositions, and, therefore, true or false, depending on the amount of information the maker of the statements possesses We see that this criterion, though difficult, is feasible, and makes agreement possible

A structural remark concerning the A-system may not be amiss here In the A-system the 'universal' proposition (which is usually a propositional function) always implies *existence* In A 'logic', when it is

said that 'all A's are B', it is assumed that there are A's It is obvious that always assuming existence leaves no place for non-existence, and this is why the old statements were supposed to be true or false In practical life, collections of noises (spell-marks) which look like words, but which are not, are often not suspected of being meaningless, and action based on them may consequently entail unexplicable disaster In our lives, most of our miseries do not originate in the field where the terms 'true' and 'false' apply, but in the field where they *do not apply,* namely, in the immense region of propositional functions and meaninglessness, where agreement must fail

Besides, this sweeping and unjustified structural assumption makes the A-system *less general* To the statement, 'all A's are B', the mathematician adds 'there may or may not be A's' This is obviously *more general* The old pair of opposites, true and false, may be enlarged to three possibilities—statements which might be true, or false, and verbal forms which have the appearance of being statements and yet have no meaning, since the noises used were spell-marks, *not symbols* for anything with actual or 'logical' existence

Again a $\bar{A}$-system shares with the $\bar{E}$ and $\bar{N}$ systems a useful and important methodological and structural innovation, namely, it limits the validity of its statements, with weighty semantic beneficial consequences, as it tends from the beginning to eliminate undue, and often intense, dogmatism, categorism, and absolutism This, on a printed page, perhaps, looks rather unimportant, but when *applied,* it leads to a fundamental and structurally beneficial alteration in our semantic *attitudes* and behaviour

In the present work, each statement is merely the best the author can make in 1933 Each statement is given *definitely,* but with the semantic *limitation* that it is based on the information available to the author in 1933 The author has spared no labour in endeavouring to ascertain the state of knowledge as it exists in the fields from which his material is drawn Some of this information may be incorrect, or wrongly interpreted. Such errors will come to light and be corrected as the years proceed

A great source of difficulty and of possible objections is that science is, at present, so specialized that it is impossible for one man to know all fields, and that, therefore, the use of a term such as 'science 1933', might be fundamentally unsound This objection should not be lightly dismissed, as it is serious. Yet it can, I believe, be answered satisfactorily At this early stage of our enquiry, a large number of the facts of knowledge does not affect my investigation, therefore, it has not proved im-

possible to keep sufficiently well informed on the points which are covered Also, the further scientific theories advance, the simpler they become For instance, books on physics are simpler and less voluminous now than twenty years ago Something similar could be said about mathematics The general outlook is simpler

The main interest of the author at this stage of his work is structural and semantic, rather than technical, and so he has only had to know enough of the technique of different sciences to be able to understand sufficiently their *structure* and *method* Revolutionary structural and methodological advances are few in the history of mankind, and so it is possible, though not easy, to follow them up in 1933

But the main point is that the affixing of the date has very far-reaching structural methodological and, therefore, psycho-logical semantic consequences For instance, it changes propositional function into propositions, converts semantically one-valued intensional methods into ∞-valued extensional methods, introduces four-dimensional methods , and so the 'date' method is to be recommended on these *structural and semantic grounds alone* As it is beneficial to affix the date in 1933, we affix the date 1933, not to give the impression that from a technical point of view I am familiar with the results of all branches of science at that date, but to indicate that no advance in *structure* and *method* of 1933 has been disregarded It will become obvious later in this book, when additional data have been taken into consideration, and a new summary and new abstractions made, that the result is a surprising simplification, which can be clearly understood by laymen as well as by scientists With the help of the generalizations of new structure and ∞-valued semantics, it will be easier to follow the advance of science, because we shall then have a better outlook on the psycho-logics of science as-a-whole

It will become clear, too, that to provide for a further elaboration of this work in the future, the establishment of a special branch of research in $\bar{A}$-systems must become a *group* activity, for, as I have been painfully aware, the production of even this outline of that branch of research has overstrained the powers of one man

The most cheering part of this work is, perhaps, the practical results which this investigation has accomplished, combined with the simplicity of means employed One of the dangers into which the reader is liable to fall is to ascribe too much generality to the work, to forget the limitations and, perhaps, one-sidedness which underlie it The limitation and the generality of this theory lie in the fact that if we symbolize our human problems ($H = f(x_1, x_2, x_3, x_4, x_5, \quad x_n)$) as a function of an enormous number of variables, the present theory deals only with a

few of these variables, let us say x_1 (say, structure), x_2 (say, evaluation)., but these variables have been found, up to the present, in *all* our experience and all our equations

A most important extension of the notion of 'function' and 'propositional function' has been further accomplished by Cassius J Keyser, who, in 1913, in his discussion of the multiple interpretations of postulate systems, introduced the notion of the 'doctrinal function' Since, the doctrinal function has been discussed at length by Keyser in his *Mathematical Philosophy* and his other writings, by Carmichael[2], and others Let us recall that a propositional function is defined as an ∞-valued statement, containing one or more variables, such that when single values are assigned to these variables the expression becomes a one-valued proposition A manifold of interrelated propositional functions, usually called postulates, with all the consequences following from them, usually called theorems, has been termed by Keyser a *doctrinal function* A doctrinal function, thus, has no specific content, as it deals with variables, but establishes *definite relations* between these variables In principle, we can assign many single values to the variable terms and so generate many doctrines from *one* doctrinal function In an ∞-valued $\bar{A}$-system which eliminates identity and is based on structure, doctrinal functions become of an extraordinary importance

In an ∞-valued world of absolute individuals on objective levels, our statements can always be formulated in a way that makes obvious the use of ∞-valued terms (variables) and so the postulates can always be expressed by propositional function As postulates establish relations or multi-dimensional order, a set of postulates which defines a doctrinal function gives, also *uniquely*, the *linguistic structure* As a rule, the builders of doctrines do not start with sets of postulates which would explicitly involve variables, but they build their doctrine around some specific content or one special respective value for the variables, and so the *structure* of a doctrine, outside of some mathematical disciplines, has never been explicitly given If we trace a given *doctrine with specific content* to its *doctrinal function without content,* but variable terms, then, only, do we obtain a set of postulates which gives us the *linguistic structure* Briefly, to find the structure of a doctrine, we must formulate the doctrinal function of which the given doctrine is only a special interpretation In non-mathematical disciplines, where doctrines are not traced down to a set of postulates, we have no means of knowing their structure, or whether *two different* doctrines originated from *one* doctrinal function, or from *two* In other words, we have no simple means of ascertaining whether the two different doctrines have similar or differ-

ent structure. Under aristotelianism, these differentiations were impossible, and so the problems of linguistic structure, propositional and doctrinal functions , were neglected, except in the recent work of mathematicians The entirely general semantic influence of these structural conditions becomes obvious when we realize that, no matter whether or not our doctrines are traced down to their doctrinal functions, our semantic processes and all 'thinking' follow *automatically* and, by necessity, the conscious or unconscious postulates, assumptions , which are given (or made conscious) *exclusively* by the doctrinal function

The terms 'proposition', 'function', 'propositional function', 'doctrinal function' , are multiordinal, allowing many orders, and, in a given analysis, the different orders should be denoted by subscripts to allow a differentiation between them When we deal with more complex doctrines, we find that in structures they represent higher order doctrines, or a higher whole, the constituents of which represent lower order doctrines Similarly, with doctrinal functions, if we take any *system,* an analysis will discover that it is a whole of related doctrinal functions. As this situation is the most frequent, and as 'thinking', in general, represents a process of relating into higher order relational entities which are later *treated as complex wholes,* it is useful to have a term which would symbolize doctrinal functions of higher order, which are made up of doctrinal functions of lower orders We could preserve the terminology of 'higher' and 'lower' order, but as these conditions are always found in all *systems,* it seems more expedient to call the higher body of interrelated doctrinal functions, which ultimately produce a system—a *system-function* At present, the term 'system function' has been already coined by Doctor H M Sheffer[1], but, to my knowledge, Sheffer uses his 'system function' as an equivalent for the 'doctrinal function' of Keyser For the reasons given above, it seems advisable to limit the term 'doctrinal function' to the use as introduced by Keyser, and to enlarge the meaning of Sheffer's term 'system function' to the use suggested in the present work, this natural and wider meaning to be indicated by the insertion of a hyphen

In a $\bar{A}$-system, when we realize that we live, act , in accordance with *non-el s r,* always involving integrated 'emotions' and 'intellect' and, therefore, some explicit or implicit postulates which, by structural necessity, utilize variable, multiordinal and ∞-valued terms, we must recognize that *we live and act by some system-functions* which consist of doctrinal functions The above issues are not only of an academic interest, as, without mastering all the issues emphasized in the present work, it is

impossible to analyse the extremely complex difficulties in which, as a matter of fact, we are immersed.

At present, the doctrinal functions and the system-functions have not been worked out, and even in mathematics, where these notions originated, we speak too little about them. But in mathematics, as the general tendency is to bring all mathematical disciplines to a postulational base, and these postulates always involve multiordinal and ∞-valued terms, we actually produce doctrinal or system-functions, as the case may be In this way, we find the *structure* of a given doctrine or system, and so are able to compare the structures of different, and sometimes very complex, verbal schemes. Similar structure-finding methods must be applied some day to all other, at present, non-mathematical disciplines The main difficulty, in the search for structure, was the absence of a clear formulation of the issues involved and the need for a $\bar{A}$-system, so as to be able to *compare two systems*, the comparison of which helps further structural discovery It is not claimed that either the A or $\bar{A}$ system-functions have been formulated here, but it seems that, in the presence or absence of identification, we find a fundamental postulate which, once formulated, suggests a comparison with experience As we discover that 'identity' is invariably false to facts, this A postulate must be rejected from any future $\bar{A}$-system

It happens that any new and revolutionary doctrine or system is always based on a new doctrinal or system-function which establishes its new structure with a new set of relations Thus, any new doctrine or system, when traced to its postulates, allows us to verify and scrutinize the initial postulates and to find out if they correspond to experience,

A few examples will make it clearer Cartesian analytical geometry is based on *one* system-function, having one system-structure, although we may have indefinitely many different cartesian co-ordinates The vector and the tensor systems also depend on two different system-functions, different from the cartesian; they have three different structures Intertranslations are possible, but only when the fundamental postulates do not conflict Thus, the tensor language gives us invariant and intrinsic relations, and these can be translated into the cartesian relations It seems certain however, although I am not aware that this has been done, that the indefinitely many extrinsic characteristics which we can manufacture in the cartesian system, cannot be translated into the tensor language, which does not admit extrinsic characteristics

Similar relations are found between other doctrines and systems, once their respective structural characteristics are discovered by the

formulating of their respective functions, which, by the explicit or implicit postulates, determine their structure.

Thus all existing schools of psychotherapy, prior to 1933, result from *one* system-function which underlies *implicitly* the system originated by Freud [4] The *particular* freudian doctrine is only one of the indefinitely many variants of *similar system-structure,* which can be manufactured from the one system-function underlying the particular freudian system. In other words, it is of no importance what 'complex' we emphasize or manufacture, the *structural principles* which underlie this new freudian and revolutionary system-function remain unchanged From this point of view, all existing schools of psychotherapy could be called 'cartesian', because, although they all have *one* general system-structure, yet they allow indefinitely many particular variations The present $\bar{A}$-system suggests that the 'cartesian' school of psychotherapy is still largely A, *el* and fundamentally of one structure

The present system involves a different system-function of different structure, rejecting identity, discovering the 'structural unconscious', establishing psychophysiology,. The mutual translatability follows the rules of general semantic principles or conditions which apply also to mathematics, namely, that a $\bar{A}$-system, being based on relations. on the elimination of identity, on structure , gives us only intrinsic characteristics and might be called the 'tensor' school of psychotherapy This system allows all the intrinsic characteristics discovered, no matter by whom, but has no place for the indefinitely many, quite consistent, yet irrelevant metaphysical, extrinsic characteristics, which we can manufacture at will.

Without the realization of the structural foundations emphasized in the present system, it is practically impossible not to confuse linguistic structural issues, which lead inevitably to semantic blockages When we deal with doctrines or systems of *different* structure, each of which involves different doctrinal or system-functions, it is of the utmost importance to keep them at first *strictly separated,* to work out each system by itself, and only after this is accomplished can we carry out an independent investigation as to the ways they *mutually intertranslate.* Let me again repeat, that the mixing of different languages of different structures is fatal for clear 'thinking' Only when a system is traced to its system-function, and the many implications worked out in their *un-mixed* form, can we make a further *independent* investigation of the ways in which the different systems intertranslate As a general rule, every new scientific system eliminates a great deal of spurious metaphysics from the older systems In practice, the issues are extremely

simple if one decides to follow the general rule; namely, either completely to reject or completely to accept *provisionally,* at a given date, a new system, use *exclusively* the structurally new terms, perform our semantic operations exclusively in these terms, compare the conclusions with experience, perform *new* experiments which the structurally new terminology suggests, and only then, as an independent enquiry, investigate how one system translates into the other In those translations, which correspond to the transformation of frames of reference in mathematics, we find the most important *invariant* characteristics or relations which survive this translation If a characteristic appears in all formulations, it is a sign that this characteristic is *intrinsic,* belongs to the subject of our analysis, and is not accidental and irrelevant, belonging only to the accidental structure of the language we use Once these invariant, intrinsic characteristics are discovered, and there is no way to discover them except by reformulating the problems in different languages (in mathematics we speak about the transformation of frames of reference), we then know that we have discovered invariant relations, which survive transformation of different forms of representations, and so realize that we are dealing with something genuinely important, *independent* from the structure of the language we use

History shows that the discovery of isolated, though interesting, facts has had less influence on the progress of science than the discovery of *new system-functions* which produce *new* linguistic *structures and new methods* In our own lifetime, some of the most revolutionary of these advances in structural adjustment and method have been accomplished The work of Einstein, the revision of mathematical foundations, the new quantum mechanics, colloidal science, and advances in psychiatry, are perhaps structurally and semantically the most important There seems no escape from admitting that no modern man can be really intelligent in 1933 if he knows nothing about these structural scientific revolutions It is true that, because these advances are so recent, they are still represented in very technical terms, their system-functions have not been formulated, and so the deeper structural, epistemological and semantic simple aspects have not been worked out These aspects are of enormous human importance But they must be represented without such an abundance of dry technicalities, which are only a means, and not an end, in search for structure

A scientist may be very much up to date in his line of work, let us say, in biology, but his physico-mathematical structural knowledge may be somewhere in the eighteenth or nineteenth century and his epistemology, metaphysics, and structure of language of 300 B C This classifi-

cation by years gives a fairly good picture of his semantic status Indeed, we can fortell quite often what kind of reaction such a man will exhibit

This functional, propositional-function, and system-function structural attitude is in accord with the methods developed by psychiatry In psychiatry, 'mental' phenomena are considered, in some instances, from the point of view of arrested development, in others, as regression to older and more primitive levels With this attitude and understanding, we cannot ignore this peculiar intermixing of different personalities in one man when different aspects of him exhibit *s r* of different ages and epochs of the development of mankind In this connection should be mentioned the problem of the multiple personalities which often occur in the 'mentally' ill Such splitting of personality is invariably a serious semantic symptom, and a person who exhibits different ages in his semantic development, as, for instance, 1933 in some respects, sixteenth century in others, and 300, or even 5000, B C in still others, cannot be a well co-ordinated individual If we teach our children, whose nervous systems are *not* physically finished at birth, doctrines structurally belonging to entirely different epochs of human development, we ought not to wonder that semantic harm is done Our efforts should be to co-ordinate and integrate the individual, help the *nervous* system, and not split the individual semantically and so disorganize the nervous system

It is necessary to remember that the organism works as-a-whole In the old days we had a comforting delusion that science was a purely 'intellectual' affair This was an *el* creed which was structurally false to facts It would probably be below the dignity of an older mathematician to analyse the 'emotional' values of some piece of mathematical work, as, for instance, of the 'propositional function' But such a mathematician probably never heard of psychogalvanic experiments, and how his 'emotional curve' becomes expressive when he is solving some mathematical problem

In 1933, we are not allowed to follow the older, seemingly easier, and simpler paths In our discussion, we have tried to analyse the problems at hand as ∞-valued manifestations of human behaviour We were analysing the doings of Smith, Brown , and the semantic components which enter into these forms of behaviour must be especially emphasized, emphasized because they were neglected In well-balanced persons, all psycho-logical aspects should be represented and should work harmoniously In a theory of sanity, this semantic balance and co-ordination should be our first aim, and we should, therefore, take particular care of the neglected aspects The *non-el* point of view makes us postulate a permanent connection and interdependence between all psycho-logical

aspects Most human difficulties, and 'mental' ills, are of *non-el* affective origin, extremely difficult to control or regulate by *el* means Yet, we now see that purely technical scientific discoveries, because structural, have unsuspected and far-reaching beneficial *affective* semantic components Perhaps, instead of keeping such discoveries for the few 'highbrows', who never use them fully, we could introduce them as structural, semantic and *linguistic* devices into elementary schools, with highly beneficial psycho-logical results There is really no difficulty in explaining what has been said here about structure to children and training them in appropriate *s r* The effect of doing so, on sanity, would be profound and lasting

CHAPTER XII

ON ORDER

The fundamental importance of the subject of order may be inferred from the fact that all the concepts required in geometry can be expressed in terms of the concept of order alone (237) E V HUNTINGTON

Dimensions, in geometry, are a development of order The conception of a *limit*, which underlies all higher mathematics, is a serial conception There are parts of mathematics which do not depend upon the notion of order, but they are very few in comparison with the parts in which this notion is involved (455) BERTRAND RUSSELL

The notion of continuity depends upon that of *order*, since continuity is merely a particular type of order (454) BERTRAND RUSSELL

Logistic may be defined as *the science which deals with types of order as such* (300) C I LEWIS

The branch of physics which is called Elementary Geometry was long ago delivered into the hands of mathematicians for the purposes of instruction But, while mathematicians are often quite competent in their knowledge of the abstract structure of the subject, they are rarely so in their grasp of its physical meaning (529) OSWALD VEBLEN

" We often think that when we have completed our study of *one* we know all about *two*, because "two" is "one and one" We forget that we have still to make a study of "and". Secondary physics is the study of "and"—that is to say, of organisation (149) A S EDDINGTON

the geometry of paths can be regarded as a generalization both of the earliest part of elementary geometry and of some of the most refined of physical theories The study of the projective, the affine and the metric geometry of paths ought to result in a comprehensive idea of what types of physical theory it is possible to construct along the lines which have been successful in the past (529) OSWALD VEBLEN

What I wish to emphasize now is the need of logistic studies which will make it possible to say more definitely than is yet possible in this field what is assumed, what is proved, and how the group of theorems and definitions hang together (529) OSWALD VEBLEN

Memory, in fact, is nothing but the reinforcement and facilitation of the passage of the nervous impulse along certain paths (411) HENRI PIÉRON

But before dealing with the brain, it is well to distinguish a second characteristic of nervous organization which renders it an organization in levels (411) HENRI PIÉRON

This affective repercussion seems to take place at the penultimate stage of the nervous system and governs complicated reflexes or instinctive reactions (411) HENRI PIÉRON

Furthermore, there are even symbols of symbols, evocative of images only in the second degree, by means of primary stations of the co-ordination centres (411) HENRI PIÉRON

In this way it is seen that the order in which a given group of stimuli taking part in a stimulatory compound are arranged, and the pauses between them are the factors which determine the final result of the stimu-

> lation, and therefore most probably the form of the reaction, and we know already that different intensities of the same stimulus can be differentiated very accurately, one definite intensity being connected with excitation and another with inhibition (394) I P PAVLOV

> Whoever studies Leibniz, Lambert and Castillon cannot fail to be convinced that a consistent calculus of concepts in intension is either immensely difficult or, as Couturat has said, impossible (300) C I LEWIS
>
> The relation between intensions and extensions is *unsymmetrical*, not symmetrical as the medieval logicians would have it (300) C I LEWIS
>
> The old "law" of formal logic, that if α is contained in β in extension, then β is contained in α in intension, and vice versa, is *false* The connection between extension and intension is by no means so simple as that (300) C I LEWIS

> I do not suggest explicit confusions of this sort, but only that traditional elementary logic, taught in youth, is an almost fatal barrier to clear thinking in later years, unless much time is spent in acquiring a new technique (457) BERTRAND RUSSELL

Section A Undefined terms

We can now introduce a structural *non-el* term which underlies not only all existing mathematics, but also the present work This *bridging* term has equal importance in science and in our daily life, and applies equally to 'senses' and 'mind' The term in question is 'order', in the sense of 'betweenness' If we say that *a*, *b*, and *c* are in the order *a*, *b*, *c*, we mean that *b* is *between* *a* and *c*, and we say, further, that *a*, *b*, *c*, has a different order from *c*, *b*, *a*, or *b*, *a*, *c*, The main importance of numbers in mathematics is in the fact that they have a definite *order* In mathematics, we are much concerned with the fact that numbers represent a definite ordered series or progression, 1, 2, 3, 4,

In the present system, the term 'order' is accepted as *undefined* It is clear that we cannot *define* all our terms If we start to define all our terms, we must, by necessity, soon come to a set of terms which we cannot define any more because we will have no more terms with which to define them We see that the structure of *any* language, mathematical or daily, is such that we must start implicitly or explicitly with undefined terms. This point is of grave consequence In this work, following mathematics, I explicitly start with undefined important terms

When we use a series of names for objects, 'Smith, Brown, Jones', we say *nothing* We do not produce a proposition But if we say 'Smith kicks Brown', we have introduced the term 'kicks', which is not a name for an object, but is a term of an entirely different character Let us call it a 'relation-word' If we analyse this term, 'kicks', further, we will find that we can define it by considering the leg (objective) of Smith (objective), some part of the anatomy of Brown (objective), and,

finally, Brown (objective) We must use a further set of terms that describes how the leg of Smith 'moves' through an 'infinity' of 'places' in an 'infinity' of 'instants' of 'time', 'continuously' until it reaches Brown.

When a donkey kicks a donkey, there may be a broken leg, but that is, practically, the only consequence Not so when Smith kicks Brown Should Brown happen to be a royal or a business man in Nicaragua or Mexico, this might be considered 'a mortal offense of a great sovereign nation to another great sovereign nation', a war might follow and many non-royals or non-business men might die When a *symbolic* class of life enters the arena, semantic complications may arise not existing with animals

In the relation terms, the statement, 'Smith kicks Brown', has introduced still further symbolic complications It involves a full-fledged metaphysics, as expressed in the terms 'moves', 'infinity', 'space', 'time', 'continuity', and what not It must be emphasized that *all* human statements, savage or not, involve a structural metaphysics

These relational terms should be elucidated to the utmost Until lately, the 'philosophers', in their 'Jehovah complex', usually said to the scientists· 'Hands off, those are superior problems with which only we chosen ones can deal' As a matter of history, 'philosophers' have not produced achievements of any value in the structural line But the 'mere' scientists, mainly mathematicians and mathematical physicists, have taken care of these problems with extremely important structural (1933) results In the solutions of these semantic problems, the term 'order' became paramount

Perhaps this example of an analysis of the statement, 'Smith kicks Brown', shows the justice of the contention of this work that no man can be 'intelligent' if he is not acquainted with these new works and their structural elucidations

We see that no statement made by man, whether savage or civilized, is free from some kind of structural metaphysics involving $s\,r$ We see also that when we explicitly start with *undefined* words, these undefined words have to be taken on faith They represent some kind of implicit creed, or metaphysics, or structural assumptions We meet here with a tremendously beneficial semantic effect of modern methods, in that we deliberately state our undefined terms We thus divulge our creeds and metaphysics In this way, we do not blind the reader or student We invite criticism, elaboration, verification, evaluation , and so accelerate progress and make it easier for others to work out issues Compare the statement of Newton, *'Hypotheses non fingo'* (I do not make hypotheses), in his *Philosophiae Naturalis Principia Mathematica,* when he pro-

ceeded to coin some very doubtful hypotheses, and such works as produced by Peano, Whitehead, Russell, and others, in which not only all assumptions are stated explicitly, *but even the assumptions,* given in single *undefined* terms, are listed It is not assumed here that even Peano, Whitehead, Russell, and the others have fulfilled this program entirely It is quite probable that not all of their assumptions are stated explicitly However, a very serious and revolutionary beginning has been made in this direction We have still far to go, for at present even mathematicians disregard the threefold relational character of mathematics, and, by a semantic confusion of orders of abstraction, make structurally *el* assumptions false to the facts of 1933, namely, that mathematics exists 'by itself', detached from the producers, Smith and others This procedure reminds one of the old *N* 'I do not make hypotheses', proffered just at the moment he begins to legislate about the structure of the universe and to postulate his 'absolute space' and 'absolute time' 'without reference to any external object whatsoever' This, of course, was structurally unascertainable, and so was a mere figment of his imagination, inside of his skin, and may become a pathological semantic projection when externalized by *affective* pressure

That we must all start with undefined terms, representing blind creeds which cannot be elucidated further *at a given moment,* may fill the hearts of some metaphysicians with joy 'Here', they might say, 'we have the goods on the scientists; they criticize us and reject our theories, and yet they admit that they also must start with blind creeds Now we have full justification for assuming whatever we want to' But this joy would be short-lived for any reasonably sane individual In mathematics, we deliberately assume the minimum, and not the maximum, as in metaphysics The undefined terms selected for use are the *simplest* of our experience, for instance, 'order' (betweenness) Also, in experimental sciences, we assume the least possible We demand from a *scientific* theory, according to the standards of 1933, that it should account for all relevant facts known in 1933 and should serve as a basis for the *prediction* of new facts, which can be checked by new experiments If metaphysicians and 'philosophers' would comply with such scientific standards, their theories would be scientific But their old theories would have to be abandoned and their new theories would become branches of science Under such structural circumstances, there is no possibility of going *outside* of science, as we can enlarge the bounds of science without known limits, in search for structure

It must be pointed out that no set of undefined terms is ultimate A set remains undefined only until some genius points out simpler and

more general or structurally more satisfactory undefined terms, or can reduce the number of such terms Which set we accept is determined in the main, by pragmatic, practical, and structural reasons Out of two systems which have many characteristics of usefulness , in common, we would and should select the one which assumes least, is the simplest, and carries the furthest Such changes from one set to another, when scientific, are usually epoch-making, as exemplified in mathematics

It is important to realize that this semantic attitude signalizes a new epoch in the development of science In scientific literature of the old days, we had a habit of demanding, 'define your terms' The new 1933 standards of science really should be, *'state your undefined terms'*. In other words, 'lay on the table your metaphysics, your assumed structure, and then only proceed to define your terms in terms of these *undefined terms'* This has been done completely, or approximately so, only in mathematics Yet, probably no one will deny that the new requirements of science (1933), no matter how laborious, are really desirable, and constitute an advance in method, in accordance with the structure of human knowledge

In the present work, this method will be employed practically all through Of course, names for objects may be accepted without enquiry So we have already a large vocabulary at our disposal But names alone do not give propositions We need *relation-words,* and it is here where our undefined terms become important Up to this stage of the present work, I have accepted, without over-full explanation, the vocabularies made by the linguists of exact science, whom we usually call mathematicians There is an enormous benefit in doing so, because, no matter how imperfect the mathematical vocabulary may be, it is an extensive and developed linguistic system of similar structure to the world around us and to our nervous system 1933 (See Part V)

Some of the most important undefined terms which play a marked role in this work are 'order' (in the sense explained), 'relation', and 'difference', although we could define relation in terms of multi-dimensional order There is a remarkable structural characteristic of these terms , namely, that they are *non-el,* and that they apply to 'senses' as well as to 'mind' It is, perhaps, well to suggest that, in future works, the terms selected should be of the *non-el* type Since these terms apply equally to 'senses' and to 'mind', we see that in *such* terms we may attempt to give a 'coherent' account of what we experience The expression 'coherent' implies 'mind', and 'experience' implies 'senses' It is amusing to watch this peculiar circularity of human knowledge many instances of which will appear later on Thus, there was great difficulty

in expressing organism-as-a-whole notions, we had to grope about in establishing the beginnings of a suitable vocabulary before we could approach problems which were antecedent in order

It is necessary to notice a rather curious structural similarity between the $\bar{N}$ and $\bar{A}$ systems In both cases, we deal with certain velocities about which we know positively that they are *finite* The velocity of light in the N-system was assumed to be infinite, although we know it is not so, and so 'simultaneity' had absolute meaning The $\bar{N}$ systems introduced the finite velocity of light by ordering events, which happens to be true to facts, and thus 'simultaneity' lost its absolute character Likewise in the A-system and language, the velocity of nervous impulses was assumed to be infinite, to spread 'instantaneously' And so we had most perplexing 'philosophical' rigmaroles about 'emotions', 'intellect', taken as independent separate entities When we introduce explicitly the finite velocity of nervous impulses (on the average, 120 metres per second in the human nerves), we are able to reach a perfectly clear understanding, *in terms of order,* of the spread of impulses Some 'infinite velocity' does not involve *order* Conversely, by considering the order of events, we introduce finite velocities We shall see later that 'infinite velocity' is *meaningless* and so all actual happenings can be ordered The above is an important factor in our *s r*

Let us give a rough example Assume that Smith has had a bad dinner Some nervous impulse, originating from the bad dinner, starts going At this stage, we may call it an 'undifferentiated' nervous impulse It travels with *finite* velocity, reaches the brain-stem and the approximately central part of his brain, which we call the thalamus, is affected by them and is no longer 'undifferentiated' but becomes, let us say, 'affective' In the cortex, it is affected again by the lessons of past experiences It returns again to the lower centres and becomes, let us say, 'emotion', and then anything might happen, from sudden death to a glorious poem

The reader must be warned that this example is rough and oversimplified Impulses are reinforced and 'inhibited' from a complex chain of nervous interconnections But what I wish to show by this example, is that, by accepting the *finite* velocity of nerve currents, in terms of *order,* we can build up a definite vocabulary to deal, not only with the 'organism-as-a-whole', but also with the different stages of the process This is important because, without some such *ordinal* scheme, it is structurally impossible to evade enormous verbal and semantic difficulties which lead to great confusion

In the analysis of the above example, only the structural and *methodological* aspects are emphasized No attempt is made to legislate for neurologists or to instruct them how they should define and use their terms

Section B Order and the nervous system

We know that, structurally, not all parts of the nervous system are of equal phylogenetic age The ventral part of the brain, the thalamus (in the rough), which is of most interest in this connection, is older than the cerebral cortex By the term 'thalamus' I denote all the subdivisions and most important appendages which we need not mention by their technical names In man, both the thalamus and the cerebral cortex are much enlarged and have a complex structural cyclic interconnection The cerebral cortex is a term applied to a superficial layer of grey nervous tissue covering the cerebral hemispheres It is called the 'new brain' by Edinger The higher correlation centres in the cerebral hemispheres can act only through the agency of the lower centres, the brain-stem, and the thalamus In other words, the cerebral cortex, the functioning of which is connected chiefly with the higher associations, is of such structure that no nervous impulse can enter it without first passing through the lower centres of the ventral parts of the brain and brain-stem

In the lower vertebrates, which lack the cerebral cortex, the subcortical mechanisms are adequate for all simple exigencies of life and simple association processes, these sub-cortical mechanisms being older phylogenetically than the cerebral cortex, yet younger than some still more ventral parts

The brush-like connections between the nerves are called synapses, and although a nerve-fibre seems to be capable of transmitting nerve impulses in both directions, the nervous impulse can seemingly pass the synapse in only one direction, so a nervous polarity is established whenever synapses are present [1]

The following diagram and explanations are taken from Professor Herrick's *Introduction to Neurology,* pp 60, 61, 62, 63, 69, 70 In the quotations I retain the spelling but change Herrick's Fig 18 to my Fig 1, all but one word of the italics are mine *

*I quote here from the Second Edition of the *Introduction to Neurology* an account of the classical theory of reflex circuits which is quite satisfactory for my purpose In his later work (see my bibliography), Professor Herrick forcibly points out the limitations of the reflex theories as *partial patterns,* as opposed to the activity of the organism-as-a-whole In the Fifth Edition (1931), the chapter on reflex circuits has been entirely rewritten, and the *non-el* attitude is expressed very clearly I am much indebted to Professor Herrick for drawing my attention to this rewritten chapter

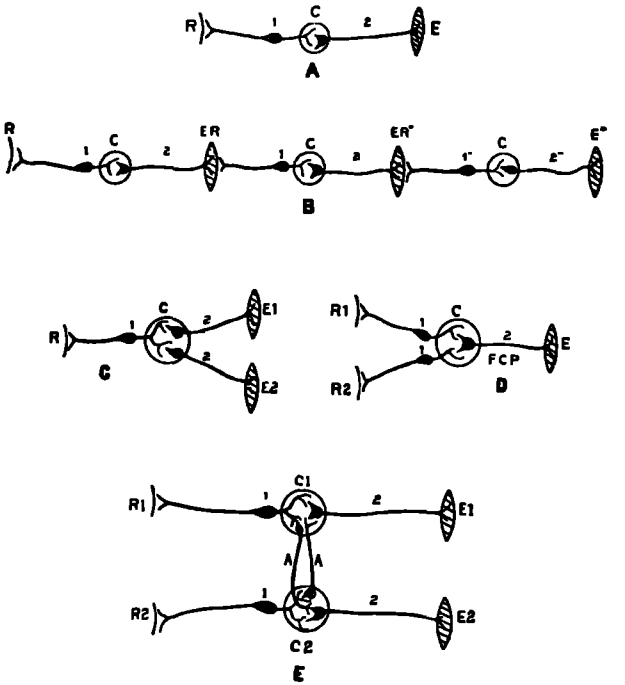


FIG 1

Diagrams representing the relations of neurons in five types of reflex arcs A, simple reflex arc, B, chain reflex, C, a complex system illustrating allied and antagonistic reflexes and physiological resolution, D, a complete system illustrating allied and antagonistic reflexes with a final common path, E, a complex system illustrating the mechanism of physiological association *A,Ā*, association neurons, *C,C',C",C1*, and *C2*, centres (adjustors), *E,E',E"*, *E1*, and *E2*, effectors, *FCP*, final common path, *R,R',R",R1*, and *R2*, receptors

'The structure of the simple reflex circuit is diagrammatically illustrated in Fig 1, A The receptor (*R*) may be a simple terminal expansion of the sensory nerve-fiber or a very complex sense organ The effector (*E*) may be a muscle or a gland The cell body of the afferent neuron (1) may lie within the center (*C*) or outside, as in the diagram A simple reflex act involving the use of so elementary a mechanism as has just been described is probably never performed by an adult vertebrate. The nervous impulse somewhere in its course always comes into relation with other reflex paths, and in this way complications in the response are introduced

'Separate reflex circuits may be so compounded as to give the so-called chain reflex (Fig 1, B) Here the response of the first reflex serves as the *stimulus* for the second, and so on in series The units of

these chain reflexes are usually not simple reflexes as diagrammed, but *complex* elements of the types next to be described . The chain reflex is a very common and a very important type Most of the ordinary acts in the routine of daily life employ it in one form or another, the *completion of one stage* of the process serving as the *stimulus* for the *initiation of the next*. .

'Figure 1, C illustrates another method of compounding reflexes so that the stimulation of a single sense organ may excite either or both of two responses If the two effectors, *E*1 and *E2*, can cooperate in the performance of an adaptive response, the case is similar to that of Fig 1, A, with the possibility of a more complex type of reaction This is an allied reflex. If, however, the two effectors produce antagonistic movements, so that both cannot act at the same time, the result is a physiological dilemma Either no reaction at all results, or there is a sort of physiological resolution (sometimes called physiological choice), one motor pathway being taken to the exclusion of the other. Which path will be chosen in a given case may be determined by the physiological state of the organs If, for instance, one motor system, *E2*, is greatly fatigued and the other rested, the threshold of *E2* will be raised and the motor discharge will pass to *E*1

'Figure 1, D illustrates the converse case, where two receptors discharge into a single center, which, in turn, by means of a final common path (*FCP*) excites a single effector (*E*) If the two receptors upon stimulation normally call forth the same response, they will reinforce each other if simultaneously stimulated, the response will be strengthened, and we have another type of allied reflex But there are cases in which the stimulation of *R*1 and *R*2 (Fig 1, D) would naturally call forth antagonistic reflexes Here, if they are simultaneously stimulated, a physiological dilemma will again arise which can be resolved only by one or the other afferent system getting control of the final common path

'Figure 1, E illustrates still another form of combination of reflexes Here there are connecting tracts (*A, A*) between the two centers so arranged that stimulation of either of the two receptors (*R*1 and *R*2) may call forth a response in either one of two effectors (*E*1 and *E*2) These responses may be allied or antagonistic, and much more complicated reflexes are here possible than in any of the preceding cases . .

'It must be kept in mind that in higher vertebrates all parts of the nervous system are bound together by connecting tracts (internuncial pathways) . These manifold connections are so elaborate that every

part of the nervous system is in nervous connection with every other part, directly or indirectly This is illustrated by the way in which the digestive functions (which normally are quite autonomous, the nervous control not going beyond the sympathetic system,) may be disturbed by mental processes whose primary seat may be in the association centers of the cerebral cortex, and also by the way in which strychnin-poisoning seems to lower the neural resistance everywhere, so that a very slight stimulus may serve to throw the whole body into convulsions .

'Our picture of the reflex act in a higher animal will, then, include a view of the whole nervous system in a state of neural tension The stimulus disturbs the equilibrium at a definite point (the receptor), and the wave of nervous discharge thus set up irradiates through the complex lines determined by the neural connections of the receptor. If the stimulus is weak and the reflex path is simple and well insulated, a simple response may follow immediately Under other conditions the nervous discharge may be inhibited before it reaches any effector, or it may irradiate widely, producing a very complex reflex pattern . . .

'The mechanism of the reflex should not be regarded as an open channel through which energy admitted at the receptive end-organ is transmitted to be discharged into the effector organ It is rather a *complex* apparatus, containing reserves of potential energy which can be released upon the application of an adequate stimulus in accordance with a pattern determined by the inherent *structure* of the apparatus itself In other words, the nervous *discharge* [italics of Professor Herrick] is *not* a mere transmission of the energy of the stimulus, but it implies *active* consumption of material and release of energy (*metabolism*) within both the nerve centers and the nerve-fibers The energy acting upon the effector organ may, therefore, be different in both kind and amount from that applied to the receptive end-organ The response likewise involves the liberation of the latent energy of the effector (*muscle or gland*), the nervous impulse serving merely to release the trigger which discharges this reserve energy'

It is necessary to warn the reader that the human nervous system is structurally of inconceivable complexity It is estimated that there are in the human brain about twelve thousand millions of nerve cells or neurons, and more than half of these are in the cerebral cortex. Most probably, the majority of the neurons of the cerebral cortex are directly or indirectly connected with every cortical field Were we to consider a million cortical nerve cells connected one with another in groups of only two neurons each, and compute the possible combinations, we would find the number of possible interneuronic connection-patterns to be repre-

sented by $10^{2\,783,000}$ What such a number is like is hardly possible to imagine For comparison, it may be said that probably the whole visible sidereal universe does not contain more than 10^{80} atoms![2]

Our present knowledge of the nervous system is limited as regards its complexities and possibilities, but we know many structural facts which seem to be well established One of these is that the human nervous system is more complex than that of any animal Another is that the human cortex is of later origin than, and in a way an outgrowth from, the more central parts of the brain (which establishes a structure of *levels*) A third is that the interconnection of the parts of the nervous system is *cyclic* A fourth is that the velocity of nerve currents is *finite* The last fact is of serious structural importance, and as a rule, disregarded

Section C Structure, relations, and multi-dimensional order.

In such an ordered cyclic chain, the nerve impulses reach and traverse the different levels with *finite* velocity and so in each case, in a *definite order* 'Intelligence' becomes a manifestation of life of the organism-as-a-whole, structurally impossible in some fictitious 'isolation'. To 'be' means *to be related* To be related involves multi-dimensional *order* and results in *structure*

'Survival', 'adaptation', 'response', 'habit formation', 'orientation', 'learning', 'selection', 'evaluation', 'intelligence', 'semantic reactions', and all similar terms involve structurally an ordered, interrelated structural complex in which and by which we live and function To 'comprehend', to 'understand', to 'know', to be 'intelligent' , in the pre-human as well as the human way, means the most useful survival adjustment to such an ordered, interrelated structure as the world and ourselves

In this vocabulary, 'structure' is the highest abstraction, as it involves a whole, taken as-a-whole, made up of *interrelated parts* the relations of which can be defined in still simpler terms of order 'Knowing', in its broadest as well as in its narrow human sense, is conditioned by structure, and so consists of *structural* knowings. All empirical structures involve relations, and the last depend on multi-dimensional order. A language of *order*, therefore, is the simplest form of language, yet in structure it is similar to the structure of the world and ourselves. Such a language is bound to be useful for adaptation and, therefore, sanity; it results in the understanding of the structural, relational, multi-dimensional order in the environment on all levels

We must stress the structural fact that the introduction of *order* as a fundamental term abolishes some fanciful and semantically very harm-

ful 'infinities' If an impulse could travel in 'no time' or with 'infinite velocity', which is a *structural impossibility* in this world, such an impulse would reach different places 'instantaneously', and so there would be *no order involved.* But, as soon as the actual order in which impulses reach their destination is found, 'infinite velocities' are abolished We shall show later that 'infinite velocity' is a meaningless noise, here we stress only the point that it is a structural impossibility, as structure involves relations and orders, and order could not exist in a world where 'infinite velocities' were possible

Conversely, if in our analysis we disregard order, we are bound to disregard relations and structure and to introduce, by necessity, some fanciful 'infinite velocities' Any one who treats 'mind' in 'isolation' makes a structurally false assumption, and, by necessity, unconsciously ascribes some meaningless 'infinite velocity' to the nerve currents

We have dwelt upon this subject at such length because of its general structural and semantic importance The first step towards understanding the theory of Einstein is to be entirely convinced on the above points Newton's disregard of order introduced an unconscious false to facts assumption of the 'infinite velocity' of light, which fatalistically leads to an objectification called 'absolute time', 'absolute simultaneity', and so introduces a terminology of inappropriate structure A similar remark applies to arguments about 'mind' in an objectified 'isolated' way These arguments disregard the *order* in which the nervous impulses spread and so, by necessity, introduce a silent false to facts assumption of the 'infinite velocity' of nerve currents

On empirical structural grounds, we know neurological and general facts on two levels (1) Macroscopically, we have a structure in levels, stratified, so to say, with complexities arising from the general colloidal physico-chemical structure of the organism-as-a-whole (2) The general sub-microscopic, atomic, and sub-atomic structure of all materials simply gives us the persistence of the macroscopic characteristics as the relative *invariance of function,* due to dynamic equilibrium, and ultimately reflected and conditioned by this *sub-microscopic structure* of all materials Under such actual structural conditions, terms like 'substance', 'material' , and 'function', 'energy', 'action' , become interconnected—largely a problem of preference or necessity of selecting the level with which we want to deal

On sub-microscopic levels, 'iron', or anything else, means only a persistence for a limited 'time' of certain gross characteristics, representing a process (structurally a four-dimensional notion involving 'time'), which becomes a question of structure. With the 1933 known unit of

the world called an 'electron', which appears as an *'energy'* factor, the relative persistence or invariance of dynamic sub-microscopic structure gives us, on macroscopic levels, an average, or statistical, persistence of gross macroscopic characteristics, which we label 'iron'.

The above should be thoroughly understood and digested As a rule, we all identify orders and levels of abstractions and so have difficulty in keeping them separate verbally (and, therefore, 'conceptually') Thorough structural understanding helps us greatly to acquire these new and beneficial *s r*

Under such structural *empirical* conditions, a language of order, which implies relations and structure, as enlarged to the order of abstractions or level of consideration, largely volitional, becomes the only language which, in *structure,* is similar to the structure of the world, ourselves included, and so, of necessity, will afford the maximum of semantic benefits

It should be understood that, on structural grounds, terms like 'substance' and 'function' become, in 1933, perfectly *interchangeable,* depending on the order of abstraction 'Substance', for instance, on the macroscopic level becomes 'invariance of function' on the sub-microscopic level It follows that what we know about the macroscopic ('anatomical') structure can be quite legitimately enlarged by what we know of *function* (structure on different levels) This interchangeability and complementary value of evidence is conditioned by structural considerations, and the fact that 'structure' is multiordinal On gross anatomical grounds, we know a great deal about this structure of the nervous system Because of experimental difficulties, very little is known of the structural sub-microscopic happenings, yet we can speak about them with benefit in *functional* terms, as, for instance, of 'activation', 'facilitation', 'resistance', 'psychogenetic effects', 'diffusion', 'permeability', the older 'inhibition',

In such a cyclic chain as the nervous system, there is, as far as energy is concerned, no last stage of the process If there is no motor reaction or other reflex, then there is a semantic or associative reaction with 'inhibitory' or activating consequences, which are functionally equivalent to a motor reaction At each stage, a 'terminal' receptor is a *reacting* organ in the chain [3]

We know quite well from psychiatry how nervous energy may deviate from constructive and useful channels into destructive and harmful channels The energy is not lost, but misdirected or misapplied For instance, an 'emotional' shock may make some people release their energy into useful channels, such as concentrated efforts in some direction, which would have been impossible without this shock; but, in

others, an 'emotional' shock leads to the building up of morbid 'mental' or physical symptoms.

Since the nervous structure is cyclic in most of its parts, as well as as-a-whole, and since these cycles are directly or indirectly interconnected, mutual interaction of those cycles may produce most elaborate behaviour patterns, which may be spoken of, in their manifestations, in terms of *order* As each more important nerve centre has incoming and outgoing nerve-fibres, the activation, or reinforcement, or diffusion of nerve currents may sometimes manifest itself in our *s r* as *reversal of order* in some aspects Neurologically, considered on the sub-microscopic level, it would only be a case of activation, or of diffusion, or of 'inhibition' , probably *never* a problem of reversed order in the actual nerve currents

The semantic manifestations of order and reversed order are of *crucial importance,* for we are able to *train* the individual to different orders or reversals of orders This procedure neurologically involves activations, enforcements, diffusions, 'inhibitions', resistances, and all the other types of nervous activities, which without the formulation of psychophysiology were all *most inaccessible to* direct training The structural fact that order and reversal of order in semantic manifestation, which all are on the un-speakable objective level, have such intimate and profound connection with fundamental nervous processes, such as activation, enforcement, diffusion, permeability, 'inhibition', resistance , gives us tremendous new powers of an educational character in building up *sanity,* and supplies methods and means to affect, direct and train nervous activities and *s r*, which we were *not able formerly to train* psychophysiologically Perhaps one of the main values of the present work is the discovery of physiological means, to be given presently, for training the human nervous system in 'sanity'.

The reader should be aware, when we speak of order and reversal of order, that we mean the order and reversal of order in the un-speakable *s r*, but the neurological mechanism is of a different character, as already explained Our analysis of the simple semantic manifestations involve *evaluation* and so *order,* permitting a most complex re-education and re-training of the nervous system, which were entirely beyond our reach with the older methods

Experimental evidence seems to corroborate what has been suggested here, and the analysis, in terms of order, seems to have serious practical neurological significance, owing to *similarity of structure,* resulting in *evaluation*, and so appropriate *s r*

For our analysis in terms of order, we start with the simplest imaginable nervous cycle, but it must be explicitly understood that such simple

cycles actually never exist, and that our diagrams have value only as picturing the cyclic *order,* without complications Let us repeat that the introduction of an analysis in terms of *order* or *reversal of order* in *the manifestation* involves, under educational influence, various other and *different actual nervous activities,* a class of activities which hitherto have always evaded our educational influences For structural purpose, it is sufficient to make use of the distinction between lower and higher centres (a rough and ready distinction) and to consider the lower centres generally in connection with the thalamus and brain-stem (perhaps also other sub-cortical layers), and the higher centres generally in connection with the cortex This lack of precision is intentional, for we need only sufficient structural stratification to illustrate *order,* and it seems advisable to assume only the well-established *minimum* of structure

We have already mentioned the absolute individuality of the organism and, as a matter of fact, of everything else on objective levels The reader need have no metaphysical shivers about such extreme individuality on the un-speakable levels In our human economy, we need both similarities and differences, but we have as yet, in our A-system, chiefly concentrated our attention and training on similarities, disregarding differences In this work, we start structurally *closer to nature* with un-speakable levels, and make *differences* fundamental, similarities appearing only at a later stage (order) *as a result of higher abstractions* In simple words, we obtain similarities by disregarding differences, by a process of abstracting In a world of only absolute differences, without similarities, recognition, and, therefore, 'intelligence', would be impossible

It is possible to demonstrate how 'intelligence' and abstracting both started together and are due to the physico-chemical structure of protoplasm All living material, usually called protoplasm, has, in some degree, the nervous functions of irritability, conductivity, integration, It is obvious that a stimulus S does not affect the little piece of primitive protoplasm A 'all over and at once' (infinite velocity), but that it affects it first in a definite spot B, that the wave of excitation spreads, with finite velocity and usually in a diminishing gradient, to the more remote portions of A We notice also that the *effect* of the stimulus S on A is not *identical* with the stimulus itself A falling stone is *not* identical with the pain we feel when the stone falls on our foot Neither do our feelings furnish a full report as to the characteristics of the stone, its internal structure, chemistry,. So we see that the bit of protoplasm is affected only *partially,* and in a *specific* way, by the stimulus Under physico-chemical conditions, as they exist in life, there is no place for any

'allness' In life, we deal structurally only with 'non-allness', and so the term, *'abstracting* in different orders', seems to be structurally and uniquely appropriate for describing the effects of external stimuli on living protoplasm 'Intelligence' of any kind is connected with the abstracting (non-allness) which is characteristic of all protoplasmic response Similarities are perceived only as differences become blurred, and, therefore, the process is one of abstracting

The important novelty in my treatment is in the structural fact that I treat the term 'abstracting' in the *non-el* way We find that all living protoplasm 'abstracts' So I make the term abstracting fundamental, and I give it a wide range of meanings to correspond to the facts of life by introducing abstractions of *different orders* Such a treatment has great structural advantages, which will be explained in Part VII

As our main interest is in 'Smith$_n$', we will speak mostly of him, although the language we use is structurally appropriate for characterizing all life 'Abstracting' becomes now a physiological term with structural, actional, physico-chemical, and *non-el* implications

Accidentally, some light is thus thrown on the problem of 'evolution' In *actual* objective life, each new cell is different from its parent cell, and each offspring is *different* from its parents Similarities appear only as a result of the action of our nervous system, which does not register absolute differences Therefore, we register similarities, which evaporate when our means of investigation become more subtle Similarities are read *into nature* by our nervous system, and so are structurally less fundamental than differences Less fundamental, but no less important, as life and 'intelligence' would be totally impossible without *abstracting* It becomes clear that the problem which has so excited the *s r* of the people of the United States of America and added so much to the merriment of mankind, 'Is evolution a "fact" or a "theory"?', is simply silly Father and son are never identical—that surely is a structural 'fact'—so there is no need to worry about still higher abstractions, like 'man' and 'monkey' That the fanatical and ignorant attack on the theory of evolution should have occurred may be pathetic, but need concern us little, as such ignorant attacks are always liable to occur But that biologists should offer 'defences', based on the confusion of orders of abstractions, and that 'philosophers' should have failed to see this simple dependence is rather sad The problems of 'evolution' are verbal and have nothing to do with life as such, which is made up all through of *different* individuals, 'similarity' being structurally a manufactured article, produced by the nervous system of the observer

In my own practice, I have become painfully aware of a similar discrepancy in the learned *s r* of some older professors of biology, who quite often try to inform me that 'Life is overlapping', and that 'no sharp distinction between "man" and "animal" can be made' They forget or do not know that, structurally, actual 'life' is composed of *absolute individuals,* each one *unique* and different from all other individuals Each individual should have its individual name, based on mathematical extensional methods, for instance, $x_1, x_2, x_3, \quad x_n$, of Smith_1, Smith_2, or Fido_1, Fido_2, 'Man' and 'animal' are only labels for verbal fictions and are not labels for an actual living individual It is obvious that as these verbal fictions, 'man' and 'animal', are not the living individual, their 'overlapping' or 'not overlapping' depends only on *our ingenuity,* our power of observation and abstraction, and our capacity of coining *non-el* functional definitions

Let us see how adaption might work in practice Let us consider two or three caterpillars, which we may name C_1, C_2, C_3, since each of them is an absolute individual and different from the others Let us assume that C_1 is positively heliotropic, which means that he is compelled to go toward light, that C_2 is negatively heliotropic, which means that he would tend to go away from light, and that C_3 is non-heliotropic, which means that light would have no effect on him of a directional character At a certain age, C_1 would crawl up the tree near which he was born and so reach the leaves, eat them, and, after eating them, would be able to complete his development C_2, and probably C_3, would die, as they would not crawl up the tree toward sufficient food Thus, we see that among the indefinite number of possible individual make-ups of C_k ($k = 1, 2, 3, \ldots n$), each one being different, only those which were positively heliotropic would survive *under the conditions of this earth,* and all the rest would die The positively heliotropic would propagate and their positive heliotropism might be perpetuated, the negatively heliotropic and non-heliotropic becoming extinct This would only occur, however, in a world in which trees have roots in the ground and leaves on their parts toward the sun In a world where the trees grew with their roots toward the sun and leaves in the ground, the reverse would happen, namely, the negatively heliotropic and non-heliotropic would survive, and the positively heliotropic would die out We can not foretell whether, in such a world, there would be caterpillars, so this is an hypothetical example

Experiments made with such caterpillars have shown that the positively heliotropic ones crawl toward the sun, even upon a plant which has been turned over, with the roots toward the sun They crawl *away*

from food, and die We see that the external *environmental* conditions determine which characteristics survive, and so we reach the notion of adjustment

The practical result of these conditions is that the indefinite number of individual variations, although they undoubtedly exist, seldom come to our attention, as those variations which do not fit their environmental conditions become extinct, their variations do not become hereditary, and consequently we can seldom find them outside of a laboratory

This shows, also, the permanent connection and interdependence of the facts of nature The structural fact that our trees grow with their roots in the ground and their leaves upward is not an independent fact, it has something to do with the structure of the world and the position and the effect of the sun, So the fact that we have positively heliotropic caterpillars of a special kind, and not negatively heliotropic ones, has something to do with the structure of the rest of the world

To illustrate this interconnection and interdependence of nature still more clearly, let me suggest an hypothetical question How would conditions, as they are on this earth, compare with those which would obtain, if it were, let us say, one mile greater in diameter? Some try to guess the answer, yet this question cannot be answered at all The diameter of this earth is strictly dependent on all the structural conditions which prevail in this world Since it is impossible to know what kind of a universe it would be, in which this earth could be different from what we know, it is, of course, equally impossible to foresee whether on such a fictitious earth, in such a fictitious universe, there would even be life at all Because the structure of the world is such as we know it, our sun, our earth, our trees, our caterpillars, and, finally, ourselves have their structure and characteristics. We do not need to enter here into the problems of determinism versus indeterminism, as these problems are purely verbal, depending on our orders of abstractions, the 'logic' we accept, and so, finally, on our pleasure, as is explained more in detail later on, and could not be solved satisfactorily in an *A*, *el* system, with its two-valued 'logic'

According to the evidence at hand in 1933, 'Smith$_n$' appears among the latest inhabitants of this earth, and subject to the general test of survival, as already explained The few thousand years during which there had been any 'Smith$_n$' are too short a period to test, with any certitude, his capacity for survival We know of many species of animals, and also races of man, of which very little trace has been left. What we know about their history is mostly through a few fossils, which are kept in museums.

The external world is full of devastating energies and of stimuli too strong for some organisms to endure We know that only those organisms have survived which could successfully either protect themselves from over-stimulations or else were under protective circumstances If we look over the series of surviving individuals, paying special attention to the higher animals and man, we find that the nervous system has, besides the task of conducting excitation , the task of so-called 'inhibition' Response to stimuli, by survival, proved its usefulness But to diminish the response to some stimuli or avoid stimuli, proved also to be useful, again by survival It is known that the upper or latest layers of the nervous system are mostly such *protective* layers, to prevent immediate responses to stimulation With the development of the nervous system from the simplest to the most complex, we see an increase in behaviour of a modifiable or individually adjustable type In terms of *order,* and using the old language, 'senses' came first in order and 'mind' next, in all their forms and degrees

If we speak in neurological terms, we may say that the present nervous structure is such that the entering nerve currents have a natural direction, established by survival, namely, they traverse the brain-stem and the thalamus first, the sub-cortical layers next, then the cerebral cortex, and return, transformed, by various paths Experience and science in 1933 are showing that this is the order established under a heavy toll of destruction and non-survival in a system of adjustment, and so should be considered the 'natural' order, because of its survival value

We all know in practice about a 'sensation', and a 'mental picture' or 'idea' As 'sensations' were often very deceptive and, therefore, did not always lead to survival, a nervous system which somehow retained vestiges, or 'memories', of former 'sensations' and could recombine them, shift them , proved of higher survival value, and so 'intelligence' evolved, from the lowest to the highest degrees

Experience and experiments show that the natural order was 'sensation' first, 'idea' next, the 'sensation' being an abstraction of some order, and the 'idea' already an abstraction from an abstraction or an abstraction of higher order

Experience shows again that among *humans,* this order in manifestations is sometimes *reversed,* namely, that some individuals have 'idea' first, namely, some vestiges of memories, and 'sensations' next, without any external reason for the 'sensations' Such individuals are considered 'mentally' ill, in legal terms, they are called 'insane' They 'see', where there is nothing to see, they 'hear', where there is nothing to hear, they are paralysed, where there is no reason to be paralysed, they have pains,

when there is no reason to have pains, and so on, endlessly Their survival value, if not taken care of, is usually nil This reversal of order, but in a mild degree, is extremely common at present among all of us and underlies mainly all human misfortunes and un-sanity

This reversal of order in its mild form is involved in identification or the confusion of orders of abstractions, namely, when we act as if an 'idea' were an 'experience' of our 'senses', thus duplicating in a mild form the mechanism of the 'mentally' ill This implies nervous disturbances, since we *violate the natural (survival) order of the activities of the nervous system* The mechanism of *projection* is also connected with this *reversal of order* This reversal transforms the external world into a quite different and fictitious entity Both ignorance and the old metaphysics tend to produce these undesirable nervous effects of *reversed order and so non-survival evaluation* If we use the nervous system in a way which is against its survival structure, we must expect non-survival Human history is short, but already we have astonishing records of extinction

That such reversal of order in the manifestations of the functioning of the nervous system must be extremely harmful, becomes evident when we consider that in such a case the upper layers of our nervous system (the cortex) not only do not protect us from over-stimulation originating in the external world and inside us, but actually contribute to the over-stimulation by producing fanciful, yet very real, irritants Experiments on some patients have shown how they benefit *physically* when their internal energy is liberated from fighting phantoms and so can be redirected to fight the colloidal disturbances Such examples could be cited endlessly from practically every field of medicine and life This problem of 'reversal of order' is not only very important semantically, but also very complex, and it will be analysed further on

The reader should not miss the fact that an analysis in terms of *order* throws a new light on old problems, and so the scientific benefit of the use of such a term is shown But this is not all; the use of the term *order* has brought us to the point where we can see far-reaching practical applications of the knowledge we already possess, and of which we have not so far made any systematic use

We know that the activity of the nervous system is facilitated by repetition, and we can learn useful habits as easily as harmful In the special case of *s r* also we can train ourselves either way, though one may have useful survival value, the other being harmful, with no survival value The problem is again one of *order,* and, among others, a problem of extension and intension, as has already been mentioned several times

Section D Order and the problems of extension and intension.

The problems of extension and intension are not new, but have been treated as yet only casually by 'philosophers', 'logicians', and mathematicians, and it has not been suspected what profound, far-reaching, and important structural psycho-logical, semantic components they represent

At this point, to avoid confusion, a warning is necessary The problems with which we are dealing have never been analysed from the point of view of this work, namely, from that of structure So, naturally, all that has been accomplished in these fields is *over-simplified,* and leaves out vital characteristics Discrepancies have arisen between the structure of the old verbiage and that of the new Before it is possible to formulate the general theory of this work, it will be necessary to go ahead in spite of discrepancies, and then to formulate the general theory and show how these discrepancies had a perfectly *general* origin in the stratified—and, therefore, ordered—structure of human knowledge The discrepancies were inherent and *unavoidable* in the old way, but are avoidable in the new It is the main aim of the present theory to elucidate structural issues in connection with *s r* and many problems of human and scientific conduct, mathematics and insanity included, and, in general, with all known problems of scientific method and theory of knowledge But we ought not to be surprised if such a pioneering enquiry proves to need many corrections and elaborations in the future Psychiatrists are the least likely to disregard the problems of structure and *s r*, since their science is young and still flexible Besides, the psychiatrists know a great deal about 'human nature' and behaviour, though they are handicapped by insufficient knowledge of the exact sciences and the absence of $\bar{A}$, *non-el* semantics The opposite, perhaps, would be true about mathematicians They know a great deal about how to play with symbols Their work is engrossing and exacting But very few are capable of separating themselves enough from this play to contemplate the broader, more 'human', aspects of their own science, the interplay of symbols in language, their structure, and the bearing of structure on *s r* and adaptation

Some of these specialists might say that the author uses their terms in a sense different from that in which they use them, and that, consequently, from their point of view, this work is not strictly legitimate. However, when a mathematician lays down a definition, such as $1+1=2$, this has nothing to do with the *application* we make of it when we say that one penny and one penny make two pennies Neither can he object when we add one gallon (of water) to one gallon (of alcohol) and do

not obtain two gallons (of the alcohol-water mixture), but slightly less This last is a profound experimental fact, intimately connected with the structure of 'matter' and, therefore, of the world around us The mathematician has nothing to do with the fact that his *additive* definitions, important as they are, do not cover the facts of the world around us, which happens not to be additive in its more fundamental aspects.

Also, the mathematical definition, one and one make two, is *not* invalidated by such non-additive facts The mathematician does not claim, but rather disclaims, content in its formulae There is no mention of pennies or apples or gallons of alcohol, It is simply a definite language of definitive structure for talking about anything which *can* be covered If facts cannot be covered by given linguistic forms and methods, new forms, new structures, new methods are invented or created to cover the structure of facts in nature.

The mathematician created such a different language long ago He now calls his additive language 'linear', and the corresponding equations are of 'first degree' He calls his non-additive language 'non-linear' and the equations are of 'higher degrees'. These latter equations happen to be much more difficult than the former and of complex structure, so that very often they can be solved only by approximation to linear equations. Now, without anybody's fault, the world around us does not happen to be an additive affair in its more fundamental structural aspects Perhaps the most important and beneficial results of the new physical theories is that they point out this structural fact, and take it into consideration The reader should recall the example about the man-made green leaf and the non-man-made green leaf, which differ in structure, and he will understand how our additive tendencies are the result of our primitive state of development and of this projection of our anthropomorphic point of view on the world We reversed the natural order and imposed on the world the structure of our verbal forms, instead of the *natural order* of patterning the structure of language after the structure of the world

This digression was especially necessary before approaching the problem of 'extension' and 'intension' These have never been analysed from the point of view of structure and order, and whatever is known about them is taken for granted It is true that we hear now and then casual remarks that mathematicians had a predilection for extension and 'philosophers' for intension, but these true remarks are not further analysed

We usually forget that whenever a mathematician or a 'philosopher' produces a work, this involves his 'attitude', which represents an ex-

tremely complex psycho-logical *s r* of the organism-as-a-whole In most cases, these attitudes determine not only the character of our work, but also other reactions which make up our individual and social life Historically, the mathematicians have a steady record of achievement, and 'philosophers' (excluding epistemologists) one of uselessness or failure Has this record something to do with the extensional and intensional *attitudes?* In fact, it has It is easy to show that the extensional attitude is the *only one* which is in accordance with the *survival order and nervous structure,* and that the intensional attitude is the reversal of the natural order, and, therefore, must involve non-survival or pathological *s r*

One of the simplest ways of approaching the problems of 'extension' and 'intension' is perhaps to point its connection with definitions A collection may be defined, so we are told, by enumeration of its members as, for instance, when we say that the collection contains Smith, Brown, Jones, Or we may define our collection by giving a defining property' We are told that the first type of definitions which enumerates individual members is to be called a definition by *extension* the second, which gives a defining 'property', is to be called a definition by *intension*

We can easily see that a 'definition by extension' uniquely characterizes the collection, $Smith_1$, $Brown_1$, $Jones_1$, Any other collection, $Smith_2$, $Brown_2$, $Jones_2$, would obviously be different from the first one, since the individuals differ If we 'define' our collection by intension, that is, by ascribing some characteristic to each of the individuals, for instance, that they have no tails many collections of individuals without tails might be selected Since these collections would be composed of entirely different individuals, they would be entirely different, yet by 'intension', or defining characteristic, they all would be supposed to be one collection

Similar contrast exists between relations in extension, and relations in intension. These relations have been defined more or less as follows 'Intensional relations are relations of "concepts", *extensional relations are relations of denoted facts*' Or, 'relations of intension are those which are ascertainable *a priori,* a relation of extension is discoverable *only by inspection of the existent*' Or, 'intension covers the relations which hold for all the possible individuals, while *extension holds only for the existent*'. 'A relation of intension is one which is only discoverable by logical analysis, a relation of extension is one which is only discoverable by the *enumeration of particulars*', [4]

All that has just been said are perhaps standard definitions, but, for my purpose, they are profoundly unsatisfactory Because we have

had no better understanding of this most important question of order, a great deal of confusion has occurred in human 'thought' and many of our disciplines have become twisted in undesirable directions This, to a large degree, accounts for the obscurity which characterizes the problems we are dealing with in this book But it should be emphasized that even in this very unsatisfactory form, 'intension' and 'extension', as they were *felt and applied* (*s r*, largely disregarding the verbal formulations), have played an enormous role in the development of our forms of representation, and our 'civilization' Unfortunately, without an ordinal analysis, it was impossible to evaluate properly the relative importance of these semantic attitudes, and to realize the serious importance of these problems for a theory of sanity and resulting consequences

Here, again, the knowledge which psychiatry gives will help a great deal We know, in the rough, quite a little about two semantic mechanisms which are called extroversion and introversion In the rough, again, the extrovert projects all that is going on within himself upon the outside world, and believes that his personal projections have some kind of non-personal objective existence, and so have 'the same' validity and value for other observers As a result, quite naturally, the extrovert is due to receive a great many unpleasant shocks, for the other observer does not necessarily observe or 'perceive' in the external events the characteristics which the first observer 'finds' He has often projected them from his 'inside', but they were entirely personal The first observer, in his semantic conviction that his observations are the only, uniquely correct, observations, feels that the second observer is either blind in some way, or unfair to him In acute cases, he develops a mania of persecution He feels that everybody misunderstands him, nobody is fair to him, everybody is hostile to him, he will get even with them, in the name of 'justice', he will punish them, A dangerous and quite often incalculable bitterness and hostility follow Such types are usually troublesome, and, if the affective components are strong, then such types are dangerously ill and liable to produce bloodshed or make other attacks The most pronounced types in this extreme direction are called paranoids and paranoiacs

The introvert type is different He is mostly concentrated on what is going on inside of his own skin Almost all of what is going on outside of his skin, he interprets in personal terms and feelings Whatever unpleasant happens, he is always guilty, always willing to take the blame, which is quite often just, for many psycho-logical reasons upon which we cannot dwell here This type, in its extreme development, quite often

finds a solution in suicide. The most extreme cases are called 'dementia praecox' or 'schizophrenic' types.

In everyday experience, it is seldom that such clear-cut types as just described can be observed For the purpose of studying such extreme types, one has to do researches in asylums Even there we find a great number of mixed cases In daily life we find in practically everybody a *predominance* of one or the other of these types of *s r*, but in some the two types appear to be inextricably mixed Observations upon this problem among so-called 'normal' men is difficult, as they represent great complexities

It has been already mentioned that the well-balanced man, a man who has survival value, should be a well-balanced mixture of both tendencies, namely, an extroverted-introvert, or, if we wish, an introverted-extrovert As yet, these problems, no matter how important they may be, are beyond our educational methods, and only in acute cases are they taken care of by physicians, and then mostly in asylums It is important to have simple means to deal with these semantic problems in elementary education as a *preventive* method, or as a branch of semantic hygiene

Even this brief analysis shows how tremendously powerful the affective factors are which may be behind the unbalanced semantic attitudes The reader should not miss the fact that in both types, when well developed, there is material for an extreme amount of self-imposed suffering Then the nervous energy produced by the organism is absorbed in fighting phantoms, instead of being directed toward useful ends, such as regulating the normal activities of the organism, or fighting internal enemies, whereas, there should also be some energy left for activities and interests useful socially or for the survival of the race

While the majority of individuals present different degrees of prevalence of one mechanism over the other, yet fairly clear-cut cases are to be found The extreme complexity of the structure of the nervous system of man justifies the enormous number of degrees recognized So large, indeed, is this number of possibilities, that we have little difficulty in understanding that the individuality of every one is unique

Extroverted and introverted individuals are usually born such; at least, they usually have a predisposition to be the one or the other To what extent these tendencies can be aggravated or improved by education is not yet solved, and, indeed, has never been much bothered about To consider our activities merely as results of inborn tendencies is too narrow a view The human nervous system is not finished at birth, and it continues its development for some time after the birth of the child. So it is much more influenced by environmental conditions, the verbal

included, than is the nervous system of an animal The make-up of the individual is thus some function of different variables, among which the hereditary inclinations and the environmental conditions appear in a relation, at present, not fully known The individual *feels and acts* according to his complex make-up, including *acquired s r*, no matter what factors have played a role in its moulding, and, as a rule, he is little influenced by the way he rationalizes his activities From this point of view, we may consider that the extensional make-ups and intensional characters are bound to show themselves later on in life, no matter how the subject may have rationalized them, if his *s r* have not been modified

It seems evident that the extroverted and introverted tendencies have some connection with extensional and intensional types of reaction, but, of course, they are not identical They influence the individual in the selection of a profession, and in the preference for some special trend of activity Thus, mathematicians, generally, have an inclination toward extension, 'philosophers' toward intension Now, it is interesting to note that mathematicians have a record of continuous constructive progress, and at each epoch have produced the highest kind of language known Also, the most important achievements in the fields which traditionally belonged to 'philosophers' have actually been produced by mathematicians The 'philosophers', in the main, have a record of failure

The reason for this difference, which is too remarkable to be a mere coincidence, may be found by application of the term 'order' in our analysis *The extensional method is the only method which is in accordance with the structure of our nervous system as established by survival* Reversed intensional methods disorganize this normal mode of activity of the nervous system, and so lead toward nervous and 'mental' illnesses

As explained before, the structure of our nervous system was established with 'senses' first, and 'mind' next. In neurological terms, the nervous impulses should be received first in the lower centres and pass on through the sub-cortical layers to the cortex, be influenced there and be transformed in the cortex by the effect of past experiences In this transformed state they should then proceed to different destinations, as predetermined by the structure established by survival values We know, and let us remember this, that the reversed order in semantic manifestation—namely, the *projection into 'senses' of memory traces* or doctrinal impulses—is against the survival structure, and hallucinations, delusions, illusions, and confusion of orders of abstractions are to be considered pathological In a 'normal' human nervous system with *survival* value, the nervous impulses should not be lost in the sub-cortical

layers In such a case, the activity of our human nervous system would correspond to the activity of the less-developed nervous systems of animals which have no cortex at all It must be remembered, also, that the sub-cortical layers which have a cortex, as in man, are quite different from corresponding layers of those animals which have never developed a cortex. It is impossible to avoid the conclusion that survival values are *sharply* characterized by *adequacy,* and that animals without cortex have nervous systems adequate for their needs under their special conditions, otherwise, they would not have survived This applies, also, to those animals who have a cortex Their activities for survival depend on this cortex, and when the cortex is removed, their activities become inadequate Their sub-cortical layers alone are not adequate to insure survival For survival, such animals must use not only their lower centres and their sub-cortical layers, but also their cortices

Among animals, as all evidence shows, the enormous majority have, without human interference, nervous systems working usually in the 'normal' way, that is, according to the survival structure 'Insanity' and kindred nervous disturbances are known only among ourselves (however, see Part VI) Apparently, the cortex, through its enormous internal complexity, which provides many more pathways, and through its complex interconnections, which offer many more possibilities, with a greater number of degrees of 'inhibition', of excitability, of delayed action, of activation , introduces not only a much greater flexibility of reaction, but, through this flexibility, a possibility for abuse, for reversal of manifestations, and so for a deterioration of the survival activity of the nervous system as-a-whole. The sub-cortical layers and other parts of the brain of man are different from the corresponding parts of the animal brain, which has a less-developed cortex The nervous system works as-a-whole, and the anatomical homology of the parts of different nervous systems is a very inadequate, perhaps even a misguiding, foundation for inferring *a priori* the *functioning* of these systems, which ultimately depend not only on the macroscopic but also on the microscopic and sub-microscopic structures For instance, we can cut off the head of some insects, and they go along quite happily and do not seem to mind the operation much But we could not repeat this with higher animals. The behaviour is changed A decorticated pigeon behaves differently from a decorticated rat, though neither of them seems affected greatly by the operation A decorticated dog or ape is affected much more Man is entirely changed None of the higher types is able to survive long if decorticated

There is on record the medical history, reported by Edinger and Fischer, of a boy who was born entirely without cerebral cortex There

were apparently no other important defects. This child never showed any development of sensory or motor power, or of 'intelligence', or signs of hunger or thirst During the first year of his life, he was continually in a state of profound stupor, without any movements, and from the second year on, until his death (at three years and nine months), was continually crying [5]

Although many animals, for instance fishes, have no differentiated cortex, yet their nervous system is perfectly *adequate* for their lives and conditions But in a more complex nervous system, the relative functions of different parts of the brain undergo fundamental transformation In the most complex nervous system, as found in man, the older parts of the brain are much more under the control of the cerebral cortex than in any of the animals, as is shown in the example above The absence of the human cortex involves a much more profound disturbance of the activities of the other parts of the brain Since the cortex has a profound influence upon the other parts of the brain, the insufficient use of the cortex must reflect detrimentally upon the functioning of the other parts of the brain The enormous complexity of the structure of the human brain and the corresponding complexity of its functioning accounts not only for all human achievements, but also for all human difficulties It also explains why, in spite of the fact that our anatomy differs but little from that of some higher animals, veterinary science is more simple than human medicine

Because of the structure of the nervous system, we see how the completion of one stage of the process which originated by an external stimulus (A) and has itself become a nervously elaborated *end-product* (B), may, in its turn, become the stimulus for a still further nervously elaborated *new end-product* (C), and so on When association or relation neurons enter, the number of possibilities is enormously increased

It must be emphasized that A, B, C., are, fundamentally, entirely *different* For instance, the external event A' may be a falling stone, which is an entirely different affair from the pain we have when this stone falls on our foot It thus becomes clearer what is meant by a statement that the 'senses' abstract in their own appropriate way, determined by survival value, the external events, give these abstractions their special colouring (a blow on the eye gives us the feeling of *light*), discharge these transformed stimuli to further centres, in which they become again abstracted, coloured, transformed,. The end-product of this second abstracting is again an entirely different affair from the first abstraction

Obviously, for survival value, this extremely complex nervous system should work in complete co-ordination. Processes should pass the

entire cycle If not, there must be something wrong with the system. The activities of the organism are then regressive, of lower order, a condition known as 'mental' illness The gross anatomical divisions of the nervous system should not be relied upon too much as an index of function Perhaps these anatomical speculations are even harmful for understanding, because they falsify the facts, emphasize the macroscopic similarities unduly and disregard subtle yet fundamentally important microscopic and sub-microscopic structures and differences, which are perfectly manifest in the functioning, but which are difficult to observe directly on their level

The term 'abstracting' is a multiordinal term, and hence has different meanings, depending on the order of abstractions It is a functional term and, to indicate the differences in meanings, it is necessary to indicate the different orders It is structurally a *non-el* term, built upon the extensional mathematical pattern x', x'', x''' , or x_1, x_2, x_3, x_n, or x_k ($k = 1, 2, 3, \quad n$) This allows us to give the term 'abstracting of different orders' a perfectly *unique* meaning in a given problem and yet to keep in a fluid state its most important *functional implications* Something similar happens when the mathematician discusses his x_n No one can miss the fact that he deals with a variable which can take n values, so this symbol has a quite definite descriptive structural and semantic value So has the 'abstracting of different orders'.

It is desirable to introduce consciously and deliberately *terms* of a *structure* similar to the *structure* of human knowledge, of our nervous system, and of the world, involving appropriate $s\,r$ Multiordinal terms are uniquely appropriate, since they take their ∞-valued structure from the structure of events (1933) and do not reflect their older, one-valued, false to fact character on the events (Note the order)

Now we are ready to reformulate the problem of extension and intension in terms of *order.*

If the natural survival order is lower abstractions first and higher next, then extension starts with absolute individuals, and conforms to the proper survival order Extension recognizes the uniqueness, with corresponding one-value, of the individual by giving each individual a unique name, and so makes confusion impossible Training in $s\,r$ of sanity becomes a possibility, and order becomes paramount Extension and order cannot be divided When we speak about 'order', we imply extension, and, when we speak about extension, order is implied That modern mathematics and mathematical 'logic' has so much to do with order, as to make this term fundamental, is a necessary consequence of the extensional method which starts with unique individuals, labels them

by unique names and only then generalizes or passes to ∞-valued higher order abstractions like 'numbers'. The direction of the process of abstraction is here in the survival order, from lower abstractions to higher. It hardly needs to be emphasized that, to the best of our knowledge in 1933, it is the only possible way to follow the natural order and to evade reading into a fundamentally one-valued external event, our older *undifferentiated* ∞-valued fancies (which happens if the process is reversed in order) involving powerful factors in our *s r*

Intension means structurally the reversal of the survival order, since it starts with undifferentiated ∞-valued higher abstractions and distorts or disregards the essential one-values of the individuals and reads into them as *uniquely* important undifferentiated ∞-valued characteristics

Historically, mathematicians have had a predilection and, because of the character of their 'element' (numbers) and their technique, a structural necessity, for the use of extensional methods It does not need much imagination to see why they have produced results of utmost (although relative) importance and validity at each date

'Philosophers' and reasoners of that class have had a predilection for intension, and this also explains why, in spite of tremendously acute verbal exercises, they have not produced anything of lasting value, for they were carried away by the structure of the language they used This predilection being already based on the reversal of the survival order, it was bound to lead in the less-resistant individuals to nervous and 'mental' defects

The issues, as presented here, are very clear-cut, and, in fact, too clear-cut, as we have disregarded for the present the *cyclic* order of the nervous process This last fact first abolishes the sharp distinction between 'pure' extension and 'pure' intension, each process never being 'pure', but always 'impure', one influencing the other. 'Pure' intension and 'pure' extension are delusional, to be found only in 'mentally' ill, with no survival value This explains why we have to use the terms of *preference* and *order* Without these terms I would not have been able to carry through this analysis at all This reversal of order in *s r* implies different distribution, diffusion, intensity of nerve currents in the submicroscopic field, and so involves important, different semantic components of non-survival value It is most desirable to learn to control the activities on the sub-microscopic level by means of training on the macroscopic level, if means to do this can be devised

The writer is not at all convinced that, acting as we do under the spell of intensional and ignorant 'philosophers', the existing systems and educational methods are not largely following the reversal of the sur-

vival order of our nervous processes It seems unnecessary to point out that a structural and semantic enquiry on this particular question might be important and beneficial It seems, without much doubt, that human institutions and activities should be in accord with 'human nature', if we are to expect them to survive without crushing us, and a scientific enquiry in this 'human nature' would be not only desirable but exceedingly important

The reader, with the help of another person, should perform a very simple experiment Let the assistant select secretly a dozen newspaper headlines of letters of equal size Let the reader then sit in a chair without altering his distance from the assistant and let the assistant show him one of these headlines If he is able to read the headline, it should be rejected, and a new one selected by the assistant and put a foot or more farther away If this one is read correctly, it should be rejected, and a third one placed still farther away By such trials we can finally find a distance which is slightly greater than the maximum range of clear visibility for the reader, so that, although the headline is only slightly beyond the distance at which one could read it, yet it would be illegible Let the reader then try as hard as possible to read headlines which are just beyond his visual range When he is convinced that he cannot read the headline, let the assistant *tell* him the content of it Then the sitter can usually *see* with his *eyes* the letters, when he *knows* what is supposed to be there The question arises, what part in the 'seeing' is due to 'senses', and what to 'mind'? The answer is, that, structurally, the 'seeing' is the result of a cyclic *interdependent* process, which can be *split only verbally* The independent elements are fictitious and, structurally, have little or nothing to do with actual facts The human nervous system represents, structurally, a mutually interdependent cyclic chain, where each partial function is in the functional chain, together with enforcing and 'inhibiting', and other mechanisms

Up to this stage, we have used the term 'cyclic order', but, in reality, the order is *recurrent,* though of a character better described by the 'spiral theory', as explained in my *Manhood of Humanity* on p 233 In the 'spiral theory', we find the foundation for this peculiar stratification in levels and orders, which is necessitated by the structure and function of the human nervous system It should be noticed that the equations of the circle and spiral are non-linear, non-plus equations

The above relation underlies a fundamental mechanism, known in psychiatry as 'sublimation', in which, and by which, quite primitive impulses, without losing their intensity and fundamental character, quite often are transformed from very primitive levels, which frequently

represent vicious and anti-social effects, into desirable characteristics, socially useful Thus, a sadistic impulse may be sublimated into the socially useful vocation of the butcher, or, still further, into the skill and devotion to the service of their fellowmen, shown by many surgeons We see that this mechanism is of tremendous importance, and responsible for what we call 'culture' and many other values Our educational methods should understand this mechanism and apply this knowledge in the semantic training of youth It is important to realize that this mechanism appears as the only semantic mechanism of correction which is in accord with the structure of the human nervous system, and so it seems workable Various metaphysical preachings usually start by disorganizing the proper survival working of the human nervous system, and then we wonder that they fail, and that we cannot change 'human nature' To deal with 'human nature', which is not something static and absolute, we need to approach it with more structural understanding and less prejudice Then, and then only, can we eventually look for better semantic results

[1] The writer does not want the reader to conclude that, because in mathematics we have followed the survival order through extension, the mathematicians must, by necessity, be the sanest of the sane Quite often this is not true, since many complexities exist which will be taken under analysis later.

Section E Concluding remarks on order

One thing remains fundamental, namely, that the problems of order and extension are of paramount structural importance for sanity and our lives They should be worked out and applied to the semantic training of the young in elementary education, This would certainly produce a new generation saner than we are, and one which would, perhaps, lead lives less troubled than our own, and so, perhaps, of better survival value

To appreciate fully the immensity of the task of a more detailed analysis of the problems of 'extension' and 'intension', the reader is advised to read the *Survey of Symbolic Logic*, by Professor C. I Lewis, University of California Press, 1918, in which Chapter V is devoted to an important attempt at a formulation of strict implication of *both* extensional and intensional character, which is the *only* organism-as-a-whole, *non-el* possibility Lewis's theory of 'strict implication' introduces the notions of *impossible* propositions and so throws considerable light on the problem of non-sense, a light which is very seriously needed

In concluding, it must be mentioned that a theory of *sanity*, because of the survival value of *order*, cannot *start* with the older, undifferentiated similarities, which are a product of *higher* abstractions, and thus of later origin, but *must* start with *differences* as fundamental, and so preserve the structure and order of the survival trend as applied in this work

Animals do not possess such a highly differentiated nervous system as human beings The difference between their higher and lower abstractions is thus not so fundamental, as we shall see later on With them the question of *order* is less important, as they cannot alter it Animals have the benefit of better co-ordination, since in them the above-described structural difficulties do not arise They have normally no 'insane' But, also, for the same reason, animals are not able to start every generation where the older left off. In other words, animals are not time-binders

The structural complexity and differentiation of the nervous system in man is responsible, as is well known, not only for all our achievements and control over the world around us, but also for practically all our human, mostly semantic difficulties, many 'mental' ills included The analysis in terms of *order* on the macroscopic level (semantic manifestations) reveals a profound connection with sub-microscopic processes of distribution , of nervous energy When the mechanism which controls these processes is properly understood, then they can be controlled and educated by special semantic training In other words, theoretical, doctrinal, higher abstractions may have a stabilizing and regulating *physiological* effect on the function of our nervous system

The reader may be interested to know that 'order' is very important in animal life An analysis of nest-building and the rearing of young among birds shows that each step of the cycle is necessary before the next step is taken. If the cycle is broken, they usually cannot adjust themselves to the new state of affairs, but must start from the beginning [6] This is a situation similar to our own when we cannot recall a line in a poem, but have to start from the beginning of the piece in order to recapture it Pavlov was able, by the change of four-dimensional order of stimuli, to induce profound nervous disturbances in the nervous systems of his dogs ,

It appears, also, that in mild cases of aphasia, which is a neurological disturbance of linguistic processes, with word-blindness, word-deafness , the notion of 'order' and 'relations' is often the first to be disturbed In some cases, lower order abstractions are carried out successfully, but calculation, algebra, and other higher order abstractions, which require

ordered chains, become impossible The aphasic seems to have a general incapacity for grasping *relations,* realizing *ordered series,* or grasping their succession [7]

We see that the problems of *order* are somehow uniquely important, and so the investigation of the psycho-logics of mathematics, which is based on *order,* might give us means of at least partial control of different undesirable human semantic afflictions.

But, after all, we should not be surprised that it is so The structure of nervous systems consists of *ordered* chains produced by the impact of external and internal stimuli in a four-dimensional space-time manifold, which have a spatial and also a temporal *order.* The introduction of the finite velocity of nerve currents, which, although known, was, as a rule, disregarded by all of us, introduces automatically our *ordering* in 'space' and 'time' and, therefore, in space-time That is why the old anatomical three-dimensional analogies are vicious and false to facts when generalized For better or worse, we happen to live in a four-dimensional world, where 'space' and 'time' cannot be divided Whoever does this splitting must introduce fictitious, non-survival entities and influences into his system, which is moulded by this actual world and unable to adjust itself to fictions.

It seems obvious that all these problems of 'adjustment' and 'non-adjustment', 'fictitious' or 'actual' worlds , are strictly connected with our *s r* toward these problems, and so ultimately with some structural knowledge about them But *attitudes* involve lower order abstractions, 'emotions', affective components, and other potent semantic factors which we have usually disregarded when dealing with science and with scientific problems and method. For adjustment, and, therefore, for *sanity,* we must take into account the neglected aspects of science, of mathematics, and of scientific method, namely, their semantic aspects In this way we shall abandon that other prevalent structural fiction referred to at the beginning of the present chapter, namely, that science and mathematics have an *isolated* existence

The above considerations of order lead to a formulation of a fundamental principle (a principle underlying the whole of the *non-aristotelian system*) , namely, that organisms which represent *processes* must develop in a certain *natural survival four-dimensional order,* and that the *reversal* of that order must lead to pathological (non-survival) developments Observations disclose that, in all human difficulties, 'mental' ills included, a *reversal of the natural order* can be found as a matter of fact, once we decide to consider order as fundamental Any identification of inherently different levels, or confusion of orders of abstractions, leads auto-

matically to the reversal of natural order As a method of preventive education and psychotherapy, whenever we succeed in reversing the reversed order or restoring the natural survival order, serious beneficial results are to be expected These theoretical conclusions have been fully justified by experience and the work of Doctor Philip S Graven in psychotherapy. It should be noticed that different primitive 'magic of words', or modern 'hypostatizations', 'reifications', 'misplaced concreteness', 'objectifications' , and all semantic disturbances represent nothing else but a confusion of orders of abstractions, or identifications in value of essentially different orders of abstractions

The above considerations are entirely general, but, because of their novelty, they have not, as yet, been applied in the *non-aristotelian* simple and workable form to psychiatry or education In a very instructive paper on *The Language of Schizophrenia*,[8] Doctor William A White applies some of these notions Because of the method of approach, I will quote from this paper It should be understood that this paper deals, also, with other issues, and the quotations do not do justice to the author, because I quote only those passages which are of particular interest here, omitting the literature given by Doctor White The italics and one footnote are mine

'It requires but a moment's serious consideration to realize that the subject of schizophrenic language must be immense if for no other reason than that it involves an understanding of the whole subject of language of which it is but a part The extent and depth of the subject of language may be further appreciated from the fact that the single feature of its neuronic background as it is brought to attention in aphasia constitutes one of the most complex problems in the whole field of neurology and one with respect to which we are still hopelessly ignorant, especially when the enormous amount of work that has been done in this field is considered . .

. . . . . .

'There have been a few other recent contributions to the subject of schizophrenic thought and speech which, as they run more in line with my own thinking on the subject, I will refer to more fully These studies *equate the processes of thinking of schizophrenic persons with those of primitive peoples and of children*

. . . . . .

' In the archaic thinking of a prelogical kind, found among primitive savage races, the vividness of the images is greater than among more highly developed races, and the effect produced in the observer is projected and believed to be an inherent attitude of the object, which thus acquires a "demonic" character All things which arouse a similar emotion are thought of as being actually the same In dementia praecox there is a similar loss of objectivity, hallucinations and reality are imperfectly distinguished, and every happening has a meaning and effect on the observer, the idea of an action produces the action directly, instead of offering a possibility of action, and this is interpreted as a compulsion from without Paralogical thinking is a stage beyond this, identification of objects is based on similarities, differences being neglected This form of thought is common in dementia praecox.

. . . . . .

' While for the normal person the chief criterion of the world of real objects is their independence of him, whereas imaginary things depend for their

existence on him, the general characteristic of the schizophrenic patient's experience is that his mental and imaginary experiences have a substantial and concrete nature when the normal person would see only symbols and analogies His thoughts have magic power and can produce real results, they have for him a substance and he can manipulate them physically

. . . . . .

'Many other childish manifestations resemble those of schizophrenic persons children's jokes, tricks, and plays in words have a similar autistic character, with no apparent meaning in relation to actualities, and this changes at puberty Children, like the patients, love to make up a sort of neoplastic language of their own, having meanings known only to themselves or their immediate circle Perseveration and stereotypy in speech and actions are often observed in children Their musical performances show the same mechanical rendering, and the same preference for simple melodies and rhythms as are found in schizophrenic patients

. . . . . .

'Just in the same way we must be careful *not to equate* the regressive psychotic and the primitive *too literally* That there are close analogies in their respective ways of thinking there is no doubt and that the recognition of these analogies has been of the utmost importance in enabling us to understand schizophrenic thinking must be acknowledged but perhaps, to be on the safe side, the matter should rest there for the present at least

. . . . . .

'Another point should be made at this time, after what has been said of the loss of the boundaries of the ego, its indefiniteness, etc These expressions are apt to be equated, if we do not think carefully, with such concepts as disintegration and dementia We must not lose sight of the magic of words and not be led astray by the old meanings when we are striving for new ones but are forced to use the words in current use Now regression to a childish or primitive level of this sort, which is what occurs in those conditions in which the ego is said to lose its clearness of definition, does *not imply disintegration* in the sense of disorder *but regression* to a different kind of order or, as my friend Korzybski would say, *to a lower order of abstraction*

'This is important for a *principle* is embodied in the nature of this change .

. . . . . .

'This *principle,* namely, that the schizophrenic thought processes and language are of a *lower order of abstraction,* accounts, in part at least, for another phenomenon If by a process of regression the mechanisms of thinking tend to ever more primitive levels then we should expect them ultimately to arrive at a concrete perceptional level, and when this occurs hallucinations, which have long been regarded as evidence of the schizophrenic splitting, come into the picture While I believe that there must be other factors to account for the hallucinations they are at least to be expected as the natural outcome of regression—as are the forms of thought already referred to

'It comes about, therefore, that we cannot understand the language of the schizophrenic patient without the aid of these principles, because the language of a lower level of psychologic development, or a lower order of abstraction, must remain unintelligible to those who think in the terms of higher levels The whole problem of the understanding of the psychoses, from this point of view, might be well considered as the problem of the translation of the language of the psychoses

. . . . . .

'Summary and Conclusions

'1 A complete understanding of the language of schizophrenia would imply an understanding of language in general of which schizophrenic language is only a part This would further imply an understanding of thought in general of which language is largely an expression Because of its extent this program is quite impossible, but certain principles need to be clearly in mind in order to avoid taking over, in any attempt to understand the language of schizophrenia, certain misconceptions in both of these territories which are still rife, not having been as yet fully replaced by the newer ways of thinking about the matters involved

'2 There is one psychiatric assumption I have made and which is fundamental to my approach to the problem of the language of schizophrenia It is that schizophrenia is a regression psychosis This is of the greatest importance for, if it is true, we should expect to find in the thinking and in the language of schizophrenic patients characteristics of earlier stages of development, earlier genetic levels

'3 The development or evolution of thought and speech, the assumption of genetic levels, implies that there must be a *law in accordance with which this development proceeds* This law is that thought and language in their development change from feeling, concreteness and perception in the direction of reasoning, differentiation and abstraction

'4 The law of schizophrenic thought and language must be the *reverse of the law for their development,* on the assumption that schizophrenia is a regression psychosis

'5 *This reversal of the law of development implies results that are very different from those implied in the old terms "disintegration" and 'dementia"*

'6 This *reversal* can be briefly and simply indicated The language of schizophrenia is of a lower order of abstraction than normal adult language

. .

'7 The thinking and the speech of schizophrenia while of a *lower order of abstraction* nevertheless make use of words which we are accustomed to use to express a higher order This *discrepancy* is one reason why such language is so hard for us to understand Another reason for our difficulty in understanding the schizophrenic patient is that while some of his symbols are of a lower order of abstraction by no means all of them are so that there is a *strange mixture* which further confuses our understanding Still another difficulty is due to the magic of words * We are still far from free of this influence and are therefore forced to think that when there is a word there must be a thing corresponding to it and also forced to think of the wording as necessarily meaning what it usually has meant in our experience

'8 *The reversal of the law of development* in schizophrenia also accounts in part at least, for hallucinations which have long been regarded as signs of the schizophrenic splitting Regression must lead ultimately to concrete perceptional configurations and all that that implies

. .

'12 For the understanding of the language of schizophrenia, therefore, the whole dynamic situation needs to be comprehended The main obstacle to this understanding has been, in the past, the magic of words * .'

Identification, or the confusion of orders of abstractions, in an *aristotelian* or *infantile* system, plays a much more pernicious role than the present official psychiatry recognizes *Any* identification, at *any* level, or of *any* orders, represents a non-survival *s r* which leads invariably to the reversal of the natural survival order, and becomes the foundation for *general* improper evaluation, and, therefore, *general* lack of adjustment, no matter whether the maladjustment is subtle as in daily life, or whether it is aggravated as in cases of schizophrenia A *non-aristotelian system,* by a complete elimination of 'identity' and identification, supplies simple yet effective means for the elimination by preventive education of this general source of maladjustment Book II is entirely devoted to this subject

*['Magic of words' represents only a minor yet very complex manifestation of *aristotelian s r* of identification and, naturally, exhibits, also, the reversed natural order in evaluation —A K]

CHAPTER XIII

ON RELATIONS

To be is to be related. (266) CASSIUS J KEYSER

Science, in other words, is a system of relations (417) H POINCARÉ

Asymmetrical relations are involved in all series—in space and time, greater and less, whole and part, and many others of the most important characteristics of the actual world All these aspects, therefore, the logic which reduces everything to subjects and predicates is compelled to condemn as error and mere appearance (453) BERTRAND RUSSELL

My own investigations in this field, extending over some fifteen years, together with the facts already at hand, as I see them, have forced me to the conclusion that the organic individual is fundamentally . . a system of relations between a physical substratum or structure and chemical reactions. (90) CHARLES M CHILD

The thalamus, which in the lower vertebrates deprived of the cortex ensures the general reactions of the organism and the elementary mental functions, possesses an affective excitability in relation with the profound biological tendencies of the organism, among the higher mammals, indeed, it seems to preserve this rôle of affective regulation, whose importance in the behaviour of the organism and mental life is so often misunderstood (411) HENRI PIÉRON

organic impressions ('interoceptive' sensibility) appear in all cases to arrive at the cortex only when translated by the thalamus, with its own affective elaboration (411) HENRI PIÉRON

Nevertheless, the consuming hunger of the uncritical mind for what it imagines to be certainty or finality impels it to feast upon shadows in the prevailing famine of substance (22) E T BELL

In the foregoing chapters I made use of an expression, 'the organism-as-a-whole', which is employed continually in biology, psychiatry, and other branches of science This expression is a restricted form of the general structural principle of non-elementalism This expression implies that an organism is *not* a mere algebraic *sum* of its parts, but is *more* than that, and must be treated as an integrated whole It was mentioned that the non-additivity and the 'more' than a mere 'sum' are complex problems which call for a new method of analysis We have already seen that a simple analysis of the expression, 'Smith kicks Brown', involves a full-fledged structural metaphysics, or set of assumptions and terms which are taken on faith, since they cannot be defined, except circularly In the present chapter, these subjects of great semantic importance will be developed further

One of the fundamental structural defects and insufficiencies of the traditional *A*-system was that it had no place for 'relations', since it

assumed that everything could be expressed in a subject-predicate form. As we shall see, this is not true. Restriction to the subject-predicate form leaves out some of the most important structural means we have for representing this world and ourselves and has resulted in a general state of un-sanity The explicit introduction of 'relations' is rather a recent innovation A few words may be said about them, although the term 'relation' is one of the terms that we may accept as undefined, or that we may define in terms of multi-dimensional order

Some relations, when they hold between A and B, hold also between B and A Such relations are called *symmetrical* For instance, the relation 'spouse' If it holds between A and B, it holds also between B and A If A is the spouse of B, B is the spouse of A Terms like 'similarity' and 'dissimilarity' also designate relations of this kind If A is similar or dissimilar to B, so is B similar or dissimilar to A In general, a symmetrical relation is such that, if it holds between A and B, it also holds between B and A In other words, the *order* in which we consider the relation of our entities is immaterial

It is easy to see that not all relations are of such a character For instance, in the relation 'A is the brother of B', B is not necessarily a brother of A, because B might be the sister of A In general, relations which hold between A and B, but not necessarily between B and A, are called *non-symmetrical* In these relations *order* becomes important It is not a matter of indifference in what *order* we consider our entities

If a relation is such that, if it holds between A and B, it *never* holds between B and A, it is called *asymmetrical.* Let us take, for instance, the relations 'father', 'mother', 'husband', We readily see that if A is a father, or mother, or husband of B, B is *never* a father, or mother, or husband of A The reversal of *order* is impossible in asymmetrical relations, and so any asymmetrical relation establishes a definite order

Relations such as *before, after, greater, more, less, above, to the right, to the left, part,* and *whole,* and a great many others of the most important terms we have, are asymmetrical The reader may easily verify this for himself For instance, if A is *more* than B, B is *never* more than A, We see at once that the troublesome little words, which are necessary to express *order* as 'before' and 'after'; terms of *evaluation,* such as 'more' and 'less', and terms on which elementalism or non-elementalism depends, such as 'part' and 'whole', are in the list of asymmetrical relations

Relations can be classified in another way, when three or more terms are considered Some relations, called *transitive,* are such that, whenever they hold between A and B and also between B and C, they

hold between A and C For example, if A is before, or after, or above, or more , than B, and B is before, or after, or above, or more , than C, then A is before, or after, or above, or more , than C

It should be noted that all relations which give origin to series are transitive But so are many others In the above examples, the relations were transitive and asymmetrical, but there are numerous relations which are transitive and symmetrical Among these are relations of equality, of being equally numerous,

Relations which are not transitive are called non-transitive For instance, dissimilarity is not transitive If A is dissimilar to B, and B dissimilar to C, it does not follow that A is dissimilar to C

Relations which, whenever they hold between A and B, *never* hold between A and C are called *intransitive* 'Father', 'one inch longer', 'one year later' , are intransitive relations

Relations are classified in several other ways, but, for our purpose, the above will be sufficient

It is necessary now to compare the relational forms with the subject-predicate form of representation, which structurally underlies the traditional A-system and two-valued 'logic'. The structural question arises whether all relations can be reduced to the subject-predicate forms of language

Symmetrical relations, which hold between B and A whenever they hold between A and B, seem plausibly expressed in the subject-predicate language A symmetrical and transitive relation, such as that of 'equality', could be expressed as the possession of a common 'property' A non-transitive relation, such as that of 'inequality', could also be considered as representing 'different properties' But when we analyse *asymmetrical* relations, the situation becomes obviously different, and we find it a structural impossibility to give an adequate representation in terms of 'properties' and subject-predicates

This fact has very serious semantic consequences, for we have already seen that some of the most important relations we know at present belong to the asymmetrical class For example, the term 'greater' obviously differs from the term 'unequal', and 'father' from the term relative' If two things are said to be unequal, this statement conveys that they differ in the magnitude of some 'property' without designating the greater We could also say that they have different magnitudes, because inequality is a symmetrical relation, but if we were to say that a thing is unequal to another, or that the two have different magnitudes, when one of them was greater than the other, we simply should *not give an adequate account of the structural facts at hand* If A is greater than

B, and we merely state that they are unequal or of different magnitudes, we *imply the possibility* that B is greater than A, *which is false to facts.* To give an adequate account, and to prevent *false implications,* there is no other way than to say which one is greater than the other We see that it is impossible to give an *A adequate* account when asymmetrical relations are present The possession of the 'same' 'property', or of different 'properties', are both *symmetrical relations* and seem covered by the subject-predicate form But it is impossible to account adequately for asymmetrical relations in terms of 'properties' In other words, we see that a language and 'logic' based upon subject-predicate structure may perhaps express symmetrical relations, but fail to express adequately asymmetrical relations, because both 'sameness' and difference of predicates are symmetrical [1] Asymmetrical relations introduce a language of *new structure,* involving new *s r* Yet asymmetrical relations include many of the most important ones They are involved in all *order,* all *series,* all *function,* in 'space', in 'time', in 'greater' and 'less 'more' and 'less', 'whole' and 'part', 'infinity', 'space-time', If we are restricted to the use of forms of representation unfitted for the expression of asymmetrical relations, ordinal, serial, functional, and structural problems could not be dealt with adequately We should also have many insoluble semantic puzzles in connection with 'space', 'time', 'cause and effect', and many other relations in the world around us, and ourselves

A very interesting structural and semantic fact should be noticed that in symmetrical relations *order* is immaterial, in non-symmetrical relations it is important, and in asymmetrical relations *order* plays an all-important role and cannot be reversed Order itself is expressed in terms of asymmetrical relations, as, for instance, 'before' or 'after', which apply to 'space', to 'time', 'space-time', 'structure' , and also to *all processes* and activities, the activities of the nervous system included The asymmetrical relations 'greater', 'father' , imply ordering, while the 'unequal' (having different 'properties') or a 'relative' , do *not* imply ordering If we consider subject-predicate forms as expressing a relation between the 'observer' and the 'observed', excluding humans this last relation is also asymmetrical Applying correct symbolism if a leaf appears green to me, I certainly do not 'appear green' to the leaf ! The last remark suggests that any A revision of the A-system is structurally impossible To attempt a revision, we must begin with the formulation of a $\bar{A}$-system of different structure

The above simple considerations have very far-reaching consequences, as without relations, and particularly without asymmetrical relations, we cannot have *order,* and without order, in the analysis of

processes, we are bound to introduce explicity or implicitly some objectively meaningless 'infinite velocities' of the propagation of the process Thus, the 'infinite velocity' of light, which is known to be false to facts, is at the very foundation of the N-system The equally false to facts silent assumption of the 'infinite velocity' of nerve currents underlies A animalistic 'psychology' and results in elementalism This *el* 'psychology', until this day, vitiates all human concerns and even all science, the newer quantum theories not excluded

General non-elementalism and, in particular, its restricted aspect, the 'organism-as-a-whole', implies the relation of the 'parts' to the 'whole', for which we need asymmetrical relations In the statement '*more* than an algebraic sum', 'more' is also an asymmetrical relation When we analysed the statement, 'Smith kicks Brown', we saw that the problems of 'space', 'time', 'infinity' , entered, the solution of which requires *serial* notions, which evade analysis without asymmetrical relations

The solution of the problems of 'space' and 'time' are fundamental for a theory of sanity, as they are potent structural factors in all $s\,r$ In the majority of 'mentally' ill, we find a disorientation as to 'space' and 'time' Similar milder forms of disorientation appear in all forms of semantic disturbances, as they are disturbances of evaluation and meanings in the form of delusional 'absolute space' and 'absolute time' These semantic disturbances can be eliminated only by considerations of multi-dimensional order, which are impossible without asymmetrical relations, and so could not have been accomplished in an A-system

The problems of multi-dimensional order and asymmetrical relations are strictly interdependent and are the foundation of structure and so of human 'knowledge', and they underlie the problems of human adjustment and sanity Without going into details, I shall suggest some relational and ordinal aspects as found in the structure and function of the human nervous system and their bearing on semantic reactions and sanity I shall also apply these considerations to the analysis of a historically very important delusional factor which has influenced, until now, the $s\,r$ of mankind away from sanity I am dealing only with selected topics, important for my purpose, which, to the reader, may appear one-sided and unduly isolated In fact, all issues involved are strictly interconnected in a circular way, and no verbal analysis of objective levels can ever be 'complete' or 'exhaustive', and this should be remembered On the A silent assumption of the infinite velocity of nervous impulses, that the nervous impulses spread 'instantaneously', 'in no time' (to use an Alice-in-Wonderland expression), order was of no importance. But when we take into account the *finite* and known velocity

of nervous impulses, and the *serial,* chain structure of the nervous system, order becomes paramount In such a serial structure, the problems of resistance, 'inhibitions', blockage, activation , become intelligible, so that some sane orientation is possible in this maze It may be added that the intensity and the transformation of nervous impulses must somehow be connected with the paths they travel and are, therefore, problems to be spoken about in terms of order

What has just been said may be illustrated by a rough and oversimplified hypothetical diagram Fig 1 shows how the normal (survival in man) impulse should travel It should pass the thalamus, pass the sub-cortical layers, reach the cortex, and return That the impulse is *altered* in passing this complicated chain is indicated in the diagram by the arbitrarily diminishing thickness of the line of the impulse

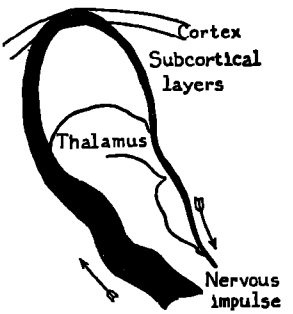


FIG 1

Fig 2 illustrates an hypothetical abnormal (non-survival in man) impulse It emerges from the lower centres For some reason or other, the main impulse is blocked semantically, or otherwise, and does not reach the cortex, only a weak impulse does What should be expected in such a case? We should expect regression to the level of activities of organisms which have no cortex, or a cortex very little developed But this could not be entirely true, as organisms without a cortex have a nervous system adequate for their lives, activities , in their environment, with survival values But a higher organism with a cortex, no matter how rudimentary, has the other parts of the nervous structure quite different in function, and without the cortex they are *inadequate* for survival, as experience shows We see that the *order* in which the impulses pass, or are deviated from their survival path, is paramount A great many different reasons may produce such deviation, too many to list conveniently A great many of them are known, in spite of the fact that, in general, we know very little about nerve mechanisms Suffice to say, that we know, on colloidal grounds and from experience, that macroscopic or microscopic lesions, drugs, and *false doctrines* affecting

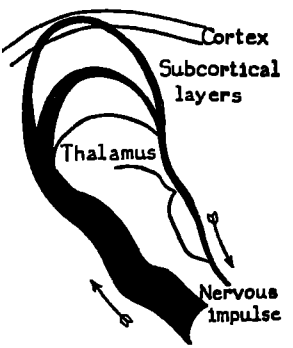


FIG 2

the sub-microscopic levels, may often produce similar end-results Here I use the term 'false doctrines' in the *non-el* sense, and, therefore, take into account affective and *evaluation*-components, which are usually disregarded when we speak about 'false doctrines'

Here we must consider a problem of crucial, general human significance It seems evident that *evaluation* in life, and particularly in human life, represents a most fundamental psycho-logical process underlying motivation and, in general, *s r*, which shape our behaviour and result in collective structures which we may call 'stages of civilization'

We may distinguish three periods of human development as characterized by their standards of evaluation

1) The pre-human and primitive period of literal, general, and unrestricted identification The semantics of this period could be formulated roughly as 'everything is everything else', which might be called one-valued semantics

2) The infantile, or A period of partial or restricted identification, allowing symmetrical relations, to the exclusion of asymmetrical relations Its semantics involve, among others, the 'law of identity'—'everything is identical with itself', its two-valued character being expressed by the postulate 'A is B or not B'

3) The adult, or $\bar{A}$, or scientific period based on the complete elimination of identification, by means of asymmetrical and other relations, which establishes *structure* as the foundation of all 'knowledge' Its semantics follow the ∞-valued semantics of probability and recognize 'equality', 'equivalence' , but no 'identity'

Before analysing the above three periods separately, it must be stated that 'identity', defined as 'absolute sameness', necessitates 'absolute sameness' in *'all'* aspects, never to be found in this world, nor in our heads Anything with which we deal on the objective levels represents a process, different all the 'time', no matter how slow or fast the process might be, therefore, a principle or a premise that 'everything is identical with itself' is *invariably false to facts* From a structural point of view, it represents a foundation for a linguistic system nonsimilar in structure to the world or ourselves All world pictures, speculations and *s r* based on such premises must build for us delusional worlds, and an optimum adjustment to an *actual* world, so fundamentally different from our fancies, must, in principle, be impossible

If we take even a symbolic expression $1 = 1$, 'absolute sameness' in *'all'* aspects is equally impossible, although we may use in this connection terms such as 'equal', 'equivalent', 'Absolute sameness in all aspects' would necessitate an *identity* of different nervous systems which produce

and use these symbols, an *identity* of the different states of the nervous system of the person who wrote the above two symbols, an identity of the surfaces , of different parts of the paper, in the distribution of ink, and what not To demand such impossible conditions is, of course, absurd, but it is equally absurd and very harmful for sanity and civilization to preserve until this day such delusional formulations as *standards of evaluation,* and then spend a lifetime of suffering and toil to evade the consequences This may be comparable to the spending of many years in teaching and training our children that one and one *never* equal two, that twice two *never* equal four , and then they would have to spend a lifetime full of surprises and disappointments, if not tragedies, to learn, when they are about to die, that the above statements are always correct in mathematics and very often true in daily life, and finally acquire the sadly belated wisdom that they were taught false doctrines and trained in delusional *s r* from the beginning

If we revised these false doctrines, we would not twist the lives of younger generations to begin with It seems that, for the sake of sanity, the term 'identity', symbolizing such a fundamental false structural doctrine, should be entirely eliminated from the vocabulary, but the term 'identification' should be retained in psychiatry as a label for extremely wide-spread delusional states which, at present, in a mild form, affect the majority of us

If we investigate the standards of evaluation of animals, the experiments of Pavlov and his followers show that, after establishing a 'conditional reflex' (which means a physiological relating of a signal with food, for instance), the *physiological* effect of the signal on the nervous system of the animal is to produce secretions similar in quantity and quality to those the food produces We can thus say that, from a physiological point of view, the animal organism *identifies* the signal with food That represents the *animal standard of evaluation* at that given period But even the animal nervous system is flexible enough to learn by experience that identification has no survival value, for, if, after the signal, food is repeatedly not forthcoming, he identifies again the signal with the absence of food In more complex experiments, when both these identifications are interplayed, the result is a real physiological dilemma, culminating, usually, in a more or less profound nervous disturbance, corresponding to 'mental' ills in humans

asymIdentification represents a comparatively unflexible, rigid form of repeatedly, laf low degree conditionality, so to say, and, by neurological necessity, represents the processes of *animal* adaptation, inadequate for modern man On human levels, it is found best exemplified in primitive

peoples and in cases of 'mentally' ill In less severe cases of semantic disturbances, we also find identification of different degrees of intensity The milder cases are usually considered as 'normal', which, in principle, is very harmful, because it establishes an animalistic, or primitive, standard of evaluation for 'normal' 'Identity', as we have seen, is invariably false to facts, and so identification produces, and must produce, non-survival *s r*, and, therefore, must be considered *pathological* for modern man

That identification afflicts the majority of us today is also shown by experiments with conditional reflexes and the psychogalvanic experiments which show clearly that the majority of humans *identify* the symbol with actualities, and *secretions very often follow* In other words, the reactions are of such a low order of conditionality as we find in animals and in primitive men In principle, it makes no difference whether a sound (or word), or other signal (symbol) is identified with food or other actualities which are not symbols, and the secretions are produced by the adrenal glands, for instance, resulting in fear or anger, instead of by the salivary or sweat glands In all such cases, *in experiments* with humans, the evaluation is false to facts, and the *physiological secretion* is uncalled for if the *evaluation would be appropriate* to the situation In very few instances, the human experiments with conditional and psychogalvanic reflexes break down, in the sense that the signal-symbol is *not identified* with first order actualities, and so such an organism has no uncontrolled glandular secretions for signal-symbols *alone* In a $\bar{A}$-system of evaluation, which involves on semantic levels the consciousness of abstracting, these exceptional persons (1933), with proper evaluation and controlled reactions, *prove the rule* for modern man In other words, modern man, when he stops the pre-human and primitive identification, will have a much-increased and *conscious control* of his secretions, colloidal states of his nervous system., and so of his reactions and behaviour The above applies to all *s r*, 'logical' processes included

Identification is found in all known forms of 'mental' ills A symbol, in any form, or any *s r* may be identified in value with some fictitious 'reality' at a given date, resulting in macro-physiological (glandular, for instance) or micro-physiological (colloidal ,) activities or disturbances which result in particular semantic states and behaviour It is impossible to deny that 'mentally' ill have inappropriate standa sameness' in tion, and that identification appears always as an impor his connection pathological evaluations. Experiments with 'mentally' il show clearly that this evaluation can be altered or impr ved by different chemical

agencies which affect the colloids of the nervous system, by environmental changes, and by *changing the standards of evaluation* which, at present, is usually called 'psychotherapy' The analysis of the mechanism of evaluation leads, naturally, to a generalized and *simplified* method, which may have not only a therapeutic but also an important new *preventive value*

Literal identification is found in all primitive peoples and accounts for their semantic states, reactions, their metaphysics, low development, but it is impossible, for lack of space, to go into details here

The A standard of evaluation departed from literal identification to some extent. We still preserve in our school books as the most fundamental 'law of thought'—the 'law of identity'—often expressed in the form 'everything is identical with itself', which, as we have seen, is invariably false to facts We do not realize that, in a human world, we are dealing at most only with 'equality', 'equivalence', at a given place and date, or by definition, but never with 'identity', or 'absolute sameness', disregarding entirely space-time relations, involving 'all' the indefinitely many aspects which, through human ingenuity, we often manufacture at will In an actual world of four-dimensional processes and the indefinitely many 'aspects' manufactured by ourselves, adjustment in principle is impossible, or, at best, only accidental, if we retain 'identity' The A evaluation was based on symmetrical relations of 'identity' and also partial 'identity', expressed even in our political, economic, doctrines and corresponding behaviour, the analysis of which would require a special volume to be written, I hope soon, by some one

Under the pre-human and primitive standards of evaluation, science was not possible Under the A standards the beginnings of science became possible, but if science had not departed from those standards, we would have had no modern science Lately, when the persecution of science has increasingly relaxed (not in all countries in a similar degree) and scientists were allowed to develop their disciplines with much less fear of persecution, sometimes even encouraged and helped by public interest, scientists found that they invariably had to build their own vocabularies of a distinctly, although unrealized, $\bar{A}$ character The chasm between human affairs and science became wider and wider The reason for it was that, in life, even at present, we preserve A standards of evaluation, and science mainly depends on subtler $\bar{A}$ means involving asymmetrical relations which alone can give us *structure* I will return repeatedly later on, to the $\bar{A}$ re-evaluation of the A standards of values

The $\bar{A}$ evaluation is based on asymmetrical and other relations I shall not attempt to summarize it here because the problems are very

large and this whole volume is devoted to that subject Here I shall mention, once more, that only with $\bar{A}$ standards of evaluation does a scientific treatment of man and his affairs become possible A $\bar{A}$-system depends on a complete elimination of identification which affects beneficially all our *s r*, as experience and experiments show

It has been already emphasized that in the human child the nervous system is not physically finished at birth, and that for some years thereafter it is plastic Hence, the 'environment'—which includes languages, doctrines, with their structure, all connected with evaluation-components —conditions the future functioning of the system The way in which the nervous system works, the 'sanity', 'un-sanity' and 'insanity' of the individual depends to a large extent on how this plastic and sensitive apparatus is treated, particularly in childhood Because of the *serial structure* of the nervous system, the language and doctrines supplied should be of the structure necessary for the adequate representation of serial structures and functions With the old A means this could not be accomplished

At this point, it will be well to introduce an important semantic subject, to which we shall return later, namely, the connection between the primitive subject-predicate language and identification For example, the statement, 'the leaf is green', is taken to imply 'greenness', which, by its verbal structure, has the character of a 'substantive' and implies some sort of objective independence It is *not* considered as an *asymmetrical relation* between the observer and the observed and, accordingly, tends toward an *additive* implication 'Greenness' is thus objectified and *added* to the leaf in describing a 'green leaf' The objectified 'greenness' leads to an anthropomorphic mythology, which, in turn, involves and develops the undifferentiated projecting mechanism so fundamental in semantic disturbances The objectification is evaluated structurally as a 'real' situation, and this introduces the non-survival *reversed* order evaluation in which the use of the 'is' of identity, resulting in identification, is the main factor The stronger the structural 'belief' in the 'truth' of the representation, or, in other words, the more we identify the higher order abstractions with the lower, which, in fact, are different, the more dangerous becomes the 'emotional' tension in the form of unjustified *evaluation,* which, ultimately, must involve *delusional* factors, no matter how slight, and result in semantic disturbances *Ignorance,* involving strong faith in the erroneous structural belief, is dangerously akin to more developed symptoms of 'mental' illness called illusions, delusions, and hallucinations We are mostly semantic victims of the primitive doctrines which underlie the A structure of our

language, and so we populate the world around us with semantic phantoms which add to our fears and worries or which lead to abnormal cheerfulness, well known among some 'mentally' ill

It should be realized that in the *A* system of evaluation many individuals profit in various ways by what amounts to distracting the attention of mankind from actual life problems, which make us forget or disregard actualities They often supply us with phantom semantic structures, while they devote their attention to the control of actualities not seldom for their personal benefit If one surveys the *A* situation impartially, one occasionally feels hopeless But, no matter how we now conspire one against another, and thus, in the long run, against ourselves, the plain realization that the difficulty is found in the standards of evaluation, establishes the necessary preliminary step to the escape

It is a well-known fact that, in a large proportion of 'mental' ills, we find a semantic flight from 'reality' (*m o*) when their 'reality' becomes too hard to endure It is not difficult to see that different mythologies, cults , often supply such structural semantic 'flights from reality', and that those who actually help, or who are professionally or otherwise engaged in producing and promulgating such semantic flights, help mankind to be un-sane, to deal with phantoms, to create dream states . There is no longer any excuse in the old animalistic law of supply and demand —that, because there is a demand foi such flights, they should be supplied That argument is not held to apply to those who peddle drugs or wood alcohol The flights from reality always have the earmarks of 'mental' illness Very often such actively engaged individuals are themselves ill to the point of hallucinations, they often 'hear voices', 'see visions', 'speak tongues'. Very often other morbid symptoms occur which are similar to those shown by the 'mentally' ill of the usual hospital types It is not generally realized that, although the patient suffers intensely, he usually shows marked resistance to any attempt to relieve him of his semantic affliction Only *after* he is relieved by semantic re-education does the patient realize how very *unhappy he was*

The situation is very serious There is a powerful well-organized system, with enormous wealth behind it, based on *A* and pre-aristotelian standards of evaluation which keeps mankind in delusional semantic states Its members do their best, better than they know, to keep mankind *un-sane* in flights from 'reality', instead of helping to revise the *A* standards of evaluation and to reorganize the horrible 'realities', *all of our own making,* into realities less painful The comparatively few psychiatrists are naturally not a match for such vast numbers of well-

organized men and women who, in their blissful ignorance, work in the opposite direction, and all of us pay the price

The activities of these individuals often promulgate something similar to the well-known 'induced insanity' Quite often paranoid or paranoiac and, more rarely, hypomanic patients can influence their immediate companions to such an extent that they join in believing in their delusions and copy their *s r* Susceptible associates begin to develop similar delusions and hallucinations and to pass through episodes themselves, perfectly oblivious to contradictions with external *m o* reality There are many paranoiac-like semantic epidemics of this kind on record It is instructive to visit some 'meetings' and watch the performer and the audience The pathetic side of it is that these performers, themselves not realizing the harmfulness of the situation, often pretend, or genuinely believe, that they are helping mankind by preaching some metaphysical 'morals' What they *actually* produce is a disorganization of the survival-working of the human nervous system, particularly if they train the structurally undeveloped nervous system of children to delusional evaluations and *s r*, and, in general, make sanity and higher and effective ethical standards very difficult or impossible It is positively known that *s r* are inextricably connected with electrical currents, secretions of different glands , which, in turn, exert a powerful influence on colloidal structure and behaviour, and so condition our neurological and physiological development There can be no doubt that imposing delusional *s r* on the undeveloped child must result in at least colloidal injury, which later on facilitates arrested development or regression, and, in general, leads away from adjustment and sanity

Lack of space and the essentially constructive aims of the present system do not allow me to analyse many fundamental interrelations in the development of man, but a brief list, worthy of analysis, may be suggested·

1) The relation between the pre-human reactions and the reactions of the primitive man, involving always some *copying* by mutants of the responses of the prevailing simpler organisms

2) The interrelation between the reactions of the primitive man, his animism, anthropomorphism, his other *s r* and the *structure* of his language and semantics

3) The relation between the structure of primitive languages and the structure of the 'philosophical grammar' formulated by Aristotle, generally called 'logic'

4) The relation between this grammar, the structure of language, and the further development of our structural metaphysics and *s r*

5) The influence the last conditions exerted on the structure of our institutions, doctrines, and the *s r* related to them

6) The relation between the 'copying animals in our nervous processes' and semantic blockages , preventing an adult civilization, agreement, sanity, and other desirable human reactions

This brief list suggests an enormous field for further research, but, even now, the formulation of a $\bar{A}$-system of evaluations makes a few points clearer.

An infant, be it primitive or modern, begins life with *s r* of identity and confusion of orders of abstractions, natural to his age, yet false in principle, and structurally false to fact At present, parents and teachers seldom check or counteract this tendency, mostly not realizing the importance of this semantic factor and its role in the future adjustment of the individual In the rough, to a baby, his cry 'is' food Words 'are' magic This identification is structurally false to facts, but in *babyhood it mostly works* To the infant, experience proves that the noises he makes, a cry or a word, have the objective value,—food The semantic identity of the symbol and the un-speakable object level,—food,—has been established This infantile attitude or *s r* is carried on into grown-up life

Under very simple conditions of primitive peoples, in spite of many difficulties, this attitude of identification is not always checked by experience, and experimenting is non-existent at this stage If it is, then such checking of identification is 'explained by some sort of demonology and 'good' or 'evil' 'spirits', Delusional, from the modern point of view, *s r* are compensated by mythologies, making the two sides of the semantic equation equivalent This equating tendency is *inherent* in all human *s r* It expresses the instinctive 'feel' for the similarity of structure as the base of 'knowledge', and it ultimately finds its expression in mathematical equations In all psycho-logical processes of 'understanding', we must have some standards of evaluation and 'equivalence' On primitive levels, this is accomplished by literal identification and delusional mythology of the type, that a storm at sea is 'caused' by a violent quarrel between a 'god' and his 'wife', or, in contemporaneous mythology, a draught, or fire, or death by lightning, is explained as 'punishment' for 'sins',. Semantic compensation is needed and produced A similar semantic process produces scientific theories, but with different standards of evaluation At present, scientific theories do not cover all semantic needs and urges of mankind, owing to the prevailing false to fact identification of different orders of abstractions With the full consciousness of abstracting, which means proper evaluation or differentiation between orders of abstractions, science will then cover all our non-pathological semantic

needs, and different primitive mythologies will become unnecessary A very harmful, primitive, delusional semantic factor of blockages would be eliminated.

The 'is' of identity plays a great havoc with our *s r*, as any 'identity' is structurally false to fact An infant does not know and cannot know that In his life, the 'is' of identity plays an important semantic role, which, if not checked intelligently, becomes a pernicious semantic factor in his grown-up reactions, which preserve the infantile character and with which *adult* adjustment and semantic health is impossible The infant begins to speak and again he is trained in the 'is' of identity Symbols are identified with the un-speakable actions, events and objects under penalty of pain or even death The magic of words begins its full sway As a rule, parental, crude disciplining of the infant, particularly in former days, trained the *s r* of the infant again in the delusional 'is' of identity The results are semantically and structurally very far-reaching and are found to underlie modern mythologies, militarism, the prevailing economic and social systems, the control by fear (be it 'hell' or machine guns), illusory gold standards, hunger,

Experience shows that such identification of symbols with the un-speakable levels works very well with animals With man, it leads only to the misuse of the human nervous system, semantic disturbances of evaluation, and the prevailing unstable animalistic systems in practically all fields, resulting in the general chaos in human affairs

It should be noticed that the 'is' of predication also expresses a sort of *partial identity,* leading to primitive anthropomorphism and general confusion of orders of abstractions By an inherent necessity, our lives are lived on the un-speakable objective levels, which include not only ordinary objects but also actions and immediate feelings, symbols being only auxiliary means The natural ordinal evaluation, which should be the foundation for healthy *s r,* appears as the event-process level first, the object next in importance, the objective level first, the symbolic next in importance, the descriptive level first, the inferential level next in importance, The semantic *identification* of these different levels not only abolishes the natural evaluation, but, in fact, reverses the natural order Once this is realized, we see clearly that all statements about the objective level, which is made up of absolute individuals, are only *probable* in different degrees and can never be certain The 'is' of identity underlies, also, the two-valued, too primitive, too restricted, and structurally fallacious *A* 'logic'.

The crucial semantic importance of asymmetrical relations becomes obvious when we consider that all *evaluation* and *non-el* meanings

depend ultimately on asymmetrical relations. In the technical fields, mathematics and the exact sciences, in the semi-scientific fields, economics, politics, sociology, in the as yet non-scientific fields, 'ethics', 'happiness', 'adjustment', represent ultimately different forms of *evaluation*, impossible to formulate adequately under aristotelianism

Obviously, a $\bar{A}$-system based on proper semantic evaluation leading to non-pathological reactions adjustments, must make relations and multi-dimensional order fundamental for sanity The semantic connection between mathematical methods and all the other concerns of man becomes also necessary and obvious

In mathematics recently the notion of equality needed a refinement and the notion of 'identity' has been introduced The present analysis discloses that, although the refinement and the symbol may be retained, yet the name should be entirely abandoned, because it conceals a very semantically vicious confusion of orders of abstractions If by definition, we produce new terms, these new terms are of a higher order abstraction than the terms used in the definition, and so the *identification* of them as to the orders of abstractions is *physiologically* and structurally false to facts

The problems discussed in the present chapter have been felt vaguely for more than two thousand years and found their first historical expression in the rift between Aristotle the biologist and Plato, the founder of mathematical philosophy Mathematics is in principle $\bar{A}$, and so in the study of mathematics we can learn most about the principles of non-aristotelianism In physics, only very recently, do we begin to eliminate the 'is' of identity and elementalism which resulted in the $\bar{A}$ systems All sciences strive to become more mathematical and exact and so $\bar{A}$ In fact, all advances in science are due to the building of new $\bar{A}$ languages usually called 'terminology' We can go further and say, definitely, that, to have any science, we must make a $\bar{A}$ revision of the languages used Similarly with 'man' either we decide to introduce into human affairs scientific evaluation, and so part company with the A and pre-aristotelian system of evaluation, or preserve A structure, and have no science of man, or science of sanity, but continue in the prevailing chaos

CHAPTER XIV

ON THE NOTION OF INFINITY

The questions on which there is disagreement are not trivialities, they are the very roots of the whole vast tree of modern mathematics (22)
E T BELL

The task of cleaning up mathematics and salvaging whatever can be saved from the wreckage of the past twenty years will probably be enough to occupy one generation (22) E T BELL

The intention of the Hilbert proof theory is to atone by an act performed once for all for the continual titanic offences which mathematics and all mathematicians have committed and will still commit against mind, against the principle of evidence, and this act consists of gaining the insight that mathematics, if it is not true, is at least consistent Mathematics, as we saw, abounds in propositions that are not really significant judgments (549) HERMANN WEYL

An objectivated property is usually called a *set* in mathematics (549)
HERMANN WEYL

If the objects are *indefinite* in number, that is to say if one is constantly exposed to seeing new and unforseen objects arise, it may happen that the appearance of a new object may require the classification to be modified, and thus it is we are exposed to antinomies *There is no actual (given complete) infinity* (417) H POINCARÉ

The structural notion of 'infinite', 'infinity', is of great semantic importance and lately has again become a subject of heated mathematical debates My examination of this subject is from the point of view of a $\bar{A}$-system, general semantic, and a theory of sanity which completely eliminates identification In Supplement III, I give a more detailed $\bar{A}$ analysis of the problem already anticipated by Brouwer, Weyl, Chwistek, and others These problems are not yet solved, because mathematicians, in their orientations and arguments, still use *el, A* 'logic', 'psychology', and epistemology, which involve and depend on the 'is' of identity, making agreement impossible

Mathematical infinity was first put on record by the Roman poet, Titus Lucretius, who, as far back as the first century B C, wrote very beautifully about it in his *De Rerum Natura* [1] As the author was a poet, and his work poetry, a few privileged literati had great pleasure in reading it, but this discovery, not being rigorously formulated, remained inoperative, and so practically worthless for mankind at large, for 2000 years Only about fifty years ago, mathematical infinity was rediscovered by mathematicians, who formulated it rigorously, without poetry Since then, mathematics has progressed with all other sciences in an unprece-

dented way That this structural linguistic discovery was made so late is probably due to the usual blockage, the old *s r*, old habits of 'thought', and prejudices.

In all arguments about infinity, from remote antiquity until Bolzano (1781-1848), Dedekind (1831-1916), and Cantor (1845-1918), there was a peculiar maxim involved All arguments against infinity involved a certain structural assumption, which, at first inspection, seemed to be true and 'self-evident', and yet, if carried through, would be quite destructive to all mathematics existing at that date Arguments favorable to infinity did not involve these tragic consequences Quite naturally, mathematicians, and particularly Cantor, began to investigate this peculiar maxim and the *s r* which were playing havoc The structural assumption in question is that 'if a collection is part of another, the one which is a part must have fewer terms than the one of which it is a part' This *s r* was deeply rooted, and even found a scholarly formulation in Euclid's wording in one of his axioms 'The whole is greater than any of its parts' This axiom, although it is not an exact equivalent of the maxim stated above, by loose reasoning, which was usual in the older days, could be said to imply the troublesome maxim It is not difficult to see that the *E* axiom, as well as our troublesome maxim, expresses a structural generalization taken from experience which applies only to *finite* processes, arrays, Indeed, both can be taken as a definition of finite processes, arrays, It does *not* follow, however, that the one definition and structure must be true of infinite processes, arrays, As a matter of fact, the break-down of this maxim gives us the precise definition of mathematical infinity. A process of generating arrays , is called infinite when it contains. as parts, other processes, arrays , which have 'as many' terms as the first process, array,

The term 'infinite' means a process which does not end or stop, and it is usually symbolized by ∞ The term may be applied, also, to an array of terms or other entities, the production of which does not end or stop Thus we may speak of the infinite process of generating numbers because every positive integer, no matter how great, has a successor; we can also speak of infinite divisibility because the numerical technique gives us means to accomplish that The term 'infinite' is used here as an adjective describing the characteristics of a *process,* but should never be used as a noun, as this leads to self-contradictions The term 'infinity', as a noun, is used here only as an abbreviation for the phrase 'infinite process of generating numbers', If used in any other way than as an abbreviation for the full phrase. the term is meaningless in science (not in psychopathology) and should never be used The above semantic

restrictions are not arbitrary or purely etymological, but they follow the rejection of the 'is' of identity of a $\bar{A}$-system

Before we can apply the term 'infinite' to physical processes, we must first theoretically elucidate this term to the utmost, and only then find out by experiment whether or not we can discover physical processes to which such a term can be applied Fortunately, we have at our disposal a *semantic process* of generating numbers which, by common experience, by definition, and by the numerical technique, is such that every number has a successor Similarly, our semantic processes are capable by common experience, by definition, and by the numerical technique to divide a finite whole indefinitely Thus, if we do not identify external physical objective processes with internal semantic processes, but differentiate between them and apply correct symbolism, we can see our way clear If we *stop* this semantic process of generating numbers at any stage, then we deal with a finite number, no matter how great, yet the process remains, by common experience, by definition, and by the numerical technique, such that it can proceed indefinitely In the $\bar{A}$ sense, 'infinite', as applied to processes, means as much as 'indefinite' We should notice that the semantic *process* of *generating* numbers should not be identified with a *selection* of *a* definite number, which, by necessity, is finite, no matter how great. The identification of the semantic process of generating numbers with a definite number, the identification of the semantic process of infinite divisibility of finites in the direction of the small with the generating of numbers in the direction of the great, and the identification of semantic internal processes with external physical processes , are found at the foundation of the whole present mathematical scandal, which divides the mathematical world into two hostile camps.

The process of infinite divisibility is closely connected with the process of the infinite generation of numbers Thus we may have an *array* of *numbers* 1, 2, 3, n, all of which are finite The *semantic process* of *passing* from n to $n+1$ *is not* a number, but constitutes a characteristic of the semantic process The *result* of the semantic process, namely, $n+1$, again becomes a finite number If we take a fraction, a/n, the greater an n is selected, the smaller the fraction becomes, but with each selection the fraction again is finite, no matter how small

Although the two processes are closely connected on the formal side, they are very different from the semantic point of view The process of generating numbers may be carried on indefinitely or 'infinitely' and has no upper limit, and we cannot assign such a limit without becoming tangled up in self-contradiction in terms Not so with the process of indefinite or infinite divisibility In this case, we start with a *finite.*

Existing mathematical symbolism and formalism lead to identification of both fundamentally different semantic processes and introduce a great deal of avoidable confusion A $\bar{A}$ orientation will allow us to retain mathematical symbolism and formalism, but will not allow the identification of the semantic process of *passing* from number to number, which passing *is not* a number, with the *result* of this process which, in each case, becomes a *definite and finite number*

It becomes obvious that the A terminology and present standard notions of 'number' identify the semantic *process* with its *result*, an identification which must ultimately be disastrous The semantic process is thus potentially infinite, but the *passing* from n to $n + 1$ characterizes the semantic process, not number, numbers representing only finite results of the indefinitely extended semantic process

A $\bar{A}$ analysis without identification discloses, then, that only the semantic process can be indefinitely extended, but that the *results* of this process, or a number in *each case*, must be *finite* To speak about an 'infinite' or, as it is called, 'transfinite' 'number', is to identify entirely different issues, and involves very definite self-contradictions in *no* terms The existing mathematical terminology has been developed without the realization of $\bar{A}$ issues and the multiordinality of terms and leads automatically to such identifications As long as mathematicians do not consider $\bar{A}$ issues, the problems of mathematical infinity will remain unsolved and hopeless, and yet, without a scientific theory of infinity, all of mathematics and most of science would be entirely impossible A $\bar{A}$ clarification of these problems involves a new semantic definition of numbers and mathematics, given in Chapter XVIII, which eliminates a great many mysteries in connection with mathematics and does not allow these dangerous and befogging identifications

From a $\bar{A}$ point of view, we must treat infinity in the first cantorian sense, namely, as a *variable finite*, the term *variable* pertaining to the semantic process but *not* to number, the term *finite* pertaining to both the semantic *arrest* of the infinite semantic process, and so characterizing also its result, namely—a number

In the meantime, the numerical technique is *indefinitely flexible* in the sense that no matter how great a number we take we always can, by a semantic process, produce a greater number, and no matter how small the difference between two numbers might be, we always can find a third number which will be greater than the smaller, and smaller than the given greater number Thus, we see that the *numerical technique* is such as to correspond in flexibility exactly to the *semantic processes*, but

there is nothing flexible about a definite number once it is selected What has been already said about a variable applies, also, to a number, namely, that a 'variable' does not 'vary' in the ordinary sense, but this term applies only to the semantic processes of the mathematician The older intensional A definition of 'number' must have led to the older identifications The $\bar{A}$, extensional, and *non-el* semantic definition of number*s* does not allow such identifications. The A term 'number' applied to a definite number, but also to an intensional definition of number*s* The $\bar{A}$, or semantic definition of number*s*, is different in the sense that it finds extensional characteristics of each number, applicable to all number*s*, and so helps not to identify a definite number with the process of generating number*s*, which the use of one term for two entirely different entities must involve

Cantorian *alephs,* then, are the result of identification or confusion of entirely different issues and must be completely eliminated The rejection of *alephs* will require a fundamental revision of those branches of mathematics and physics which utilize them, yet, as far as I know, with a very few exceptions, the *alephs* are not utilized or needed, although the *'name'* is used, which spell-mark has become fashionable in many mathematical and physical circles In the case of *alephs,* history may repeat itself and the *alephs,* like the 'infinitesimal', when their self-contradictory character becomes understood, will be eliminated without affecting the great body of mathematics, but only the small portions which are built on the *alephs.*

As to the existence of infinite processes, we know positively *only* about the *semantic process* of generating number*s* and the *semantic process* of infinite divisibility These processes are evident in our common experience We cannot *a priori* know if such infinite processes can be found in the world which must be discovered by investigation and experimentation

The existing terminology is still A and is based on, and leads to, identification, and so in my $\bar{A}$ presentation I cannot use it and expect to clear up some of the issues involved The terms such as 'class', 'aggregate', 'set' , imply a definite static collection The term 'infinite', in the meantime, can only be correctly and significantly used as applied to a dynamic semantic process We cannot speak of 'infinite' classes, aggregates, sets , and evade the issues of identification of entirely different entities The term 'series' has a technical meaning in connection with numbers and so, for a general discussion of processes, is a little too specific The term 'array' is more general, yet extensional, of which 'series' would be a special case. The general term 'number'

is multiordinal and intensional and so, in the $\bar{A}$ extensional system, ∞-valued, and must be used in the plural, namely, 'numbers' The term 'number' in the singular will be used to indicate a definite number The term 'denumerable' has been introduced by Cantor and means any extensional array of terms, facts, states, observables , which can be put in one-to-one correspondence with the infinite array of positive integers

Let me repeat once more the semantic process may be carried on without limits, and the infinite series of positive integers is an extensional, technical, and verbal expression of this semantic process and the only infinite array of which existence we are certain

We shall be able to explain, and to give a better definition of, mathematical infinity if we introduce an extremely useful structural term, 'equivalence' Two processes, arrays , between which it is possible to set up, by some law of transformation, a *one-to-one* correspondence are said to be *equivalent* A process, array , which is equivalent to a part of itself, is said to be infinite. In other words, a process, array , which can be put into a *one-to-one* correspondence with a part of itself is said to be infinite We can define a *finite* process, array , (class, aggregate ,) as one which is not infinite The following is valid *exclusively* because of the use of the '**etc.**'

A few examples will make this definition clearer If we take the series of positive integers, 1, 2, 3, 4, . **etc.**, we can always double every number of this row *provided* we retain the *process-character, but not otherwise* Let us write the corresponding row of their doubles under the row of positive integers, thus

1, 2, 3, 4, 5, . . . **etc.**
2, 4, 6, 8, 10, . **etc.**

or we can treble them, or n-ble them, thus:

1, 2, 3, 4, 5, . . . **etc.**
3, 6, 9, 12, 15, . **etc.**

there are obviously as many numbers in each row below as in the row above, *provided we retain the* '**etc.**', so the numbers of numbers in the two rows compared must be equal All numbers which appear in each bottom row also occur in the corresponding upper row, although they only represent a *part* of the top row, *again provided that we retain the* '**etc.**'

The above examples show another characteristic of infinite processes, arrays , In the first example, we have a *one-to-one* correspondence between the natural numbers and the *even* numbers, which are equal in number at each stage Yet, the second row results from the first row by

taking away all odd numbers, which, itself, represents infinite numbers of numbers.

This example was used by Leibnitz to prove that infinite arrays cannot exist, a conclusion which is not correct, since he did not realize that both finite and infinite arrays depend on definitions We should be careful not to approach *infinite* processes, arrays , with prejudices, or silent doctrines and assumptions, or, in general *s r*, taken over from *finite* processes, arrays,

Thus we see that the process of generating natural numbers is structurally an infinite process because its *results* can be put in a *one-to-one* correspondence with the results of the process of generating even numbers , which is only a part of itself Similarly, a line AB has infinitely many points, since its points can be put into a *one-to-one* correspondence with the points on a segment CD of AB Another example can be given in the Tristram Shandy paradox of Russell. Tristram Shandy was writing his autobiography, and was using one year to write the history of one day The question is, would Shandy ever complete his biography? He would, provided he never died, or he lived infinite numbers of years The hundredth day would be written in the hundredth year, the thousandth in the thousandth year, **etc.** No day of his life would remain unwritten, *again provided his process of living and writing would never stop*

Such examples could be given endlessly. It is desirable to give one more example which throws some light on the problems of 'probability', 'chance', The theory of probability originated through consideration of games of chance Lately it has become an extremely important branch of mathematical knowledge, with fundamental structural application in physics, general semantics, and other branches of science For instance, Boltzman based the second law of thermodynamics on considerations of probability Boole's 'laws of thought', and the many-valued 'logic' of Łukasiewicz and Tarski are also closely related to probability, and the new quantum mechanics uses it constantly,

The term 'probability' may be defined in the rough as follows If an event can happen in a different ways, and fails to happen in b different ways, and all these ways are equally likely to occur, the probability of the happening of the event is $\frac{a}{a+b}$, and the probability of its failing is $\frac{b}{a+b}$.

Let us assume that in a certain city a lecture is held each day, and that, though the listeners may change each day, the numbers of listeners

are always equal Suppose that one in each twenty inhabitants of this town has M as the first letter of his name What is the probability that, *'by chance'*, all the names of the audience would begin with M? Let us call such a happening the M-event In the simplest case, when the daily number of listeners is only one, the probability of an M-event is 1 in 20, or 1/20 The probability of an M-event for an audience of 2 is 1 in $20 \times 20 = 400$, or 1/400 The probability that an audience of three members should have all three names begin with M would decrease twenty times further Only once in 8000 lectures, on an average, would an M-event happen For five people it would amount to 1 in $20 \times 20 \times 20 \times 20 \times 20 = 3{,}200{,}000$ days, or 1/3,200,000, or once in approximately 9000 *years*, for ten people, about once in thirty billion years, for twenty people, about once in a third of a quadrillion years For one hundred people, the recurrence period of the M-event would be given as once in a number of years represented by more than a hundred figures If the town, in this last example, should be as old as the solar system, and if the lectures had been delivered daily to an audience of one hundred people through this inconceivably long period, the probability is extremely small that the M-event would happen at all [2]

From the human, *anthropomorphic*, point of view, we would say that such an event is impossible But it must be remembered that this is only an anthropomorphic point of view, and our judgements are coloured by the temporal scale of our own lives Of course, to carry such an anthropomorphic viewpoint into cosmic speculations is simply silly, a survival of the primitive structure of language and its progeny—metaphysics and mythologies

The theory of infinity throws considerable structural light on such primitive speculations In this external world, we deal with processes, and, as we measure 'length' by comparison with freely selected convenient units of 'length', let us say, an inch, or we measure 'volume' by freely selected convenient units of 'volume', so, also, we compare *processes* with some freely selected and convenient *unit-process* The diurnal rotation of our earth is such a process, and, if we choose, we can use it as a measuring unit or as a comparison standard Of late, we have become aware that the rotation of the earth is not quite regular, and so, for accurate measurements, the old accepted unit-process of a day, or its subdivision, a second, is not entirely satisfactory For scientific purposes, we are trying to find some better unit-process, but we have difficulty, as the problem is naturally circular When we speak in terms of a 'number of years', or of seconds, we speak about perfectly good observational experimental facts, about quite definite relations, the best we know in

1933. We do not make any metaphysical assertions about 'time' and we should not be surprised to find that statements involving 'years' are generally propositions, but that statements involving 'time' often are not It is necessary not to forget this to appreciate fully what follows

The theory of infinity will clear away a troublesome stumbling-block We will use the expression 'infinite numbers of years', remembering the definition of 'infinite numbers' and what was said about the *unit-process* which we call a year We have seen in an example above that if only a hundred individuals attend a lecture, and all 'by chance' have their names begin with M, such an event happens, on an average, only once in an inconceivably large number of years, represented by a number with a hundred figures If we would ask *how many* times an occurrence would happen, we would have to state the period in years for which we ask the *how many*. It is easy to see that in infinite numbers of years, this humanly extremely rare occurrence would happen precisely *infinite numbers of times,* or, in other words, 'just as often', this last statement being from a non-anthropomorphic point of view An event that appears, from our human, limited, anthropomorphic point of view, as 'rare', or as 'chance', when transposed from the level of finite process, arrays , to that of infinite processes, arrays., is as 'regular', as much a 'law', involving 'order', as anything else It is the old primitive *s r* to suppose that man is the only measure of things

Here the reader might say that infinite numbers of years is a rather large assumption to be accepted so easily This objection is indeed serious, but a method which can dispose of it is given later on At this stage, it is sufficient to say that, on the one hand, this problem is connected with the semantic disturbance, called identification (objectification of 'time'), which afflicts the majority of us, excepting a few younger einsteinists, and that, on the other hand, it involves the structurally reformulated law of the 'conservation of energy', 'entropy',

Before parting with the problem of infinity, let me say a word about the notion of 'continuity', which is fundamental in mathematics Mathematical continuity is a structural characteristic connected with ordered series The difficulties originated in the fact that a 'continuous' series must have infinite numbers of terms between any two terms Accordingly, these difficulties are concerned with infinity That mathematicians need some kind of continuity is evident from the example of two intersecting lines If the lines have gaps, as, for instance, — — — — , there would be the possibility that two gaps would coincide, and the two lines not intersect, although in a plane the first line would pass to the other side of the second line At present, we have two kinds of 'con-

tinuity' used in mathematics One is a supposedly 'high-grade' continuity; the other, supposedly, is a 'low-grade' continuity, which is called 'compactness' or 'density', with the eventual possibility of gaps I am purposely using rather vague language, since these fundamental notions are now being revised, with the probability that we shall have to be satisfied with 'dense' or 'compact' series and abandon the older, perhaps delusional, 'high-grade' continuity It is interesting to note that the differential and integral calculus is supposedly based on the 'high-grade' continuity, but the calculus will not be altered if we accept the 'low-grade' compactness, all of which is a question of an A or $\bar{A}$ orientation

Vague feelings of 'infinity' have pervaded human *s r* as far back as records go Structurally, this is quite natural because the term infinity expresses primarily a most important semantic process The majority of our statements can also be reformulated in a language which explicitly involves the term 'infinity' An example has been already given when we were speaking about the universal propositions which were supposed to be of *permanent* validity, in other *language,* valid for 'infinite numbers of years' We see how the trick is done—a vague quasi-qualitative expression like 'permanent' or 'universal' is translated into a quantitative language in terms of 'numbers of years' Such translation of qualitative language into quantitative language is very useful, since it allows us to make more precise and definite the vague, primitive structural assumptions, which present enormous semantic difficulties This brings to our attention more clearly the structural facts they supposedly state, and aids analysis and revision In many instances, such translations make obvious the illegitimacy of the assumptions of 'infinite velocities' and so clear away befogging misunderstandings, and beneficially affect our *s.r.*

CHAPTER XV

THE 'INFINITESIMAL' AND 'CAUSE AND EFFECT'

> But we are not likely to find science returning to the crude form of causality believed in by Fijians and philosophers, of which the type is "lightning causes thunder" (457) BERTRAND RUSSELL
>
> The notion of causality has been greatly modified by the substitution of space-time for space and time . Thus geometry and causation becomes inextricably intertwined (457) BERTRAND RUSSELL

> In classical mechanics, and no less in the special theory of relativity, there is an inherent epistemological defect which was, perhaps for the first time, clearly pointed out by Ernst Mach No answer can be admitted as epistemologically satisfactory, unless the reason given is an *observable fact of experience* The law of causality has not the significance of a statement as to the world of experience, except when *observable facts* ultimately appear as causes and effects (155) A EINSTEIN

> The chain of cause and effect could be quantitatively verified only if the whole universe were considered as a single system—but then physics has vanished, and only a mathematical scheme remains The partition of the world into observing and observed system prevents a sharp formulation of the law of cause and effect (215) W HEISENBERG

Of late, another perplexing semantic problem concerning 'causality' or 'non-causality' has arisen in connection with the newer quantum mechanics It is possible to examine this question by different methods The simpler one is connected with vague feelings of 'infinity' and its supposed opposite, the 'infinitesimal'; the more fundamental method is based on the orders of abstractions leading toward the ∞-valued semantics of probability

Because of man's natural tendency to speak in terms of 'infinity', and his further marked tendency of having opposites, such as 'yes', 'no', 'right', 'left', 'positive', 'negative', 'love', hate', 'honesty', 'dishonesty' , quite naturally the notion of 'infinity' carried with it the tendency to invent the 'infinitesimal' Even mathematicians have had great semantic difficulties in breaking away from this habit Analysis persistently reveals that structurally no matter how far we go in dividing something, let us say an inch, whatever is left may be extremely small, but yet it is a perfectly good *finite* quantity Thus, structural difficulties were encountered with the postulated 'infinitesimal' The *name* implies that they are not finite, yet analysis shows only finites Mathematicians supposed that an 'infinitesimal' was necessary for mathematics, and so they were reluctant to abandon it

The 'infinitesimal', like so many other baffling suppositions, was invented by the Greeks, who regarded a circle as differing 'infinitesimally'

from a polygon with a very large number of very small equal sides. With the invention of the differential and integral calculus, 'infinitesimal calculus', as it was called, the importance of the 'infinitesimal' increased, and even mathematicians used it as a fundamental notion Finally, Weierstrass succeeded in showing the meaningless character of the 'infinitesimal', and also that the 'infinitesimal' was not structurally necessary for the calculus Up to that date, the problem was baffling, we knew that the calculus required 'continuity', which, in turn, seemed to require 'the infinitely little', and yet no one could tell what this 'infinitely little' might represent It was quite obviously not zero, because a sufficient number of them was able to make up a finite whole and we knew no fraction which was not zero and yet not finite The discovery by Weierstrass that the calculus does not require the 'infinitesimal', and that all deductions could be made without it, abolished a very serious structural verbal, metaphysical, and semantic bugaboo Common sense, of course, is much simpler, although unreliable in such matters, and was satisfied also

The elimination of the 'infinitesimal' is a great semantic step forward, and helps to clarify structurally some deeply rooted vague, fallacious notions, which are overloaded with affective components and are extremely vicious in their effects

If there is no 'infinitesimal', there is no 'next moment', for the interval between any two moments must be finite, and so there are always other moments in the interval between them Also, two moments cannot be consecutive, for between any two there are always other moments, no matter how far we go, similarly, the 'present' becomes a very vague notion

For our purpose, the most fundamental semantic application of what has been said above is in the vast field embraced by the old structural notions of 'cause' and 'effect'. These terms are of great antiquity, of a distinctly pre-scientific one-, two-valued semantic epoch They originated in the rough experience of our race, and are firmly rooted in the habits of 'thought' and the structure of our old two-valued 'logic' and language, and because of that are even now unduly baffling These terms, in the *two-valued sense,* were and are the structural assumptions of our 'private' and 'official' 'philosophies' The unenlightened use of these terms has done much to prevent the formulation of a science of man and to build up vicious anti-scientific metaphysics of various sorts involving pathological *s r* With the new quantum mechanics, a better understanding of these notions, based on the ∞-valued semantics of probability, becomes a paramount issue for all science. In daily life, the

indiscriminate use of two-valued 'cause' and 'effect' leads structurally to a great deal of absolutism, dogmatism, and other harmful semantic disturbances, which I call confusion of orders of abstraction

We usually follow the 'philosophers' and ascribe—or, rather feel, as conscious ascribing would not stand criticism—some mysterious structural continuity, some mysterious overlapping of 'cause' and 'effect' We 'feel', and try to 'think', about 'cause and effect' as *contiguous* in 'time' But 'contiguous in time' involves the impossible 'infinitesimal' of some unit of 'time' But, since we have seen that there is no such thing, we must accept that the interval between 'cause' and 'effect' is finite This structural fact changes the whole situation If the interval between 'cause' and 'effect' is finite, then always something might happen between, no matter how small the interval may be The 'same cause' would not produce the 'same effect'. The expected result would not follow This means only that in this world, to be sure of some expected effect, requires that there must be nothing in the environment which can interfere with the process of passing from the conditions labelled 'cause' to the conditions labelled 'effect' In this world, with the structure which it has, we can never suppose that *a* 'cause', as we know it, is *alone* sufficient to produce the supposed 'effect' When we consider the ever-changing environment, the number of possibilities increases enormously If it were possible to take into account the *whole* of the environment, the *probability* that some event would be repeated, in all details, thus exhibiting the assumed two-valued relation of 'cause' and 'effect', which we took for granted in the old days, would practically be nil The principle of non-elementalism, as we see, requires an ∞-valued semantics of probability

The reader should not take what is said here as a denial that in this external world some regularities of sequence occur, but the above analysis, which is mainly due to Russell,[1] shows clearly that the verbal principle of 'same cause, same effect' is structurally untenable We can never manage to observe the 'same cause' in detail As soon as the antecedents have been sufficiently ascertained, so as to calculate the consequences with some plausible accuracy as to details, the relations of these antecedents have become so complex that there is very little *probability* that they will ever occur again

The clearing up of the problems of 'cause' and 'effect' is of serious importance, because powerful semantic reactions are connected with it To begin with, we must differentiate between the terms 'cause' and 'effect', which, linked together, imply a two-term relation nowhere to be found in this world, and thus represent a language and a two-valued

'logic' of a structure not similar to the structure of the world, and the *general ∞-valued notion of causality* This last notion is the psychological foundation of all explanations leading toward ∞-valued determinism, and is an exclusive test for structure, and so of extreme semantic importance

Besides the analysis from the point of view of the impossible 'infinitesimal', the term 'cause-effect' represents a two-term relation, and, as such, is a primitive generalization *never* to be found in this world, as all events are *serially* related in a most complex way, independent of our way of speaking about them If we expand our two-term relation 'cause-effect' into a *series,* we pass from the inferential level to the *descriptive* level, and so can apply a behaviouristic, functional, actional language of order In such series, we could only use the language of 'cause' and 'effect' if we could select neighbouring factors, a selection which is often impossible Also, if we pass from macroscopic to microscopic or sub-microscopic levels, we could use such language, but then the terms would have different meanings, supplied by the theory of probability

The semantic side of this problem is of importance, because, in the old *el* way, it was neglected General speculations about such *m o* terms as 'cause' and 'effect' are useless Such statements are not propositions, but involve variable meanings and, therefore, generate propositional functions which are neither true nor false Our expanding of the too simple, two-term relation 'cause-effect' into a complex series is closer to the structure of this world, as far as we know it

The understanding and habitual application of what has just been said would not only save us from silly dogmatizing and inappropriate *s r*, but would teach us not to disregard any regularity, and to investigate any relation which might appear Then, in a *specific case,* we could again use the restricted principle of causality, based on probability and averages The old absolute and objectified semantic attitude toward 'cause-effect' was and often is a serious hindrance in observing impartially the sequence of events (order) and relations Preconceived notions and old *s r* played havoc, for it is well known that we usually find what we want to find If we approach a problem with definite unconscious *'emotional'* wants, and cannot satisfy these *s r*, we become bewildered, down-hearted, and perhaps utter some such non-sense as the 'finite mind', or the like Under such semantic pressure, our power of observation and analysis is reduced by a kind of 'emotional stupor' Such an occurrence is harmful in science and in life 'Human knowledge' depends on human ingenuity, power of observation, power of abstraction, It is an activity

of the human nervous system inside of our skin and can never be the events themselves.

We see that the old two-valued verbal structure of 'cause' and 'effect' is not similar to the structure of the world, but a rash limiting generalization from probability Since these expressions belong to the class of statistical averages and depend on the scale of the events and intervals dealt with, we must not expect that such terms as two-valued 'causality', which is a term of statistical macroscopic averages, will apply in that sense to small-scale events when the intervals are much smaller and when entirely different conditions and 'causes' prevail Today we have structural evidence that even 'space' and 'time' represent statistical averages and do not apply to the smallest scale events It is natural that 'cause' and 'effect' should join their company The above involves epistemologically the passing from the A two-valued system to a $\bar{A}$ ∞-valued system Psychophysiologically, it involves new *s r*

In mathematics, the old religious attitude toward the 'infinitesimal' is rapidly vanishing Many mathematicians deliberately, and justly, avoid the use of the word A term like 'indefinitely small' or 'indefinitesimal' is a better descriptive term, truer in its implications We even see scientists like Eddington, who had the pluck—it is still pluck, unfortunately—to treat enormous stellar distances as 'infinitesimals of second order' ('Infinitesimal' is used here in a mathematical sense of indefinitesimal)

It has been already mentioned that most of the important discoveries of mathematics were due to a special semantic attitude on the part of those who made them This attitude was an unconscious or conscious treatment of mathematics as a form of human behaviour We see an example in the work of Weierstrass and his analysis of the 'infinitesimal' He did not take the 'infinitesimal' as some objectified metaphysical structure and remain content, he analysed the *genetic process* by which the 'infinitesimal' was *made* by Smith and Brown, and so treated mathematics structurally as a form of human behaviour Any deepening of the foundations, or clarification of fundamental notions, or investigation of underlying assumptions , *must,* by necessity, have this characteristic The man who does it must take into account how the given process was produced—analyse its structure, and so start with the ways and methods of production In other words, he must treat the given problem as a form of human behaviour The fact that this simple and quite obvious method has been formulated and structurally explained as *desirable* is helpful It shows the *method* and structure of the path by which advances can be reached We can *train* the semantic reactions of students to it and make progress inevitable, but now, instead, it takes a genius to break, by him-

self through the old semantic habits which have been produced by the lack of scientific psycho-logics and training

The term 'correct symbolism' has already been used In this world of structurally absolute individuals, the minimum of structurally desirable correct symbolism must provide for the possibility of labelling these absolute individuals by separate names For scientific purposes, we must use terms built on the pattern of mathematical symbolism, i e, according to the *extensional* methods We must adopt a behaviouristic attitude and habits in our term-making. As we proceed, we must emphasize *order,* considering what comes first and what next This is semantically important, for the usual procedure is entirely different first, we have our structurally 'preconceived' doctrines and languages, next, we observe the structure of the world, and *then* we try to force the observed facts into the linguistic structural patterns But, in the new way, we *start* with silent observations, and search empirically for structure, next, we invent verbal structures similar to them, and, finally, we see what can be said about the situation, and so test the language Experience shows that the old habits of labels first, objects next, instead of the structurally natural order of *objects first, labels next,* is semantically pernicious and harmful In Part VII, it is shown that the semantic structural reversal of the unnatural reversed order is crucial for sanity

From the days of the Greeks an acute difficulty has made itself felt, namely, how to reconcile the world of physics with the world of mathematics For mathematics, we need 'extensionless' points, for physics, we need finite-sized elements Whitehead and Russell have suggested different structures by which this may be accomplished It seems possible to demand that none of the material dealt with shall be smaller than an assigned finite size That this condition can be reconciled with mathematical continuity seems to be novel Whether this device is valid or not, it is yet too early to decide This problem of reconciliation will become important further on when we come to speak of events as made up from point-events.[2]

CHAPTER XVI

ON THE EXISTENCE OF RELATIONS

> We cannot choose to do without them, without seeking to choose, since choice is action, and involves, for instance, the aforesaid difference between affirming and denying that we mean to do thus and thus (449)
>
> JOSIAH ROYCE

In concluding the foregoing remarks, I must explain one more general consideration This concerns an extremely profound structural psycho-logical discovery, made by Prof Royce,[1] which underlies any and all semantic problems of human 'mentality' Royce, although a 'philosopher', was a lover of mathematics and was much interested in the problems of *order* He was trying to reformulate 'logic' in terms of order We had already encountered the inherent circularity in the structure of human knowledge, which admittedly is semantically disconcerting if not faced boldly. But, when recognized, this circularity is not only not vicious, but even adds to the interest and beauty of life and makes science more interesting Besides, the structure of human knowledge is such that there are activities of man which are not only circular but also 'absolute', or 'necessary' Whatever we do, we cannot get away from them—a fact of serious semantic importance Except from Royce and a few of his students, these problems have as yet received little attention.

Royce shows that there are certain activities which we reinstate and verify through the very fact of attempting to assume that these forms of activity do not exist, or that these laws are not valid If any one attempts to say that there are no classes whatsoever in his world, he thereby inevitably classifies If any one denies the existence of relations, and, in particular, a semantic relation between affirmation and denial, or affirms that 'yes' and 'no' have *one* meaning, in that breath he affirms and denies He makes a difference between 'yes' and 'no', and emphatically asserts relational equivalence even in denying the difference between 'yes' and 'no' To use Royce's own remarkable words 'In brief, whatever actions are such, whatever types of action are such, whatever results of activity, whatever conceptual constructions are such, that the very act of getting rid of them, or of thinking them away, logically implies their presence, are known to us indeed both empirically and pragmatically (since we note their presence and learn of them through action), but they are also absolute And any account which succeeds in telling what they are has absolute truth Such truth is a "construction"

or "creation", for activity determines its nature It is "found", for we observe it when we act'

We see that we have definite semantic guides in this enquiry One guide to follow is these unescapable characteristics of the structure of human knowledge, which Royce called 'absolute', but which I prefer to call 'necessary'. The other guide leads us to avoid 'impossible' or absurd statements, or statements which have no 'logical existence', which, in the rough, means statements which abuse symbolism and produce noises, instead of symbols As we have already seen, both guides have sound *neurological* justification, to be expressed in terms of *order* and *circularity,* terms uniquely fit structurally to speak about processes, stages of processes, orders of abstractions, Obviously, our task of formulating a theory of sanity can proceed along these structural and semantic lines It should be noticed that mathematics, considered as a form of human behaviour, and 'mental' illnesses, also considered as definitely human behaviour, have yielded their share for our structural guidance

Although many a scientist has instinctively proceeded in the way indicated, yet the instinctive successful procedure of an isolated scientist is usually not capable of being transmitted to others. It is his personal benefit Only a *methodological structural* formulation of such private routes to semantic success can become a *public* fact, to be analysed, criticized, improved, and transmitted or rejected

It must be noticed that terms like 'chance' or 'law' are fundamentally connected with discussions of determinism versus indeterminism, and so involve problems in connection with 'necessary' semantic processes In the example about the probability of the M-event, it was shown how a 'chance' event on one level may become a 'law' on another The structural *possibility* of such transformations is very interesting and of basic semantic importance For scientific purposes, we must accept ∞-valued determinism on the scientific level as *it is the test of structure,* but this has nothing to do with the *apparent,* mostly two-valued indeterminism in our daily lives To solve a number of equations, we must have as many equations as we have unknowns If we have fewer equations than unknowns, we do not get definite values, our unknowns are still undetermined The origin of 'indeterminism' is similar, we lack knowledge; the number of equations is less than the number of unknowns Hence, it is impossible to discover determined values in all cases This gives an appearance of two-valued indeterminism, but with the increase of our knowledge, or with additional equations, the unknown may be determined Determinism is a more fundamental point of view than indeterminism, in it we find a *test for structure* It is also a more general point

of view, in which indeterminism is only a particular case and does not allow of the structural test In a science of man, in a $\bar{A}$-system, we must start with the more fundamental and general Accordingly, we have to accept ∞-valued determinism, which, in 1933, becomes the broad scientific point of view The unnecessary semantic war between the advocates of the different points of view has been unduly bitter and necessarily futile

As words *are not* the things we speak about, and the only link is structural, the 'human mind' must require linguistic structural ∞-valued determinism as a condition of rationality As soon as we find that any linguistic issues are not deterministic, it is an unmistakable sign that the language or the 'logic' we are using is *not* similar in structure to the empirical world and so should be changed

This statement seems to be general In application to the new quantum mechanics' special problem, it would appear that the old macroscopic language of 'space', 'time' , is not similar to the sub-microscopic structure and should, therefore, be changed. Perhaps the electrodynamic language, instead of the macro-mechanistic, would fare better.

CHAPTER XVII

ON THE NOTIONS OF 'MATTER', 'SPACE', 'TIME'

Common sense starts with the notion that there is matter where we can get sensations of touch, but not elsewhere Then it gets puzzled by wind, breath, clouds, etc , whence it is led to the conception of "spirit"—I speak etymologically After "spirit" has been replaced by "gas," there is a further stage, that of the aether (457) BERTRAND RUSSELL

The supposition of common sense and naive realism, that we see the actual physical object, is very hard to reconcile with the scientific view that our perception occurs somewhat later than the emission of light by the object, and this difficulty is not overcome by the fact that the time involved, like the notorious baby, is a very little one (457)
BERTRAND RUSSELL

We have certain preconceived ideas about location in space which have come down to us from ape-like ancestors (149) A S EDDINGTON

But it does not seem a profitable procedure to make odd noises on the off-chance that posterity will find a significance to attribute to them (149) A S EDDINGTON

There is a blessed phrase "hidden reserves", and generally speaking the more respectable the company the more widely does its balance-sheet deviate from reality This is called sound finance
Thanks to Minkowski a way of keeping accounts has been found which exhibits realities (absolute things) *and balances* (149) A S EDDINGTON

The quest of the absolute leads into the four-dimensional world (149)
A S EDDINGTON

The views of space and time which I wish to lay before you have sprung from the soil of experimental physics, and therein lies their strength They are radical Henceforth space by itself, and time by itself, are doomed to fade away into mere shadows, and only a kind of union of the two will preserve an independent reality (352) H MINKOWSKI

It is a *thing*, not like space, which is a mere negation, nor like time, which is—Heaven knows what! (149) A S EDDINGTON

Newton objectivises space Since he classes his absolute space together with real things, for him rotation relative to an absolute space is also something real (151) A EINSTEIN

Space is only a word that we have believed a thing (417) H POINCARÉ

In fact, our ordinary description of nature, and the idea of exact laws, rests on the assumption that it is possible to observe the phenomena without appreciably influencing them (215) W HEISENBERG

Even when this arbitrariness is taken into account the concept "observation" belongs, strictly speaking, to the class of ideas borrowed from the experiences of everyday life It can only be carried over to atomic phenomena when due regard is paid to the limitations placed on all space-time descriptions by the uncertainty principle (215) W HEISENBERG

Section A Structural considerations.

The facts at hand in 1933 show that the language we use for the purpose of describing events *is not* the events, the representation symbolizes what is going on inside our skins, the events are outside our skins and *structural similarity* is the only link between them Historically, as a race, we learned sooner and more about the events outside our skins than about the events inside our skins, just as a fish or a dog 'knows' a lot about his world, lives sometimes happily and abundantly, and yet 'knows' nothing about biology, or physiology, or psycho-logics Only recently did we begin to study ourselves scientifically At some stage of our development, we introduced structurally simple forms of representation, such as a *language* of subject-predicate, of additivity,. We are still perplexed when we find that the events outside our skins cannot be pressed into schemes which are manufactured inside our skins. Our nervous system, with its ordered and cyclic structure and function, manufactures abstractions of different orders, which have quite distinct structure and different characteristics On different levels, we manufacture different abstractions, dynamic and static, continuous and discontinuous , which have to take care of our needs If the verbal schemes we invent do not fit structurally the world around us, we can always invent new schemes of new structure which will be more satisfactory It is not a problem of the world around us, for our words cannot change that, but of *our ingenuity* In the meantime, we learn something very important, namely, about the world's *structure*, which is the only content of knowledge

There are good structural reasons why the world should, or should not, be accounted for in terms of differential equations, or in *terms and language* of 'causality', The term *order* is structurally fundamental and will help us in a radical and constructive way, in our quest

First, however, we will investigate some further semantic problems, remembering that a theory of sanity, which means a theory of adjustment, should emphasize the methodological and structural means for such semantic adjustment The dynamic-static translations are fundamentally connected with different orders of abstractions and involve psycho-logical issues connected with 'emotions' and 'intellect', linearity versus non-linearity, 'straight' versus 'curved' , explained in Parts VII and VIII

In life, as well as in science, we deal with different happenings, objects, and larger or smaller bits of materials We have a habit of speaking about them in terms of 'matter' Through a *semantic disturb-*

ance, called identification, we fancy that such a thing as 'matter' has separate physical existence It would probably be a shock to be invited seriously to *give* a piece of 'matter' (give and *not* burst into speech) I have had the most amusing experiences in this field. Most people, scientists included, hand over a pencil or something of this sort. But did they actually give 'matter'? What they gave *is not* to be *symbolized* simply 'matter' The object, 'pencil', which they *handed,* requires linguistically 'space', otherwise, there would be no pencil but a mathematical point, a fiction It also requires verbally 'time', otherwise, there would be no pencil but a 'flash'.

Similarly, if any one is invited to *give* a piece of 'space' (again *give* it, and *not* burst into speech), the best he could do would be to wave his hand and try to show 'space' But the waving of the hand referred to what we call air, dust, microbes, gravitational and electromagnetic fields, In other words, structurally, the supposed 'space' was *fulness* of some materials already 'in space' and 'in time'

In the case of *giving* 'time', one could *show* his watch A similar objection holds, also, namely, that he has shown us so-called 'matter' which is 'moving' in 'space' It is very important to acquire the *s r* that when we use the term 'matter' we refer to something, let us say, the pencil, which, according to the accepted *el language,* also involves 'space' and 'time', which we disregard. When we use the term 'space', we refer to a fulness of some materials, which exists in 'time' But because these materials are usually invisible to the 'senses', we again disregard them In using the term 'time', we refer to 'matter' moving in 'space', which again we disregard

What is said here and what will follow is structurally unconditionally fundamental for a theory of sanity, because in most cases of 'insanity' and un-sanity, there is a disorientation as to 'space' and 'time'. In identification, the semantic disturbance which affects nearly all of us, and is at the foundation of the majority of human difficulties, private or public, there invariably appears a special semantic disorientation in our feelings toward 'matter', 'space', and 'time' This is only natural, for the 'insane' and un-sane are the unadjusted, the 'sane' are the supposedly adjusted

Adjusted to what? To the world around us and ourselves Our *human* world differs from the world of animals It is more complex and the problems of human adjustment become also more subtle In animal life, attitudes toward the world do not matter in a similar sense, with us, they become important, hence the need of analysis of the new human 'semantic universe', which involves the 'universe of discourse'. This

'universe of discourse' is strictly connected with the *terms* of 'matter', 'space', and 'time', structure, and our semantic *attitude* toward these terms.

Let us return to the analysis of our object which we call the 'pencil' We have seen that the *object* pencil *is not* 'matter', nor 'space', nor 'time' A question arises, which has been asked very often and has *never*, to my knowledge, been answered satisfactorily · what 'is' the *object* pencil, and what 'are' the *terms* 'matter', 'space', and 'time'? Here and there some one has given fragments of answers or some satisfactory detached statements But in every case I know, the semantic disturbance called identification appears, and so even the casual correct answer is not applied but remains enmeshed in some other identifications I have spent much 'time' and labour in overcoming my own identifications, and now confront the situation that nearly every work I read from this point of view cannot be criticized, but requires rewriting. This task is impossible for me, technically and otherwise So, finally, I decided to formulate the present $\bar{A}$-system, and then see what kind of reconstruction can be accomplished with the new evaluation

The answer to the questions set above is childishly simple, yet I will carry it all through and let the semantic consequences speak for themselves The chunk of nature, the specially shaped accumulation of materials , which we call a pencil, 'is' fundamentally and *absolutely un-speakable,* simply because whatever we may *say* about it, *is not it* We may write with this something, but we cannot write with its name or the *descriptions* of this something So the object *is not words* It is important that the reader be entirely convinced at this point, and it requires some training, performed repeatedly, before we get our *s r* adjusted to this simple fact Our statement had two parts One was rather unpromising, namely, that the object was absolutely un-speakable, because no amount of words will make the object The other was more promising, for we learned an extremely important, perhaps crucial, semantic fact; namely, what the *object* pencil *is not,* namely, that the *object is not words* We must face here an important semantic fact If we are told that we cannot get the moon, we stop worrying about it, and we regard any dream about getting the moon as an infantile phantasy In this example, we could not even say that such news as the impossibility of getting the moon was sad, or unpleasant, news We might say so, jokingly, to an infant, but the majority of the grown-ups would not have their *s r* perturbed by it A similar situation arises with the object called pencil The *object* is *not words* There is nothing sad or depressing about this fact We accept it as a fact and stop worrying about it, as

an infant would The majority of the old 'philosophical' speculations about this subject belong to the semantic period of our infancy, when we live in phantasies and structurally gamble on words to which we affectively ascribe objective existence. This represents full-fledged un-sanity due to identification The answer to the question, what 'are' the *terms* 'matter', 'space', and 'time', is, as usual, given in the properly formulated question They 'are' *terms*,—'*Modi considerandi*', as Leibnitz called them without fully realizing the semantic importance of his own statement Incidentally, it must be noticed that it was the psycho-logical characteristic of Leibnitz who was capable of such a statement, that was probably responsible for his whole work, as will become more apparent later on When we abandon primitive standards of evaluation, geniuses will be *made* by a semantic education which relieves the race from the older blockages

So we see clearly that outside of our skins there is something going on, which *we call* the world, or a pencil, or anything, which is *independent* of our words and which is *not* words Here we come across a very fundamental irreversible process. We can say that in this world a man and his words have happened There is a 'causal' eventual complex series between the world, us, and our words, but in unaided nature this process is, in the main, irreversible, a fact unknown to primitives who believe in the magic of words Through our ingenuity we can make this process partially reversible, namely, we can produce gramophones, telephones in all their developments electromechanical men who obey orders,.

We know in 1933 that in the semantic world this process is dramatically effective Words are the result of the activity of one organism, and they, in turn, activate other organisms On the macroscopic level of ordinary behaviour, this last was known long ago, but only in the last few years has psychiatry discovered what kind of semantic and psychophysiological disasters words and their consequences may produce in the human organism These last are already on sub-microscopic levels, not obvious and, therefore, only recently discovered

The structure of the language of 'matter', 'space', and 'time' is ancient The primitive saw something, ate something, was hurt by something, Here was an occasion for a grunt of satisfaction, or of pain The equivalents of words like 'matter', substance', originated Neither he, nor the majority of us realized that the small or large bits of materials we deal with appear as extremely complex *processes* (explained in Part X) For him, as for most of us, these bits of materials 'are' 'concrete', whatever that means, and he might know 'all about them', which

must have led to identification , and other delusional evaluations Of course, these were phantasies of human infancy, and, in lives lived in a world of phantasies, adjustment, and, therefore, sanity, is impossible Since he did not see or feel, or know about the material he was immersed in, the *fulness* he was living in, he invented the term 'space', or its equivalent for the *invisible* materials which were present Knowing nothing of fulness, he objectified what appeared to him to be empty 'space' into 'absolute emptiness', which later became 'absolute space', 'absolute nothingness', by 'definition'.

There are several important remarks which can be made about this 'absolute emptiness' and 'absolute nothingness' First of all, we now know, theoretically and empirically, that such a thing does not exist There may be more or less of something, but never an *unlimited* 'perfect vacuum' In the second place, our nervous make-up, being in accord with experience, is such that 'absolute emptiness' requires 'outside walls' The question at once arises, is the world 'finite' or 'infinite'? If we *say* 'finite', it *has* to have outside walls, and then the question arises · What is 'behind the walls'? If we say it is 'infinite', the problem of the psychological 'walls' is not eliminated, and we still have the semantic need for walls, and then ask what is beyond the walls So we see that such a world suspended in some sort of an 'absolute void' represents a *nature against human nature,* and so we had to invent something *supernatural* to account for such assumed nature against human nature In the third place, and this remark is the most fundamental of all, because a symbol must stand for something to be a symbol at all, *'absolute nothingness' cannot be objective and cannot be symbolized at all* This ends the argument, as all we may say about it is neither true nor false, but *non-sense* We can make noises, but say nothing about the external world It is easy to see that 'absolute nothingness' *is a label for a semantic disturbance,* for verbal objectification, for a pathological state inside our skin, for a fancy, but not a symbol, for a something which has *objective* existence outside our skin

Some other imaginary consequences of this semantic disturbance are far-fetched and very gloomy If our world and all other worlds (island universes) were somehow suspended in such an 'absolute void', these universes would radiate their energy into this 'infinite void', whatever that means, and so sooner or later would come to an end, their energy being exhausted But, fortunately, when we eliminate this pathological semantic state by proper education all these gloomy symptoms vanish as mere fancies It must be noticed that this 'absolute space', 'absolute void', 'absolute nothingness' with its difficulties, which are due

to very primitive structural speculations on *words*, and to some un-sane ascribing of objectivity to words, can be abolished quite simply if we decide to investigate and re-educate our *s r*

What we know positively about 'space' is that it is not 'emptiness', but 'fulness', or a 'plenum'. Now 'fulness' or a 'plenum', first of all, is a term of entirely different *non-el* structure When we have a plenum or fulness, it must be a plenum of 'something', 'somewhere', at 'some time', and so the *term implies,* at least, *all three of our former elementalistic terms* Furthermore, fulness by some psycho-logical process does not require 'outside walls' If we ask if such a universe of fulness is 'finite' or 'infinite', without any psycho-logical difficulties, we may reply that we do not know, but if we study enough of the materials of this universe we *may know* A universe of fulness may be assumed to have boundaries, and then we may ask again the annoying question What is beyond? With the proper use of *language,* this difficulty is again eliminated

Without going into unnecessary details, we see that a boundary, or a limit, or a wall, is something by *definition,* beyond which we cannot go If there is nothing to restrict our progress, there are *no boundaries.* Let us fancy some cosmic traveller with some extraordinary flying machine, and let us assume that he flies without stopping in a 'definite direction' If he never encounters any boundary, he is surely entitled to say that his universe is unbounded The question may arise Is such an unbounded universe finite or infinite in size? Again let us apply correct language and a little analogy A traveller on a sphere, like our own earth, could travel *endlessly* without ever coming to a boundary, and yet we know that the sphere, our earth, is of finite size Mathematicians have worked out this point, and it is embodied in the Einstein theory The universe is unbounded, an answer which satisfies our feelings, yet it is finite in size, although very large, an answer which satisfies our rationality * The visualization of such a universe is quite difficult It should not be visualized as a sphere, but, at a later stage, we will see that it *can* be visualized satisfactorily The condition for visualization is to eliminate identification, that *semantic disturbance* which is strictly connected with primitive ways of 'thinking'.

The problems of 'time' are similar, although they have a different neurological background The rough materials we deal with mostly affect our sight, touch, Invisible materials, like air., affect these 'senses'

*I do not introduce here the latest speculations in this field, because, from a non-aristotelian point of view, they appear meaningless

less, but more the kinesthetic 'senses' by which muscular movements are appreciated, and so 'space' and 'time' have different neurological backgrounds 'Time' seemingly represents a general characteristic of *all* nervous tissue (and, perhaps, living tissue in general) connected with summarizing or integrating What we have to deal with in this world and in ourselves appears as periods and periodicity, pulsations, We are made up of very long chains of atomic pulsating clocks, on the submicroscopic level On the macroscopic level, we have also to deal with periodic occurrences, of hunger, sleep, breathing, heart-beats, We know already that, beyond some limits, discontinuous times, when rapid enough, are blended into continuous feelings of pressure, or warmth, or light, On objective levels we deal with times, and we feel 'time', when the times are rapid enough

Again, the moving pictures are a good illustration. The normal moving-picture film shows sixteen pictures a second The film gives us static pictures with finite differences When we put it on the projector, the differences vanish Our nervous system has summarized and integrated them, and we see 'continuous motion' If pictures are taken at the rate of eight a second and then run on the normal projector for the speed of sixteen a second, we summarize and integrate again, but we see a fast moving picture If the pictures are taken at the rate of 128 exposures a second and run on the normal projector of sixteen pictures to a second, we have what is called a slow moving picture It should be noticed that the order of the semantic rhythmic processes is fourfold, it involves order not only in 'space' (three dimensions) but in 'time' also Periods of contraction alternate with periods of rest, and this occurs at nearly regular intervals

This rhythmic tendency is, indeed, so fundamental and so inherent in living tissue that we can, at pleasure, make voluntary muscles, for example, exhibit artificially induced rhythmic contractions by immersing them in special saline solutions, as, for instance, a solution of sodium chloride We should also not wonder why modern science assumes that life may have originated in the sea The physico-chemical conditions of saline solutions are such that they favour rhythmic processes, they not only may originate them, but may also keep them up, and life seemingly is very closely connected with autonomous rhythmic processes

Such rhythmic processes are *felt* on lower orders of abstraction as 'continuous time', probably because of the rapidity and overlapping of periods On higher order abstractions, when structurally proper linguistic and extra-neural means are developed, they appear as times

Perhaps, neurologically, animals *feel* similarly as we do about 'time', but they have no neurological means to elaborate linguistic and extra-neural means which alone allow us to extend and summarize the manifold experience of many generations (time-binding) They cannot pass from 'time' to 'times'. Obviously, if we do not, we then renounce our human characteristics, and copy animals in our evaluating processes, a practice which must be harmful

In nature the visible and invisible materials seemingly consist of recurring pulsations of extremely minute and rapid periods, which, in some instances, become macroscopic periods In the first case, we cannot see them or feel them, so we talk about 'concreteness', In the second case, we see the periodic movements, as of the earth around the sun , or we feel our heart-beats , We see that the visible or invisible materials in nature are compounded of periodic pulsations and are simply two aspects of one process The splitting of these processes into 'matter', 'space', and 'time' is a characteristic function of our nervous system These abstractions are *inside* our skins, and are methods of representation for ourselves to ourselves, and *are not* the objective world around us

It must be realized that under such circumstances we cannot speak about 'finiteness' or 'infiniteness' of 'matter', 'space', and 'time', as all the old 'philosophers' have done, Leibnitz included, because these terms 'finite' and 'infinite', though they may be conceivably applied to *numbers* of aspects of objective entities, have *no meaning* if applied to linguistic issues, that is, to *forms of representation* outside of numbers Of course, if, through a semantic pathological disturbance (objectification), we do ascribe some delusional objective existence to verbal terms, we can then talk about anything, but such conversations have no more value than the deliria of the 'mentally' ill The terms 'finite' or 'infinite' are only legitimately applied to *numerical* problems, and so we can speak legitimately of a finite or infinite numbers of inches, or pounds, or hours, or similar entities, but statements about the 'finite mind' or the 'understanding of the infinite'., have *no* meanings and only reveal the pathological semantic disturbance of the patient.

The objectification of *our feeling* of 'time' has had, and has at present, very tragic consequences strictly connected with our un-sanity It must be remembered that particularly in 'mental' and nervous difficulties the patient seldom realizes the character of his illness He may feel pains, he may feel very unhappy, and what not, but he usually does not understand their origin This is particularly true with semantic disturbances One may explain endlessly, but, in most cases, it is perfectly hopeless to try to help. Only a very few benefit. Here lies, also, the

main difficulty in writing this book Readers who identify, that is, who believe unconsciously with all their affective impulses in the objectivity of 'matter', 'space', and 'time', will have difficulty in modifying their *s r* in this field.

Let us see now what consequences the objectification of 'time' will have for us If we do *not* objectify, and *feel* instinctively and permanently that words *are not* the things spoken about, then we could not speak about such *meaningless* subjects as the 'beginning' or the 'end' of 'time' But, if we are semantically disturbed and objectify, then, of course, since objects have a beginning and an end, so also would 'time' have a 'beginning' and an 'end' In such pathological fancies the universe must have a 'beginning in time' and so must have been made , and all of our old anthropomorphic and objectified mythologies follow, including the older theories of entropy in physics But, if 'time' is only a *human form of representation* and *not an object,* the universe has no 'beginning in time' and no 'end in time', in other words, the universe is 'time'-less It was not made, it just 'was, is, and will be' The moment we realize, feel permanently, and utilize these realizations and feelings that words *are not* things, then only do we acquire the semantic freedom to use different forms of representation We can fit better their structure to the facts at hand, become better adjusted to these facts which *are not* words, and so evaluate properly *m o* realities, which evaluation is important for sanity

According to what we know in 1933, the universe is 'time'-less, in other words, there is no such *object* as 'time' In terms of periods, or years, or minutes, or seconds, which is a *different language,* we may have infinite numbers of such time*s* This statement is another form of stating the principle of conservation of energy, or whatever other fundamental higher abstraction physicists will discover

Because 'time' is a *feeling,* produced by conditions of this world outside and inside our skins, which can be said to represent time*s*, the problem of 'time' becomes a neuro-mathematical issue It must also be noticed that time*s*, as a term, implies time*s* of something, somewhere, and so, as with plenum or fulness, it is structurally a *non-el,* $\bar{A}$ term

Time*s* has also many other most important implications It implies *numbers* of time*s*, it implies periods, waves, vibrations, frequencies, units, quanta, discontinuities, and, indeed, the whole structural apparatus of modern science

Euclidean 'space' had the semantic background of 'emptiness' In it we moved our figures from place to place and always assumed that this could be done quite safely and accurately Newtonian mechanics

also followed this path and even postulated an 'absolute space' (emptiness) All of which harks back to the old aristotelianism.

$\bar{E}$, $\bar{N}$, and $\bar{A}$ systems have the semantic background of fulness or plenum, although, unfortunately, this background is, as yet, mainly unrealized, not fully utilized, it has not, as yet, generally affected our *s r*.

A simple illustration will make the difference clear Imagine that in one part of a large room we have an open umbrella which we would like to compare with another 'unit' open umbrella Let us imagine that the room has the air pumped out and also that all other eventual disturbing factors are eliminated We can move our open 'unit' umbrella from one part of the room to another, and this movement will not considerably distort our 'unit' umbrella Now let us perform a similar experiment in two houses, separated some distance, during a storm, a storm implying, of course, *fulness* Can we transport our 'unit' umbrella through the storm and preserve its shape , in a fulness, without taking the fulness into account? Of course not We see what serious difference it makes if our theories presuppose 'emptiness' or 'fulness'

This shows also why the non-euclidean geometries which deal with a plenum are structurally preferable and semantically sounder and more in accord with the structure of the world, than the language of euclidean 'emptiness', to which there is nothing in nature to correspond Should we wonder that modern linguists (mathematicians) work in the direction of fulness and of fusing geometry with physics It is obviously the only thing to do Differential geometry is the foundation of this new outlook, but, even in this geometry, lines could legitimately be transported over great distances Weyl introduced a semantic improvement of this point of view by assuming that for a differential geometry it is illegitimate to use comparisons at large distances,.but that all operations should be between indefinitely near points [1]

It should be noticed that scientists, in general, disregard almost completely the verbal and semantic problems explained here, a fact which leads to great and unnecessary confusion, and makes modern works inaccessible to the layman Take, for instance, the case of the 'curvature of space-time' Mathematicians use this expression very often and, inside their skins, they know mostly what they are talking about Millions upon millions of even intelligent readers hear such an expression as the 'curvature of space-time' Owing to nursery mythology and primitive *s r*, 'space' for them is 'emptiness', and so they try to understand the 'curvature of emptiness' After severe pains, they come to a very *true*, yet, for them, hopeless, conclusion, namely, that 'curvature of emptiness' is either *non-sense* or 'beyond them', with the semantic result that either

they have contempt for the mathematicians who deal with non-sense or feel hopeless about their own capacities—both undesirable semantic results

The truth is that 'curvature of emptiness' has no meanings, no matter *who* might say it, but curvature of fulness is entirely different Let the reader look at the cloud of smoke from his cigarette or cigar, and he will at once understand what 'curvature of fulness' means Of course, he will realize, as well as the mathematicians do, that the problem may be difficult, but, at least, it *has sense* and represents a problem It is not non-sense

Similar remarks apply to higher dimensions in 'space' Higher dimensions in 'emptiness' is also non-sense, and the layman is right in refusing to accept it But higher dimensions in fulness is entirely a different problem A look at the cloud of smoke from our cigarette will again make it completely plain to everybody that to give an account of fulness, we may need an enormous number of data or, as we say roughly, of dimensions This applies, also, to the new four-dimensional world of Minkowski It is a fulness made up of world lines, a network of events or intervals , and it is not non-sense

Lately, there has appeared an excellent book by Bertrand Russell, published by the International Library of Psychology, Philosophy and Scientific Method, and yet the title is *The Analysis of Matter,* without any quotation marks

This book is really an unusually fine and fundamental work which has no defects which could be implied by the title This title simply disregards the issues explained here, it should be *The Analysis of 'Matter'*

It is with some pleasure that one sees such an authority as Eddington, in his *The Mathematical Theory of Relativity,* on p 158, making the statement 'In using the word "space" it is difficult to repress irrelevant ideas, therefore let us abandon the word and state explicitly that we are considering a *network of intervals*'

For the reasons already given, I do not use the terms 'matter', 'space', or 'time' without quotation marks, and, wherever possible, shall use, instead, the terms 'materials', 'plenum', 'fulness', 'spread', and 'times', (say seconds) Indeed, these semantic problems are so serious that they should be brought to the attention of International Mathematical and Physical Congresses, so that a new and *structurally correct* terminology could be established It is *not* desirable that science should *structurally mislead* the layman and disturb his *s r* It is easier for trained specialists to change their terminology than to re-educate semantically the rest of the race I would suggest that terms 'matter', 'sub-

stance', 'space', and 'time' should be completely eliminated from science, because of their extremely wide-spread and vicious structural and so semantic implications, and that the terms 'events', 'space-time', 'material', 'plenum', 'fulness', 'spreads', 'times' , be used instead These terms not only do not have the old structural and semantic implications, but, on the contrary, they convey the *modern* structural notions and involve new *s r*. The use of the old terms drags in, unconsciously and automatically, the old primitive metaphysical structure and *s r* which are entirely contradicted by experience and modern science I venture to suggest that such a change in terminology would do more to render the newer works intelligible than scores of volumes of explanations using the old terminology

Before summarizing in Parts IX and X what modern science has to tell about the structure of the world around us, it will be profitable to enquire what are the means by which we can recognize this structure.

Section B The neurological function of abstracting

Protoplasm, even in its simplest form, is sensitive to different mechanical and chemical stimulations, and, indeed, undifferentiated protoplasm has already all the potentialities of the future nervous system If we take an undifferentiated bit of protoplasm, and some stimulation is applied to some point, the stimulus does not spread somehow 'all over at once', with some mysterious 'infinite' velocity, but propagates itself with finite velocity and a diminishing gradient from one end of our bit of protoplasm to the opposite end

Because of the *finite velocity* of propagation and the fact that the *action is by contact in a plenum,* the impulse has a definite direction and diminishing intensity, or, as we say, the bit of protoplasm acquires a temporal polarity (head-end) Such polarity conditions produce a directed wave of excitement of diminishing intensity, which Child calls a dynamic gradient If such a stimulation were applied to one spot for a considerable length of 'time', some kind of polarization may become lasting In some such way those dynamic gradients have become *structuralized* in the forms of our nervous system, which represent the preferred paths by which the nervous impulses travel

The bodies of most organisms are protected from outside stimulation by some kind of membrane or cuticle and the parts of the surface have developed so as to be sensitive to one form of stimulation and not to others For instance, the eye registers the stimulations of light waves, while it is insensitive to sound , and, even if hit, it gives only the feeling of light Each 'sense-organ' has also the nervous means of concentrating

stimuli, intensifying them , and so of effecting the most efficient response of the corresponding end-organ

In our school days we were taught that we have five 'senses' Modern researches show that there are more than twenty different 'senses' Besides, as far as 'Smith' is concerned, we know that 'senses' and 'mind' cannot be divided

The main stimulations which we find in the outside world may be divided into three groups The first are connected with the roughest macroscopic manifestations of the outside world, they are mechanical impacts which we abstract as 'tactile sensations', which range from a single mechanical contact to rhythmically repeated contacts with our skin as frequently as 1552 vibrations per second Above this limit 'times' begin to be registered as a 'duration', that is, the individuality of 'times' is lost, and we feel pressure At this level we deal with gross macroscopic manifestations, which are not only felt but can also be seen

The second group of manifestations is, in the main, no more on the gross level Here belong the vibratory manifestations which are no more visible to the unaided eye We may speak of them as on the microscopic level. They are mechanical vibrations of the air , and we become acquainted with them in the form of sound The vibrations which the average ear is able to register range from about 30 (sometimes even 12) to about 30,000 or even 50,000 vibrations a second The ear does not register any other vibrations *

The third group of vibratory manifestations belongs to a still subtler level They are electromagnetic waves of an enormous variety of wavelengths and number of vibrations per second The lower members of this series are the Hertzian electric waves, the higher members are the X-, or Rontgen-rays Our nervous systems are capable of registering only a very limited range of these vibrations, namely, the waves called radiant heat, the light waves, and the ultra-violet rays, these last only on a chemical level It seems that we have no organ which responds directly to electric waves, ultra-violet rays, X-rays, and the many other rays which we know from laboratory work

Similarly, the chemical 'senses' of taste and smell register only a very small number of actual excitations to which they are exposed

Animals have different limits of nervous susceptibility, but we can have no idea how the world looks to them unless their nervous system is quite similar to our own The above statements will become clearer if we tabulate some of them The following table is taken from *An Introduction to Neurology* by Professor C Judson Herrick, p 85 (Fifth Edition)

*Latest researches seem to modify these data

TABLE OF PHYSICAL VIBRATIONS*

Physical process	Wave length	Number of vibrations per second	Receptor	Sensation
Mechanical contact	. . . .	From very slow to 1552 per second	Skin	Touch and pressure
Waves in material media	Above 12,280 mm	Below 30 per second	None	None
	12,280 mm to 13 mm	30 per second to 30,000 per second	Internal ear	Tone
	Below 13 mm	Above 30,000 per second	None	None
Ether waves	∞ to 2 mm (electric waves)	0 to 1500 billion (1.5×10^{12})	None	None
	1 mm to 0004 mm	3000 billion (3×10^{12}) to 800,000 billion (8×10^{14})	Skin	Radiant heat
	0008 mm to 0004 mm	400,000 billion (4×10^{14}) to 800,000 billion (8×10^{14})	Retina	Light and color.
	0004 mm to 000008 mm (ultra-violet rays)	800,000 billion (8×10^{14}) to 40,000,000 billion (4×10^{16})	None	None
	00002 mm to 00000001 mm (x-rays)	15,000,000 billion (1.5×10^{16}) to 30,000,000,000 billion (30×10^{18})	None	None.
	00000014 mm to 0000000005 mm (γ-rays)	2 billion billion (2×10^{18}) to 600 billion billion (6×10^{20})	None	None
	00000000005 mm to 000000000008 mm (cosmic rays)	6,000 billion billion (6×10^{21}) to 40,000 billion billion (4×10^{22})	None	None

*The use of names for large numbers is not uniform in different countries, and so I give, in brackets, the United States and French equivalents to the English names

Million 1,000,000 $= 10^6$, (million)
Milliard 1,000,000,000 $= 10^9$, (billion or milliard)
Billion $10^6 \times 10^6 = 10^{12}$, (trillion)

In this table 1 billion $= 10^9$.

As a further illustration of the mechanism of abstracting, we may suggest the observation of Weber that if, for instance, a room is lighted with 100 candles, and if one more candle is brought in, the increased illumination will be appreciated very slightly But not so if we had a room illuminated with 1000 candles In this case, we should not appreciate the addition of one candle at all Ten candles should be introduced to make an appreciable difference in our perceptions The Weber law, as it is called, stated that in the above case 1/100 of the original strength of the stimulus is needed to make a change appreciable For light, the fraction is about 1/100, for noise, about 1/3, for pressure, it varies between 1/30 and 1/10, for weight, between 1/70 and 1/40 in various parts of the body.

If we use compasses and experiment with pricks, we find that in different parts of the body the limit of the distance apart of the points when we *feel one prick* and yet have two, is different

On the tip of the tongue this limit is	1 mm
On the palmar surface of third phalanx of forefinger	2 mm
On the palmar surface of second phalanges of fingers	4 mm
On the palm of the hand	10 mm
On the dorsal surface of first phalanges of fingers	14 mm
On the back of hand	25 mm
On the upper and lower parts of forearm	37 mm
On the middle thigh and back	62 mm [2]

A 'sensation' requires appreciable 'time' (times by a clock) for its development Part of the 'time' is spent at the end-organ, part in conveying the nervous impulse along the nerves to the brain and part in the brain A 'sensation' usually outlasts the stimulus, and often a single stimulus produces a whole series of 'after-sensations'.

As compared with the 'sensations' obtained from pain spots, touch is quicker in its development and persistence. With a vibrating string, 1500 vibrations a second are recognizable by touch as vibrations At over 1552 vibrations a second, the vibratory character is lost, and we feel only continuous pressure A toothed revolving wheel gives the feeling of smoothness (and 'continuity') when the teeth meet the skin at the rate of from 480 to 680 per second [3]

The above given tables and facts are deeply significant. We see, first of all, that structurally we are immersed in a world full of energy manifestations, out of which we abstract directly only a very small portion, these abstractions being already coloured by the specific functioning and structure of the nervous system—the abstractors Very probably, there are many more energy manifestations which, as yet, we have not

discovered Every few years we discover some new form of energy manifestation, and, at present, our knowledge is already so advanced that it is highly probable that the list is much longer Finally, and here the whole 'structure of human knowledge' begins to play its role, for sanity *we have to know and evaluate this world* around us, if we want to adjust ourselves satisfactorily to it

Section C Problems of adjustment

Is the problem of adjustment in the animal world similar to that in the human world? No, it is entirely different Animals do not alter their environment so rapidly, nor to such an extent as humans do Animals are not time-binders, they have not the capacity by which each generation can start where the former left off Neurologically, animals have no means for extra-neural extensions, which extensions involve the complex mechanism with which we are dealing throughout this work

The example of the caterpillar, already cited, shows clearly how organisms not adapted to their environment perish and do not propagate their special, non-survival characteristics Similar remarks apply to hens, their eggs, and chicks which are kept in buildings without sunlight or with ordinary glass windows, these, also, do not survive, and so pass out of the picture

With humans, the situation is entirely different We are able to produce conditions which do not exist in unaided nature We produce artificial conditions and so *our numbers and distribution* are not regulated by unaided nature alone Animals cannot over-populate the globe, as they do not produce artificially We do over-populate this globe because we produce artificially With *animals, selfishness comes before altruism, and the non-selfish perish An animal has to live first, then act* With man, the reverse is true The selfish may produce such conditions that they are destroyed by them We can over-populate the globe because of artificial production, and so we are actually born nowadays into a world where we must *act first before we can live* As I have already shown in my *Manhood of Humanity* (p 72), the old animalistic, fallacious generalizations have been, and are, the foundation of our 'philosophies', 'ethics', systems , and naturally such animalistic doctrines must be disastrous to us Neurologically, we build up conditions which our nervous systems cannot stand, and so we break down, and, perhaps, shall not even survive

Animals have no 'doctrines' in *our meaning* of the term, thus, doctrines are no part of their environment, and, accordingly, animals cannot perish through false doctrines We do have them, however, and,

since they are the most vital environmental semantic conditions regulating our lives, if they are fallacious, they make our lives unadjusted and so, ultimately, lead to non-survival.

So we see that 'human adjustment' is quite a different and much more complex affair than 'animal adjustment' The 'world' of 'man' is also a different and much more complex 'world' than that of the animal There seems to be no escape from this conclusion We see, also, that what we used to call 'senses' supply us with information about the world that is very limited in quantity, *specific* in quality, an abstraction of low order, never being 'it' Being often unaffected, our 'senses' are not able to abstract, obviously, some of the most fundamental manifestations of energy to be found in the external world If we speak of the older so-called 'sense perceptions' as lower order abstractions, then we find that we learn about the other subtler manifestations of energy through science, higher neural and extra-neural means, which we may call higher order abstractions In the older days, we called this kind of knowledge 'inferential knowledge' The animals do not have these higher order abstractions in that sense, and so their world is for them devoid of these extra-sensible manifestations of energy.

It must be remembered that these higher order abstractions and the 'inferential knowledge' of the old theories (they are not equivalent by definition) have a very similar status Organisms work as-a-whole, and to separate completely higher and lower order abstractions is impossible All that is said here justifies the new terminology Our nervous system does abstract, does summarize, does integrate on different levels and in different orders, and the *result* of a stimulus *is not* the stimulus itself. The stone *is not* the pain produced by the stone dropping on our foot; neither is the flame we see, nor the burn we feel The actual process goes on outside of our skin, as represented by the 'realities' of modern science

We have already spoken frequently of the different order abstractions, their special characteristics, dynamic versus static , and the means of translation of lower orders into higher, and vice versa Events which are going on and for which we have no direct 'senses' of abstraction, as, for instance, electric waves, Rontgen-rays, wireless waves , we know only through extra-neural extensions of our nervous system given by science and scientific instruments Naturally, we should expect that the structure of our abstracting mechanism would be also reflected in these higher order abstractions Facts show this to be true; and practically all modern science proves it directly or indirectly This is why, for instance, we have the mathematical methods for passing from dynamic

to static, and vice versa, why we have quantum theories and conditions, and why we have problems of continuity versus discontinuity, atomic theories,

The above is not a plea for certain old-fashioned 'idealistic philosophies' and still less for 'solipsism' Far from it The object of this present work is to face hard structural experimental *m o* facts, analyse these facts in a language of a similar *structure* ($\bar{A}$), and so to reach tentatively new conclusions which again can be verified by experiments Once more the reader must be warned against carelessly translating the structurally *new* terms into the *old* terms The complete structural, psycho-logical, semantic, and neurological analysis of one single such new term would afford material for several volumes and so is impossible in this work The usefulness of the old terms has been exhausted The structural consequences of the old terms have been practically all worked out, and, as a rule, we cannot have much quarrel with the older conclusions in the *old language* If we reach *different* conclusions, or get some new emphasis, it will be due to the use of the structurally *new* language If we translate the new into the old, the old conclusions are usually *truer* than the new ones The reverse is also true, the old conclusions become false or, at best, only gain emphasis because of the structure of the new language The problem of all theories, old or new, is to give a structural account of the facts known, to account for exceptions, and to predict new experimental structural facts which again may be verified empirically

Section D Semantic considerations

We speak much and vaguely about the 'structure' of language, but extremely little work has been done in this field In the present work, we not only tackle this problem as best we can, theoretically, but we also use a language of a new *non-el,* functional structure, and the results, whatever their value, are actually the results of such procedure

A short while ago we did not even know that such problems existed Dreams, alone, about such problems did not help, for, before the structures of two different entities can be compared, these entities must first be produced Then, and only then, can we compare and evaluate them Before we could compare the A, the E, and the N systems with $\bar{A}$, $\bar{E}$, and $\bar{N}$ systems the last had to be produced, no matter how imperfect they might be at the beginning

Something similar can be said about languages Before we can speak of them in the plural and compare them, we must have more than one for comparison Mathematics has pointed out this problem for us in

geometry For instance, we have to deal with different frames or references, or different systems of co-ordinates We find that they represent different languages and that they may introduce purely verbal statements which have nothing to do with the subject of our analysis (extrinsic characteristics) We have also found that some characteristics may appear in one form of representation and not appear so readily in another For instance, we know that every line, except the X axis through a point 0 which is the intersection of a parabola with its X axis, cuts the curve a second time This fact, important for us to know, appears clearly in the polar co-ordinate form of representation, but does not appear in the rectangular form of equations, although, when once a characteristic of a curve is discovered, it can be usually translated into the other co-ordinate languages In such cases as this, a language of new structure has a kind of creative character, in that it makes some structural discoveries easier.

But the co-ordinate methods were not quite satisfactory They introduced, too easily, too many extraneous, extrinsic characteristics, belonging to the language and not to the subject Mathematicians decided to get away from these metaphysical 'outside' references by referring the entity to itself to become more experimental They invented the internal theory of surfaces, a vector language where they *refer the entity to itself,* its curvature, its length and direction. Finally, in the extension of the vector language which is called the tensor calculus, they achieved a still larger kind of independence Having invented *three* languages in which we can speak about *one* issue, we are now able to meet the problem of *comparison* of these languages At once, most important structural and methodological problems arise

The newer quantum mechanics are also an epoch-making linguistic structural innovation, not only in physics, but also in *methodology* We have, at present, three, or, perhaps, more, quantum mechanics which speak about one subject, but in entirely different languages I say 'three or more', because, from a methodological point of view, it is very hard, at present, to be precise, as the problems are too new and, as yet, too little analysed Similar remarks apply to systems Before two systems can be compared, a second system must be produced Then we can compare them

In our brief verbal analysis of 'space', and 'time', and 'matter', we have seen that these represent *terms,* or *linguistic means, not objects* We have seen, also, that these antique forms of representation have very unsatisfactory structural implications They introduce a verbal *elementalism* structurally *absent* in nature, and by a process of objecti-

fication lead to many kinds of fanciful semantically harmful metaphysics. Since Einstein and Minkowski, the excellent term 'event' has been introduced into scientific literature It is a term of such epoch-making semantic importance that it should become a term of daily use and should be introduced into elementary schools Teachers do not perform their duties honestly or intelligently if they disregard such structural, linguistic, and semantic issues, which, as we have seen, are the central problem of all possible education.

Likewise, we have already seen that the chunk of nature which we call a 'pencil' *is not* 'matter' nor 'space' nor 'time', the terms being only *terms* Is such *el language* structurally appropriate for the purpose of speaking about the world around us? It seems undeniable that such language is quite out-dated and very unsatisfactory It introduces structurally an artificial elementalism of a verbal character, in spite of the fact that even the most elementary consideration shows that structurally the opposite is true, namely, that 'matter', 'space', and 'time' can *never* be experimentally divided The term 'event' is precisely the term which does away with this old and vicious elementalism

All that we deal with in the outside world involves indivisibly 'matter', 'space', and 'time' Using the old language, there cannot be something somewhere at 'no time', or something at some 'time' and 'no where' or 'nothing' 'somewhere' at 'some time' Everything which happens must be structurally represented as something, somewhere, at some 'time'. If the structure of the world happened to be such that 'nothing' would happen 'nowhere' at 'no time', then we should have nothing to talk about, and all we would or could say would deal with our fancies The four-dimensional language, which describes happenings structurally more nearly as we experience them, is precisely the language of 'events' It should be remembered that in daily life we live by four-dimensional event-conditions That is, the events which interest us are something, somewhere, and some 'time' If we want two of our friends to become acquainted with each other, we invite them to our home The appointment is in three dimensions in 'space' (to the left or to the right, forward or backward, up or down), and at a given hour So we see that our daily life is lived in a four-dimensional space-time manifold, and we begin to appreciate the fact that science has lately caught up with such fundamental structural 'realities'. It must be noticed that the new four-dimensional space-time *language* does not, or should not, use the *term* 'matter' as we used it in the old way In the new language, the bits of materials we deal with are connected analytically with the 'curvature' of this space-time manifold.

The reader should realize that the structurally new language is similar to the structure of our experience, and involves profound methodological and, therefore, psycho-logical, semantic factors It has entirely different semantic values, and, perhaps, because of this fact, it is an irreversible advance, no matter how details may be altered

The newtonians, for the most part, overlook the fact that all theories, their own included, are a semantic product of the functioning of the nervous system, and so involve some 'logic' and 'psychology'. In the new theories, a kind of *physical* subjectivity always appears which ought to be taken care of We know, for instance, that if we immerse a part of a straight stick in water, the stick appears to be broken, although actually it has not been broken A photographic camera gives a similar record So we see that, besides the psycho-logical subjectivity, there is a most important *physical subjectivity,* which is introduced by the use of instruments The main difficulties in modern science are precisely in the elimination of this physical subjectivity, particularly when we deal with such minute entities that the light waves miss them In the case of an hypothetical gamma-ray microscope, for instance, the rays would produce what is called a Compton effect,* and so the results of the experiment would be altered by the instrument and procedure

We ought not to be surprised that the old systems of 'motion' and 'emotion' in science (Newton) and 'philosophy' (Bergson) should result from speculations on the old *A el* language and the introduction of fanciful and fallacious assumptions of an 'infinity' somewhere, and other fancies The realization of this marks a new semantic epoch in our lives It is to the credit of these two men that they have summarized these old tendencies in such a masterly way that we are enabled to go beyond them We shall return to this subject when we analyse the four-dimensional 'world' of Minkowski, and, then, we shall summarize briefly what we now know about 'space', 'time', and 'matter' (see Parts IX and X).

*Compton discovered, in 1923, that the generation of secondary continuous Rontgen radiation by a primary radiation is accomplished by an increase in the wave-length

PART V

ON THE NON-ARISTOTELIAN LANGUAGE CALLED MATHEMATICS

Once a statement is cast into mathematical form it may be manipulated in accordance with these rules and every configuration of the symbols will represent facts in harmony with and dependent on those contained in the original statement Now this comes very close to what we conceive the action of the brain structures to be in performing intellectual acts with the symbols of ordinary language In a sense, therefore, the mathematician has been able to perfect a device through which a part of the labor of logical thought is carried on outside the central nervous system with only that supervision which is requisite to manipulate the symbols in accordance with the rules (583) HORATIO B WILLIAMS

The toughminded suggest that the theory of the infinite elaborated by the great mathematicians of the Nineteenth and Twentieth Centuries, without which mathematical analysis as it is actually used today is impossible, has been committing suicide in an unnecessarily prolonged and complicated manner for the past half century (22) E T BELL

The solution goes on famously, but just as we have got rid of the other unknowns, behold! V disappears as well, and we are left with the indisputable but irritating conclusion—

$$0 = 0$$

This is a favourite device that mathematical equations resort to, when we propound stupid questions (149) A S EDDINGTON

Who shall criticize the builders? Certainly not those who have stood idly by without lifting a stone (23) E T BELL

. let me remind any non-mathematicians that when a mathematician lays down the elaborate tools by which he achieves precision in his own domain, he is unprepared and awkward in handling the ordinary tools of language. This is why mathematicians always disappoint the expectation that they will be precise and reasonable and clear-cut in their statements about everyday affairs, and why they are, in fact, more fallible than ordinary mortals (529) OSWALD VEBLEN

CHAPTER XVIII

MATHEMATICS AS A LANGUAGE OF A STRUCTURE SIMILAR TO THE STRUCTURE OF THE WORLD

To-day there are not a few physicists who, like Kirchhoff and Mach, regard the task of physical theory as being merely a mathematical description (*as economical as possible*) of the empirical connections between observable quantities, *i e* a description which reproduces the connection, as far as possible, without the intervention of unobservable elements (466) E SCHRODINGER

But in the prevalent discussion of classes, there are illegitimate transitions to the notions of a 'nexus' and of a 'proposition' The appeal to a class to perform the services of a proper entity is exactly analogous to an appeal to an imaginary terrier to kill a real rat (578) A N WHITEHEAD

Roughly it amounts to this mathematical analysis as it works today must make use of irrational numbers (such as the square root of two), the sense if any in which such numbers exist is hazy Their reputed mathematical existence implies the disputed theories of the infinite The paradoxes remain. Without a satisfactory theory of irrational numbers, among other things, Achilles does not catch up with the tortoise, and the earth cannot turn on its axis But, as Galileo remarked, it does It would seem to follow that something is wrong with our attempts to compass the infinite (22) E T BELL

The map is not the thing mapped When the map is identified with the thing mapped we have one of the vast melting pots of numerology (604) E T BELL

The theory of numbers is the last great uncivilized continent of mathematics. It is split up into innumerable countries, fertile enough in themselves, but all more or less indifferent to one another's welfare and without a vestige of a central, intelligent government If any young Alexander is weeping for a new world to conquer, it lies before him. (23) E T. BELL

The present work—namely, the building of a *non-aristotelian system,* and an introduction to a theory of sanity and general semantics—depends, fundamentally, for its success on the recognition of mathematics as a language similar in structure to the world in which we live

The maze of often unconnected knowledge we have gathered in the fields with which this part is dealing is so tremendous that it would require several volumes to cover the field even partially Under such conditions, it is impossible to deal with the subject in any other way than by very careful selection, and so I shall, therefore, say only as much as is necessary for my present semantic purpose

It is a common experience of our race that with a happy generalization many unconnected parts of our knowledge become connected, many 'mysteries' of science become simply a linguistic issue, and then the mysteries vanish New generalizations introduce new *attitudes* (evaluation) which, as usual, seriously simplify the problems for a new generation. In the present work, we are treating problems from the point of view of such a generalization, of wide application, namely, *structure,* which is forced upon us by the denial of the 'is' of identity , so that structure becomes the only link between the objective and verbal levels The next consequence is that structure alone is the only possible content of knowledge

Investigating structure, we have found that structure can be defined in terms of relations, and the latter, for special purposes, in terms of multi-dimensional order Obviously, to investigate structure, we must look for relations, and so for multi-dimensional order. The full application of the above principles becomes our guide for future enquiry.

In the recent past, we have become accustomed to such arguments as, for instance, that the theory of Einstein has to be accepted on 'epistemological' grounds Naturally, the scientist or the layman who has heard the last term, but never bothered to ascertain that it means 'according to the structure of human knowledge', would recognize no necessity to accept something which violates all his habitual *s r*, for reasons about which he does not know or care But if we say that the Einstein theory has to be accepted, for the 'time' being, at least, as an irreversible *structural linguistic progress,* this statement carries for many quite a different verbal and semantic implication, and one worth considering

Mathematics has, of late, become so extremely elaborate and complex that it takes practically a lifetime to specialize in even one of its many fields Here and there notions of extreme creative generality appear, which help us to see relations and dependence between formerly non-connected fields For instance, the arithmetization of mathematics, or the theory of groups, or the theory of aggregates, has each become such a supreme generalization At present, there is a general tendency among all of us, scientists included, to confuse orders of abstractions This results in a psycho-logical semantic blockage and in the impossibility of seeing broader issues clearly

Some of the structural issues are still but little understood, and, in writing this chapter, I lay myself open to a reproach from the layman that I have given too much attention to mathematics, and from the professional mathematician that I have given too little My reply is that what is said here is necessary for rounding up the semantic foundations of the system, and that I explain only enough to carry the main points of structure and as semantic suggestions for further semantic researches

I have found that among some physicists and some mathematicians the thesis that mathematics is the only language which, in 1933, is similar in structure to the world, is not always acceptable As to the second thesis, the similarity of its structure to our nervous system, some even seem to feel that this statement borders on the sacrilegious! These objectors, apparently, believe that I ascribe more to mathematics than is just Some physicists point out to me the non-satisfactory development of mathematics, and they seem to confuse the inadequacy of a given mathematical theory with the general *m o* structure of mathematics Thus, if some physical experimental investigation is conducted—for

instance, on high pressure—and the older theories predict a behaviour exemplified by the curve (A), while the experimental new data show that the actual curve is (B), such a result would show unmistakably that the first theory is not structurally correct But, in itself, this result does not affect the correctness of a statement about the general structure of mathematics which can account for *both curves*

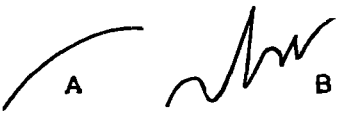


FIG 1

Until very lately, we had a very genuine problem in physics with the quantum phenomena which seem to proceed by discrete steps, while our mathematics is fundamentally based on assumptions of continuity. Here we had seemingly a serious structural discrepancy, which, however, has been satisfactorily overcome by the wave theory of the newer quantum mechanics, explained in Part X, where the discontinuities are accounted for, in spite of the use of differential equations and, therefore, of continuous mathematics

But, if we start with fundamental assumptions of continuity, we always can account for discontinuities by introducing wave theories or some similar devices Therefore, it is impossible, in our case, to argue from the wave theory (for instance) to the structure of mathematics, or vice versa, without a fundamental and *independent* general structural analysis, which alone can elucidate the problem at hand

Mathematicians may object on the ground that the new revision of the foundation of mathematics, originated by Brouwer and Weyl, challenges the 'existence' of irrational numbers . and, therefore, destroys the very foundations of continuity and the legitimacy of existing mathematics

In answer to such a criticism, we should notice, first, that the current 'continuity' is of two kinds One is of a higher grade, and is usually called by this name, the other continuity is of a lower grade and is usually called 'compactness' The new revision challenges the higher continuity, but does not affect compactness, which, as a result, will, perhaps, have to suffice in the future for all mathematics, since compactness is sufficient to meet all psycho-logical requirements, once the problems of 'infinity' are properly understood

A structural independent analysis of mathematics, treated as a language and a form of human behaviour, establishes the similarity of this language to the undeniable structural characteristics of this world and of the human nervous system These few and simple structural foundations are arrived at by inspection of known data and may be considered as well established

The existing definitions of mathematics are not entirely satisfactory. They are either too broad, or too narrow, or do not emphasize enough the main characteristics of mathematics A semantic definition of mathematics should be broad enough to cover all existing branches of mathematics, should be narrow enough to exclude linguistic disciplines which are not considered mathematical by the best judgement of specialists, and should also be *flexible* enough to remain valid, no matter what the future developments of mathematics may be

I have said that mathematics is the only language, at present, which in structure, is similar to the structure of the world *and* the nervous system For purposes of exposition, we shall have to divide our analysis accordingly, remembering, in the meantime, that this division is, in a way, artificial and optional, as the issues overlap In some instances, it is really difficult to decide under which division a given aspect should be analysed The problems are very large, and for full discussion would require volumes, so we have to limit ourselves to a suggestive sketch of the most important aspects necessary for the present investigation.

From the point of view of general semantics, mathematics, having symbols and propositions, must be considered as a language From the psychophysiological point of view, it must be treated as an activity of the human nervous system and as a form of the behaviour of the organisms called humans

All languages are composed of two kinds of words: (1) Of *names* for the somethings on the un-speakable level, be they external objects , or *internal feelings,* which admittedly are *not* words, and (2) of *relational terms,* which express the actual, or desired, or any other relations between the un-speakable entities of the objective level

When a 'quality' is treated physiologically as a reaction of an organism to a stimulus, it also becomes a relation It should be noticed that often some words can be, and actually are, used in both senses, but, in a given context, we can always, by further analysis, separate the words used into these two categories Numbers are not exceptions, we can use the labels 'one', 'two' , as numbers (of which the character will be explained presently) but also as names for anything we want, as, for instance, Second or Third Avenue, or John Smith I or John Smith II. When we use numbers as names, or labels for anything, we call them numerals, and this is *not* a mathematical use of 'one', 'two' , as these names do not follow mathematical rules Thus, Second Avenue and Third Avenue cannot be added together, and do not give us Fifth Avenue in any sense whatever

Names alone do not produce propositions and so, by themselves, say nothing Before we can have a proposition and, therefore, meanings,

the names must be related by some relation-word, which, however, may be explicit or implied by the context, the situation, by established habits of speech The division of words into the above two classes may seem arbitrary, or to introduce an unnecessary complication through its simplicity, yet, if we take modern knowledge into account, we cannot follow the grammatical divisions of a primitive-made language, and such a division as I have suggested above seems structurally correct in 1933

Traditionally, mathematics was divided into two branches one was called arithmetic, dealing with numbers, the other was called geometry, and dealt with such entities as 'line', 'surface', 'volume', Once Descartes, lying in bed ill, watched the branches of a tree swaying under the influence of a breeze It occurred to him that the varying distances of the branches from the horizontal and vertical window frames could be expressed by numbers representing measurements of the distances An epoch-making step was taken geometrical relations were expressed by numerical relations, it meant the beginning of analytical geometry and the unification and arithmetization of mathematics

Further investigation by the pioneers Frege, Peano, Whitehead, Russell, Keyser, and others has revealed that 'number' can be expressed in 'logical terms'—a quite important discovery, provided we have a valid 'logic' and structurally correct *non-el* terms

Traditionally, too, since Aristotle, and, in the opinion of the majority, even today, mathematics is considered as uniquely connected with quantity and measurement Such a view is only partial, because there are many most important and fundamental branches of mathematics which have nothing to do with quantity or measurement—as, for instance, the theory of groups, analysis situs, projective geometry, the theory of numbers, the algebra of 'logic',

Sometimes mathematics is spoken about as the science of relations, but obviously such a definition is too broad If the only content of knowledge is structural, then relations, obvious, or to be discovered, are the foundation of all knowledge and of *all* language, as stated in the division of words given above Such a definition as suggested would make mathematics co-extensive with *all* language, and this, obviously, is not the case

Before offering a semantic definition of mathematics, I introduce a synoptical table taken from Professor Shaw's *The Philosophy of Mathematics,* which he calls only suggestive and 'doubtless incomplete in many ways' I use this table because it gives a modern list of the most important mathematical terms and disciplines necessary for the purpose of this work, indicating, also, in a way, their evolution and structural interrelations

CENTRAL PRINCIPLES OF MATHEMATICS*

MATHEMATICS ≡ QUALITATIVE STUDY OF STRUCTURE

PATTERNS

MOTRICITIES

Static Mathematics

Kinematic Mathematics

			WORLDS	MORPHOLOGY	INVARIANCY	FUNCTIONALITY	IDEALITY
Ordered	Chaotic	Rhythm Patterns—Arithmetic	Integers Rationals Irrationals Ensembles ATOMICITY	Integers Ensemble theory Literal arithmetic Complexes Point geometries Functional spaces	Congruences Arithmetic invariants Modular geometry	Arithmetic functions Algebraic functions Functions of real variable Infinitesimal calculus General analysis	Arithmetic ideals Galois ideals Higher number theory Picard-Vessiot theory
		Space Patterns—Geometry	Points Lines Surfaces Varieties Higher elements CONTINUITY	Point space of two or more dimensions Line geometry Surface geometry Absolute geometry Higher elements Expansions	Geometric invariants Algebraic invariants Symmetric and alternating forms Modular systems	Real functions of N variables Vector fields Functions of lines Partial derivatives Differential geometry	Systems of differential equations Mathematical physics Relativity Theory
		Design Patterns—Tactic	Arrangements Configurations Constellations DESIGN	Combinatory analysis Stereochemistry Theory of symbols Poincare's theory of differential equations	Stable systems Irreducibles	Functions of arrangements, configurations, constellations, and structures	Ideal elements of construction Mathematical chemistry
		Idea Patterns—Logistic	Concepts Relatives CONSISTENCY	Foundations Postulational systems Calculus of classes, or of relatives	Equivalent systems Logical invariants	Classes functions of classes Functions of relatives Implications	Ideal classes or relatives Classificatory schemes
	Chaotic	Mutation Motricities—Operators	Substitutions Transformations Groups MUTATION	Theory of finite or infinite groups Calculus of operations	Projective geometry Inversion geometry Differential and integral invariants Analysis situs	Geometric transformations Homomorphisms Transmutations	Automorphic functions Functional equations Calculus of variations Functional analysis Integral equations Difference equations Differential equations
		Quality Motricities—Algebras	Negatives Imaginaries Hypernumbers QUALITY	Linear algebras Functional transformations	Invariant equations Invariants of expressions	Functions of complex and hypercomplex variables General function theory	Hyperideals
Ordered		Action Motricities—Processes	Routes Displacements Combinations ACTION	Composite actions Actional structures	Equivalents of actions Invariants of processes	Processes dependent on processes Functions of action	Ideal processes
		Inferences	Transpositions Syllogisms Implications DEDUCTION	Syllogisms Calculus of deduction	Laws of inference Equivalent deductions Invariants	Functions of inferences	Ideal entities that satisfy inferences Scientific theories

Objects: Numbers (Worlds); Figures (Space Patterns—Geometry); Forms (Design Patterns—Tactic); Propositions (Idea Patterns—Logistic); Operators (Mutation Motricities—Operators); Vids (Quality Motricities—Algebras); Processes (Action Motricities—Processes); Thoughts (Inferences)

*This table differs slightly from the one printed in *The Philosophy of Mathematics* The corrections have been made by Professor Shaw and kindly communicated to me by letter

A semantic definition of mathematics may run somehow as follows: Mathematics consists of limited linguistic schemes of multiordinal relations capable of exact treatment at a given date

After I have given a semantic definition of number, it will be obvious that the above definition covers all existing disciplines considered mathematical However, these developments are not fixed affairs Does that definition provide for their future growth? By inserting as a fundamental part of the definition 'exact treatment at a given date', it obviously does Whenever we discover any relations in any fields which will allow exact 'logical' treatment, such a discipline will be included in the body of linguistic schemes called mathematics, and, at present, there are no indications that these developments can ever come to an end When 'logic' becomes an ∞-valued 'structural calculus', then mathematics and 'logic' will merge completely and become a general science of m o relations and multi-dimensional order, and all sciences may become exact

It is necessary to show that this definition is not too broad, and that it eliminates notions which are admittedly non-mathematical without invalidating the statement that the content of all knowledge is structural, and so ultimately relational The word 'exact' eliminates non-mathematical relations If we enquire into the meaning of the word 'exact', we find from experience that this meaning is not constant, but that it varies with the date, and so only a statement 'exact at a given date' can have a definite meaning

We can analyse a simple statement, 'grass is green' (the 'is' here is the 'is' of predication, not of identity), which, perhaps, represents an extreme example of a non-mathematical statement, but a similar reasoning can be applied to other examples Sometimes we have a feeling which we express by saying, 'grass is green' Usually, such a feeling is called a 'perception' But is such a *process* to be dismissed so simply, by just calling it a name, 'perception'? It is easy to 'call names under provocation', as Santayana says somewhere; but does that exhaust the question?

If we analyse such a statement further, we find that it involves comparison, evaluation in certain respects with other characters of experience , and the statement thus assumes relational characteristics These, in the meantime, are non-exact and, therefore, non-mathematical If we carry this analysis still further, involving data taken from chemistry, physics, physiology, neurology , we involve relations which become more and more exact, and, finally, in such terms as 'wave-length', 'frequency' , we reach structural terms which allow of exact 1933 treatment It is true that a language of 'quality' conceals relations, sometimes very effectively, but once 'quality' is taken as the reaction of a given organism

to a stimulus, the term used for that 'quality' becomes a name for a very complex relation This procedure can be always employed, thus establishing once more the fundamental character of relations

These last statements are of serious structural and semantic importance, being closely connected with the $\bar{A}$, fundamental, and undeniable negative premises These results can be taught to children very simply, yet this automatically involves an entirely new and modern method of evaluation and attitude toward language, which will affect beneficially the, as yet entirely disregarded, *s r*

We must consider, briefly, the terms 'kind' and 'degree', as we shall need them later Words, symbols., serve as forms of representation and belong to a different universe—the 'universe of discourse'—since they are not the un-speakable levels we are speaking about They belong to a world of higher abstractions and not to the world of lower abstractions given to us by the lower nerve centres

Common experience and scientific investigations (more refined experience) show us that the world around us is made up of absolute individuals, each different and unique, although interconnected Under such conditions it is obviously optional what language we use The more we use the language of diverse 'kind', the sharper our definitions must be Psycho-logically, the emphasis is on difference Such procedure may be a tax on our ingenuity, but by it we are closer to the structural facts of life, where, in the limit, we should have to establish a 'kind' for every individual

In using the term 'degree', we may be more vague We proceed by similarities, but such a treatment implies a fundamental interconnection between different individuals of a special kind It implies a definite kind of metaphysics or structural assumptions—as, for instance, a theory of evolution As our 'knowledge' is the result of nervous abstracting, it seems, in accordance with the structure of our nervous system, to give preference to the term 'degree' first, and only when we have attained a certain order of verbal sharpness to pass to a language of 'kind', if need arises

The study of primitive languages shows that, historically, we had a tendency for the 'kind' language, resulting in over-abundance of names and few relation-words, which makes higher analysis impossible Science, on the other hand, has a preference for the 'degree' language, which, ultimately, leads to mathematical languages, enormous simplicity and economy of words, and so to better efficiency, more intelligence, and to the unification of science Thus, chemistry became a branch of physics; physics, a branch of geometry, geometry merges with analysis, and

analysis merges with general semantics, and life itself becomes a physico-chemical colloidal occurrence The language of 'degree' has very important *relational, quantitative,* and *order* implications, while that of 'kind' has, in the main, qualitative implications, often, if not always, concealing relations, instead of expressing them.

The current definition of 'number', as formulated by Frege and Russell, reads 'The number of a class is the class of all those classes that are similar to it' [1] This definition is not entirely satisfactory first, because the multiordinality of the term 'class' is not stated, second, it is A, as it involves the ambiguous (as to the order of abstractions) term 'class' What do we mean by the term 'class'? Do we mean an extensive array of absolute individuals, un-speakable by its very character, such as some *seen aggregate,* or do we mean the *spoken definition* or *description* of such un-speakable objective entities? The term implies, then, a fundamental confusion of orders of abstractions, to start with—the very issue which we must avoid most carefully, as positively demanded by the non-identity principle Besides, if we explore the world with a 'class of classes', and obtain results also of 'class of classes', such procedure throws no light on mathematics, their applications and their importance as a tool of research Perhaps, it even increases the mysteries surrounding mathematics and conceals the relations between mathematics and human knowledge in general

We should expect of a satisfactory definition of 'number' that it would make the semantic character of numbers clear Somehow, through long experience, we have learned that numbers and measurement have some mysterious, sometimes an uncanny, importance This is exemplified by mathematical predictions, which are verified later empirically Let me recall only the discovery of the planet Neptune through mathematical investigations, based on its action upon Uranus, long before the astronomer actually verified this prediction with his telescope Many, a great many, such examples could be given, scientific literature being full of them Why should mathematics and measurement be so extremely important? Why should mathematical operations of a given Smith, which often seem innocent (and sometimes silly enough) give such an unusual security and such undeniably practical results?

Is it true that the majority of us are born mathematical imbeciles? Why is there this general fear of, and dislike for, mathematics? Is mathematics really so difficult and repelling, or is it the way mathematics is treated and taught by mathematicians that is at fault? If some light can be thrown on these perplexing semantic problems, perhaps we shall face a scientific revolution which might deeply affect our educational

system and may even mark the beginning of a new period in standards of evaluation, in which mathematics will take the place which it ought to have Certainly, there must be something the matter with our epistemologies and 'psychologies' if they cannot cope with these problems

A simple explanation is given by a new $\bar{A}$ analysis and a *semantic* definition of numbers What follows is written, in the main, for non-mathematicians, as the word 'semantic' indicates, but it is hoped that professional mathematicians (or some, at least) may be interested in the *meanings* of the term 'number', and that they will not entirely disregard it As semantic, the definition seems satisfactory, but, perhaps, it is not entirely satisfactory for technical purposes, and the definition would have to be slightly re-worded to satisfy the technical needs of the mathematicians In the meantime, the gains are so important that we should not begrudge any amount of labour in order to produce finally a mathematical and, this time, $\bar{A}$ semantic definition of numbers

As has already been mentioned, the importance of notation is paramount Thus the Roman notation for number—I, II, III, IV, V, VI ,—was not satisfactory and could not have led to modern developments in mathematics, because it did not possess enough positional and structural characteristics Modern mathematics began when it was made possible by the invention or discovery of positional notation We use the symbol '1' in 1, 10, 100, 1000 , in which, because of its place, it had different values In the expression '1', the symbol means 'one unit'; in 10, the symbol '1' means ten units, in 100, the symbol '1' means one hundred units, .

To have a positional notation, we need a symbol '0', called zero, to indicate an empty column and, at least, one symbol '1' The number of special symbols for 'number' depends on what base we accept Thus, in a binary system, with the base 2, our 1 is represented by 1 , our 2, by a unity in the second place and a zero in the first place, thus by 10 , our 3, by 11 , our 4, by a unity in the third place and two zeros in the first and second places , namely, 100 , our 5, by 101 , our 6, by 110 , 7. by 111 , 8, by 1000 , 9, by 1001 , 15, by 1111 , 16, by 10000 , In a binary system, we needed only the two symbols, 1 and 0 For a system with the base 3, we would need three symbols, 1, 2, 0 our 1 would be represented by 1 , our 2, by 2 , 3, by 10 , 4, by 11 , 5, by 12 , 6, by 20 , In our decimal system, obviously, we need 10 symbols, 1, 2, 3, 4, 5, 6, 7, 8, 9, 0

For more details on notation, the interested reader is referred to the fascinating and elementary book of Professor Danzig, *Number the Language of Science* Here we only emphasize what is necessary for our purpose Every system has its advantages and drawbacks. Thus, in

the binary system, still used by some savage tribes, of which we retain traces when we speak of couples, or pairs, or braces, we get an enormous simplicity in operations by using only two symbols, 1 and 0 It should be remembered that, in every system, the tables of addition and multiplication must be memorized In the binary system, these tables are reduced to $1 + 1 = 10$ and $1 \times 1 = 1$, while in our decimal system, each table has 100 entries But what we gain in simplicity by a low base-number is offset very seriously by the cumbersomeness of the notation As Danzig tells us, our number 4096 is represented in a binary system by 1,000,000,000 That we adopted the decimal system is probably a physiological accident, because we have ten fingers The savage, with his binary system, did not reach even the finger stage, he is still in the fist stage.

For practical purposes, it is simpler to have a base which has many divisors, as, for instance, 12 We still use this duodecimal system when we divide a foot into twelve inches, or a shilling into twelve pennies, or count by dozens or gross It seems that mathematicians would probably select a prime number for a base, but the gain would be so slight and the difficulty of offsetting a physiological habit so tremendous, that this will probably never happen [2]

From what was said already, it is, perhaps, clear that mathematics requires a positional notation in which we must have a symbol for '1' and zero, at least For these and other reasons, the two numbers 1 and 0 are somehow unusually important Even in our decimal system we generate numbers by adding 1 to its predecessor Thus $1 + 1 = 2$, $2 + 1 = 3$, and we must enquire into the semantic character of these numbers

The notions of matching, comparing, measuring, quantity, equality , are all interwoven and, by necessity, involve a circularity in definitions and implications if the analysis is carried far enough The interested reader may be referred to the chapter on equality in Whitehead's *The Principle of Relativity* to learn more on this subject

In the evolution of mathematics, we find that the notions of 'greater', 'equal', and 'less' precede the notion of numbers Comparison is the simplest form of evaluation, the first being a search for relations, the second, a discovery of exact relations This process of search for relations and structure is inherent and natural in man, and has led not only to the discovery of numbers, but also has shaped their two aspects; namely, the cardinal and the ordinal aspects For instance, to ascertain whether the number of persons in a hall is equal to, greater than, or less than the number of seats, it is enough to ascertain if all seats are

occupied and there are no empty seats and no persons standing; then we would say that the number of persons is equal to the number of seats, and a *symmetrical relation* of equality would be established If all seats were occupied and there were some persons standing in the hall, or if we found that no one was standing, yet not all seats were occupied, we would establish the *asymmetrical relation* of greater or less.

In the above processes, we were using an important principle; namely, that of *one-to-one* correspondence In our search for relations, we assigned to each seat one person, and reached our conclusions without any counting This process, based on the *one-to-one* correspondence, establishes what is called the cardinal number It gives us specific relational data about this world, yet it is not enough for counting and for mathematics To produce the latter, we must, first of all, establish a definite system of symbolism, based on a definite relation for generating numbers, for instance, $1+1=2$, $2+1=3$, which establishes a definite *order* Without this ordinal notion, neither counting nor mathematics would be possible, and, as we have already seen, order can be used for defining relations, as the notions of relation and order are interdependent Order, also, involves asymmetrical relations

If we consider the two most important numbers, 0 and 1, we find that in the accepted symbolism, if $a=b$, $a-b=0$, and if $a=b$, $a/b=b/b=1$, so that both fundamental numbers express, or can be interpreted as expressing, a *symmetrical relation* of equality

If we consider any other number—and this applies to all kinds of numbers, not only to natural numbers—we find that any number is not altered by dividing it by one, thus, $2/1=2$, $3/1=3$, in general, $N/1=N$; establishing the *asymmetrical* relation, *unique* and *specific* in a given case that N is N times more than one

If we consider, further, that $2/1=2$, $3/1=3$, *and so on,* are all *different, specific,* and *unique,* we come to an obvious and $\bar{A}$ semantic definition of number in terms of relations, in which 0 and 1 represent *unique* and *specific symmetrical* relations and all other numbers also *unique* and *specific asymmetrical* relations Thus, if we have a result '5', we *can always say* that the number 5 is five times as many as one Similarly, if we introduce apples Five apples are five times as many as one apple Thus, a number in any form, 'pure' or 'applied', can always be represented as a relation, *unique* and *specific* in a given case, and this is the foundation of the exactness of dealing with numbers. For instance, to say that a is greater than b also establishes an asymmetrical relation, but it is *not unique* and *specific,* but when we say that a is five

times greater than *b*, this relation is *asymmetrical, exact, unique,* and *specific*

The above simple remarks are not entirely orthodox That $5/1 = 5$ is very orthodox, indeed, but that numbers, in general, represent indefinitely many *exact, specific,* and *unique,* and, in the main, *asymmetrical* relations is a structural notion which necessitates the revision of the foundations of mathematics and their rebuilding on the basis of new semantics and a future structural calculus When we say 'indefinitely many', this means, from the reflex point of view, 'indefinitely flexible', or 'fully conditional' in the semantic field, and, therefore, a prototype of human semantic reactions (see Part VI) The scope of the present work precludes the analysis of the notion of the lately disputed 'irrational'; but we must state that this revision requires new psycho-logical and structural considerations of fundamental 'logical' postulates and of the problems of 'infinity' If, by an arbitrary process, we *postulate* the existence of a 'number' which alters all the while, then, according to the definition given here, such expressions should be considered as functions, perhaps, but not as a number, because they do not give us *unique* and *specific relations*

These few remarks, although suggestive to the mathematician, do not, in any way, exhaust the question, which can only be properly presented in technical literature in a postulational form

It seems that mathematicians, no matter how important the work which they have produced, have never gone so far as to appreciate fully that they are willy-nilly producing an ideal human relational language of structure similar to that of the world *and* to that of the human nervous system This they cannot help, in spite of some vehement denials, and their work should also be treated from the semantic point of view

Similarly with measurement. From a functional or actional and semantic point of view, measurement represents nothing else but a search for *empirical structure* by means of extensional, ordered, symmetrical, and asymmetrical relations Thus, when we say that a given length measures five feet, we have reached this conclusion by *selecting* a unit called 'foot', an *arbitrary and un-speakable* affair, then laying it end to end five times in a definite *extensional order* and so have established the asymmetrical, and, in each case, *unique* and *specific* relation, that the given entity represents, in this case, five times as many as the arbitrarily selected unit

Objection may be raised that the formal working out of a definition of numbers in terms of relations, instead of classes, would be very

laborious, and would also involve a revision of the foundations of mathematics This can hardly be denied, but, in the discussions of the foundations, the confusion of orders of abstractions is still very marked, thereby resulting in the manufacture of *artificial semantic difficulties* Moreover, the benefits of such a definition, in eliminating the mysteries about mathematics, are so important that they by far outweigh the difficulties

As the only possible content of knowledge is structural, as given in terms of relations and multiordinal and multi-dimensional order, numbers, which establish an endless array of exact, specific, and, in each case, unique, relations are obviously the most important tools for exploring the *structure* of the world, since structure can always be analysed in terms of *relations* In this way, all mysteries about the importance of mathematics and measurement vanish The above understanding will give the student of mathematics an entirely different and a very natural feeling for his subject As his only possible aim is the study of structure of the world, or of whatever else, he must naturally use a *relational tool* to explore this complex of relations called 'structure' A most spectacular illustration of this is given in the internal theory of surfaces, the tensor calculus , described in Part VIII

In all measurements, we select a unit of a necessary kind, for a given case, and then we find a *unique* and *specific* relation as expressed by a number, between the given something and the selected unit By relating different happenings and processes to the same unit-process, we find, again, *unique* and *specific* interrelations, in a given case, between these events, and so gather structural (and most important, because uniquely possible) wisdom, called 'knowledge', 'science',

If we treat numbers as relations, then fractions and all operations become relations of relations, and so relations of higher order, into the analysis of which we cannot enter here, as these are, of necessity, technical

It should be firmly grasped, however, that some fundamental human relations to this world have not been changed The primitive may have believed that words *were* things (identification) and so have established what is called the 'magic of words' (and, in fact, the majority of us still have our *s r* regulated by some such unconscious identifications) , but in spite of this, the primitive or 'civilized' man's words *are not,* and never could be, the things spoken about no matter what semantic disturbances we might have accompanying their use, or what delusions or illusions we may cherish in respect to them

At present, of all branches of mathematics the theory of numbers is probably the most difficult, obscure , and seemingly with the fewest applications With a new $\bar{A}$ definition of numbers in terms of relations, this theory may become a relational study of very high order, which, perhaps, will some day become the foundation for epistemology and the key for the solution of all the problems of science and life In the fields of cosmology many, if not the majority, of the problems, by necessity, cannot be considered as directly experimental, and so the solution must be epistemological

At present, in our speculations, we are carried away by words, disregarding the simple fact that speaking about the 'radius of the universe', for instance, has *no meaning,* as it cannot possibly be observed Perhaps, some day, we shall discover that such conversations are the result of our old stumbling block, identification, which leads to our being carried away by the sounds of words applicable to terrestrial conditions but meaningless in the very small, as discovered lately in the newer quantum mechanics, and, in the very large, as applied to the cosmos An important illustration of the retardation of scientific progress, blocked by the confusion of orders of abstractions, is shown in the fact that the newer quantum mechanics were slow in coming, and though astronomers probably know about it, yet they still fail to grasp that expressions such as the 'radius of the universe', the 'running down of the universe' , are meaningless outside of psychopathology.

In this connection, we should notice an extremely interesting and important semantic characteristic, namely, that the term 'relation' is not only multiordinal but also *non-el,* as it applies to 'senses' and 'mind' Relations are usually found empirically, so in a language of relations we have a language of similar structure to the world and a unique means for predictability and rationality

Let me again emphasize that, from time immemorial, things have *not* been words, the only content of knowledge has been structural, mathematics has dealt, in the main, with numbers, no matter whether we have understood the character of numbers or not, numbers have expressed relations and so have given us structural data willy-nilly, This explains why mathematics and numbers have, since time immemorial, been a favorite field, not only for speculations, but also why, in history, we find so many religious semantic disturbances connected with numbers Mankind has somehow felt instinctively that in numbers we have a potentially endless array of *unique* and *specific exact relations,* which ultimately give us structure, the last being the only possible content of knowledge, because words are *not* things.

As relations, generally, are empirically present, and as man and his 'knowledge' is as 'natural' as rocks, flowers, and donkeys, we should not be surprised to find that the unique language of exact , relations called mathematics is, by necessity, the natural language of man and *similar in structure* to the world *and* our nervous system

As has already been stated, it is incorrect to argue from the structure of mathematical theories to the structure of the world, and so try to establish the similarity of structure, but that such enquiry must be *independent* and start with quite ordinary structural experiences, and only at a later stage proceed to more advanced knowledge as given by science Because this analysis must be independent, it can also be made very simple and elementary All exact sciences give us a wealth of experimental data to establish the first thesis on similarity of structure; and it is unnecessary to repeat it here I will restrict myself only to a minimum of quite obvious facts, reserving the second thesis—about the similarity of structure with our nervous system—for the next chapter

If we analyse the silent objective level by objective means available in 1933, say a microscope, we shall find that whatever we can see, handle , represents an *absolute individual*, and *different from anything else in this world* We discover, thus, an important *structural* fact of the external world, namely, that in it, everything we can see, touch , that is to say, all lower order abstractions represent absolute individuals, different from everything else

On the verbal level, under such empirical conditions, we should then have a language of *similar structure*, namely, one giving us an indefinite number of *proper names, each different* We find such a language *uniquely* in numbers, each number 1, 2, 3 , being a unique, sharply distinguishable, *proper name* for a relation, and, if we wish, for anything else also

Without some higher abstractions we cannot be human at all No science could exist with absolute individuals and no relations; so we pass to higher abstractions and build a language of say x_i, $(i = 1, 2, 3, \ldots n)$, where the x shows, let us say, that we deal with a variable x with many values, and the number we assign to i indicates the individuality under consideration From the structural point of view, such a vocabulary is similar to the world around us, it accounts for the individuality of the external objects, it also is similar to the structure of our nervous system, because it allows generalizations or higher order abstractions, emphasizes the abstracting nervous characteristics, The subscript emphasizes the differences, the letter x implies the similarities

In daily language a similar device is extremely useful and has very far-reaching psycho-logical semantic effects Thus, if we say 'pencil$_1$', 'pencil$_2$', . . 'pencil$_n$', we have indicated structurally two main characteristics (1) the absolute individuality of the object, by adding the indefinitely individualizing subscript 1, 2, . n, and (2) we have also complied with the nervous higher order abstracting characteristics, which establish similarity in diversity of different 'pencils' From the point of view of *relations,* these are usually found empirically, besides, they may be invariant, no matter how changing the world may be

In general terms, the structure of the external world is such that we deal always on the objective levels with absolute individuals, with absolute differences The structure of the human nervous system is such that it abstracts, or generalizes, or integrates , in higher orders. and so finds similarities, discovering often invariant (sometimes relatively invariant) relations To have 'similar structure', a language should comply with both structural exigencies, and this characteristic is found in the mathematical notation of x_i, which can be enlarged to the daily language as 'Smith$_i$', 'Fido$_i$' , where $i = 1, 2, 3, \ldots n$

Further objective enquiry shows that the world and ourselves are made up of *processes,* thus, 'Smith$_{1900}$' is quite a different person from 'Smith$_{1938}$'. To be convinced, it is enough to look over old photographs of ourselves, the above remark being structurally entirely general A language of 'similar structure' should cover these facts We find such a language in the vocabulary of 'function', 'propositional function', as already explained, involving also four-dimensional considerations

As words are not objects—and this expresses a structural fact—we see that the 'is' of identity is unconditionally false, and should be entirely abolished as such Let us be simple about it This last semantic requirement is genuinely difficult to carry out, because the general *el* structure of our language is such as to facilitate identification It is admitted that in some fields some persons identify only a little, but even they usually identify a great deal when they pass to other fields Even science is not free from identification, and this fact introduces great and artificial semantic difficulties, which simply vanish when we stop identification or the confusion of orders of abstractions Thus, for instance, the semantic difficulties in the foundations of mathematics, the problems of 'infinity', the 'irrational' , the difficulties of Einstein's theory, the difficulties of the newer quantum theory, the arguments about the 'radius of the universe', 'infinite velocities', the difficulties in the present theory , , are due, in the main, to semantic blockages or commitment to the structure of the old language—we may call it 'habit'—*which says structurally very little,*

and which I disclose as a semantic disturbance of *evaluation* by showing the *physiological mechanism in terms of order*

If we abolish the 'is' of identity, then we are left only with a functional, actional , language elaborated in the mathematical language of function Under such conditions, a *descriptive* language of ordered happenings on the objective level takes the form of 'if so and so happens, then so and so happens', or, briefly, 'if so, then so', which is the prototype of 'logical' and mathematical processes and languages We see that such a language is again similar in structure to the external world descriptively, yet it is similar to the 'logical' nervous processes, and so allows us, because of this similarity of structure, predictability and so rationality

In the traditional systems, we did not recognize the complete semantic interdependence of differences and similarities, the empirical world exhibiting differences, the nervous system manufacturing primarily similarities, and our 'knowledge', if worth anything at all, being the *joint product* of both Was it not Sylvester who said that 'in mathematics we look for similarities in differences and differences in similarities'? This statement applies to our whole abstracting process

The empirical world is such in structure (by inspection) that in it we can add, subtract, multiply, and divide In mathematics, we find a language of similar structure Obviously, in the physical world these actions or operations alter the relations, which are expressed as altered unique and specific relations, by the language of mathematics Further, as the world is full of different shapes forms, curves , we do not only find in mathematics special languages dealing with these subjects, but we find in analytical geometry unifying linguistic means for translation of one language into another Thus any 'quality' can be formulated in terms of relations which may take the 'quantitative' character which, at present, in all cases, can be also translated into geometrical terms and methods, giving structures to be *visualized*

It is interesting, yet not entirely unexpected, that the activities of the higher nervous centres, the conditional reflexes of higher order, the semantic reactions, time-binding included, should follow the exponential rules, as shown in my *Manhood of Humanity*

In our experience, we find that some issues are additive—as, for instance, if one guest is added to a dinner party, we will have to add plates and a chair Such facts are covered by additive methods and the language called 'linear' (see Part VIII) In many instances—and these are, perhaps, the most important and are strictly connected with submicroscopic processes—the issues are not additive, one atom of oxygen

'plus' two atoms of hydrogen, under proper conditions, will produce water, of which the characteristics are *not* the sum of the characteristics of oxygen and hydrogen 'added' together, but entirely *new* characteristics *emerge* These may some day be taken care of by non-linear equations, when our knowledge has advanced considerably These problems are unusually important and vital, because with our present low development and the lack of structural researches, we still keep an additive *A* language, which is, perhaps, able to deal with additive, simple, immediate, and comparatively unimportant issues, but is entirely unfit structurally to deal with principles which underlie the most fundamental problems of life Similarly, in physics, only since Einstein have we begun to see that the primitive, simplest, and easiest to solve linear equations are not structurally adequate

One of the most marked structural characteristics of the empirical world is 'change', 'motion', 'waves', and similar dynamic manifestations Obviously, a language of similar structure must have means to deal with such relations In this respect, mathematics is unique, because, in the differential and integral calculus, the four-dimensional geometries and similar disciplines, with all their developments, we find such a perfect language to be explained more in detail in the chapters which follow

It will be profitable for our purpose to discuss, in the next chapter, some of the mathematical structural characteristics in connection with their similarity to the human nervous system, but here I will add only that, for our purposes, at this particular point, we must specially emphasize *arithmetical* language, which means numbers and arithmetical operations, the theory of function, the differential and integral calculus (language) and different geometries in their two aspects, 'pure' and applied Indeed, Riemann tells us bluntly that the *science* of physics originated only with the introduction of differential equations, a statement which is quite justified, but to which I would add, that physics is becoming scientific since we began to eliminate from physics semantic disturbances, namely, identification and elementalism This movement was originated, in fact, although not stated in an explicit form, by the Einstein theory and the new quantum theories, the psycho-logical trend of which is formulated in a *general semantic theory* in the present work

It is reasonable to consider that metric geometry, and, in particular, the *E*-system, was derived from touch, and, perhaps, the 'kinesthetic sense', and projective geometry from sight

Although the issues presented here appear extremely simple, and sometimes even commonplace, yet the actual working out of the verbal

schemes is quite elaborate and ingenious, and impossible to analyse here more fully; so that only one example can be given

The solution of mathematical equations is perhaps to be considered as the central problem of mathematics The word 'equation' is derived from Latin *aequare,* to equalize, and is a statement of the symmetrical relation of equality expressed as $a = b$ or $a - b = 0$ or $a/b = 1$ An equation expresses the relation between quantities, some of which are known, some unknown and to be found By the solution of an equation, we mean the finding of values for the unknowns which will satisfy the equation

Linear equations of the type $ax = b$ necessitated the introduction of fractions Linear equations with several variables led to the theory of determinants and matrices , which underwent, later, a tremendous independent development, yet they originated in the attempt to simplify the solution of these equations

Quadratic equations of the type $x^2 + ax + b = 0$ can be reduced to the form $x^2 = A$, the solution of which depends on the extraction of a square root Here, serious difficulties arose, and seemingly necessitated the introduction of 'irrational' numbers and ordinary complex numbers, involving the square root of minus one ($\sqrt{-1} = i$), a notion which revolutionized mathematics

Cubic equations of the form $x^3 + ax^2 + bx + c = 0$ necessitated the extraction of cube roots, in addition to the problems connected with the solution of quadratic equations, and involved more difficulties, which have been analysed in an extensive literature.

Biquadratic equations of the type $x^4 + ax^3 + bx^2 + cx + d = 0$ involve the problems of quadratic and cubic equations When we consider equations of a degree higher than the fourth, we find that we cannot solve them by former methods, and mathematicians have had to invent theories of substitutions, groups, different special functions and similar devices The solution of differential equations introduced further difficulties, allied with the theory of function

The linear transformations of algebraic polynomials with two or more variables in connection with the theory of determinants, symmetrical functions, differential operations , necessitated the development of an extensive theory of algebraic forms which, at present, is far from being complete

In the above analysis, I have refrained from giving details, most of which would be of no value to the layman, and unnecessary for the mathematician; but it must be emphasized that the theory of function and the theory of groups, with their very extensive developments,

involving the theory of invariance, and, in a way, the theory of numbers, rapidly became a unifying foundation upon which practically the whole of mathematics is being rebuilt. Many branches of mathematics have become, of late, nothing more than a theory of invariance of special groups

As to practical applications, there is no possibility to list them, and the number increases steadily But, without the theory of analytic function, for instance, we could not study the flow of electricity, or heat, or deal with two-dimensional gravitational, electrostatic, or magnetic attractions The complex number involving the square root of minus one was necessary for the development of wireless and telegraphy; the kinetic theory of gases and the building of automobile engines require geometries of n dimensions, rectangular and triangular membranes are connected with questions discussed in the theory of numbers, the theory of groups has direct application in crystallography, the theory of invariants underlies the theory of Einstein, the theory of matrices and operators has revolutionized the quantum theory, and there are other applications in an endless array [3]

In Part VIII, different aspects of mathematics are analysed, but the interested reader can be referred also to the above-mentioned book of Professor Shaw for an excellent elementary, yet structural, view of the progress of mathematics.

CHAPTER XIX

MATHEMATICS AS A LANGUAGE OF A STRUCTURE SIMILAR TO THE STRUCTURE OF THE HUMAN NERVOUS SYSTEM

In recent times the view becomes more and more prevalent that many branches of mathematics are nothing but the theory of invariants of special groups. S LIE

A natural law,—if, strictly speaking, there be such a thing outside the conception thereof,—is fundamentally nothing more nor less than a constant connection among inconstant phenomena it is, in other words, an invariant relation among variant terms (264) CASSIUS J KEYSER

Whatsoever things are invariant under all and only the transformations of some group constitute the peculiar subject-matter of some (actual or potential) branch of knowledge (264) CASSIUS J KEYSER

The general laws of nature are to be expressed by equations which hold good for all systems of co-ordinates, that is, are co-variant with respect to any substitutions whatever (generally co-variant) (155) A EINSTEIN

The things hereafter called tensors are further characterized by the fact that the equations of transformation for their components are linear and homogeneous Accordingly, all the components in the new system vanish, if they all vanish in the original system If, therefore, a law of nature is expressed by equating all the components of a tensor to zero, it is generally covariant. By examining the laws of the formation of tensors, we acquire the means of formulating generally covariant laws (155) A EINSTEIN

The thalamus is a centre of affective reactivity to sensory stimuli, while the cortex is an apparatus for discrimination (411) HENRI PIÉRON

Section A Introductory

It becomes increasingly evident that we have come to a linguistic impasse, reflected in our historical, cultural, economic, social, doctrinal , impasses, all these issues being interconnected The structural linguistic aspect is the most fundamental of them all, as it underlies the others and involves the *s r*, or psycho-logical responses to words and other events in connection with meanings

One of the benefits of building a system on undeniable negative premises is that many older and controversial problems become relatively simple and often uncontroversial, disclosing an important psycho-logical mechanism Such formulations have often the appearance of the 'discovery of the obvious', but it is known, in some quarters, that the discovery of the obvious is sometimes useful, not always easy, and often much delayed, as, for instance, the discovery of the equality of gravitational and inertial mass, which has lately revolutionized physics

As words are *not* the things we are talking about, the only possible link between the objective world and the verbal world is structural If the two structures are similar, then the empirical world becomes intelligible to us—we 'understand', we can adjust ourselves, If we carry out verbal experiments and predict, these predictions are verified empirically If the two structures are not similar, then our predictions are not verified —we do not 'know', we do not 'understand', the given problems are 'unintelligible' to us , we do not know what to do to adjust ourselves.

Psycho-logically, in the first case we feel security, we are satisfied, hopeful , in the second case, we feel insecure, a floating anxiety fear, worry, disappointment, depression, hopelessness, and other harmful *s r* appear The considerations of structure thus disclose an unexpected and powerful semantic mechanism of individual and collective happiness, adjustment , but also of tragedies, supplying us with *physiological* means for a certain amount of desirable control, because relations and structure represent fundamental factors of all meanings and evaluations, and, therefore, of all *s r*

The present increasing world unrest is an excellent example of this. The structure of our old languages has shaped our *s r* and suggested our doctrines, creeds , which build our institutions, customs, habits and, finally, lead fatalistically to catastrophes like the World War We have learned long ago, by repeated sad experience, that predictions concerning human affairs are not verified empirically Our doctrines, institutions, and other disciplines are unable somehow to deal with this semantic situation, and hence the prevailing depression and pessimism

We hear everywhere complaints of the stupidity or dishonesty of our rulers, as already defined, without realizing that although our rulers are admittedly very ignorant, and often dishonest, yet the most informed, gifted, and honest among them cannot predict or foresee happenings, if their arguments are performed in a language of a structure dissimilar to the world *and* to our nervous system Under such conditions, calling names, even under provocations, is not constructive or helpful enough Arguments in the languages of the old structure have led fatalistically to systems which are structurally 'un-natural' and so must collapse and impose unnecessary and artificial stress on our nervous system The self-imposed conditions of life become more and more unbearable, resulting in the increase of 'mental' illness, prostitution, criminality, brutality, violence, suicides, and similar signs of maladjustment It should never be forgotten that human endurance has limits Human 'knowledge' shapes the human world, alters conditions, and other features of the

environment—a factor which does not exist to any such extent in the animal world

We often speak about the influence of heredity, but much less do we analyse what influence environment, and particularly the *verbal environment,* has upon us Not only are all doctrines verbal, but the structure of an old language reflects the structural metaphysics of bygone generations, which affect the *s r* The vicious circle is complete Primitive mythology shaped the structure of language In it we have discussed and argued our institutions, systems , and so again the primitive structural assumptions or mythologies influenced them It should not be forgotten that the affective interplay, interaction, interchange is ever present in human life, excepting, perhaps, in severe and comparatively rare (not in all countries) 'mental' ills We can stop talking, we can stop reading or writing, and stop any 'intellectual' interplay and interaction between individuals, but we cannot stop or entirely abolish some *s r.*

A structural linguistic readjustment will, it is true, result in making the majority of our old doctrines untenable, leading also to a fundamental scientific revision of new doctrines and systems, affecting all of them and our *s r* in a constructive way It is incorrect, for instance, to use the terms 'capitalism' as opposed to 'socialism', as these terms apply to different non-directly comparable aspects of the human problem If we wish to use a term emphasizing the *symbolic character* of human relations, we can use the term 'capitalism', and then we can contrast directly individual, group, national, international., capitalisms If we want to emphasize the psycho-logical aspects, we can speak of individualism versus socialism, Obviously, in life the issues overlap, but the verbal implications remain, preventing clarity and inducing inappropriate *s r* in any discussion

In vernacular terms, there is at present a 'struggle' and 'competition' between two entirely different 'industrialisms' and two different 'commercialisms', based ultimately on two different forms of 'capitalism'. One is the 'individual capitalism', rapidly being transformed into 'group capitalism', in the main advanced theoretically to its limits in the United States of America and to a lesser extent in the rest of the civilized world, and 'social capitalism', proclaimed in the United Socialistic Soviet Republics Both these extreme tendencies, connected also with semantic disturbances, are due to a verbal or doctrinal 'declaration of independence' of two, until lately, much isolated countries The United States of America proclaimed the doctrine that man is 'free and independent', while, in fact, he is *not* free, but is inherently *interdependent* The Soviets accepted uncritically an unrevised antiquated doctrine of the

'dictatorship of the proletarians' In *practice*, this would mean the dictatorship of unenlightened masses, which, if left *actually to their creeds*, and deprived of the *brain-work* of scientists and leaders, would revert to primitive forms of animal life Obviously, these two extreme creeds violate every typically *human* characteristic We are interdependent, time-binders, and we are interdependent because we possess the higher nervous centres, which complexity animals do not possess Without these higher centres, we could not be human at all, both countries seem to disregard this fact, as in both the brain-work is exploited, yet the brain-workers are not properly evaluated The ignorant mob, with its historically and psycho-logically cultivated animalistic *s r*, retards human progress and agreement Leaders do not lead, but the majority play down to the mob psycho-logics, in fear of their heads or stomachs

In both countries, the *s r* are such that brain-work, although commercially exploited, is not properly evaluated, and is still persecuted here and there For instance, in the United States of America, we witness court trials and resolutions against the work of Darwin, in spite of the fact that without some theory of evolution most of the natural sciences, medicine included, would be impossible. In Russia, we find decrees against researches in pure science, without which *modern* science is impossible. Both countries seemingly forget that all 'material' progress among humans is due uniquely to the *brain-work* of a few mostly underpaid and overworked workers, who exercise properly their higher nervous centres With science getting hold of problems of *s r* and sanity, our human relations and individual happiness will also become the subject matter of scientific enquiry If international and *inter*dependent brain-workers produce discoveries and inventions, any one, even of the lowest development, can use or misuse their achievements, no matter what 'plan', or 'no-plan', is adopted Both countries seem at present not to understand that a great development of mechanical means and the application of scientific achievements exclusively for animal comfort fail to lead to greater happiness or higher culture, and that, perhaps, indeed, they lead in just the opposite direction Personally, I have no doubt that some day they will understand it, but an earlier understanding of this simple semantic fact would have saved, in the meantime, a great deal of suffering, bewilderment, and other semantic difficulties to a great number of people, if the rulers in both countries would be enlightened enough and could have foreseen it soon enough

The future will witness a struggle between the individual and group capitalism, as exemplified in the United States of America, and the collective or social capitalism, as exemplified in the Soviet Republics It does

not require prophetic vision to foresee that some trends of history are foregone conclusions because of the structure of the human nervous system As trusts or groups have replaced the theoretically 'individual' capitalism in the United States of America, so will the state capitalism replace the trusts, to be replaced in its turn by international capitalism

We are not shocked by the international character of science We are not '100 per cent patriotic' when it comes to the use in daily life of discoveries and inventions of other nations Science is a semantic product of a *general human symbolic characteristic,* so, naturally, it must be general and, therefore, 'international' But 'capitalism' is also a unique and *general* semantic product of symbolism, it is also a unique product of the human nervous system, dependent on mathematics, and, as such, by its inherent character, must become some day international There is no reason why our *s r* should be disturbed in one case more than in the other The ultimate problem is not whether to 'abolish capitalism' or not, which will never happen in a symbolic class of life, but to transfer the control from private, socially irresponsible, uncontrolled, and mostly ignorant, leaders to more responsible, *professionally trained,* and socially controlled *public servants,* not bosses If a country cannot produce honest, intelligent, and scientifically trained public men and leaders, that is, of course, very disastrous for its citizens, but this is not to be proclaimed as a rule, because it is an exception Thus, in the Soviet Republics, graft is practically non-existent in the sense that it exists in the United States, but the mentality of the public men is practically at a similar standstill because of a deliberate minimizing of the value of brainwork I wonder if it is realized at all, in either country, that *any* 'manual worker', no matter how lowly, is hired *exclusively* for his *human brain,* his *s r*, and *not* primarily for his hands!

The only problem which the rest of mankind has to face is how this struggle will be managed and how long it will last, the outcome admitting of no doubt, as the ruthless elimination of individual capitalism by group capitalism (trusts) in the United States is an excellent example In the Soviet Republics, they simply have gone further, but in a similar direction Struggles mean suffering, and we should reconcile ourselves to that fact If we want the minimum of suffering, we should stop the animalistic methods of contest Human methods of solving problems depend on higher order abstractions, scientific investigations of structure and language, revision of our doctrines , resulting in peaceful adjustment of living facts, which are actualities whether we like it or not If we want the maximum of suffering, let us proceed in the stupid, blind, animalistic and unscientific way of trial and error, as we are doing at present

My aim is not to be a prophet, but to analyse different structural and linguistic semantic issues underlying all human activities, and so to produce material which may help mankind to *select* their lot *consciously* What they will do is not my official concern, but it seems that both countries, which have so much in common, and which are bound to play an important role in the future of mankind, owing to their numbers, their areas, and their natural resources , will have to pay more attention to the so-called 'intellectual' issues, or, more simply, not disregard the difference between the reactions of infants and adults Otherwise, very serious and disastrous cultural results for all of us will follow

The problems of the world 1933 are acute and immediate, overloaded with confusion, bitterness, hopelessness, and other forms of semantic disturbances Without some means—and, in this case, scientific and physiological means—to regulate our *s r*, we shall not be able to solve our problems soon enough to avoid disasters The similarity in structure of mathematics, and our nervous system, once pointed out and *applied,* gives us a unique means to regulate the *s r*, without which it is practically impossible to analyse dispassionately and wisely the most pressing problems of immediate importance

The present investigation shows that the old languages which, in structure, are *not* similar to the world and our nervous system, have automatically reflected their structure on our doctrines, creeds, and habits, *s r*, and also on those man-made institutions which result from verbal arguments These, in turn, shape further *s r* and, as long as they last, control our destinies

Four important issues could be shown in detail, but, for lack of space, I give only a suggestive sketch of them here

1) In the A-system, all our existing older sub-systems, with all their benefits as well as shortcomings, follow as an A psycho-logical structural semantic necessity

2) The tremendous handicap for any new and less deficient systems consists in the fact that such systems lack new constructive ∞-valued semantics, and are carried on the one side by linguistic two-valued arguments in the language of old *el* structure, yet they aspire 'emotionally' to something new and better, while the two cannot be reconciled

3) An argument carried on in the old *el* and two-valued way, no matter how fundamentally true and eventually beneficial, can be easily defeated on verbal grounds if it follows the old structure of language Our decisions are never well-grounded psycho-logically, and so can never command the respect or achieve the reliability of scientific reason-

ing. That is why we are groping—the only method possible under such conditions being the animalistic trial-and-error methods, swaying masses by inflammatory speeches because reason has nothing to offer, being tied up by the old verbal structure to the older consequences based on animalistic and fundamentally false-for-man assumptions

4) In the old *A, el,* two-valued system, agreement is theoretically impossible, so one of the main, and perhaps revolutionary, semantic departures from the old system is the fact that a *non-el* ∞-valued $\bar{A}$-system, based on fundamental *negative* premises, leads to a theory of *universal agreement,* which is based on a structural revision of our languages, producing new and undisturbed *s r*, which eliminate the copying of animals in our nervous reactions

The subject matter of this chapter divides, naturally, into three interconnected semantic parts In the first, we shall recall a few general notions, known in the main but seldom taken into consideration, reformulated in a language of different structure In the second, I shall indicate how the most important mathematical disciplines, which traditionally and, in the opinion of the majority, could hardly be called mathematical, represent a scientific and exact formulation of the *general* 'thinking' process In this connection, a few words will be said about the theory of aggregates, and a little more about the theory of groups This latter theory, with its implications and applications, leads to a reformulation of mathematics on quite obvious psycho-*logical* grounds, bringing mathematics into the closest relationship to the general processes of mentation Finally, in the third part, I shall indicate the astonishing and quite unexpected *physiological* fact of the similarity of the structure of mathematics with the structure and function of our nervous system

The intelligent layman should be reminded that, although he needs to know *about* mathematics, the minimum given here, supplemented, perhaps, by a few most elementary and fascinating books on mathematical philosophy, given in the bibliography to this volume, yet he does not need, and probably never will need, more technical mathematics than is given in the high schools and supplemented by the fundamental notions of the differential calculus For directly we treat all languages, mathematics included, from a more general (and, at present, perhaps, the most general) aspect, namely, *structure,* the reader will obtain all the essential psycho-logical benefits of modern science by absorbing the $\bar{A}$-system and habits, which will result in completely novel standards of evaluation and distinctly modern and adult *s r*

The last is of extreme and unrealized importance In fact, its importance cannot be fully appreciated until we actually acquire such reactions,

because only then shall we have semantic disturbances eliminated, so that all problems can be analysed properly, and, therefore, agreement *must* be reached

The future generations, of course, will have no difficulties whatsoever in establishing the healthy $s\,r$, neither at present have very young children These do not need such treatises as the present work But, before the grown-up parents or teachers can train their children, they must first unlearn a great deal and train themselves to new habits involving the $\bar{A}$ *standards* of evaluation So, for them, such a book, in order to be convincing, must deal with the foundations of their difficulties The last task is difficult for the writer as well for the reader

What has been said here does not apply, I am sorry to say, to *professional* 'philosophers', 'logicians', 'psychologists', psychiatrists, and teachers These, to be adequate at all for their responsible and difficult professional duties, *must become thoroughly acquainted* with *structure* in general, and with the *structure of mathematics* in particular, as factors in $s\,r$, and must work out the present outline much further

Section B. General

Mathematics in the twentieth century is characterized by an enormous productiveness, by the revision of its foundations, and the quest for rigour, all of which implies material of great and unexplored psychological value, a result of the activity of the human nervous system Branches of mathematics, as, for instance, mathematical 'logic', or the analytical theory of numbers, have been created in this period, others, like the theory of function, have been revised and reshaped The theory of Einstein and the newer quantum mechanics have also suggested further needs and developments

Any branch of mathematics consists of propositional functions which state certain structural relations The mathematician tries to discover new characteristics and to reduce the known characteristics to a dependence on the smallest possible set of constantly revised and simplest structural assumptions Of late, we have found that no assumption is ever 'self-evident' or ultimate

To those structural assumptions, we give at present the more polite name of postulates These involve undefined terms, not always stated explicitly, but always present implicitly A *postulate system gives us the structure of the linguistic scheme* The older mathematicians were less particular in their methods Their primitive propositional functions or postulates were less well investigated They did not start explicitly with undefined terms The twentieth century has witnessed in this field

a marked progress in mathematics, though much less in other verbal enterprises, which accounts for the long neglect of the structure of languages Without tracing down a linguistic scheme to a postulate system, it is extremely difficult or impossible to find its structural assumptions

A peculiarity of modern mathematics is the insistence upon the formal character of all mathematical reasoning which, with the new *non-el* theory of meanings, ultimately should apply to all linguistic procedures

The problems of 'formalism' are of serious and neglected psychological importance, and are connected with great semantic dangers in daily life if associated with the lack of consciousness of abstracting, or, in other words, when we confuse the orders of abstractions Indeed, the majority of 'mentally' ill are *too formal* in their psycho-logical, one-, two-, or few-valued processes and so cannot adjust themselves to the ∞-valued experiences of life Formalism is only useful in the search for, and test of, structure, but, in that case, the consciousness of abstracting makes the attitude behind formal reasoning *∞-valued and probable*, so that semantic disturbances and shocks in life are avoided Let us be simple about it the mechanism of the semantic disturbance, called 'identification', or 'the confusion of orders of abstractions' in general, and 'objectification' in particular, is to a large extent, dependent on two-valued formalism without the consciousness of abstracting

In mathematics formalism is uniquely useful and necessary In mathematics, the formal point of view is pressed so far as to disclaim that any meanings, in the ordinary sense, have been ascribed to the undefined terms, the emphasis being on the postulated relations between the undefined terms The last makes the majority of mathematicians able to adjust themselves, and mathematics extremely general, as it allows us to ascribe to the mathematical postulates an indefinite number of meanings which satisfy the postulates

This fact is not a defect of mathematics, quite the opposite It is the basis of its tremendous practical value It makes mathematics a linguistic scheme which embodies the possibility of perfection, and which, no doubt, satisfies semantically, at each epoch, the great majority of properly informed individual Smiths and Browns There is nothing absolute about it, as all mathematics is ultimately a product of the human nervous system the best product produced at each stage of our development The fact that mathematics establishes such linguistic relational patterns without specific content, accounts for the generality of mathematics in applications

If mathematics had physical content or a definite meaning ascribed to its undefined terms, such mathematics could be applied only in the given case and not otherwise If, instead of making the mathematical statement that one and one make two, without mentioning what the one or the two stands for, we should establish that one apple and one apple make two apples, this statement would not be applied safely to anything else but apples The generality would be lost, the validity of the statement endangered, and we should be deprived of the greatest value of mathematics Such a statement concerning apples is not a mathematical statement, but belongs to what is called 'applied mathematics', which has content Such experimental facts as that one gallon of water added to one gallon of alcohol gives *less* than two gallons of the mixture, do *not* invalidate the mathematical statement that one and one make two, which remains valid by definition The last mentioned experiment with the 'addition' of water to alcohol is a deep sub-microscopic structural characteristic of the empirical world, which must be discovered at present by experiment The most we can say is that we find the above mathematical statement applicable in some instances, and non-applicable in others

Not assigning definite meanings to the undefined terms, mathematical postulates have variable meanings and so consist of propositional functions Mathematics must be viewed as a manifold of patterns of exact relational languages, representing, at each stage, samples of the best working of the human 'mind' The application to practical problems depends on the ingenuity of those desiring to use such languages

Because of these characteristics, mathematics, when studied as a form of human behaviour, gives us a wealth of psycho-logical and semantic data, usually entirely neglected

As postulates consist of propositional functions with undefined terms, all mathematical proof is formal and depends exclusively on the form of the premises and not on special meanings which we may assign to our undefined terms This applies to all 'proof' 'Theories' represent linguistic structures, and must be proved on semantic grounds and never by empirical 'facts' Experimental facts only make a theory more plausible, but no number of experiments can 'prove' a theory A proof belongs to the *verbal* level, the experimental facts do not, they belong to a different order of abstractions, not to be reached by language, the connecting link being *structure,* which, in languages, is given by the systems of postulates

Theories or doctrines are always linguistic They formulate something which is going on inside our skin in relation to what is going on

on the un-speakable levels, and which is not a theory. Theories are the rational means for a rational being to be as rational as he possibly can As a fact of experience, the working of the human nervous system is such that we have theories Such was the survival trend; and we must not only reconcile ourselves with this fact, but must also investigate the structure of theories

Theories are the result of extremely complex cyclic chains of nerve currents of the human nervous system Any semantic disturbance, be it a confusion of orders of abstractions, or identification, or any of their progeny, called 'elementalism', 'absolutism', 'dogmatism', 'finalism', introduces some deviations or resistances, or semantic blockages of the normal survival cycles, and the organism is at once on the abnormal non-adjustment path

The structure of protoplasm of the simplest kind, or of the most elaborate nervous system, is such that it abstracts and reacts in its own specific way to different external and internal stimuli.

Our 'experience' is based normally on abstractions and integrations of different stimuli by different receptors, with different and specific reactions The eye produces its share, and we may see a stone, but the eye does not convey to us the *feel* of weight of the stone, or its temperature, or its hardness, To get this new wisdom, we need other receptors of an entirely different kind from those the eye can supply If the eye plays some role in establishing the weight, for instance, without ever giving the *actual feel* of weight, it is usually misleading. If we would try to lift a pound of lead and a pound of feathers, which the balance would register as of equal weight, the pound of lead would feel heavier to us than the pound of feathers The eye saw that the pound of lead is smaller in bulk, and so the doctrinal, semantic, and muscular expectation was for a smaller weight, and so, by contrast, the pound of lead would appear unexpectedly heavy.

As the eye is one of the most subtle organs in fact, a part of the brain, science is devising methods to bring all other characteristics of the external world to direct or indirect inspection of the eye We build balances, thermometers, microscopes, telescopes, and other instruments, but the character and *feel* of weight, or warmth, must be supplied directly by the special receptors, which uniquely can produce the special 'sensations' The swinging of the balance, or the rise of the column of the thermometer, establishes most important *relations,* but does not give the immediate specific and un-speakable feel of 'weight' or of 'warmth' Our first and most primitive contact with a stone, its feel, is a personal abstraction from the object, full of characteristics supplied by the

peculiarities of the special receptors Our primitive picture 'stone' is a summary, an integration, of all these separate 'sense' abstractions. It is an abstraction from many abstractions, or an abstraction of a higher order

Theories are relational or structural verbal schemes, built by a process of high abstractions from many lower abstractions, which are produced not only by ourselves but by others (time-binding) Theories, therefore, represent the shortest, simplest structural summaries and generalizations, or the highest abstractions from individual experience and through symbolism of racial past experiences Theories are mostly not an individual, but a collective, product They follow a more subtle but inevitable semantic survival trend, like all life Human races and epochs which have not revised or advanced their theories have either perished, or are perishing

The process of abstracting in different orders being inherent in the human nervous system, it can neither be stopped nor abolished, but it can be deviated, vitiated, and forced into harmful channels contrary to the survival trend, particularly in connection with pathological *s r* No one of us, even when profoundly 'mentally' ill, is free from theories The only selection we can make is between antiquated, often primitive-made, theories, and modern theories, which always involve important semantic factors

The understanding of the above is of serious importance, as, by proper selection of theories, all wasteful semantic disturbances, which lead even to crimes, and such historical examples of human un-sanity as the 'holy inquisition', burning at the stake, religious wars, persecution of science, the Tennessee trial , could have been avoided

Whenever *any one* says *anything,* he is indulging in theories A similar statement is true of writing or 'thinking' We *must* use terms, and the very selection of our terms and the structure of the language selected reflect their structure on the subject under discussion Besides, words are *not* the events Even simple 'descriptions', since they involve terms, and ultimately undefined terms, involve structural assumptions, postulates, and theories, conscious or unconscious—at present, mostly the latter

It is very harmful to sanity to teach a disregard for theories or doctrines and theoretical work, as we can never get away from them as long as we are humans If we disregard them, we only build for ourselves semantic disturbances The difference between morbid and not so obviously morbid confusions of orders of abstractions is not very clear The strong affective components of such semantic disturbances must

lead to absolutism, dogmatism, finalism, and similar states, which are semantic factors out of which states of un-sanity are built

We know that we must start with undefined terms, which may be defined at some other date in other undefined terms At a given date, our undefined terms must be treated as postulates If we prefer, we may call them structural assumptions or hypotheses From a theoretical point of view, these undefined terms represent not only postulates but also variables, and so generate propositional functions and not propositions In mathematics, these issues are clear and simple Every theory is ultimately based on postulates which consist of propositional functions containing variables, and which express relations, indicating the structure of the scheme

It appears that the main importance of the linguistic higher order abstractions is in their *public* character, for they are capable of being transmitted in neural and extra-neural forms But our private lives are influenced also very much by the lower order abstractions, 'feelings', 'intuitions', These can be, should be, but seldom are, properly influenced by the higher order abstractions These 'feelings' , are personal, unspeakable, and so are non-transmittable For instance, we cannot transmit the actual feeling of pain when we burn ourselves, but we can transmit the invariant relation of the extremely complex fire-flesh-nerve-pain manifold A relation is present empirically, but also can be expressed by words It seems important to have means to translate these higher order abstractions into lower, and this will be the subject of Part VII

Section C The psycho-logical importance of the theory of aggregates and the theory of groups

Starting with the $\bar{A}$ denial of identity, we were compelled to consider structure as the only possible link between the empirical and the verbal worlds The analysis of structure involved relations and *m o* and multi-dimensional order, and, ultimately, has led us to a semantic definition of mathematics and numbers These definitions make it obvious that all mathematics expresses general processes of mentation *par excellence* We could thus review all mathematics from this psycho-logical point of view, but this would not be profitable for our purpose, so we will limit ourselves to a brief sketch connected with the theory of aggregates and the theory of groups, because these two fundamental and most general theories formulate in a crisp form the general psycho-logical process, and also show the mechanism by which all languages (not only mathematics) have been built Besides, with the exception of a few specialists, the general public is not even aware of the existence of such

disciplines which depart widely from traditional notions about mathematics They represent most successful and powerful attempts at building exact relational languages in subjects which are on the border-line between psycho-logics and the traditional mathematics Because they are exact, they have been embodied in mathematics, although they belong just as well to a general science of relations, or general semantics, or 'psychology', or 'logic', or scientific linguistics and psychophysiology There are other mathematical disciplines, as, for instance, analysis situs, or the 'algebra of logic' , to which the above statements apply, but, for our present purposes, we shall limit ourselves to the former two

Dealing with the theory of aggregates, I will give only a few definitions taken from the *Encyclopaedia Britannica,* with the purpose of drawing the attention of the 'psychologists', and others, to those psychological data.

The theory of aggregates underlies the theory of function An aggregate, or manifold, or set, is a system such that (1) It includes all entities to which a certain characteristic belongs, and (2) no entity without this characteristic belongs to the system, (3) any entity of the system is permanently recognizable as distinct from other entities

The separate entities which belong to such a collection, system, aggregate, manifold, or set are called elements We assume the possibility of selecting at pleasure, by a definite process or law, one or more elements of any aggregate A, which would form another aggregate B,

The above few lines express how the human 'thought' processes work and how languages were built up It is true that the exactness imposes limitations, and so the mathematical theories are not expressed in the usual antiquated 'psychological' terms, although they describe one of the most important psycho-logical processes

Lately, the theory of aggregates has led to a weighty question Does one of the fundamental laws of old 'logic', namely, the two-valued law of the 'excluded third' (A is either B or not B), apply in all instances? Or is it valid in some instances and invalid in others?

This problem is the psycho-logical kernel of the new revision of the foundation of mathematics, which has lately been considerably advanced by Professor Łukasiewicz and Tarski with their many-valued 'logic', which merges ultimately with the mathematical theory of probability, and on different grounds has perhaps been solved in the present *non-el, $\bar{A}$*-system

The notion of a group is psycho-logically still more important It is connected with the notions of transformation and invariance Without giving formal definitions unnecessary for our purpose, we may say that

if we consider a set of elements a, b, c., and we have a rule for combining them, say O, and if the result of combining any two members of the set is itself a member of the set, such aggregate is said to have the 'group property'.

Thus, if we take numbers or colours, for instance, and the rule which we accept is '+', we say that a number or a colour is transformed by this rule into a number or a colour, and so both possess the 'group property'. Obviously, by performing the given operation, we have transformed one element into another, yet some characteristics of our elements have remained invariant under transformation Thus, if 1 is a number and 2 is a number, the operation '+' transforms 1 into 3, since $1 + 2 = 3$, but 3 has the character of being a number; so this characteristic is preserved or remains invariant Similarly, with colours, if we add colours, these are transformed, but remain colours, and so both sets have the 'group property'. Keyser suggests that the 'mental' processes have the group property, which is undoubtedly true [1]

The role this theory plays in our language is of great importance, because in it we find a method of search for structure, and a method by which we can establish a similarity of structure between the un-speakable objective level and the verbal level, based on invariance of relations which are found or discovered in both

The role of groups in physical theory is best described by quoting Professor Rainich (Remarks in brackets are mine) 'A physicist, we may take it, is a person who measures according to certain rules Let us denote by a the number he obtained in a given situation by applying the rule number one, by b the number obtained in the same situation by measuring according to rule number two and so on (a may be e g the volume, b the pressure, c the temperature of gas in a given container). The physicist finds further that the results of measurements of the same kind undertaken in different situations satisfy certain relations, we may write, for instance:

$$r(a,b) = c$$

'A mathematician is busy deducing from some given propositions other propositions, this usually leads to numbers which we may call A, B, C, . These numbers also satisfy certain relations, say

$$R\ (A,B) = C$$

'Then comes, as Professor Weyl says, a messenger, a go-between who may be a mathematician or a physicist, or both, and says· "If you establish a correspondence between the physical quantities and the mathematical quantities, if you assign A to a, B to b, etc, the *same* relations

hold for the physical quantities as for the corresponding mathematical quantities so that $R \equiv r$" [*Similarity of structure*]

'In the course of time new procedures of measurement are invented, some physical relations do not find their counterpart in the mathematical theory, the mathematical theory has to be patched up by introducing new quantities till too many quantities appear in it which do not correspond to physical quantities, then comes the phenomenological point of view and sweeps the theory out of applied mathematics—the theory becomes pure mathematics once more, and physicists begin to look around for a new theory. Everybody can find examples for this situation, it is enough to mention the Bohr atom which was not even mentioned today only fifteen years after its introduction.

'However the theory of groups which is being applied to physics is not just one of many mathematical theories of the character described above, its application is of a far more fundamental nature and we shall be able to indicate what it is by analysing further the scheme outlined above

'It may happen, and in fact it happens often, that the same mathematical theory can be applied to the same physical facts in more than one way, for instance, instead of assigning to the physical quantities $a,b,$. the mathematical quantities $A,B,$ we might have assigned to them A',B', . . with the same results, that is, the relations for physical quantities are the same as for the mathematical quantities corresponding to them now (think of space considered from the experimental point of view—and of coordinate geometry, different ways of establishing a correspondence result from different choices of coordinate axes) If this happens it means that the mathematical theory possesses a peculiar property, namely, that if A' is substituted for A, B' for B and so on, no relation of the type $R(A,B) = C$ which was correct before the substitution is destroyed, in other words, there are substitutions or transformations for which all relations are invariant All such transformations constitute what we call a group, the existence and the properties of such a group present a very important characteristic of the mathematical theory Moreover it is clear that if two different mathematical theories can be applied—in the sense described above—to the same physical theory, the groups of these two theories will be essentially the same, so that the groups reflect some of the most fundamental properties of physical systems'[2]

The connection between groups and structure is described by Professor Shaw as follows 'The first branch of dynamic mathematics is the theory of operations It includes the general theory of operators

of any type and in particular the theory of groups of operators The structure of such groups is evidently a study of form It may often be exemplified in some concrete manner Thus the groups of geometric crystals exemplify the structure of thirty-two groups of a discontinuous character, and the 230 space-groups of the composition of crystals exemplify the corresponding infinite discontinuous groups The study of the composition series of groups, the subgroups and their relations, whether in the case of substitution groups, linear groups, geometric groups, or continuous groups, is a study of form Also, the study of the construction of groups, whether by generators, or by the combination of groups, or in other ways, is also a study of structure or form The calculus of operations in general, with such particular forms as differential operators, integral operators, difference operators, distributive operations in general, is for the most part a study of structure In so far as any of these is concerned with the synthesis of compound forms from simple elements, it is to be classed as a study of form, as the term is here used '[3]

In the notion of a group, we have become acquainted with two terms, namely, transformation and invariance The first implies 'change', the other, a lack of 'change' or 'permanence' Both of these characteristics are semantically fundamental, but involve serious complexities

The world, ourselves included, can be considered as processes which can be analysed in terms of transformed stages with all their derivative notions In the objective world, 'change' is ever present and is, perhaps, the most important structural characteristic of our experience But when a highly developed nervous system, a process itself, is acted upon by other processes, such nervous system discovers, at some stage of its development, a certain relative permanence, which, at a still later stage, is formulated as invariance of function and relations The latter formulation is *non-el* because it can be discovered empirically, which means by the lower nerve centres, but also is the main necessity and means of operating of the higher nerve centres, so-called 'thought'. All that we usually call a process of 'association' is nothing else than a *process of relating,* a direct consequence of the structure of the nervous system, where stimuli are registered in a certain four-dimensional order, which, on the psycho-logical level, take the form of relations From this point of view, it is natural that the higher nerve centres, as a limit of integrating processes, should produce *and* discover invariance of relations, which appears then as the supreme product and so, ultimately, a necessity of the activity of the higher centres Obviously, if the invariance of relations has any objective counterpart whatsoever in the external world,

this invariance is impressed on the nervous system more than other characteristics, and so, at a certain stage, a nervous system which is capable of producing and using a highly developed symbolism, must discover and formulate this invariance

It seems that *relations*, because of the possibility of discovering them and their invariance in *both* worlds, are, in a way, more 'objective' than so-called objects We may have a science of 'invariance of relations', but we could not have a science of permanence of things, and the older doctrines of the permanence of our institutions must also be revised Under modern conditions, which change rather rapidly nowadays, obviously, some relations between humans alter, and so the institutions must be revised If we want *their invariance*, we must build them on such *invariant relations between humans* as are not altered by the transformations This present work, indeed, is concerned with investigating such relations, and they are found in the *mechanism of time-binding*, which, once stated, becomes quite obvious after reflection

As Professor Shaw says 'We find in the invariants of mathematics a source of objective truth So far as the creations of the mathematician fit the objects of nature, just so far must the inherent invariants point to objective reality Indeed, much of the value of mathematics in its applications lies in the fact that its invariants have an objective meaning When a geometric invariant vanishes, it points to a very definite character in the corresponding class of figures When a physical invariant vanishes or has particular values, there must correspond to it physical facts When a set of equations that represent physical phenomena have a set of invariants or covariants which they admit, then the physical phenomena have a corresponding character, and the physicist is forced to explain the law resulting The unnoticed invariants of the electromagnetic equations have overturned physical theories, and have threatened philosophy Consequently the importance of invariants cannot be too much magnified, from a practical point of view'[4]

It should be noticed that the *non-el* character of the terms relation, invariance , which apply both to 'senses' and 'mind', is particularly important, as it allows us to apply them to all processes, and that such a language is similar in structure not only to the world around us, but also to our nervous processes Thus, a process of being iron, or a rock, or a table, or you, or me, may be considered, for practical purposes, as a temporal and average invariance of function on the sub-microscopic level Under the action of other processes, the process becomes structurally transformed into different relational complexes, and we die, and a table or rock turns into dust, and so the invariance of this function vanishes.

The notion of a function involves the notion of a variable The functional notion has been extended to the propositional function and, finally, to the doctrinal function and system-function The term transformation is closely related to that of function and relation This notion is based on our capacity to associate, or relate, any two or more 'mental' entities We can, for instance, associate a with b or b with a We say that we have transformed a into b, or vice versa

An excellent example of transformation, given by Keyser, is an ordinary dictionary, which would be genuinely mathematical if it were more precise In a dictionary, every word is transformed into its verbal meaning, and vice versa A telephone directory is another example. Quite obviously, the term 'transformation' has far-reaching implications If a is transformed into b, this implies that there is a relation between a and b which is being established, by the fact of transformation Once a relation is established, we have a propositional function of two or more variables which define an extensional set of all elements connected by this relation [5]

We see that these three terms are inseparably united and are three aspects of one psycho-logical process If we have a transformation, we have a function and a relation, if we have a function, we have a relation and a transformation; if we have a relation, we have a transformation and a function Transformation, as we see, is a psycho-logical term of action A relation has a psycho-logically mixed character. A propositional function is a static statement, on record, with blanks for the values of the variables In it the form is invariant, but it may take an indefinite number of values The *extensional manifold* of the values for the variable is static, given once for all in a given context It is extensional and, therefore, may be empirical and experimental

Let us take as an example, for instance, the transformation of a set of integers 1, 2, 3, . Let us suppose that the given law of transformation is given by the function $y = 2x$ The result would be the manifold of even integers 2, 4, 6, We see that integers are transformed into integers; therefore, the characteristic of being an integer is preserved; in other words, this characteristic is an invariant under the given transformation $y = 2x$, but the values of the integers are not preserved.

The theory of invariance is an important branch of mathematics, made famous of late through the work of Einstein Einstein fulfilled the dearest dream of Riemann and attained the methodological and scientific ideal, that a 'law of nature' should be formulated in such a manner as to be invariant under groups of transformations. Such a semantic ideal, once stated, cannot be denied, it expresses exactly a necessity of

the proper working of the human nervous system In fact, a 'law' of nature represents nothing else than a statement of the invariance of some relations When the Einstein criterion is applied, it renders most of the old 'natural laws' invalid, as they cannot stand the test of invariance. The older 'universal laws' then appear as local private gossips, true for one observer and false for another

The method of the theory of invariance gives us the trend of relations that abide, and so expresses important psycho-logical characteristics of the human 'mind' Its further significance is revealed by Keyser in the suggestion that when a group of transformations leaves some specified psycho-logical activity invariant, it defines perfectly some actual or potential branch of science, some actual or potential doctrine [6]

We all know how deeply rooted in us is the feeling, the longing for stability, how worried we are when things become unstable Worries and fear are destructive to semantic health and should be taken into account in a theory of sanity A similar semantic urge apparently moved mathematicians when they worked out the theory of invariance, it was a formulation of a necessity of the activities of the human nervous system That similar semantic methods, if applied, would give similar results in our daily lives, scarcely needs to be emphasized.

We have already spoken of the mathematical theory of invariance as a mathematical species of a semantic theory of universal agreement Similarly, in a $\bar{A}$-system based on relations and structure, it is possible to formulate a theory of universal agreement which would be structurally impossible in the A-system, and so the dreams of Leibnitz become a sober reality; but we must first re-educate our *s r.*

Section D Similarity in structure of mathematics and of our nervous system

In the chapter on the Semantics of the Differential Calculus, the fundamental notions and method of this calculus are explained. Here we may say, briefly, that it consists in stratifying, or expanding into a series, of an interval of any sort which proceeded by large steps The large steps are divided into a great number of smaller and smaller steps, which, in the limit, when the numbers of steps become infinite, take on the aspect of 'continuity' so that we can study the 'rate of change' When 'time' is taken into consideration, the dynamic may be translated into static, and vice versa, processes can be analysed at any stage, This short description is far from exact or exhaustive, I emphasize only in an intuitive way what is of main semantic importance for our purpose

The main object of the present chapter is to explain that the structure of the human nervous system is such that, on some levels, we produce dynamic abstractions, on others, static As the organism works as-a-whole, for its optimum working, and, therefore, for sanity, we need a language, a method, which may be translated into a *s r* by which to translate the dynamic into the static, and vice versa, and such a language, such a method, is produced and supplied by mathematicians To some readers, these remarks may appear so obvious as to make it unnecessary to write them, but I have found, through personal observation of reactions of different individuals, and by a careful survey of the literature of the subject, that even many mathematicians and physicists do not have this *s r* in all problems—or, at least, they do not know how to apply it.

In Part VII, elementary $\bar{A}$ methods are worked out, which supply the neurological semantic benefits of the calculus, very easily imparted to even small children *without any mathematical technique,* and establishing in them a mathematical attitude toward all language in general, training them in the only structural psycho-logics of sanity, namely, that of the calculus, which thus becomes the foundation of healthy and normal human *s r*. And this, let us repeat again, without any mathematical technique We find, also, that there are simple and *physiological* means, based on structure, of training our *s r* and imparting the feel for the structural stratification inherent in the consciousness of abstracting.

To start with, let me mention briefly a quite unexpected, unconscious, structural *biological* characteristic of mathematics; namely, its (in the main) *non-el*, organism-as-a-whole character.

From the time of Aristotle, biologists, physiologists, neurologists, 'psychologists', psychiatrists and others have spoken a great deal about the organism-as-a-whole, yet, they have not seemed to realize that if they produce *el* terms, they cannot apply the *non-el* principle.

It will probably not be an exaggeration to say that the majority of mathematicians have never heard of this principle, and that, if they have, they paid no attention to it, *yet*, in practice, they have applied it very thoroughly The main mathematical terms are *non-el*, organism-as-a-whole terms which apply to 'senses' as well as to 'mind'. For instance, relation, order, difference, variable, function, transformation, invariance , can mostly be seen as well as 'thought' of. The use of such terms prevents our speculation from degenerating into purely *el* speculations on words, a process always closely related to the morbid semantic manifestations of the 'mentally' ill, and obviously based on the pathological confusion of orders of abstractions, involving inappropriate evaluation

This fact alone is of serious importance, as it indicates that mathematics is a language of similar structure to the structure of organisms and is a correct language, not only neurologically, but also *biologically*. This characteristic of mathematics, quite unexpectedly discovered, made the fusion of geometry and physics possible It underlies, also, the theory of space-time and the Einstein theory. It will be seen later that it has also serious psycho-neurological importance

It was already emphasized that the existing 'psychologies' are animalistic or metaphysical, because either they disregard one of the most unique human characteristics, such as the behaviour called mathematizing, or they indulge in speculations on, and in, *el* terms It was suggested that no *human* 'psychologist' can actually perform his official task unless he is an equipped student of mathematics Unless we actually apply the *non-el* principle, and take into account that the structure of languages introduces implications, unconscious in the main, and that no man is ever free from some doctrines and some so-called 'logical' processes involving physiological and semantic concomitants, no general theory of *human* 'psychology' can be produced.

The above solves a very knotty semantic problem, for we see that if we apply the *non-el* principle, any 'psychology' on the human level must become *psycho-logics*, though the old term 'psychology' could be retained as applying to animal researches only The very name 'psychology', or the 'theory or science of mind', is obviously *el*, and treats 'mind' as an objective separate entity As these results were originally reached independently, it is interesting to notice that the modern methods and the application of the structural positive knowledge 1933 lead to very many analogies and similarities, though this, after all, might be expected

Notice the hyphen which, out of the *el* and delusional objectified 'space' and 'time', made the einsteinian space-time a language of *non-el* structure similar to the world around us, and the hyphen which out of *el* 'psychology' makes a *non-el* human discipline of psycho-logics It seems that a little dash here and there may be of serious semantic importance when we deal with symbolism.

To facilitate exposition, it is useful to stress, in the present section, the neurological and psychiatrical side, as an outline of the methods of the calculus, and related subjects will, of necessity, require separate treatment.

When rats are trained to perform a simple experiment requiring some 'mentality' and afterwards a large part of the cerebral cortex is removed, their training may be wholly lost If such decorticated rats are trained again, they re-acquire the habit as readily as before It appears

that, with rats, the cortex is not essential for these learning processes They 'learn' as well, or nearly as well, with their sub-cortical and thalamic regions ? In what follows, to avoid misstatements, I will use the rather vague term, yet sufficient for my purpose, 'thalamic region' or 'lower centres' instead of more specific terms, the use of which would complicate the exposition unnecessarily With dogs, apes, and men, the situation is increasingly different Their nervous systems are more differentiated Their functional interchangeability is impaired In the most complex human brain there still exists some interchangeability of function When an arm, for instance, is paralysed through a brain-lesion, the arm may re-acquire a nearly normal function, though there is no regeneration of the destroyed brain tissue However, the interchangeability is less pronounced than in the lower brains There seems to be no doubt that the thalamic regions are not only a vestibule through which all impulses from the receptors have to pass in order to reach the cortex, but also that the affective characteristics are strictly connected with processes in these regions It seems that some very primitive and simple associations can be carried on by the thalamic regions

The cortex receives its material as elaborated by the thalamus The abstractions of the cortex are abstractions from abstractions and so ought to be called abstractions of higher order. In neurology, similarly, the neurons first excited are called of 'first order'; and the succeeding members of the series are called neurons of the second order,. Such terminology is structurally similar to the inherent structure and function of the nervous system. The receptors are in direct contact with the outside world and convey their excitation and nerve currents to the lower nerve centres, where these impulses are further elaborated and then abstracted by the higher centres

According to our daily experience and scientific knowledge, the outside world is an ever-changing chain of events, a kind of flux, and, naturally, those nerve centres in closest contact with the outside world must react in a shifting way These reactions are easily moved one way or another, as in our 'emotions', 'affective moods', 'attention', 'concentration', 'evaluation', and other such semantic responses In these processes, some associative or relational circuits exist, and there may be some very low kind of 'thinking' on this level Birds have a well-developed, or, perhaps, over-developed, thalamus but under-developed and poor cortex, which may be connected with their stupidity and excitability.

Something similar could be said about the 'thalamic thinking' in humans, those individuals who overwork their thalamus and use their cortex too little are 'emotional' and stupid. This statement is not exag-

gerated, because there are experimental data to show how through a psycho-neural training the *s r*, in some cases, can be re-educated, and that with the elimination of the semantic disturbances there is a marked development of poise, balance, and a proportional increase of critical judgement, and so 'intelligence' Idiots, imbeciles, and morons are usually 'emotional' and excitable, as well as deficient in their 'mental' processes A similar characteristic can be found in other unclassified 'mentally' deficient, and their name is legion—a characteristic strictly connected with, and often produced by, disturbances of the *s r* When these shifting, dynamic, affective, thalamic-region, lower order abstractions are abstracted again by the higher centres, these new abstractions are further removed from the outside world and must be somehow different

In fact, they *are* different, and one of the most characteristic differences is that they have *lost* their *shifting* character. These new abstractions are relatively static It is true that one may be supplanted by another, but they do not change In this fact lies the tremendous value and danger of this mechanism, as disclosed clearly by the disturbances of the *s r* The value is chiefly in the fact that such higher order abstractions represent a perfected kind of memory, which can be recalled exactly in the form as it was originally produced For instance, the circle, *defined* as the locus of points in a plane at equal distance from a given point called the centre, remains permanent as long as we wish to use this definition We can, therefore, recall it perfectly, analyse it , without losing the definiteness and the stability of this memory Thus, critical analysis, and, therefore, progress, becomes possible Compare this perfected memory, which may last indefinitely unchanged, with memories of 'emotions' which, whether dim or clear, are always distorted We see that the first are reliable, that the others are not

Another most important characteristic of the higher order abstractions is that, although of neural origin, they may be preserved and used over and over again in extra-neural forms, as recorded in books and otherwise This fact is never fully appreciated from a neurological point of view. Neural products are stored up or preserved in extra-neural form, and they can be put back in the nervous system *as active neural processes* The above represents a fundamental mechanism of time-binding which becomes overwhelmingly important, provided we discover the physiological mechanism of regulating the *s r*, on the one hand, and discover the mechanism by which these extra-neural factors can be made physiologically effective, on the other

If humans are characterized by the fact that they build up this cumulative affair called 'civilization', this is possible through those higher

order abstractions and the time-binding ability to extend our nervous system by extra-neural means, which in the meantime, may play a most important neural role and become active nervous impulses The last is only possible if some abstractions are static, and so can be recorded, leading ultimately to further extensions of the human nervous system by extra-neural means, such as microscopes, telescopes, and practically all modern scientific instruments, books, and other records

To illustrate what has been said here, I know of no better example than is found in moving pictures When we watch a moving picture representing some life occurrence, our 'emotions' are aroused, we 'live through' the drama, but the details, in the main, are blurred, and a short time after seeing it either we forget it all or in parts, or our memory falsifies most effectively what was seen It is easy to verify the above experimentally by seeing one picture twice or three times, with an interval of a few days between each seeing The picture was 'moving', all was changing, shifting, dynamic, similar to the world *and* our feelings on the un-speakable levels The impressions were vague, shifting, non-lasting, and what was left of it was mostly coloured by the individual mood , while seeing the moving picture Naturally, under such conditions, there is little possibility of a rational scientific analysis of a situation

But if we *stop* the moving film which ran, say, thirty minutes, and analyse the static and extensional series of small pictures on the reel, we find that the drama which so stirred our 'emotions' in its moving aspect becomes a series of slightly different static pictures, each difference between the given jerk or grimace being a *measurable* entity, establishing relations which last indefinitely

The *moving* picture represents the usually brief processes going on in the lower nerve centres, 'close to life', but unreliable and evading scrutiny The *arrested* static film which lasts indefinitely, giving *measurable* differences between the recorded jerks and grimaces, obviously allows analysis and gives a good analogy of the working of higher nerve centres, disclosing also that all life occurrences have many aspects, the selection of which is mostly a problem of our pleasure and of the selection of language The moving picture gives us the process, each static film of the reel gives us stages of the process in chosen intervals In case we want a moving picture of a growing plant, for instance, we photograph it at given intervals and then run it in a moving-picture projector, and then we see the process of growth. These are empirical facts, and the calculus supplies us with a language of similar structure with many other important consequences.

It is characteristic that those who claim to be most interested in human affairs and human processes, whom we call, among others, 'philosophers', 'psychologists'., should not have discovered much of value in these fields But mathematicians, who disclaim meaning in their undefined terms, or 'truth' in their postulates, or interest in human affairs, have had a most astonishing and unique success by elaborating methods for the translation of the dynamic into static and the static into dynamic Claims and disclaims matter little, but working in accordance with the survival order of the nerve structure and currents has produced most valuable results

The different methods of mathematics and the four-dimensional 'world' of Minkowski form the means for translating the dynamic into static and vice versa Minkowski established a language of a new structure, closer to actual facts of the world around us and ourselves, making the general theory of Einstein possible Further analysis of these issues is carried out in Part IX. and it is one of the semantic foundations upon which a positive theory of sanity can be built

Disclaiming definite meanings, mathematicians have an intuitive predilection for selecting their terms and pursuing their line of enquiry among *possible meanings,* although formally these meanings are disregarded The feeling which directs the selection of material which is formally interesting and important is akin to the artistic sense, but, unfortunately, in spite of its importance, it has been neglected by 'psychologists' Quite often it is the 'feel' which directs the mathematicians in their researches and suggests or modifies lines of development or the selection of one set of postulates in preference to other sets This is why the ordinary sense of the terms used in mathematics is so important, although it represents only some of the possible meanings These, with their implications, usually represent most important structural characteristics of the human nervous system and the world

This is to be expected because of the reasons given above, the more so that invariance in this shifting world is a characteristic of relations, and mathematics is a language of exact relations which, in the meantime, have mostly objective counterparts The highest abstractions at every date are detached from the outside world neurologically, and *should remain detached,* to represent 'pure mind' in action These higher abstractions are on the public level, as they are transmittable verbally with all characteristics included They are static, unhampered directly by the outside events, although they normally originate in them These higher order abstractions are 'digested' and translated into lower order abstractions and returned to the lower centres, and they receive their

meanings close to life Such meanings are enlightened meanings, a survival process, and each nervous level did its work properly

We know that a number of human races have perished without leaving many traces of their existence. This process is going on continually, even now Some races are progressing, some are regressing, some are at a seeming standstill It would appear that the mechanism of higher order abstractions had and has survival value, and, therefore, should not be neglected but cultivated In this special case, cultivation is a condition inherent in the process and a necessity for time-binders

Serious semantic dangers are also revealed by analysis and verified by observation These higher order abstractions, let us repeat, are static and may last indefinitely, as long as for structural reasons we do not replace the old by new ones Even then, though rejected, they remain as a permanent fact on record Obviously, these higher abstractions have only a 'second-hand' connection with the outside world Even their character is changed, they are static while the world is dynamic The lower 'sense' world has 'characteristics left out', owing to the mechanism of abstracting of the lower centres, and the abstractions of higher orders have 'all characteristics included', because these are abstractions from abstractions, an *intra-organismal* process in its entirety, their starting material being already an end-product of the activities of the lower centres This mechanism is only under full control if we are conscious of abstracting, because the higher order abstractions in the nervous chain affect, in their turn, the lower centres, and, in pathological cases, impress on them a semantic *delusional* or *illusional* evaluation as if a character of experience In severe cases, even the lower nerve centres are stimulated to such an extent that hallucinations appear

If we do not know how to handle different order abstractions, this results in serious semantic dangers If the distribution of the returning nerve currents is a non-survival one, we exhibit semantic disturbances, such as identification or confusion of orders of abstractions, delusions, illusions, and hallucinations Thus, we ascribe to the products of the lower nerve centres, the lower order abstractions, characteristics fictitious and impossible for them, such as 'immutability', 'permanence', involving disorientation about 'time' , , which are characteristics of the higher order abstractions, but do not belong to the world as given by the lower abstractions, and result in an improper evaluation disturbing to the *s r* Such disturbances make us, naturally, absolutists and dogmatists, involve serious affective disturbances, and lead to non-adaptive behaviour and reactions, and other semantic manifestations of un-sanity These, in their turn, make adjustment more difficult, often affecting the

structure of man-made institutions, which again make adjustments more complex and often impossible. We become un-sane, 'insane', and life, whether public or private, becomes a mess In such a vicious semantic circle, we distort our education, our systems, and institutions Often the morbid reactions of powerful individuals are forced upon masses, who are then ruled by these morbid products, with injury to their nervous systems Different mass hysterias, 'revivals', wars, political and religious propaganda, very often commercial advertisements, offer notable examples.

The morbid semantic influence of commercialism has not been investigated, but it does not take much imagination to see that commercial psycho-logics, as exemplified by the theories of commercial evaluation, 'wisdom', appeal to selfishness, animal cunning, concealing of true facts, appeal to 'sense' gratification , produce a *verbal and semantic environment* and slogans for the children which, if preserved in the grown-ups, must produce some pathological results It is hoped that some day a psychiatrist will investigate this large, neglected, and very important semantic problem

The lack of structural linguistic researches and investigation of our *s r*, and the ignorance of those who rule, make us nearly helpless Malaria or other germ diseases would never be eliminated were we to preserve religiously the sources of infection The semantic sources of un-sanity are not only defended but are actively sponsored by organized ignorance and the power of merchants, state, and church

The situation is acute If we could entirely eliminate our cortex, it would, perhaps, not be so serious We could, perhaps, live as complex a life as a fish and have a nervous system perfectly adjusted to such a life But, unfortunately, with a structural change, or, according to Lashley, with the change even in the total mass of the brain, the activities and the role of the whole, including other parts, are profoundly altered [8] These become inadequate, as shown by the boy born without the cortex, already described. His nervous system was much more complex than that of fishes or of some lower animals which lead *adequately* a rather complex life But the boy was less equipped for life than they. Even his 'senses', though apparently 'normal' on macroscopic levels, must have been pathological on colloidal and sub-microscopic levels and did not function properly. We know, also, that in many cases of 'mental' ills the 'sense reactions' are abnormal, sometimes the patients seem to be entirely insensitive to stimuli which would produce most acute pain to other less pathological individuals

It is impossible to eliminate completely from our lives or nerve currents the higher abstractions and their psycho-neural effect Curiously enough, this elementary fact has never been emphasized or taken into account seriously, yet it is a crucial semantic factor in our attitude toward science and our future Those who attempt such elimination, whether by actively persecuting science, or by emitting propaganda against science, or by the cynical or ignoring attitude toward 'mental' achievements, whether personally, or in education, or in public prints, or other public activities, do not succeed in eliminating the higher order abstractions, but simply introduce *pathological semantic reactions* and succeed in disorganizing their own nervous systems and those of others I intended this implication when I said that our existing educational systems *produce* morons, but 'geniuses' are born Such very general semantic directives are, perhaps, responsible for the extremely low level of our non-technical development Humans are not to be judged simply by the ability to drive an automobile or by the knowledge of how to use a bathtub, nor yet by their capacity for buying and selling things produced by others.

The tendency of some public prints to appeal to the morbidity of mob psycho-logics and to its ignorance, insisting that all that is said should be said in 'one-syllable' words, so that the mob can understand, in a *human* class of life, is an *arresting* or *regressive tendency*. What should be urged for sanity, and for humans, is that the mob should also learn the use of at least two-syllable words! Then, perhaps, the day would come when they could follow easily and habitually the use of *non-el* terms and, perhaps, even of words connected by a hyphen

This appeal to mob psycho-logics and ignorance affects profoundly our *s r* and should be investigated. It definitely appears that in countries where the majority reads only the sort of publications referred to above and commercial advertisements, their psycho-logical equipment and standards are lower than those of perfectly illiterate peasants of other countries It is not fully realized that in a symbolic class of life, symbolism of any sort—e g, public prints—plays an environmental role and creates *s r* which may be distinctly morbid The problems of public prints, commercialism, and their psycho-logical effect on the *s r* should undergo a searching analysis by psychiatrists, and definite suggestions should be formulated by psychiatric scientific organizations or congresses

Under the conditions prevailing at present, it is futile to preach 'morals' of any metaphysical kind They have never worked satisfactorily, and increasingly they cannot work, particularly under the present much more complex conditions of life They disorganize the survival

activities and processes of the human nervous system. The imposed and delusional dogmas are themselves the result of pathological evaluation in their originators, a necessity, perhaps, on a primitive level, but profoundly semantically harmful under the complexities of life-conditions 1933.

As it is impossible to eliminate the influence of the higher order abstractions, we should investigate whether or not we can control these processes and the related *s r* We can learn to regulate these processes, which otherwise may become pathological, and to redirect the currents into constructive survival channels I can state definitely that this is possible We can control physiologically the *s r* through the elimination of identification, by training in order, in consciousness of abstracting, and similar disciplines, and thus eliminate the pathological semantic disturbances of confusion of orders of abstractions Such training, whenever possible, has seemingly a beneficial influence even on the more extreme pathological states listed above, and suggests general preventive value

Let me briefly restate the fundamental differences between lower order abstractions and higher The lower order abstractions are manufactured by the lower nerve centres, which are closer to, and in direct contact with, actual life experiences These are non-permanent, shifting, vague and un-speakable, but often very intense They play a most important role in our daily lives They cannot be transmitted, as they are essentially of a non-transmittable character, and have a private, non-public character All 'sense' impressions, 'feelings', 'moods' , are representative of them We should remember that, detached, they are fictions, manufactured verbally, because our language happens to be *el* Actually, these lower centres are in the cyclic chain and so influence, and are influenced by, the full cycle, including the higher order abstractions, whatever the latter may be in a given individual The main point is that they are shifting, changing, non-permanent, non-stable—'moving', so to say—and remain un-speakable

The higher order abstractions are abstractions from the lower order abstractions, being further removed from the outside world, and are of a distinctly different character. These are static, 'permanent', and cannot be entirely eliminated from any one

From the point of view of sanity, the problem of how we can handle these functions becomes paramount In the cyclic nervous chain, we always must translate one level into the other Obviously, if, in the *higher* centres, we elaborate shifting, changing, non-permanent material, this material is not appropriate for them , they cannot work properly, and some pathological processes may set in

If we elaborate in the *lower* nerve centres abstractions that are static, permanent , in character, and hence inappropriate for the lower centres, we build up morbid non-survival identifications, delusions, illusions, hallucinations, and other disturbances of evaluation, resulting in milder cases in absolutism, dogmatism, fanaticism , and, in heavier cases, in a neurosis or even a psychosis.

It seems quite obvious that each nervous level has its own specific kind of material to deal with As they are in a cyclic nervous chain and are interconnected in a bewilderingly complex way, the problem of appropriate translation of one level of abstractions into the other becomes a semantic foundation for a well-balanced functioning of the nervous system In this respect, we differ fundamentally from animals The above difficulties do not arise in animals to that extent, because their nervous systems are not differentiated enough for such sharp differentiation in the functioning For this reason, without human interference, there could be no 'insane' animals which could survive (see Part VI) But, having no static higher order abstractions in the human sense, they cannot pass on their 'experiences', which are transmittable *only* in the higher order formulations in neural and extra-neural forms to the next generations Animals are not time-binders

For humans, the proper translation of dynamic into static and static into dynamic becomes paramount for sanity, on psycho-logical levels, affecting, probably by colloidal processes, the psycho-neural foundation of semantic responses

Psychiatry informs us that most of the 'mentally' ill have their main disturbances in the dynamic affective field It is a very difficult field to reach by the older methods, the more so that the older *el* sharp distinction between 'intellect' and 'emotions' prevented the discovery of workable means 'Thinking' and 'feeling' are not to be divided so simply We know how 'thinking' is influenced by 'feeling', but we know very little how 'feeling' is influenced by 'thinking'—perhaps, because we have not analysed the semantic issues in *non-el* terms

All psychotherapy, with its manifold theories, each contributing its share, is a semantic attempt to influence 'feeling' by 'thinking' A large number of successful cases seems to show clearly that some such means are possible Large numbers of failures show equally that the methods used are not structurally satisfactory The need of more scientific investigations of a more general and fundamental, *non-el* character becomes emphatic The present enquiry shows that such structural investigations suggest that the method can be found in the psycho-logics of the 'mind' at its best; namely, in mathematics, which unexpectedly leads to a

physiological control of the *s r*, effective not only as a therapeutic, but also as a preventive, educational means

Identification as a factor of un-sanity seems to be a natural consequence of the evolution from 'animal' to 'man', particularly at our present stage, while the human race is so recent a product The human cortex appeared only comparatively lately and is a young structure; the thalamic regions have a much longer history of functioning It seems natural that the nervous impulses should pass the shorter, more phylogenetically travelled, paths in preference to comparatively newer and longer paths, a principle well known in neurology in connection with so-called 'Bahnung' If education, and on human levels any kind of adjustment involving *s r* involves some education, fails to force the nerve currents into their proper channels, or actively establishes in them semantic psycho-neural blockages through pathological evaluation acquired because of faulty training, we should expect either infantilism or regression to still lower levels Whatever the correct explanation of the distribution of nerve currents, semantic blockages , may be, observation shows unmistakably that some such assumptions are necessitated by observed manifestations in behaviour Experiments show, also, that such defects can be helped greatly by the proper re-training and re-education of the *s r*.

To understand the structure of these semantic disturbances, we must become acquainted with the affective components which underlie mathematics and mathematical methods, hitherto disregarded, because of the *el* character of our old terminology There is another striking connection In severe 'mental' illnesses, we usually find a disorientation in 'space' and 'time', which are, by necessity, *relational data* of experience In the semantic disturbances called identification, we also find, as a rule, relational disorientation *about* 'space' and 'time', more subtle but very vicious in effect, bordering on what are called 'philosophical' problems, which, as a matter of fact, represent psycho-neural disturbances Since Einstein, the disturbances can be easily eliminated, provided we take into account structural *non-el* issues in connection with *s r* and a $\bar{A}$-system

It is instructive to make a short survey of the methods by which the mechanism of the nervous cycle—'senses', 'feelings' , first, 'mind', which again influences the 'feelings', next—works in mathematics Weierstrass, the famous mathematician, says, in one of his writings, that a mathematician is a kind of poet This is largely true Mathematics is not only a rigorous linguistic relational pattern, but it uses the highest abstractions which we have reached at a given period from

the data given by the lower nerve centres, which are closer to experience, or rather which constitute experience The older arguments about the connection or lack of connection between the lower order abstractions ('sense' data ,), and mathematics are due solely to a confusion of orders of abstractions and are a useless gambling in *el* terms Only in severe 'mental' ills is the speech of the patients entirely unconnected with first order external 'realities', and so the study of relations of many kinds and orders, called 'mathematics', cannot, as long as it is sane, be entirely detached from 'reality'. In fact, it is useless for mathematicians to try to produce disciplines which have no practical applications As long as it is professionally accepted as mathematics, and, therefore, a science and sane, whatever mathematicians produce will always be connected with lower order abstractions, and must have an application sooner or later When these higher order abstractions, produced very often by many individuals, are absorbed and returned in a modified form to the lower centres as 'visualization', 'intuition', 'feelings' , the given individual is closer to the external world than he was before, because he has absorbed, digested, and appropriated the nervous results of many more experiences than he himself could have gathered alone He is able to compare, evaluate, and relate, revise and adjust his private experiences and observations with the *translated* experiences from higher abstractions of many more individuals The *translation* is indispensable, because the reactions of both levels are entirely different, and comparable only when they are on one level *Creative work has begun*

Experiences given by the lower centres and lower abstractions are full of meanings, colouring, affective and semantic components, and these are not directly comparable with the higher abstractions produced by the higher nerve centres They must be first transformed, 'digested', and translated into terms of the lower centres, which are the only ones which are effective on the lower levels We call them 'visualization', 'intuition', 'feeling', 'culture', The exact mechanism is not well known, but we have a number of data which show that the lower nerve centres are somehow engaged in these processes

When this is accomplished, the mathematician has at his disposal an enormous amount of data , first, his personal experiences and observation of actual life (lower centres and lower order abstractions), and also all the personal experiences and observations of past generations. Although the latter were stored in the form of higher order abstractions only as an *account* of past experiences in neural or extra-neural forms, his nervous cycle was affected by them, and they were translated back into experiences of the lower levels

With such an enormous amount of data of experience, he can *re-evaluate* the data, 'see' them anew, and so produce new and more useful and structurally more correct higher order abstractions In their turn, these will produce similar semantic effects with other individuals, The mechanism is, after all, well known and general, obvious even in the relations between some feeble-minded parents and their eventually feeble-minded children. It is entirely obvious on racial grounds, but, at present, it is not so obvious, and often but slightly effective, on personal and individual grounds, because we have had no means of training structurally and effectively the *s r* in proper evaluation The mechanism is entirely general, but it is obvious and seen at work in the majority of *creative* scientists and so-called 'geniuses' These processes have not been analysed in terms of order, and so, although we use them often, we are not conscious of their mechanism and have no means of training our *s r*. The *s r* are a product of training, education , and are not inborn in *a given form* Even birds bred in a laboratory which have never heard their parents or other birds sing will sing, as this is an inborn reflex, but the melody produced is different from that of their parents Under normal conditions, the form of the song is standardized and is a result of *copying* parents In other words, the melody-environment has affected them With humans, it is not only a question of the given noises, the 'melody-environment' which we relate with some experiences, but the *s r* involve affective responses to meanings, and this depends on the structure of language, involving unconscious, yet vital, evaluation factors and our *attitude* toward language, which ultimately depends on our knowledge of the mechanism and use of language

These problems are extremely complex and subtle, and, at this stage, we are not ready to go into further details, the more so that there is a very simple and effective physiological structural method given in Part VII, which in practice eliminates enormous theoretical difficulties. There is little doubt that this mechanism of recasting, or translation of abstractions, is present in all of us, but this mechanism requires knowledge of the proper way to handle it, and that knowledge is not inborn, but has to be acquired by education. Up to the present date, these problems have been disregarded, and the *s r* treated in a haphazard way; once the physiological mechanism of these reactions is discovered, however, we shall be able to use its benefits without the inherent dangers of disturbances

Here we must face a rather unexpected fact

Mathematics is alone and unique in that it has no content or definite meanings ascribed to the undefined terms, and, therefore, only in mathe-

matics can we avoid the vicious influencing of lower centres through the feeling of false analogies which distort and disorganize the process It is important to notice that the main and only lasting advances in 'philosophy' have been made by mathematicians, and, as a rule, whenever a trained mathematician attempts to work at any other profession not requiring mathematics, he shortly becomes an outstanding worker in the new field It must be obvious that the returning nerve currents, when they produce the 'feel' (language of the lower centres) of physics, or chemistry, or biology, or other sciences with a definite content, must have a most pronounced semantic effect Because of this physical content, identification and other semantic disturbances are usually present, instead of the highly beneficial visualization

Empirically, this is quite obviously true Let us survey the character of this process in physicists and chemists Their problems, the content of their abstractions, are obviously not so closely related to human lives as the problems of biology History shows that the attitude (affective) of those scientists toward human affairs is often shallow, but very seldom vicious or harmful But let us take the attitudes of biologists, whose subject is seemingly much closer, or, at least, more affectively related to our problems, and we see, from Aristotle on, the brutalizing and *unscientific* (1933) effect of the false biological analogies Practically all the vicious, unjustified, and unscientific generalizations which have made the white race the most animalistic, selfish, cruel, hypocritical, and un-sane race on earth are mainly due to the biological, A, distorted reasonings and $s\,r$ produced by false analogy.

In all this 'philosophy', they always reasoned from pigs, cats, and dogs to man Since they were 'scientific', we blindly assumed that they must know what they were talking about Even today, the majority of the older biologists refuse to investigate the structure of their language. They do not seem to be able to realize that most biological 'philosophies' are structurally fallacious and unscientific in 1933 They still unconsciously follow Aristotle They refuse to understand that life is made up of absolute and *unique* individuals, and that 'man' or 'animal' *is not* an object, but labels verbal fictions.

In actual life, the differences between individuals are absolute, and father and son are different These are the empirical facts of their sciences the rest being verbal fictions The notorious Tennessee trial demonstrated that in a large country like the United States of America, with a few good universities, there was no biologist to voice these points about 'evolution' It is true that, through the work of neurologists and some others, biologists, of late, are beginning to see that they cannot

generalize in the way they have done for more than two thousand years Naturally, there are notable exceptions, yet even these do not realize the structural linguistic and semantic issues involved.

I most emphatically do not deny that animal researches are extremely useful and necessary, but I question the right of biologists to remain innocent of the importance of linguistic and semantic issues, and to indulge in vicious, unwarranted generalizations which, although they may express their own metaphysics and *s r*, should not be advanced as 'scientific' results Biologists ought to be informed enough to understand that 'man' and 'animal' are verbal fictions, and labels for something going on inside our skins—not labels for the unique individuals with which they have to deal outside their skins

An example may, perhaps, be useful. We know that rats, prairie dogs, and some other animals are mostly immune to scurvy, but that man, monkeys, and guinea pigs are mostly not immune How can we generalize from a rat to a man *or* a guinea pig? Or how much can we learn about the behaviour of a bee from the behaviour of an oyster, to use the example of Professor Jennings? Even in 'man', what helps one 'man', kills another

Similar false analogies occur in the *A* classification of 'man' as an 'animal' This classification disregards completely the *s r* and twists the generally accepted folk-meaning of the term 'animal' into a special meaning which introduces very vicious semantic implications If we classify 'man' as an 'animal', the structural *A* 'plus' elementalism is automatically introduced, since 'man', obviously, has many characteristics of behaviour not shown by the 'animal', taken in its folk-meaning The disregard of the folk-meaning in our terminology shows clearly the complete disregard for *s r* which are very strongly related to those folk-meanings If we are to call 'man' an 'animal', then 'man' must be an 'animal' 'plus' something If we were to call him some sort of a junior 'god', he would be a 'god' 'minus' something The latter structural fallacy would be just as vicious in its implications, and would again deliver our speculations into the semantic clutches of the structure of a primitive-made *el* language

Similar objections could be raised to that class of 'biological psychologies' exemplified by the 'behaviourists'—(not to be confused with the illuminating and highly constructive biological psychiatry or psychobiology introduced by Professor Adolf Meyer) [9] The 'behaviourists' try to be ultra-'scientific', not realizing that their knowledge of scientific method and structure belongs somewhere to the sixteenth century

Creative mathematicians, after becoming acquainted with the work of their predecessors and contemporaries, achieve their own results, at first, through 'intuition', 'feeling', They 'visualize' the most abstract theories, though sometimes it takes the invention of new means to achieve this result Their lower nervous centres are affected by the higher abstractions made by themselves and others. This process accounts for the fact that no mathematical achievement is ever detached, or possibly can be detached, from life The source of all creative work is always in the lower centres, which are in more direct contact with the world around us, through 'feelings', 'intuitions', 'visualization', and other first order reactions

Mathematics and what is called 'sublimation' in psychiatry have a similar neural mechanism, which is expressed structurally in the spiral theory, or in the cyclic chain of nerve currents, where the end-product of one process becomes the starting point of the next As was said before, this is quite obvious on racial grounds, but more difficult to discover or apply in individual experience, if we disregard structure and *non-el s r.*

If we can, let us discover means by which the 'feel' of modern science can be imparted without falsification and technicalities, which, perhaps, may be only auxiliary means to get the more fundamental life results We may at once anticipate the means which we shall discover. The key problem is to eliminate, first, the semantic disturbance called identification or the confusion of orders of abstractions, and similar disturbances of evaluation This elimination is attained physiologically through the development of the consciousness of abstracting, which leads to proper evaluation, visualization *without* semantic disturbances In other words, we must find means by which higher abstractions can be translated physiologically into lower abstractions, uniquely connected with the translation of the dynamic into the static and vice versa

The present status of the white race—I do not know enough about the structures of languages of other races and their *s r* to speak about them—is such that a majority of our self-imposed difficulties is due to the lack of scientific structural analysis, which lack makes it impossible to control or regulate physiologically and adequately the semantic evaluation through education Under such conditions, everything based on arguments involving the 'is' of identity and the older *el* 'logic' and 'psychology', such as the prevailing doctrines, laws, institutions, systems , cannot possibly be in full accordance with the structure of our nervous system This, in turn, affects the latter and results in the prevailing private and public un-sanity Hence, the unrest, unhappiness, nervous

strain, irritability, lack of wisdom and absence of balance, the instability of our institutions, the wars and revolutions, the increase of 'mental' ills, prostitution, criminality, commercialism as a creed, the inadequate standards of education, the low professional standards of lawyers, priests, politicians, physicians, teachers, parents, and even of scientists —which in the last-named field often lead to dogmatic and antisocial attitudes and lack of creativeness.

This is, naturally, an unsatisfactory semantic state of affairs, and, in consequence, our nervous systems do not function properly, according to the potentialities of proper evaluation inherent in their structure False creeds or doctrines underlying the *s r*, particularly when connected with strong affective tension, play as great a havoc with our responses and capacities on sub-microscopic colloidal levels as any macroscopic organic lesion of our nervous system. If our *s r* are pathological, invariably some affective disturbance, and psycho-neural blockages on the colloidal level, must be present. The nervous currents are then deviated and forced into lower, non-survival-for-man channels, resulting in various forms of arrested development or regressive symptoms Through this we are deprived of the higher (*human*) 'intelligence', which is the result of the optimum working of the nervous system on all levels, we become 'mentally' deficient in various aspects and degrees, and we have to copy animals, primitives, and infants, and so present, in milder disturbances, the pathetic picture—so often seen—of adult infantilism, or display other regressive manifestations Thousands of such cases have been analysed and recorded in psychiatrical literature The mechanism of these disturbances is quite clear, because, after the re education of the *s r*, if this is at all successful, the psycho-neurological colloidal blockage is eliminated, and the patient is relieved from his semantic afflictions.

Instances of infantilism and animalistic reactions are abundant everywhere, but as this problem is analysed further in Part VII, here we shall not pursue the matter further.

It should be noticed, however, in this connection, that sex abnormalities of every description and most sex disturbances are also interconnected with infantilism in adults In public life and activities, the results are equally pathetic. Instead of analysing and foreseeing, we proceed by trial and error, as animals do, a wasteful and painful method The possession of an adequate physiological method for the translation from the appropriate reactions of one level to that of another, therefore, becomes paramount The *non-el* language and the methods of mathematics appear, then, to be of neurological value The terms are easily

and correctly applied to both levels, and thus facilitate passing from the language appropriate to one level to the language appropriate to the other. But, in this case, to avoid confusion, we should have to make clear the multiordinality of terms and to embody recognition of this multiordinality in every, even the most elementary, education, as *any* education shapes and moulds some *s r* This will aid the working of the human nervous system, which, at present, is blocked, sometimes very effectively, by disturbances of evaluation The old *el*, subject-predicate language has a structure dissimilar to the structure of this world as we know it in 1933, and also dissimilar to the structure and function of the human nervous system, and so by necessity, hampers the *s.r* and deviates them from their natural course

That the problems before us are subtle, and that the demarcation line between 'sanity', 'un-sanity', and 'insanity' is extremely thin, is no reason for neglecting this neurological benefit of psychophysiological investigation It seems obvious that the attitude toward our forms of representation, and toward our *s r*, are fundamentally affected by the disturbances of evaluation called identification or confusion of orders of abstractions, and, in particular, by objectification, which ascribe unjustified and delusional values and meanings to these forms

Up to this point, we have been emphasizing the beneficial structural aspect of mathematics, and it is now necessary to explain why mathematizing, when considered as a formal interplay of contentless symbols, should not be considered a high-class 'mental' activity, no matter how useful and important it may be, and why the majority of mathematicians do not get the *full* psycho-logical semantic benefit of their training and activities The nervous systems of many such mathematicians do not act fully and successfully, nor pass normally through the cycle of their natural activities Such a technician is seldom, if ever, what we call a great man He seldom has a direct creative influence on our lives But, in the case of a man with a more efficient nervous system, the cycle is completed successfully, the higher abstractions are translated back into new lower abstractions, which are closer to life Such an individual 'sees', 'visualizes', has 'intuitions' , in his symbolic interplays He then has a new structural vision through a new survey of his own experiences and all the experiences of others when translated in terms of lower centres. He gains a deeper insight, which he ultimately makes useful to all of us

Immediate experience, always un-speakable, is strictly connected with the lower centres In the translation of experience into higher order abstractions and language, the un-speakable character of experi-

ence is lost, and a *new neurological process* is needed to re-translate these higher order abstractions into new lower abstractions, and thus fully and successfully to complete the nervous cycle One can learn to play with symbols according to rules, but such play has little creative value If the translation is made into the language of lower centres—namely, into 'intuitions', 'feelings', 'visualizations' ,—the higher abstractions gain the character of experience, and so creative activity begins Individuals with thoroughly efficient nervous systems become what we call 'geniuses' They create new values by inventions of new methods and in other ways, which give us a new structural means of exploring, and thus of dealing with, the world around us and ourselves, and so, ultimately, human adjustment is helped

It is important for the reader to become thoroughly familiar with the simple division of our nervous processes into terms of order in a cyclic chain Even neurology calls the neurons excited first of 'first order', and the succeeding members of the series, of 'second order', The above considerations have an important practical semantic bearing for all of us, since many of the processes which we are describing can be influenced educationally by simple methods, because the term 'order', when applied, acquires a *physiological* character for *evaluation* The description and verbal analysis of the process is, naturally, complex, but once the physiological base of evaluation is discovered, the training becomes very simple, although not easy

The principal aim of this present work is to make available a simple and practical physiological means for accomplishing what is highly desirable, and, at the same time, for eliminating what is semantically undesirable. We deal with mathematics, because mathematics is *unique,* and, being unique, has no substitute When discussing the theory of meanings, we have shown that all verbalism is, ultimately, similar to mathematics in structure This conclusion contradicts many current theories of language and meanings, and so, at this stage of our argument, we lay special emphasis on the only discipline in which these issues are clear and obvious, namely, mathematics The older theories, based on ignorance of mathematics, have led to serious abuses of our linguistic capacities and to *s r* which are mostly pathological, with the result that practically 99 per cent of us are semantically disturbed and un-sane Many of us, even, are on the verge of more serious 'mental' illnesses

It will be well to give a rough picture of the similarities of, and differences between, the working of the human 'mind' at its worst ('insanity'), and its working at its best (mathematics) We shall find that the average man is between the two, often dangerously close to the

first The following picture is rough and one-sided, but suggestive, and should be worked out more fully

The 'insane' have structural, conscious or unconscious, 'premises', which are 'false', or, in general, semantically inappropriate Their *s r* are shifting when they should be static, or static when they should be flexible In the main, the difficulty of evaluation lies in the lower abstractions and the affective field These abstractions are not properly transmitted or translated or regulated by the higher centres; or else, the higher order static abstractions are projected with too strong affective components on the lower centres Hence, different identifications, delusions, illusions, and hallucinations result Their 'ideas' are evaluated as things or experience, and affectively objectified in different degrees, which results in the above mis-evaluating manifestations These semantic disturbances and tensions make the 'mentally' ill believe irresistibly in the 'truth' of their 'premises' and their inductions and deductions, which they follow blindly In them, as in the rest of us, some internal affective pressure comes first, but because in humans the effect of higher nerve centres cannot be entirely abolished, this affective pressure is rationalized somehow into some sort of 'premises' This organism-as-a-whole process is entirely general and applies to all of us in all our activities, but is most clearly seen in the ordered details in the work of creative scientists and 'geniuses', and in the more severe cases of 'mental' illness To the 'mentally' ill these 'premises' have the value of 'the' and not 'a' premise *They act upon them,* and so cannot adjust themselves to a world different from their fancies They would seldom survive at all if left alone by themselves, particularly in a complex 'civilization'

Mathematicians, also, have structural premises, often called postulates, but they *never* evaluate them to be 'true', wherefore their premises *cannot* be 'false' They have no claims, and claims are always affective Like the 'insane', they follow up these premises blindly, but, being generally conscious of abstracting in the field of their profession, they are not usually subject to semantic disturbances *in this field* and do not live out their theories in life, the theories thus remaining affectively hypothetical If a mathematician were to believe, with strong affective evaluation, that his premises are 'true', these premises then would become mostly false, or meaningless, or, in general, inappropriate If he lived through them, the given individual would then be 'mentally' ill, *not* because of his premises, but because of the semantic disturbance, which would involve erroneous evaluation, identifications, confusion of orders of abstractions in his affective *attitude toward his premises* This subtle organism-as-a-whole mechanism, in which all affective pressure

can be rationalized, and all rationalization can produce affective manifestations, not only makes the present *non-el* analysis possible and legitimate, but also offers some explanation of those remarkable cases of 'mental' illness in a number of mathematical geniuses Under such organism-as-a-whole structural conditions, a *general* consciousness of abstracting not restricted to a special field is the only possible safeguard against the semantic disturbances which lead to an unbalanced 'mental' condition.

As we have seen, the difference between 'sanity' and 'insanity' is subtle The reader must be reminded that it takes a good 'mind' to be 'insane'. Morons, imbeciles, and idiots are 'mentally' deficient, but could not be 'insane'.

The so-called 'sane' also have structural premises, we all have some standards of evaluation These are also usually false, or, in general, inappropriate, being mostly due to our savage inheritance. But the saner we are, the less we abide by them Therefore, in a world quite different structurally from our fancies, we are often able to adjust ourselves for all practical purposes, often avoiding major disasters for a number of years

For instance, the believers in extraordinary blisses in the 'other life' or the 'other world' should welcome death Why be so unhappy here, when, according to their doctrines, there is such an ideally happy future after death? Why make use of medicine and doctors, when a deadly illness should open the door to everlasting bliss! In conflict with such a creed, he lives as long as he can, often most unhappily, and is generally willing to spend fortunes on doctors and medicines to delay the bliss! The genuine and very serious danger to all of us of such creeds is that when the *s r* of an individual are trained in this way he finally does become indifferent, or apathetic toward actualities in *this world,* so that cunning, and often pathological, individuals are thus given an opportunity of directing human affairs toward their personal ends

Naturally, with the increase of the complexities of conditions, the dangers also increase in a geometrical ratio, because when *m o* realities become too unbearable, the masses cease to be influenced by these semantic illusions, and they break all barriers, only to fall again under the influence of new leaders very often equally irresponsible and ignorant

Unfortunately, the failure to understand these semantic issues, based on animalistic lack of foresight, results invariably in a great deal of unnecessary suffering There is little doubt that without these delusions and illusions we should look after the conditions of our actual lives more closely, and many of our pressing needs would be adjusted

The difficulties which we have are mostly man-made, and so only mankind can remedy them, and any attempts to escape from *m o* reality only aggravate the situation

Lack of space does not allow me to dwell here on many other aspects of mathematics which are of neurological structural importance, except to mention the theory of statistics and probability All human knowledge is neurologically due to a process of abstracting in different orders, giving us the only structural knowledge of processes, which, in 1933, must always be considered on three levels, the macroscopic, the microscopic, and the sub-microscopic

Because the nervous system is an abstracting, integrating mechanism, all human psycho-neurological reactions and, particularly, psychological, to be similar in structure, *must* be based on the mathematical theories of statistics and *probability* On the objective level, we deal with absolute individuals, and so all statements, or higher order abstractions, can only be probable Historically, mathematicians have elaborated not only both theories, but Boole, in his *Laws of Thought,* extended the mathematical approach to 'logic' in connection with the theory of probability Finally, the difficulties of the law of excluded third have been solved by Łukasiewicz and Tarski[10] in their 'many-valued logic', which, when N increases indefinitely, merges with the mathematical theory of probability, a result reached independently by a different type of analysis in the present system Any possible future scientific $\bar{A}$, *non-el* 'logic', which I call general semantics, must be built on this structurally more correct foundation It should be noticed that the notions of probability are very flexible, and entirely cover our structural needs, the field of degrees of probability ranging from impossibility to certainty This new semantics involves entirely new affective attitudes, and underlies new and better balanced *s r*

Under such conditions, the restricted 'uncertainty principle' of Heisenberg becomes a structural, most revolutionary, and creative *general principle,* transferring the laws of two-valued 'cause and effect' from the realm of gambling on words by 'philosophers' to the scrutiny of scientists, and establishing ∞-valued 'determinism' on a neuro-mathematical base of 'the greatest probability' Methodologically and psychologically, this requires *full consciousness of abstracting,* achieved, as yet, by extremely few of us, even among physicists and mathematicians Then the 'law' of two-valued 'cause and effect', instead of depending on the *el* and objectified older interpretations, will be based on the mathematical, and much more reliable, ∞-valued principle of greatest proba-

bility This will eliminate to a large extent semantic disturbances, and so the problems of sanity will be greatly helped towards solution

To those who are accustomed to the disclaimers made by many mathematicians of human values in their work, such an analysis as I have given in the present chapter must seem unexpected But, upon reflection, we may see that, after all, it is only a natural evaluation Language is a unique, and, therefore, most important, human characteristic Ought we to wonder that these linguists of exact sciences, whom we call mathematicians, should have produced unknowingly and unwittingly great human values, fundamentally affecting the *s r*? They could not help it Once they worked out their own problems properly—and no one doubts that they did it well—the results were bound to have broad human significance Their activities were kept on the proper levels and so were naturally a help toward sanity In Part VII, I shall discuss another mathematical discovery, known as the 'theory of mathematical types', of Russell, which, when generalized, becomes a *physiological* theory of enormous semantic importance and of fundamental and constant human application

In spite of popular belief, mathematics is the simplest language in existence Our daily language is so very complex in its structure that for many thousand years it evaded analysis Probably, the writer, without the study of mathematics, would not have been able to discover the ultimately extremely simple yet workable principles outlined in the present work.

PART VI

ON THE FOUNDATION OF PSYCHOPHYSIOLOGY

It is an important principle of physiological epistemology that a phenomenon which occurs generally, cannot possibly be the *specific* function of an organ which is peculiar to a few forms only (306) JACQUES LOEB

I have observed, as a consequence of serious and repeated emotional shocks, very curious cases of infantilism in adults, where complete amnesia, accompanying sexual inhibition and disturbances of the affective area, produced the mentality and conduct of a little child (411) HENRI PIÉRON

The organism is reacting as a whole to its environment as a whole, and it is doing so in ways that cannot be formulated in terms of an algebraic sum or simple mechanical resultant of the interplay of the simple reflex responses to external stimulation the mechanisms of traditional reflexology seem hopelessly inadequate. (224) C. JUDSON HERRICK

CHAPTER XX

GENERAL CONSIDERATIONS

> We know also how different extra stimuli inhibit and discoordinate a well-established routine of activity, and how a change in a pre-established order dislocates and renders difficult our movements, activities and the whole routine of life (394) I P PAVLOV
>
> The experiments show that a compound stimulus the component units of which remain themselves unaltered, and consequently most probably affect the same cells of the cerebral cortex, behaves in different modifications as a different stimulus, evoking in these cells now an excitatory process and now an inhibitory one (394) I P PAVLOV
>
> We thus come to the following conclusion when perfectly neutral stimuli fall upon the hemispheres at a time when there prevails a state of inhibition they acquire an inhibitory function of their own, so that when they act subsequently upon any region of the brain which is in a state of excitation they produce inhibition (394) I P PAVLOV

Some of the most important researches in the function of the higher nervous centres have been done lately by Professor Pavlov in his work on the so-called 'conditioned reflexes' This work was developed in a series of papers covering a period of nearly thirty years of experimentation, but the average international scientist did not know this work as an entirety, because the papers were scattered and written mostly in Russian Only in 1927 did the Oxford Press publish Pavlov's *Conditioned Reflexes, an Investigation of the Physiological Activity of the Cerebral Cortex* in the English translation of Doctor G V Anrep, and in 1928 The International Publishers (New York) published Pavlov's *Lectures on Conditioned Reflexes, Twenty-five Years of Objective Study of the Higher Nervous Activity (Behaviour) of Animals* in the translation of Doctor W Horsley Gantt Both translators were collaborators of Professor Pavlov in Leningrad for a number of years In these two books, the latest experiments and interpretations are given

Hitherto, most of the researches on the function of the higher nervous systems were formulated in 'psychological' languages, which, obviously, are not fit for physiological disciplines Professor Pavlov, himself, suggests this fact as an explanation why, until his work, the physiology of the cerebral cortex was so little known There is no doubt that the descriptive physiological language of happenings, functionings , used by him exclusively, is responsible for his results This language suggests structurally new experimentations, which suggestions are lacking in other accounts of the kind where antiquated 'psychological' terms are used

Although I knew as much as the average scientist about the work of Pavlov, this knowledge was not integrated enough to make some

issues clear But, after I had formulated my $\bar{A}$-system, I read the books of Pavlov and found, to my great satisfaction, that a neurological mechanism, the analysis of which underlies my own work, and the existence of which was independently discovered by me on *theoretical* grounds, had been discovered by Professor Pavlov and his co-workers on *experimental* grounds, thus supplying additional experimental verification for my system

It seems that the so-called 'ethics' , in general, sanity, which underlie desirable human characteristics have a definite *physiological* mechanism, automatically involving on psycho-logical levels these desirable semantic attitudes It appears that some of the psycho-logical problems enormously complex and difficult to reach, or even inaccessible, are solved, not by preaching, but by the most simple and elementary *physiological* training, a fact which has been verified empirically Obviously, such simplification, if at all possible, must be of fundamental importance

Physiology deals, in the main, with the functioning of organs in organisms, and results in various formulations Thus, there might be an hypothetical 'physiological theory of most effective feeding', for instance, stating that food should be secured first in one's hand, or spoon, or fork, before putting it in the mouth, A group of people who habitually disregarded the 'physiological theory' and abandoned attempts to act in accordance with it after the first unsuccessful one, would be badly underfed or would simply perish Facts of experience show that some such 'physiological theory' must have been known and applied from time immemorial, and that, perhaps, because of it we survive at all!

How about the 'mental' field? As I demonstrate—and close observation will verify this very generally—the existing theories of 'mental' life, closely related with our linguistic habits, are A, grossly inadequate, and lead to a wholesale production of morons, imbeciles, 'emotionally' disturbed, and, in general, un-sane individuals Investigation shows the possibility of a simple and obvious *physiological* theory of the use of our nervous system, which automatically leads to desirable psycho-logical, semantic states of general sanity.

In the frivolous example of a 'physiological theory of feeding' given above, the problems of *order* were important. In the physiological theory of sanity, order becomes paramount Processes and function involve series of states, by necessity exhibiting order. Adjustment to life-conditions means adjustment of processes, and a physiological theory of sanity must be based structurally on four-dimensional order, where 'space' and 'time' are indivisibly interwoven.

Pavlov shows, in an unusually impressive variety and numbers of experiments, how 'order' and 'delay' (four-dimensional order, in the language used here in this connection) are intimately related with most fundamental processes in the higher nervous centres, and how, by the changes or interplays of them, we can produce or eliminate *pathological states* of the nervous system

In the human field we find a quite similar situation, unanalysable by older methods, because all order involves asymmetrical relations, which, as we have already shown, cannot be dealt with by A means

The issue is clear and definite either we persist in our old A habits of speech, in which case asymmetrical relations and order evade our grasp, and proper evaluation and sanity are *physiologically* impossible, *or* we build a $\bar{A}$-system free, or at least more free, from these evaluational limitations, which allows us to deal with order, and sanity becomes *physiologically possible.*

'Stimuli are never "simple", and, by necessity, involve fourfold space-time structure and order Survival values involve, also, this four-dimensional order For instance, the natural survival order is "senses" first, "mind" next, object first, label next, description first, inference next,. The reversal of the natural order appears pathological and pathogenic and is found as a symptom in practically all forms of "mental" ills, as well as in most human difficulties and disturbances which, at present, are still not considered abnormal. Thus, objectivity is ascribed to words, "mind" projected into "senses", inferences evaluated as descriptions.,—quite common "symptoms" .. Observations on human levels show that we still copy animals in our nervous responses, confuse orders of abstractions (non-existent for the animals), leading fatalistically to the reversal of the natural order and to pathological results, making the great majority of us un-sane '*

A structural *non-el* enquiry into the objective world shows quite clearly that no event is ever 'simple', it is, at least, a limited whole of interrelated factors The eventual 'simplicity' is manufactured by a nervous process of higher and higher abstractions

In our consideration of 'order' and 'delay', and the role they play in connection with the activities of the nervous system, we must first discriminate sharply between the objective level which is *un-speakable,* because anything that can be said *is not* the object, and the verbal level, on which we can, at will, concentrate attention on similarities, or differences, or both Secondly, we must pay special attention to structure—

*From—Discussion by A Korzybski *Proceedings of the First International Congress of Mental Hygiene* New York, 1932

that is to say, search for structure in the empirical world, and, once this has been found, adjust, accordingly, the structure of our language

The structure of the daily, as well as of the 'philosophical', language, which we inherited, in the main, from our primitive ancestors, is such that we have *separate terms* for factors which are not separable, such as 'matter', 'space', 'time', or 'body', 'soul', 'mind',. Then, as it were, we try to make out of the word, flesh, by reversing the natural order and affectively ascribing a delusional *objectivity* to these terms.

If we deal with the silent, un-speakable, objective level and try to divide according to the implications of the verbal division, we find a brutal fact, which, until Einstein and Minkowski, has escaped scientific verbal formulation, that this cannot be done at all On the objective level every dealing with 'matter' involves 'space' and 'time'; any dealing with 'space' involves some fulness of something and 'time'; and every dealing with 'time' involves 'something' and 'space'

The structure of the world happens to be such that empirically 'matter', 'space', 'time', cannot be divided, wherefore, we should have a *non-el* language of *similar structure* This was accomplished by Einstein-Minkowksi, when they created a language of 'space-time', in which the hard lumps against which we bump our noses are connected analytically with the curvature of space-time

In this new, *non-el,* four-dimensional language, every three-dimensional point of 'space' has a date, and so is different For our purpose, we do not need, at present, to bother much about its curvature or the kinks in space-time, called in the old way 'matter', but we must emphasize that the fourfold order is of great importance, as it corresponds structurally to *experience,* and is intimately connected with physiological reactions, the semantic included

There is a great deal of confusion about these problems among laymen and also among scientists From a structural point of view, the issues are quite simple, and there is nothing sensational in the latest announcement of Einstein that 'space' in its importance is displacing 'matter' (*Nottingham Lectures*) Naturally, the statement *in this form* is rather baffling and attracted much—even newspaper—attention Yet it seems that even the einsteinists do not fully realize the *verbal, structural,* and semantic issues involved

For the layman, as well as for the majority of the physicists in their less sober, or metaphysical, moments, 'space' is 'emotionally' newtonian and an 'absolute void', which, of course, being 'absolute nothingness', cannot have *objective* existence, by definition For Einstein, 'space-time' is, semantically, 'fulness', not 'emptiness', and, in *his language,* he does

not need any term like 'ether', as his 'plenum', structurally, covers the ground, without his committing himself to a definite two-valued mechanistic ether. The confusion of orders of abstractions, from which we all suffer, is semantic, and is due to disregard of the structure and role of language If we accept a *non-el* language of space-time, structurally we deal with fulness, and we should not use the term 'space', as its old semantic implications are 'emptiness' and so are very confusing The 'sensation' of Einstein's declaration amounts to the fact that the submicroscopic fulness ('space') is more important than a few kinks or concentrations of that fulness ('matter'),—a fact which science has established, and which is quite obvious

Experiments with 'conditioned reflexes' have established firmly the fact that stimuli can be compounded, and that, when established, the compound stimulus acts as a unit, and that a change in the four-dimensional order of factors (including delays) acts as a *different* stimulus, not necessarily resulting in the established reflex This often introduces great complexities

As an example of this, we will use the so-called 'delayed reflex' When established, the 'conditioned reflex' does not appear at once after the stimulation, but after the stimulation combined with the usual 'time'-delay has occurred, thus showing that the 'time' factor plays a physiological role in a compound stimulus. Organisms live in, and consist of, periodic processes, such as the alternation of day and night, sleep, taking in food, heart-beats, breathing, electronic pulsations , so that *any* stimulus, no matter how nominally 'simple', is, in reality, a compound stimulus of, let us say, x and y heart-beats and what not An organism represents, invariably, a clock of some sort, and, when that clock stops, life ceases

Under such actual structural conditions a four-dimensional analysis makes every 'simple' stimulus compound, and thus four-dimensional *order* becomes a potent *physiological* factor, exerting definite effects The interplay of four-dimensional order of factors represents, in general, a new stimulus , we have an interplay of positive and negative excitations which may lead to clashes between the two that the nervous system finds difficult to resolve, and so pathological results follow

If we pass to sub-microscopic levels and processes, we find that, although we may speak of them as 'chemical' or 'stimuli of greater physiological strength' , yet, by structural necessity, they represent different kinds of *multi-dimensional* order, because, as we say in 1933, the dynamic physical unit of that order is a quantum of action The metaphysician should not get excited about this statement, because whatever

he might say will also be a verbal statement of a given date, made mostly without any structural considerations, and based mostly upon the reversed survival order, confusion of orders of abstractions and other semantic disturbances. As the world, both outside and inside our skins, is invariably found to exhibit a fourfold space-time order, it is inevitable that this order should be structurally impressed on the nervous system, establishing a natural survival order Therefore, changes in this order on the macroscopic level, the level of outward events, must have direct inward sub-microscopic effects, disturbing or restoring the nervous equilibrium This statement may appear innocent, it is not, it has a vital human significance, as it involves standards of evaluation In short, it means that, in the *actual application* of the consideration of order in education and training on the daily-life levels, we can affect the evasive (as yet) microscopic and sub-microscopic structural levels of the human nervous system, thus directly affecting our *s r* and behaviour

To make this clearer, let us recall some of the neurological researches of Bolton (as quoted by Herrick) The cortex has different layers, characterized by the difference in the number, size, shape, internal structure, and density of neural cells Bolton's third layer of granules divides the cortex into two types of layers Those closer to the base of the brain, or below the third, are called the infragranular, those above, the supragranular, layers.

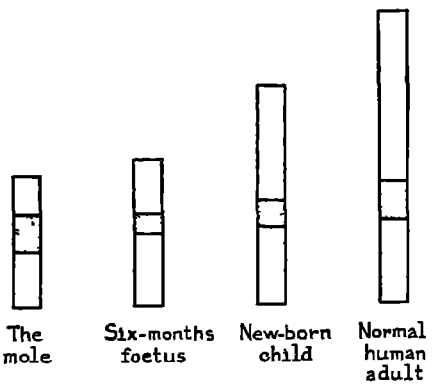


FIG 1

Diagrams of the relative thickness of the supragranular, granular, and infragranular cerebral cortex in the six-months foetus, the new-born child, the normal human adult, and the adult mole The granular layer is dotted (Redrawn from G A Watson (1907), and adopted from Herrick[2])

The lower mammals show a well-developed infragranular cortex, and a very poorly organized supragranular cortex, the latter increasing in relative size and complexity as we ascend the animal series On the human level, we find a most important, and usually disregarded, fact—that the human nervous system is not completed at birth, but develops structurally years after birth

The above explains why animalistic theories and methods, primitive-made languages of wrong structure, and similar relics, result in training the *s r* of our children in the patho-

logical order, and bring about such great harm, individually and collectively It enables us to understand, also, why all forms of 'mental' ills invariably exhibit infantile characteristics of some sort

If we train a child with a physically undeveloped nervous system in animalistic doctrines strictly connected with a primitive-made language of wrong structure, in the pathological reversed order of responses, such semantic training must affect harmfully the still developing nervous system So, when we say, and demonstrate, that we still copy animals in our nervous responses, we imply an undeveloped or thwarted nervous system, of which the development has been arrested or made regressive Such a deficiency, of course, is superimposed functionally, and so structurally, upon whatever congenital deficiency there might have been in a given case We are nearly all in a situation of this kind We continue to be educated under animalistic conditions since we became time-binders, which, from a biological point of view, is a very recent event, and it is not rash to assume that our nervous system is still not fully developed, the more so that we submit the cortex, which in childhood is still incomplete, to injurious semantic influences Obviously, such a fundamental human function as language, when used in a way not in correspondence with the structure of the nervous system, must act detrimentally on its development

In congenital extreme imbecility, the cortex is poorly organized, thin, and deficient in nerve cells, and the infragranular layers show less impairment than the supragranular layers It seems that Bolton's second supragranular layer is the last to mature, and its relative development corresponds to the relative development of an animal or human being, and, in a way, it goes parallel with the so-called 'intelligence'

In human defectives, its deficiency corresponds with the degree of psycho-logical arrest, regression, or deterioration Let us recall that these 'mental' deficiencies, which, in behaviour as well as in nervous structure, take us one step (or several) back toward the level of the infant, or even to that of the animal, are always connected with infantile behaviour in adults, and semantic disturbances

Nervous as well as muscular tissues have differentiated from the general protoplasm, and we know positively that, through training, we can enlarge or otherwise improve muscular tissues, and there is no reason to doubt that something similar can be done to nervous tissue All education, and the establishing of any conditional or *s r*, shows this, although in a rather vague way

If, by a *physiological* training based on order, we can alter a nervous deficiency, as shown by behaviour, we may conclude that there are physio-

logical means by which we can effectively train and help the development of nervous cells and supragranular layers—or, at least, *not hinder* their natural development On the macroscopic levels, this beneficial training consists in forming habits of proper evaluation through the natural survival order The effect of this on the sub-microscopic level is neural, colloidal, and structural, a result which, by the older methods, could not be reached, either with ease or with effectiveness

Although these conclusions are necessary, it is impossible directly to verify them empirically, because we should have to dissect the brain of a given person before, and during, the training In this case, as in many others, we have to observe 'human nature' and semantic responses to stimuli of a given individual before and after the training, and, on the foundation of what we know of the development of the nervous system in animals, infants, 'mentally' defective and well-developed adults, build our eventual conclusion as preliminary hypotheses for further structural testing, improvement, and empirical verification

To realize fully the importance and necessity of this conclusion, we must first understand that, in accordance with the modern discoveries of mathematics, physics, chemistry, colloidal chemistry, and other branches of science, all 'function' depends on *structure,* because the unit-brick of structure represents a dynamic unit of a quantum of action In the remarks which follow, it is impossible to be as full and precise as I should like to be, because to be able to do so would be equivalent to being able to solve all scientific problems, yet the reader should realize that the considerations of structure will become extremely creative and helpful as long as we recognize a quantum of action, or any other *dynamic unit*

We may recall that the characteristics of molecules are due to atomic structure, and that the characteristics of atoms are due to electronic structure The latest quantum theories also seem to find that the characteristics of electrons are an outgrowth of structure, and, if the suggestions of Dirac are verified, even the difference between positive and negative electricity is structural Even at present it appears that 'structure' is not only a term fit to handle and explain, but that it has an objective counterpart, allowing a similarity of structure, and, therefore, making the understanding of this world possible

This last very important semantic point is based on the fact that relations of similar structure have similar 'logical' characteristics, and that, therefore, in structure we find means by which the events can always be made intelligible to us, and so properly evaluated

Experience—my own, as well as that drawn from scientific literature—impresses me with the fact that we very seldom realize that our

'knowledge' (or, roughly, what we can *say*) *is not 'it'*, as the 'it' is always un-speakable

Between two houses or two stones, there is some sort of sub-microscopic interaction, but on the macroscopic level, nothing definite happens So we say that in the given context or configuration, the units under consideration are too heavy (implying gravitational structure), or the medium, the plenum in which they are immersed, is too light (again structural implications) and so, macroscopically, nothing obvious happens

If that structure is changed, different conditions, different relations and results prevail Thus, if the particles are very small, and the media not too heavy, the surface phenomena, electrical charges , begin to play an important role We then have colloidal behaviour of enormous complexity and variability where we find, not necessarily life, but many inorganic forms, duplicating some forms found in life Obviously, colloidal structure accounts for that [2]

When little colloidal wholes, most probably of specialized internal structure, arise, we may have not only colloids, but also little wholes, separated by a membrane, or perhaps by surface phenomena, which represent a most generalized membrane We may have a new structural fact, an interplay of the inside with the outside, and life begins.

The general irritability and conductivity of protoplasm is known to be strictly connected with permeability to the passage of ions and, therefore, is a structural phenomenon On this structural foundation, physiological gradients result, forming a dynamic field of forces, again involving structure The development of the differentiated tissue of muscles and nerves consists of higher order complex structures, based on more primitive structures, and, finally, function and behaviour of all life, man included, is due to sub-microscopic, microscopic, and macroscopic structure.

I may be reproached by specialists that, although what I have just said may possibly be true, yet, actually, to make these assertions is, perhaps, premature, in 1933, because we lack too many details

My answer is sharp and definite, and may be considered a serious scientific suggestion, because it can be made legitimately in this form:

1) All science depends on human 'knowledge'

2) All human 'knowledge' is structurally circular and self-reflexive, and so depends on some conscious or unconscious theory of knowledge and undefined terms

3) Words are *not* the things we speak about, and, therefore,

4) The only possible connection between the objective and unspeakable levels and words is *structural*, introducing

5) Structural analysis of languages as fundamental, making

6) The *only possible content of 'knowledge' structural,* and

7) All science becomes a search for the unknown structure of the empirical world on all levels, and the matching of this unknown structure with the *potentially known* structure of languages, so that

8) All knowledge is hypothetical, in which

9) The most important facts must be *negative* When the structures do not match, then we learn something quite definite about the empirical structures

10) All predictability becomes possible because of similarity of structure, and so definitely making

11) All possible aims and quests of science uniquely structural, necessitating

12) Unique methods of translation of dynamic into static, and vice versa, in order to cover the structural exigency of both the dynamic world and the static languages

13) Such unique methods of translation are given in the differential calculus and four-dimensional geometries, in which

14) What in a four-dimensional language is structure becomes in three-dimensional language 'importing time' function, showing once more that

15) Structural considerations are not only a modern necessity, but also the most creative and helpful for the future development of science and man, and justifying the above assertions, with the setback that

16) Full 1933 structural analysis, being one of the, or perhaps *the,* highest abstraction of this date, the mastering of that language may represent some difficulties

The reader must be reminded (see, for details, Part VII) that the terms 'structure', 'function', are multiordinal terms with many meanings, and so that they have no general meaning apart from context, but have definite meaning in each context Without this realization of the multi-ordinality of terms, the statement above could not be made, for it is a structural statement about languages

As an example of the immense and inherent importance of considerations of four-dimensional order, the following psychological experiment for which Doctor Harry Helson has suggested lately the name of Tau effect, is useful [3]

If we stimulate three spots of the skin by touching them lightly with the end of a pencil in quick succession, and if the distance between the first and the second spots is say, 20 mm, and that between the second and the third is 10 mm, but the 'time' interval between the second and

the third stimulations is twice as long as that between the first and the second, the distance between the second and the third spots will be judged as nearly twice as great as that between the first and second Similar results are obtained with other analysers, such as vision and hearing If we change the conditions of the experiment, the results may be reversed It is interesting to note that the effect does not depend on 'knowing', as similar results happen when the subject knows the conditions of the experiment The last shows that the experiment deals with a physiological and neurological mechanism In general terms, if we vary the time-interval in the opposite sense from the space-interval, the latter will be distorted, showing once more the structural fact that in actual life and experience we deal *exclusively* with the four-dimensional space-time order, which, as such, must have physiological and neurological significance, and an adapting mechanism

CHAPTER XXI

ON CONDITIONAL REFLEXES

> The conditioned reflex is conventionally regarded as differing essentially from the unconditioned reflex, but this is contradicted by evidence drawn from the development of behavior (107) G E. COGHILL

The main experiments of Pavlov were made on dogs, animals with a rather well-developed nervous system, and so most of what he has to say is about dogs, although some general physiological facts apply to all the higher nervous systems, man included In some instances, because of human complexities, some results must be re-interpreted. structural linguistic re-adjustments made, and some obscuring, wrong-in-structure, *el* 'psychological' terms analysed and rejected My linguistic, structural, *non-el, theoretical* revision leads to a new and important enlargement of the application to man of the Pavlov *experimental* theory of 'conditioned' reflexes The fact that these independent discoveries reinforce and support each other is a striking instance of the usefulness of theoretical researches

We must take care to notice and beware of the differences in languages Any happening has as many aspects as there are sciences, or even human interests Thus, if we speak about an objective 'pencil, we may speak about its chemistry, or methods of manufacturing, its uses, prices, markets,. As the content of knowledge is structural, we must search empirically for structure, understood nowadays always on three levels (the term being multiordinal), the macroscopic gross structure the microscopic, and sub-microscopic structures

When we deal with life phenomena, we have also different languages dealing with their different aspects Thus, a biological language would cover eventually the vital events in general, a physiological language would be narrower and cover the analysis of phenomena in an organism, the function of its organs and the conditions and the mechanism which determine these functions, a neurological language would be physiological as applied only to the nervous system The day is not distant when all these problems will be formulated in the language of the quantum mechanics.

A psycho-logical language is legitimate only on human levels, as we never know, or can know, what an animal 'thinks', 'feels'., and on human levels it applies to so-called 'psychic' phenomena only

Usually, one extremely fundamental semantic fact is disregarded, namely, that what on the psycho-logical level is *objective* and in language *descriptive* to one person (e g , 'my toothache'), is *inferential* to the other

person, and vice versa The lack of consciousness of abstracting introduces, by structural necessity, an identification of orders of abstractions, namely, the confusion of descriptions with inferences, and vice versa This makes it imperative to avoid psycho-logical language as much as possible It is also bad epistemology to use a language which applies to a few individuals (psycho-logics) for describing functions which are much more general, and which, fundamentally, apply to all organisms

It is a striking fact that, although physiology is a fairly old and well-developed discipline, yet the purely physiological approach to the study of the brain-functions is very recent, and, in the main, has been carried on by Pavlov and his followers Pavlov gives us a simple yet profoundly true explanation, namely, that the higher nervous centres have never been treated on equal footing with other organs, or other parts of the nervous system The activities of the hemispheres have been treated from a 'psychological' point of view, and, by analogy, we have ascribed to animals similar 'psychological' states, a remnant of primitive animism As such attitudes have become more and more obviously absurd, we have drifted into the opposite absurdity of animalism, ascribing animal characteristics to man, forgetting that the human nervous system is far more complex, matures later than in any animal, and is a non-additive affair Naturally, reasoning by such analogies must be fallacious

The prevalent complete disregard of the fact that these issues are linguistic and structural makes the advances in these fields very slow and halting, and only so-called 'geniuses' are capable of breaking through these semantic barriers Once the linguistic character of the issues is fully realized, the psycho-logical, semantic blockage is removed, freedom of analysis is inwardly established, and even 'non-geniuses' will produce important creative work Indeed, we may find that with this realization, particularly if embodied in early education, the 'normal' man would be, what we call at present, a 'genius'.

This conclusion naturally follows if we abandon animalistic analogies and face the fact that high-grade human intelligence happens to be not less 'natural' and inherent in the history of evolution than any other 'tropism'. By eliminating the psycho-logical semantic blockage due to copying animals in our nervous reactions, we may handle this important *human function* of language properly Man will function as *man*, in accordance with the structure of his more complex nervous system There is no doubt at present that some organisms called 'man' have an important function connected with *s r* called 'speech', perhaps the most complex and involved and also *unique* function evolved by this class of life, and which it does not yet know how to use. Biologically and physio-

logically, this misuse of a function must be a *non-survival tendency* for *this* class of life

Sanity must be based on methods for the most efficient use of the human nervous system, in accordance with its structure, and will thus bring about the full working of human capacities, which at present are still semantically blocked by faulty handling of the apparatus.

Before going further, I will analyse and suggest the complete elimination from the English language of the term 'conditioned' reflex, which is structurally false to facts, and suggest in its place the uniform use of the term 'conditional' reflex, introduced by Pavlov and used occasionally by some English writers I will also suggest the elimination of a *psychological* term, 'inhibition', from physiology and neurology, in which it should have no place at all. Such a change in language leads to new results, and also suggests new experiments It is little known and seldom taken into consideration that long ago Locke was quite clear on the point that the misuse of language has often been taken for deep mysteries of science, but Locke, unfortunately, did not take into consideration *structure*, and *s r*, so his arguments were, in general, non-operative.

As everything in this actual world is structurally interrelated with everything else, we should consciously look for interrelations, in which case we have to build special languages for the eventual synthesis As we must first ascertain empirical structure, and only then coin the languages, obviously to start with a descriptive, impersonal, non-'psychological' language of ordered events on a given level is most important

In our case, we are investigating the structural and semantic problems in connection with language We have to accept the structural facts as discovered by physicists, physiologists, neurologists, and other scientists, and then build a language similar in structure to the empirical world The language in which the present theory is formulated is a physiological and neurological one, as it deals with observed impersonal functionings of the organisms called 'man' When we reach results in a physiological language, these have, naturally on the human level, a psychological aspect, and perhaps the main importance, and even value, of the present work is that it reaches the very difficult psycho-logical, semantic level by purely functional and easily controlled physiological methods

Thus the reader must translate for himself, as nobody else can do it for him, the physiological results into his psycho-logical feelings and attitudes and evoke the un-speakable *s r* These must be *evoked* by the reader, otherwise he will inevitably miss the point For instance, if it is said that 'the objective level is un-speakable', the reader should try to become entirely 'emotionally' impassive, outwardly and *inwardly* silent

about an object, or a feeling, as whatever we may say *is not 'it'*. This, obviously, involves a complete checking of affective responses, 'preconceived ideas', making him an 'impartial observer'. In fact, to do this successfully is something very difficult to achieve, requiring long semantic training with the Structural Differential, and usually involving a complete reversal of our habitual modes of affective responses.

Similarly, when we speak of 'natural order' or reversal of this order, let the reader try actually to evoke these *s r*, and he will find it is not so easy, as it involves a completely new process of re-evaluation In both cases, we can gain physiological, easily operating means to re-educate the very stubborn semantic responses, by *functional and ordinal methods* The difficulties are only serious with grown-ups, they present no difficulties in the early semantic training of infants, for whom this training becomes a powerful preventive method against future nervous disturbances (limited, of course, to this aspect of un-sanity)

Directly such a semantic re-education is accomplished, the formerly impossible is also performed, and 'human nature' has been changed Obviously, the trouble has not been with 'human nature', but with the lack of physiological and educational means to affect the psycho-logical level and to change the *s r* The above applies to the so-called 'normal' man, as well as to the 'mentally' ill It works with both types, provided the latter is in a condition to be at all accessible to approach

The term 'nervous reflex' was originated by the mathematician Descartes Structurally, it was a genuinely scientific notion It implies necessity, namely, that a stimulus results in a response Obviously, if such were not the case, an animal would not be in sufficient correspondence with its environment and could not survive Thus an animal must be attracted and not repelled by food, it must avoid fire and so forth [1] The term 'reflex' is usually used in connection with *A* two-valued implications, this makes reflexology *el* and generally inadequate to account for organic *non-el* responses in the colloidal sense In a $\bar{A}$-system based on the ∞-valued semantics of probability, I prefer to avoid the two-valued implication and use the term reaction instead

The main function of the nervous system is the co-ordination of all activities of the organism for its preservation Thus there must be no conflict between the opposing activities of different parts of the organism, and any action must ultimately benefit the whole There may be a conflict of different excitations, but one must finally dominate the others, as otherwise co-ordination would be impossible

If food or some noxious material is put into the mouth of a dog, a secretion of saliva is produced, either to alter the food chemically and

help digestion, or to wash the mouth out and eliminate it. But observation shows further that other factors, not food or noxious materials alone, may produce similar secretions Thus, for instance, the sight or smell of some such material, or of the person who usually administers it, or even the latter's footsteps may produce salivary secretions

To make the experiments as exact as possible, the dogs observed by Pavlov were submitted to minor operations Among others, the opening of the salivary duct was transplanted to the outside of the skin, so that all secretions could be carefully and exactly collected and measured

The principle which underlies these experiments is the observation that if we combine some hitherto neutral stimulus, such as a definite tone, colour, or shape, with the presenting of the food or acid, after a few trials this neutral stimulus acquires the potentiality of producing similar secretory effects as the food or acid itself

This fundamental and exact method of experimentation allows considerable freedom in the selection of neutral stimuli, affecting, as we prefer, the visual, or auditory, or tactile, or other nerve centres of the animal We can also control their numbers, intensity, their combinations, the *order* and *delays* in their application,

If food or noxious materials are placed in the mouth, the secretion of saliva is an almost automatic reaction, owing to the physico-chemical action of these materials Such reaction is inborn and practically general for a given species, the nervous paths for such reactions being mostly completed at birth Not so with the reactions produced by neutral stimuli, which acquire the secretory characteristics only after some experiences. These characteristics are reactions acquired during individual life, and the nervous paths and connections have to be completed during the lifetime of the individual

Thus when puppies are shown meat or bread, which they had never eaten before, usually no salivary secretion appears Only after eating meat and bread on several occasions will the sight of them produce secretions

Some of the effects of these acquired reactions are very strong and lasting In some experiments, the dogs were given a hypodermic injection of morphine The usual effect of the drug is to produce nausea with profuse secretion of saliva, followed by vomiting and deep sleep In further experimenting, it was found that the preliminaries, or even seeing the experimenter, without injection, was often enough to produce the effects of the actual injection of the drug

Pavlov studied the nervous mechanism of the functioning of the salivary glands, not because of any special physiological importance of

these glands, but because such experimenting was the simplest, and the method used allowed him to conduct the most varied experiments under accurate control

The experiments disclosed an amazingly subtle and complex nervous mechanism, probably typical for the functioning of other glands of internal secretions These findings, when translated into a language applicable to the human level, disclose a great deal about the nervous mechanism underlying so-called 'associations' and other 'mental', relational, or psycho-logical semantic manifestations. Usually, the salivary glands are not supposed to be as closely connected with psycho-logical manifestations as the thyroid, the adrenals, and other glands are known to be It is, therefore, a new and very important general discovery of Pavlov that the salivary glands have such intricate and far-reaching nervous interconnections

The example of the dog reacting to the 'associations' (relations) of the experiment with morphine in a similar way as to the actual injection of the drug, is a close parallel to the example already given, of the patient who reproduced symptoms of hay fever at the *sight of paper roses*. In this case, the 'associations' were also uncritical, compulsory, almost automatic, of the type found in the animals In fact, this statement is very nearly general, and we shall find later that most of 'mental' ills follow neurologically the patterns of animal responses, and so become pathological for man This observation has very far-reaching consequences, to be explained later, but we want to emphasize it from the beginning, and to stress the fact that copying animals in our nervous reactions must be detrimental to humans.

The above narrows our problem considerably. we have to discover only the main differences between the nervous responses of animals and humans, and draw our conclusions

The alimentary reactions to food and the mild defense-reaction to noxious materials may be roughly divided into two components, the secretory and the motor It was found possible to link another neutral stimulus to an already acquired reaction. Thus, if a dog was trained to respond to a bell, which was a signal for food, he could be trained, further, to link a formerly neutral stimulus, let us say, the sound of a buzzer, with the bell, and the bell with food Such a secondary acquired reaction may be called of the *second order* Naturally, it is very instructive to find out if these responses could be extended to more orders Experiments disclosed the important fact that, as far as dogs and *alimentary* reactions are concerned, it was impossible to go beyond the second order. However, when *defense* reactions were tested, it was found that

it was possible to establish acquired reactions of the *third order.* But it was impossible to go beyond the third order, even in these cases.

In our field, where we have to formulate sharp differences between the nervous responses of 'man' and 'animal', we say that animals stop abstracting or linking of signals on some level, while humans do not The latter abstract in indefinitely higher orders—at least potentially.

Here we encounter a fundamental and sharp far-reaching difference between the nervous functioning of 'animal' and 'man'. This abstracting in indefinitely higher orders no doubt conditions the mechanism of what we call human 'mentality' If we stop this abstracting anywhere, and rest content with it, we copy animals in our nervous processes, involving animalistic *s r* As will be shown later, this is the actual case with practically all of us, owing to our *A* education and theories. This 'copying animals' in our nervous responses is, perhaps, a natural tendency at an extremely low level of development; but as soon as we understand the physiological mechanism, we can correct our education, with corresponding human semantic results Naturally, such 'copying animals' by humans must be a process of arrested development or regression It must be pathological for man, no matter how severe or how mild the affliction may be Various absolutists, and the 'mentally' ill in general, show this semantic mechanism clearly

The reactions can be divided into two groups, those which are *inborn,* almost automatic, almost unconditional, rather few and simple, belonging to the so-called 'species', and those which are *acquired* during individual life, allow a great variety of complications, are *conditional in different degrees,* and are acquired by the individual Pavlov suggests different terminologies, for instance, he calls the one 'inborn', the other 'acquired', or as usually incorrectly translated into English as 'unconditioned' and 'conditioned' respectively The two last terms have received a scientific general acceptance, yet I would suggest that in the English incorrect translation they are *structurally unsatisfactory,* and that particularly, when applied to humans, they carry harmful implications. Structurally, 'inborn' and 'acquired' are entirely satisfactory. Terms like 'conditional' and 'unconditional' (in the original language of Pavlov), although less satisfactory, are more appropriate, as they do not imply some sort of 'cause-lessness' In fact, the 'unconditioned' salivary reactions *are conditioned* and produced by the physico-chemical effect of the food, and so to call them 'unconditioned' is structurally erroneous The terms 'conditional' and 'unconditional' do not have similar implications, and carry others, as, for instance, the possibility of very important

degrees of conditionality, establishing the ∞-valued character of the reactions; conditional meaning non-absolute, and non-one-valued

For these structural reasons, I shall use the terms 'inborn' and 'acquired' or else 'unconditional' and 'conditional' reactions

Under natural conditions, an animal, to survive, must respond not only to normal stimuli, which bring immediate harm or benefit, but also to different physical and chemical stimuli, in themselves neutral, such as waves of sound or light , which are *signals* for animals and *symbols* for man The number of inborn reactions is comparatively small, and, alone, they are not sufficient for the survival of higher animals in their more complex environment. Experiments have made this point quite obvious A completely decorticated animal may retain his inborn reactions and become a kind of automatic mechanism, but all his subtler means of adjustment, owing to acquired reactions, disappear, and if unaided he can not survive Thus, a decorticated dog will only eat when food is introduced into his mouth, and would otherwise die of starvation though food be placed all around him

Experimental evidence seems to show that all higher activities of the nervous system, the whole signalizing apparatus, which underlies the formation and maintenance of the acquired conditional reactions, depend on the integrity of the cortex Stimuli which produce conditional reactions are acting as signals of benefit or danger These signals are sometimes nominally 'simple', sometimes very complex, and the structure of the nervous system is such that it can abstract, analyse, and synthetize the factors of importance for the organism, and integrate them into excitatory complexes The analysing and synthetizing functions, as usual, overlap, and cannot be sharply divided, both functions being only aspects of the manifestation of the activity of the nervous system as-a-whole In general, one of the most important functions of the cerebral cortex is that of reacting to innumerable stimuli of variable significance, which act as signals in animals and symbols in humans, and give means of very subtle adjustment of the organism to the environment. In psycho-logical terms, we speak of 'associations', 'selection', 'intelligence' , in mathematical terms, of relations, structure, order., in psychophysiological terms of semantic reactions

The language of reactions is of special interest because its structure is similar to the structure of protoplasm in general and the nervous system in particular This language can be expanded and supplemented by the following further structural observations

1) That reactions in animals and humans exhibit ***different degrees of conditionality;***

2) That the signals and symbols may have *different orders,* indicating superimposition of stimuli,

3) That animals cannot extend their responses to signals of higher order indefinitely;

4) That humans can extend their semantic responses to higher order symbols indefinitely, and, in fact, have done so through language which is always connected with *some* response, be it only repression or some other neurotic or psychotic manifestations

The above extension is structurally fundamental, because we can extend the vocabulary of conditional reactions to humans in all their functions Without it, we find ourselves saddled with a vocabulary which does not correspond in structure to the well-known elementary facts concerning *human* responses to stimuli, and we relapse into the old 'behaviourism', which is structurally insufficient.

The present system is based on such observations and extensions It was reached independently from structural and physico-mathematical considerations With this structural verbal extension, we can easily be convinced that everything that we call 'education', 'habits', 'learning' , on all levels is building up acquired or conditional and *s r* of *different orders,* as one of the differences between 'man' and 'animal' consists in the fact that humans can extend their symbolism and responses to indefinitely high orders, while with animals this power of abstracting and response *stops somewhere* We establish here a sharp distinction between the high abstractions 'man' and 'animal', and so build up a psychophysiological and structurally satisfactory language.

It is obvious that the fundamental means which man possesses of extending his orders of abstractions indefinitely is conditioned, and consists in general in symbolism and, in particular, in *speech.* Words, considered as symbols for humans, provide us with endlessly flexible conditional semantic stimuli, which are just as 'real' and effective for man as any other powerful stimulus

Take, for instance, the example of the World War! Would the men in the trenches have endured all the horrors they had to live through if it had not been for words, and, neurologically speaking, because of the conditional *s r* connected with words?

'If any question why we died,
Tell them, because our fathers lied'

said the poet truly, and experience shows it is not limited to the trenches [2]

In interpreting the experiments on animals as applied to humans, it should be remembered that some of the experiments of Pavlov, *as they stand,* would be, at the least, *neurotic* for man. The reason for this is

that the higher abstractions of man, which are due to the more developed complexities of his nervous system, would often make such simple experiments impossible Once a conditional reaction is established with an animal, no amount of any sort of 'intellectual' persuasion, or the like, would disturb his glandular secretions, as the animal's range of 'meanings' is very limited These secretions can be diminished or even abolished by other means, but not by 'intellectual' means alone In the 'normal' man, his 'knowing' that the sound of the metronome or bell is part of an experiment and not a signal for actual food, would, *or should,* alter his nervous reactions and glandular secretions and make the experiments much more complex The conditional reactions of the animals have still the *element of unconditionality* In man, they may become *fully conditional* and depend on a much larger number of semantic factors called 'mental', 'psychic' , than we find in any animal

On the human level, outside of the experiments with the salivary glands, we have in the psychogalvanic reaction a most subtle semantic means of experimenting with the effect of words as connected with some secretions, probably at least the sweat glands. Humans react to different events or words by minute electrical currents (among others) which can be registered by a very sensitive galvanometer and the curves photographed It is interesting to notice that so-called 'self-consciousness' disturbs the success of the experiments, or makes them impossible, *at least with some individuals* It should be remembered that general statements are invalidated if there are any exceptions.

In experiments, we are usually interested in their success When analysing the ∞-valued *degrees of conditionality,* we are equally interested in their failures, which suggest a far-reaching revision of the *interpretation* of our experimental data in this field Although some writers say that the reactions registered are 'beyond control' (unconditional), this statement, in general, is not correct, and should be amended to '*often* beyond control' (conditional of different degrees) It is impossible to go into details here, as the problems are extremely complex In addition to this, the testing of *degrees of conditionality* presents an extremely wide *new semantic field* for experimentation which has not yet been attempted It should be noted, however, in passing, that in these experiments different types of 'mentally' ill, as well as the 'healthy' persons, exhibit different types of curves [3]

When psycho-logical events or $s\,r$ are interpreted, the difficulties become particularly acute Thus, we seldom discriminate between the average and the 'normal' person In the *animal world,* under natural conditions—by which is meant entirely without human interference—

the survival conditions are *two-valued* and very sharp The animals survive or they die out Because of this, it could be said, with regard to the animal world, with some sort of plausibility, that the average, with a long list of specifications, could be considered the 'normal' animal We usually enlarge this notion to humans and land in fallacies, particularly in so-called 'psychological' problems, which admittedly are very difficult

In general medical science, such mistakes are made more seldom No physician, studying a colony of lepers or syphilitics, could conclude that a 'normal' man should be a leper or a syphilitic. He would say that probably, in a given colony, the average person is afflicted with such and such a disease, and he would keep as his medical standard for desirable health, a 'normal' man, that is to say, one free from this disease

It is true that in the example given above, outside of such rare colonies, we have a majority which, in respect to the given disease, are healthy, so we are empirically forewarned against fallacies, although existing theories of knowledge do not forewarn us But the main point remains true, namely, that in human life the average 1933 does *not* mean 'normal', and the standard for 'normal' will have to be established *exclusively* by scientific research In our present work, we show that the average person copies animals in his psycho-logical and nervous processes, exhibits the unconditionality of nervous responses, confuses orders of abstractions, reverses the natural order , semantic symptoms of similar *structure* as found in obviously 'mentally' ill Therefore, the average person 1933 *must be considered pathological* If we take the animalistic average for 'normal', and apply it to man, we commit a similar fallacy as that of treating a colony of lepers as a 'normal' or 'healthy' group

In conditional $s\,r$ of man, the average person cultivates, through inheritance and training in A doctrines, languages of inappropriate structure , animalistic, nervous, and so psycho-logical, $s\,r$ But here, as in general medicine, the average pathological situation should not be considered 'normal' Only a structural study can disclose what with man should be considered 'normal' The present system performs this task to a limited degree and in various ways, among others, by the revision and the widening of the reaction vocabulary to a larger structural conditionality, as found in the, as yet, exceptional 'normal' man, and introduces the important notion of *non-elementalistic semantic reactions*

Because of this 'average for normal' fallacy, the theories of 'conditional reflexes' in man should be thoroughly revised and enlarged to include *non-elementalistic semantic reactions,* and then we should find that often what is 'normal' with animals is quite pathological for man The semantic difficulties are serious, because the accepted two-valued

structure of language and semantic habits reflect the primitive mythologies, so there is always the danger of drifting either into animalism, or into some other sort of equally primitive mysticism.

The net psycho-logical result of such a revision appears to be that, on structural grounds, what on human level appears as desirable, and, at present, exceptional—as, for instance, the complete conditionality of conditional and *s r*, based on the consciousness of abstracting—ought to be considered the rule for a 'normal' man Then the older animalistic generalizations will become invalid and reactions transformed But for this purpose, and to be able to apply these considerations in practice, we shall have to analyse 'consciousness of abstracting' and, therefore, 'consciousness' which must be defined in simpler terms, discussed in Part VII

When we deal with 'mentally' ill persons, the reactions which would be conditional with 'normal' persons become, in a sense, unconditional, compulsory, and semi-automatic in effect, inwardly as well as outwardly As with animals, no amount of 'intellectual' persuasion has any effect on them, and the reactions, secretions , follow automatically From the physiological point of view, 'mental' ills in humans compare well with *conditional reactions in animals* It seems that under such circumstances a physiological language of different orders of abstractions, different orders of conditional and *s r* would be structurally satisfactory. In such a language, we should pass from the inborn reactions, which exhibit the maximum of persistence, unconditionality, and almost automatic character, to the acquired or conditional reactions *in animals,* which would be called *lower order conditional reactions,* still, to some extent, automatic in their working, and, finally, to the much more flexible, variable, ∞-valued and *potentially fully conditional reactions in man,* which we will call *conditional reactions of higher orders* which include the *semantic reactions.*

In such a vocabulary, the main term 'reaction' would be retained as a structural implication, yet the *degrees of conditionality* would be established by the terms of 'lower order' or 'higher order' conditional reactions Such a language would have the enormous advantage of being physiological and ∞-valued Structurally, it would be in accordance with what we know from psychiatry, namely, that the 'mentally' ill exhibit arrested development or regressive tendencies

We would say that 'mental' illness exhibits not only arrested development or regression, but we could state definitely that the *fully conditional* (∞-valued) reactions of higher order have not developed enough, or have degenerated (regression) into *less conditional* (few-valued) reactions of lower orders as found in animals. All the 'phobias',

'panics', 'compulsory actions', identifications or confusions of orders of abstractions., show a similar semantic mechanism of mis-evaluation. Although they naturally belong to the so-called 'conditional reactions', yet, being impervious to reason, they have the one-valued character of *unconditionality,* as in animals

Similarly with the difference between signals and symbols The signal with the animal is *less* conditional, more one-valued, 'absolute', and involves the animal in the responses which we have named conditional reactions of lower order Symbols with the *normally developed man* (see discussion of 'normal' above) are, or should be, ∞-valued, indefinitely conditional, not automatic, the *meanings,* and, therefore, the situation as-a-whole, or the context in a given case, become paramount, and the reactions should be fully conditional—that is to say, reactions of higher order. In human regression or undevelopment, human symbols have degenerated to the value of signals effective with animals, the main difference being in the *degree* of conditionality Absolutism as a semantic tendency in humans involves, of necessity, one- or few-valued attitudes, the lack of conditionality, and thus represents a pre-human tendency.

To what extent the language of the *degrees of conditionality* is helpful in understanding the development of *human* 'intelligence', and why a fully developed *human* 'mind' should be related with *fully conditional* reactions of higher order, can be well illustrated by an example taken quite low in the scale of life.

This example is selected only because it is simple, and illustrates an important principle very clearly. We know that fishes have a well-developed nervous system, do not possess a differentiated cerebral cortex, but experiments show that they can learn by experience If we take a pike (or a perch) and put it in a tank in which some minnows, its natural food, are separated from it by a glass partition, the pike will dash repeatedly against the glass partition to capture the minnows After a number of such dashes it abandons the attempt If we then remove the partition, the pike and the minnows will freely swim together and the pike will not attempt to capture the minnows [4]

The dash for capturing the minnows was a positive and unconditional, inborn feeding reaction, unsuited for the environmental conditions as they happened to be at that moment The (perhaps) painful striking of the glass was a negative stimulus, which abolished the positive reaction—speaking descriptively—and established a negative conditional reaction, the result of individual experience, which, as we observe by the actions of the fish, is not flexible, not adjustable, and quite rigid,

one-valued, and semi-unconditional, or of low degree of conditionality, because, when the glass partition is removed, the pike swims freely among the minnows without adjusting itself to the new conditions and capturing the minnows

A cat separated from a mouse by a glass partition also stops dashing against the glass, but this negative reaction is *more conditional* In 'psychological' terms, the cat is 'more intelligent', *evaluates relations* better than the fish, and when the glass partition is removed, the cat captures the mouse almost immediately

In this connection, an interesting experiment could be made, though I am not aware that it has been performed, namely, to separate the above fishes with a wire screen, which would be *visible* to the fishes, and repeat the experiments to test if the removal of a *visible* obstacle would alter the outcome of the experiment or the 'time' of the reactions If the 'time' for capturing the minnows were reduced, this would mean that the conditionality of the reaction was increased, and so the seeing of the obstacle, or the increased power of abstraction, would play some role in it Even humans are deceived by Houdinis Are we so 'superior' to the 'poor fish'?

These problems of degrees of conditionality can also be studied in the life of insects, and the works of Professor Wm M Wheeler, for instance, furnish most instructive material, which we have not space to analyse here [5]

In the process of human evolution from the lowest savage to the highest civilized man, it is natural that we should pass through a period in which the primitive doctrines and languages must be revised The newest achievements in science indicate that the twentieth century may be such a period Even in mathematics and physics, to say nothing of other disciplines, it is only the other day that the old elementalism and two-valued semantics were abandoned Obviously, consciousness of abstracting produces *complete conditionality* in our conditional higher order reactions, and so must be the foundation on which a science of man, or a theory of sanity and human progress, must be built

The suggested extension of the reaction vocabulary would allow us, at least, to apply a uniform physiological language to life, *man included* We should have a general language for life and all activities, 'mind' included, of a structure similar to the known protoplasmic and nervous structure, not excepting the highest activities 'Mental' ills would be considered as arrested development or regression to one-, or few-valued semantic levels, sanity would be in the other direction, namely, progression conditioned by larger and larger flexibility of conditional and seman-

tic reactions of higher order, which, through ∞-valued semantics, would help adjustment under the most complex social and economic conditions for man The maximum of conditionality would be reached, let us repeat, through the consciousness of abstracting, which is fundamental for sanity, and is the main object of the present work, explained in Part VII

It seems that the aggregate of inborn, almost unconditional and acquired or conditional reactions of different orders and types constitute the foundation of the nervous activities of humans and animals The mechanism is not an additive one A little bit of cortex 'added' involves most far-reaching differences of behaviour in life; in fact, the number of possibilities probably follow the combinations of higher order

Higher order combinations are constructed from groups which themselves are groups Thus, out of twenty-six letters of the English alphabet, there are probably trillions of pronounceable combinations of letters Sentences are groups of words which are groups of letters, and their number, therefore, exceeds enormously the original trillions Books are combinations of sentences, and, finally, libraries are combinations of books Thus, a library is a combination of fifth order, and the number of possible different libraries is inconceivably large As a rule, we pay little attention to combinations of higher order, disregarding the fact that even materials and the possible variety of them have some such structure

To give an intuitive feel how combinations of higher order increase, let me quote Jevons on the simplest case, starting with 2 'At the first step we have 2, at the next 2^2, or 4, at the third, 2^{2^2}, or 16, numbers of very moderate amount Let the reader calculate the next term, $2^{2^{2^2}}$, and he will be surprised to find it leap up to 65,536 But at the next step he has to calculate the value of 65,536 *two's* multiplied together, and it is so great that we could not possibly compute it, the mere expression of the result requiring 19,729 places of figures. But go one step more and we pass the bounds of all reason The sixth order of the powers of *two* becomes so great, that we could not even express the number of figures required in writing it down, without using about 19,729 figures for the purpose '[6]

In actual life, the number of possibilities of higher order combinations are limited by structural and environmental conditions, nevertheless, the numbers of possibilities which follow such a rule increase surprisingly fast.

CHAPTER XXII

ON 'INHIBITION'

. . . "destructive lesions never cause positive effects, but induce a negative condition which permits positive symptoms to appear," has become one of the hall-marks of English neurology. (212) H HEAD

Excitation rather than inhibition is important in correlation because from what has been said it appears that so far as known inhibition is not transmitted as such The existence of inhibitory nervous correlation is of course a familiar fact, but in such cases the inhibitory effect is apparently produced, not by transmission of an inhibitory change, but by transmission of an excitation and the mechanism of the final inhibitory effect is still obscure (92) CHARLES M CHILD

But since inhibition is not a static condition but a mode of action, the mechanism of the total pattern must be regarded as participating in every local reflex (107) G E. COGHILL

It is highly probable that excitation and inhibition, the two functions of the nerve cell which are so intimately interwoven and which so constantly supersede each other, may, fundamentally, represent only different phases of one and the same physico-chemical process (394) I P. PAVLOV

The term 'unconditional reflex' applies only under 'normal' or 'natural' conditions, as we know that different drugs, such as ether, which alter the conductivity of nervous tissue , can also alter its irritability. Similarly, with conditional reactions, the introduction of *degrees* of conditionality becomes an important ∞-valued structural refinement of language, depending on, and introducing explicitly or by implication, the number of factors, the degrees of freedom , which are observed empirically, and so should have a linguistic and semantic parallel

If we disregard, for instance, the possibility of the use of a drug , then the '*un*conditional' reactions are largely *un*conditional The 'conditional reflexes' in animals are a much subtler form of adjustment to many more factors, and if we call them 'conditional of lower orders' we cover structurally their limited conditionality, which with higher animals is considerable For example, a fly in the laboratory might disturb the reactions, but merely 'intellectual' interference would be ineffective And, finally, the 'conditional reactions of higher orders' in man involve still more factors, introduce more and new complexities, and necessitate that the human reactions should be *fully conditional,* requiring ∞-valued semantics At present, this is an exceptional occurrence, although the potentiality for such *full* conditionality is present in the majority of us.

The mechanism of the unconditional reaction is, under ordinary circumstances, almost automatic It is evolved on the background of

general protoplasmic characteristics, combined with structural polarity, symmetry., and is not efficient enough for the survival of higher organisms.

Under more complex conditions, the adjustment for survival must be more flexible· a similar direct stimulation must, under different conditions, result in different reactions, or different stimuli, under other conditions, produce similar reactions, resulting, ultimately, not only in direct responses to stimuli, but also in the equally important holding in abeyance of the reaction, or even the abolishing of it Let us assume that the direct response of a cat to a mouse would be clawing and chewing If that given cat would just claw and chew when the mouse was some distance away, I am afraid such a cat would soon starve, for such an immediate response would not be a survival response, and this characteristic could not become hereditary The cats which have survived and perpetuated their characteristics are, as a rule, different When they see, hear, or smell the mouse at a distance they flatten out, keep still, crouch , and get ready, until they are in such a position that a jump will procure the victim, and not merely frighten it away.

We see that, under more complex conditions, the nervous mechanism must produce not only direct responses to the stimuli but also equally important delays and temporal or permanent abolishments of these direct responses to stimuli

Hitherto, we have analysed the simplest reactions of a positive character in which a stimulus produces a direct and obvious response: e g , the showing of the food or the ringing of the bell results in an excitation in the nervous system and the secretion from the salivary glands We are, however, acquainted with another type of fundamental nervous activity of equal importance For instance, in experimenting with the positive reactions, we must be careful not to introduce any extra stimuli, as any new stimulus immediately excites an investigatory reaction, and the alimentary conditional reaction becomes temporarily abolished From our personal experience, we know a large number of stimuli which have some such hindering effect on our respiration, circulation, locomotion , which we describe as 'paralysed with fear', 'speechless with rage , 'struck dumb', 'stupefied with pain', The diminution, or deviation, or the lack of some function or response on the nervous level is usually called 'inhibition'

The term 'inhibition' is structurally a profoundly unsatisfactory and a misleading psycho-logical term, and should be *completely* abandoned in physiology and neurology, although it could be retained in psycho-logics and psychiatry This term is in general use, and the sug-

gestion of abandoning a term in general use is always hard to accept. Therefore, it will be well to analyse it in some detail In this case, it does not matter if the positive suggestion of a new term or terms is structurally acceptable, the analysis of the term 'inhibition' shows clearly that it has false to fact implications, and so should be rejected in neurology in any case.

This term is a favorite word in ecclesiastical and legal literature, and means, in the main, to forbid, to prohibit, to hinder, to restrain It is a psycho-logical term, it implies anthropomorphic 'free will' and 'authority' notions perfectly unfit for *neurological* use It is not an exaggeration to say that the structural implications of this term underlie the older animalistic prohibitive and punitive education, legal and ecclesiastical tendencies, which, in 1933, are known to be not only in a larger sense inoperative, but positively harmful On the human level, this word is, perhaps, responsible for the fact that so much about our educational and social methods is uncertain and often harmful Education is a process of building conditional and *s r* of different orders If the *neurological* terms dealing with conditional reactions are structurally unsatisfactory, our speculations which are carried on in these terms must involve these false implications When the empirical results are unsatisfactory, as they must be, because of wrong structure of the arguments, and a scrutiny of our argumentation shows them to be correctly following the structural implications of the language used, then we usually blame 'human nature', which is a very unintelligent excuse, indeed

The implications of the term 'inhibition' become a guidance for our conduct, we repress and, in consequence, breed un-sanity and maladjustment On animal level, 'repression' is workable, but, on human levels, we need a subtler regulative mechanism, in accordance with the structure of the *human* nervous system, and this is found in the fuller conditionality of reactions, based upon consciousness of abstracting, and involving, of course, affective components, semantic factors of evaluation which regulate human impulses without the animalistic repression In humans, the 'inhibited', repressed impulses *often remain as internal excitatory factors,* they are not eliminated by some 'supernatural' hocus-pocus, but remain active, sometimes very active, semantic sources of internal excitation, resulting in conflicts which generally have pathological results

We are usually told that 'inhibition' plays an important role in conditional reactions With the introduction of the *degrees* of conditionality, the importance of the possibility of altering, delaying, or abolishing some immediate response becomes much more accentuated Indeed, it appears that this possibility of influencing responses is an important factor in the

mechanism of conditionality of lower orders, but becomes the *main factor* in establishing the *degrees* of conditionality of higher orders. Obviously, the reactions become very labile, the adjustment to conditions very subtle, allowing the organism to survive under the most complex conditions, such as are found in highly 'civilized' life

This mechanism is responsible not only for human intelligence, but also for all that is constructive in so-called 'civilization'. Vice versa, for survival in such complex civilization, one must possess these *fully* conditional reactions At this point, it will suffice to mention that in organisms below humans, 'inhibition', which underlies the mechanism of conditionality of reactions, plays a most important biological and survival role, while on the human level it is the foundation on which all human *s r*, 'intelligence', and desirable human characteristics are built The present theory introduces methods to make the application of the above considerations possible in daily life

All possible analysis depends not only on definitions of terms but also on *undefined terms,* which, outside of mathematics, have seldom, if ever, been investigated, thus making the structural assumptions which they introduce unconscious In definitions, we also usually posit structure, though we seldom realize this fact. When we approach the experimental side of science, which is the search for empirical structure, the implications involved consciously or unconsciously in the defined and undefined terms play a very important role, and they direct, to a large extent, our efforts and ingenuity This is why we still have so few genuinely creative scientists, although since the psycho-logically and semantically liberating work of Einstein, the number of creative physicists of the younger generation has increased surprisingly. Yet the majority of scientists do not realize to what extent their *s r* are influenced by the terms they use and what enormous help and creative freedom they would have from being conscious of the role the structure of language plays

With this realization, before we begin the constructive analysis of such an important term as 'inhibition', we must state clearly what the general biological presuppositions which underlie such an analysis are

The present work is a $\bar{A}$-system, structurally very different from the older systems, which attempts to build a verbal system of similar structure to the empirical structures, as given by science 1933 The older systems had also a structure similar to the very limited knowledge of empirical structure which our primitive ancestors had Hence, animism, anthropomorphism, 'psychologism', and the rest, and the per-

sistence of such structural features in science as 'inhibition' in neurology, 'force' and 'heat' in physics, .

According to scientific standards of 1933, there is, as far as I know, only one biological system in existence which can be called modern, and this is the $\bar{A}$ biology of Professor C M Child (see Chapter VIII) It is, therefore, necessary to accept this system, and also the $\bar{A}$ neurology of Professor Herrick, which is based on this biology

Generally, the neurologists tell us that the structural aspects of 'inhibition' are unknown To a large extent, this is true, although it is quite obvious that a *'psychological'* term cannot shed any light on its physiological structure To get glimpses of this mechanism, we must start our analysis quite low in the scale of life and see what the most general characteristics of protoplasm are

All protoplasm is irritable In any undifferentiated bit of protoplasm an excitation must (1933) spread in a diminishing gradient, establishing, by necessity, a region of highest excitation in contact with the stimulus, resulting in a polar orientation, with an eventual future head-end, and establishing a physiological gradient, long preceding the appearance of any differentiated tissue The nervous system is a later outgrowth of such an oriented dynamic field, and its primary morphological and physiological characteristics are, to that extent, predetermined, being, in the meantime, a joint phenomenon of the inherent characteristics of protoplasm, its irritability, conductivity, and what not, and of its reaction to the environment The physiological gradient is, then, the simplest and the most general primary reaction arc in a given individual, and constitutes the physiological basis for the structural and functional development of all other arcs [1]

Amoebas are primitive little aquatic animals of approximately spherical symmetry which have no differentiated organs at all, yet they show quite complex reactions and various adaptive activities to be found in higher animals The amoebas can pursue their victim, show preference for stimuli, and move away from the prick of a pin, select their food, This fact shows that protoplasm, so little differentiated, and, from the organic point of view, undifferentiated, exhibits both muscular as well as neural characteristics This fact is fundamental It shows that in colloids which happen to be sensitive and which possess a special type of conductivity, which, from a physico-chemical point of view, is only a special aspect of one mechanism, there is already present the potentiality for any further development Professor Child's physiological gradients, the structural precursors of the nervous system, are a necessity, because of the dynamic potentialities of the plenum and the necessary relation

to the environment, as there is no such thing as anything without environment The stimulus, in the meantime, establishes structurally a functional polarity as a fundamental characteristic of all, even most primitive, protoplasm, and as the result of the contact of sensitive and conducting colloidal structures with the environment [2]

In sponges, which have primitive muscular tissue but no nervous system, the muscular tissue exhibits also both characteristics, combining receptive and motor functions, showing that from the start the supposed muscles are, in reality, neuro-motor organs [3] The actinians have no central nervous system By the aid of an incision, we may produce in them special additional growths of tentacles sometimes with a mouth, sometimes without If, in the last case, we place a piece of food in the tentacles, they will bend toward where the mouth should be If we cut such a tentacle away from the body, we still find that in contact with food it will bend in the one direction But here we are dealing not only with the sub-microscopic dynamic structure but with macroscopic structure, where the irritability and the structure of the peripheral organs determine the reaction [4]

When we experiment with animals with a more developed nervous system, such as ascidians or worms, we come to new and very instructive facts Loeb has removed the ganglion from a number of *Ciona intestinalis,* a large transparent ascidian, which normally, when touched at the oral or aboral opening, closes the openings, and the whole animal contracts into a small ball It appears that a few hours after the operation mentioned they relax If a drop of water falls on such an animal, the characteristic reaction appears again, showing that the reaction was not due to the ganglion but is determined by the structure and arrangement of the peripheral parts and the muscles The nerves and the ganglion play only the main role as a quicker conductor for the stimulus

Even in higher animals we find vestiges of such primitive generalized mechanisms For instance, Loeb, in his experiments in removing the brain from sharks, found that, even after death and when signs of decomposition had already begun, light produced a contraction of the pupils [5]

In a decapitated worm, practically all normal reactions are retained If we cut the nervous system of a worm in two, the two parts of the worm move in a co-ordinated way as long as they are connected by a little bit of tissue The experiments were carried further a worm was cut in two completely, the two halves were connected by a string, and they still moved in a co-ordinated way, showing once more that originally the nervous system was a specialization of general protoplasmic characteristics of irritability and conductivity and structure, which, at present,

are known to be strictly interconnected [6] Multiordinal structure is the explanation of this behaviour Similar examples could be given in great numbers, all of which would support the above well-established view.

Among the general protoplasmic characteristics we do not find 'inhibition', but only positive excitation and conductivity This issue is fundamental and should be taken as a foundation for further analysis

If a wandering amoeba comes to an illuminated spot, the animal will not remain in that region Here is, seemingly, a new fact, and we must *select* the language we want to use in this connection If we follow the old animism and anthropomorphism, we could say the animal 'knows' , or that some 'demon' has forewarned it, or, with equal justification, say that it is an example of 'internal inhibition' or 'prohibition' The introduction of such terms, of course, explains nothing physiologically, but simply multiplies metaphysical identifications on the unconscious yet false to fact assumption that a word 'is' the thing we are talking about—a vestige of the primitive 'magic of words'

Loeb pointed out long ago that to be forced to introduce animism and anthropomorphism is enough *to neglect the analysis of an external stimulus* This is true not only in biology, physiology, neurology , but also in physics The difference between the N and $\bar{N}$ systems depends on the fact that Newton did not take into consideration the character of the stimulus, the finite velocity of the ray of light, which is fundamental in any observation, but that Einstein did take this into consideration The ∞-valued determinism (the restricted principle of uncertainty) in the newer quantum mechanics depends on taking into account the disturbing effects an 'observation' has on the 'observed',

What are the known facts in the meantime? Let us start with the character of the stimulus, light We know, positively, that light can be considered a very potent stimulus, and so the behaviour of the amoeba was a direct response to this stimulus In fact, we know a little about this mechanism without introducing any 'demons' or 'internal inhibition'

The starfish of a certain species has a symmetrical structure consisting of five arms Its nervous system consists of a central ring around the mouth and peripheral nerves radiating from the ring into the arms If such an animal is laid upon its back, it will right itself, but it is essential that not all arms should move simultaneously In a normal animal, having five arms, usually three arms do the work and two of them remain quiet If we destroy the nervous connection between the arms, this co-ordination is destroyed, all five arms begin to struggle, and the starfish cannot right itself, unless by accident Should we again invoke 'demons' or 'inhibitions', or analyse the stimulus-complex and its effect?

Obviously, when the starfish is put on its back, a new stimulus-complex is operating upon it, resulting in a complex adjustment.

As we already know, any stimulus applied to a bit of living protoplasm, because of the colloidal structure and of the inherent irritability and conductivity of the plenum, produces a physiological gradient, establishing, thus, some sort of polarity, symmetry, relations, order, and structure, and indicating what structure our language should have. Again, no trace of any 'inhibition' or 'prohibition' is found, and on the silent, un-speakable, objective level everything happens the usual way, without any regard to, or respect for, our *talking*. Talking only becomes a very genuine danger when on language of primitive structure we build our creeds, institutions, rules of conduct, and our methods of investigation. In the last case, our sciences are nearly as slow, halting, perplexing, difficult, non-co-ordinated, and, in a larger sense, ineffective, as our creeds and institutions have proven to be. Our sciences may have added to our comfort, but, outside of psychiatry, they have not contributed much to human happiness.

As structure seems so fundamental and can be discovered everywhere, we should not be surprised to find that in structure, or perhaps, still better, in the general structuro-sensitive-conductive dynamic complex with definite structure on different levels, we shall find the solution for obvious positive reactions of organisms, as well as for the lack of them.

It is not possible or necessary to go into further details here. The structural data, however, although they are not particularly emphasized, are given in handbooks of physics, colloidal chemistry, chemistry, biophysics, biochemistry, biology, physiology, neurology,. At present, it is realized in science that structure is of extreme importance, but, because of identification, it is not realized that structure is *the* only possible *content* of science and of all human 'knowledge'. This fact, of course, makes the quest of science uniquely structural. Because of it, we come to a very far-reaching general rule, that all 'understanding', to be such, must exhibit or assume structure, thus formulating the supreme aim, and, perhaps, uniquely indicating the only possible method, of science.

Two more simple examples may be helpful. *Mnemiopsis* or *Eucharis* have swimming plates which beat rhythmically, with considerable regularity. When the plates are stimulated mechanically, the movement ceases in the presence of sufficient calcium salts in the water. In similar media, but containing no calcium, a mechanical stimulus does not stop the movement of the plates, but just the opposite. It accelerates their motion, showing clearly that the effect of direct stimulation can

be reversed when the structural relations are altered. Once more, no 'demons' and no 'inhibition' [8]

In higher animals, we usually find a well-developed symmetry and muscles of which the activities oppose the results of the activity of other muscles Such muscles are called antagonists If two antagonists of equal strength are stimulated equally, no macroscopic effect of the stimulation of both muscles results If one of the antagonists is stronger than the other, the macroscopic effect of the stimulation of both muscles results not in some general convulsion, but in a one-sided action of the stronger muscle Obviously, these results are the necessary consequence of structure on different levels We had, in the first case, a lack of obvious macroscopic reaction, although stimulation was present and did its work This was due to structure

It is known that some drugs, such as strychnine or the toxin produced by the tetanus bacillus, produce a state of *general* and high irritability of the nervous system The slightest stimulus to the surface will produce a spasm which affects practically every muscle of the body. The pinching of the foot, instead of producing a withdrawal, results in the rigid extension of the legs, arms, and back The extension is no longer a co-ordinated process, but is associated with strong contraction of the flexors, the final state of the limbs being determined by the surpassing strength of the stimulated extensors The effect of the tetanus toxin is similar. In a monkey, under normal conditions, the electrical stimulus of a certain spot of the cortex will produce the opening of the mouth; similar stimulation of another spot will produce the closing of the jaws But, under the effect of the toxin, the stimulation of *any* of these spots will produce the *closure* of the jaws, because any attempt to open the mouth will excite the stronger masseter muscles and effectively close the mouth [9]

The above examples show again that no 'demon' or 'inhibition' has prohibited the withdrawal of the foot or opening of the mouth, but that the excitation of stronger antagonists is responsible for the result—or, if we wish, for the lack of results All of which is obviously structural

All the above discussions and examples—and they could be expanded and extended to fill volumes—show clearly: (1) That in the structurally more complex organisms the process of co-ordination and adjustment to more and more complex environmental conditions, leading to wider activities and fuller conditionality of reactions, is partially based —to the extent of one-half, or even more—on the lack of direct response to a stimulus, leading to delayed action and involving the four-dimensional order, all of this being a function of the entirely general charac-

teristics of protoplasm, namely, its structure, excitability, and conductivity (the last two characteristics being also a result of sub-microscopic structure) without the intervention of 'demons' or of 'inhibition', (2) that in every case there is an *excitation,* no matter whether the result is a positive or a negative reaction, or whether we can, at present, trace it in detail

As Professor Herrick says 'On this view of the situation the supposed inhibitory effect of the cerebral cortex resolves itself into a differential dynamogenic cortical influence This is partly specific and phasic, acting upon particular subcortical functional systems while these are in process and tending to depress all conflicting activities either by withdrawing available nervous energy from their apparatus of control or by equal activation of agonist and antagonist systems with resulting stasis It is partly a general and tonic activation or reinforcement of all lower reflex systems Upon removal of the visual cortex the specific phasic activation of learned reactions is abolished Upon removal of the entire cortex the general tonic cortical effect is abolished The operation has not stimulated inhibitory fibers, as some have supposed, it has removed the sources of tonic activation which normally are always operating '[10]

'The cerebral cortex from its inception exerts more or less inhibitory influence upon subcortical functions In the simpler learning processes of rats there seems to be a differential activation of some key factor of a subcortical learning process . . which in effect draws off all available cortical energy, leaving other and irrelevant sensori-motor processes relatively enfeebled so that they are subordinated The effect is the same as if a specific inhibitory action were exerted by the cortex upon the inappropriate movements . It may be suggested, further, that all inhibition is in reality a differential activation, the mechanism being in some cases simply the "drainage" phenomenon and in other cases this effect supplemented by positive activation of two antagonistic motor mechanisms so that their interference blocks all reactions of non-adaptive sorts '[11]

In these statements of Professor Herrick, we find a language of similar structure to the known facts The terms of *differential dynamogenic cortical influence* and *differential activation* cover all known facts, and may cover future facts, because the terms are structurally very flexible, and will always allow us to enlarge our knowledge of the mechanism of the so fundamental *differential activation.*

The difficulty in eliminating the term 'inhibition' and suggesting a new physiological term to take its place is considerable, because this term is used in many different forms and meanings The term 'inhibit' is

used in its various forms as a substantive, an adjective, a verb, an adverb, sometimes as a psycho-logical term, sometimes as a physiological one, yet *never* carrying physiological implications, but always psychological and anthropomorphic ones connected with its origin and standard use. It was introduced into science when physiology and neurology were in their infancy, and so were still under the influence of primitive animism and anthropomorphism

The term, because of its character, is not scientifically descriptive It does not suggest functional, actional, directional, or other structural implications, but suggests notions irrelevant to science connected with its origin and standard use, making it a far-fetched inferential term, the use of which must retard the advances of these sciences

Once we introduce a physiological term with physiological and, therefore, structural implications, our expressions will have to be reshaped to make the use of the term possible Such re-wording will always carry quite definite structural implications, which, in turn, suggest further experiments in the search for structure and so have a *creative* character, not to be disregarded Thus, as we have already seen, the term of 'degrees of conditionality' suggested further experiments and the revision of older data

This statement is quite general and may be summed up as follows· The introduction of a new structural term may (1) eliminate the improper implications of the older terms, (2) introduce new and creative implications which suggest the need of verification and so lead to new experiments

At this point, I suggest a term which may be useful and will, perhaps, be acceptable for scientific use As the fundamental character of 'inhibition' seems to be 'differential activation', the term to be coined should possess two main structural implications (1) it should be directional, or indicate the sense of the reaction, and (2) it should imply activation

We find such a term in 'negative excitation', 'negative stimulation', 'negative activation', 'negative phase' , and it is possible to extend the use of this term by making as many compound terms as we need

If possible, we should have terms which help us to keep on one level of analysis, and so automatically prevent us from confusing levels, since modern science always deals, at least in principle, with not less than three levels, the macroscopic, the microscopic, and the sub-microscopic, thus making confusion quite easy If we call the positive effect of a stimulation on the macroscopic level 'positive', any other stimulation which might fail to produce the positive effect on *this level,* or which

might counteract it, would be negative The implication would remain that there was some excitation, but that it did not produce the effect which we had called positive. Structurally, such a term would be satisfactory, especially as it would help us to keep on one level of analysis and not confuse the main levels through verbal structure

Such a language would help us to study the mechanism of 'differential activation', and would carry helpful implications If any cases appeared in which this term did not cover the field, either the term could be enlarged, keeping the implications, or the statements should be altered so as to be expressible by such terms The last would always prove to carry interesting implications, suggesting experiments.

In the processes going on in the nervous system, there is no occasion for the application of terms like 'prohibition' or 'inhibition' There is no standstill in these sub-microscopic processes, though the manifestation on the macroscopic levels can be either of a positive or of a negative character On the sub-microscopic levels, there is a nervous excitation which often stimulates antagonistic processes , with results which are not always obvious

The implication of the term 'negative excitation', although limited, is structurally correct in 1933 Without going into full detail here, I merely suggest a few considerations First of all, the term preserves its main implication; namely, that of excitation, 'negative' suggesting that this excitation takes an opposite course to the positive one If, for instance, a positive excitation produces, let us say, the activities of the salivary glands, a negative excitation in this respect will not produce them but will produce other activities, such as, for instance, an investigatory reaction With a negative excitation, there is an excitation, but it produces different results There is no possibility of stopping or prohibiting or inhibiting nervous activities, short of death as-a-whole or destruction in parts, but only a possible deviation of activities, owing to enormous possibilities in establishing nervous connections, endlessly subtle dynamogenic effects,.

In some instances, 'inhibition' might be regarded as a form of nervous exhaustion; but such a notion cannot always be structurally correct, as there is much evidence at hand that 'inhibition' spreads to other cortical elements which were not functionally exhausted, or that it can be counteracted by some new excitation. 'Inhibition' thus preserves its *active* character The origin of 'inhibition' is also very instructive, and a mass of experimental data shows that it can be produced experimentally. Among other ways, it can be produced by very weak, very strong, or unusual stimuli, *but stimuli, anyway* As a rule, any

extra *nervous excitation* in the central nervous system manifests itself at once, either in diminishing, or in completely abolishing (temporarily, at least) the conditional reflexes prevailing at the date [12] If we find that exhaustion is, in some instances, the structurally correct term, there is no reason why we should not use it, instead of using a *psycho-logical* term of 'inhibition', on neurological levels

That the terminology of positive and negative *excitation* is structurally appropriate finds its further support in the so-called 'disinhibition' Thus, an 'inhibition' of an 'inhibition' reverses the neural process prevailing at a given 'time' and becomes a positive excitatory one. In our language, because of structural considerations, we should say that 'disinhibition' should be labelled as 'negative excitation of *second degree*', resulting in a positive excitation If we were to 'inhibit' 'disinhibition', we should have, again, 'inhibition', With the new terminology, it would be a negative excitation of the third degree, which would give negative results, and a general rule could be established, in complete accordance with the mathematical language in which the even degrees of a negative excitation would have positive characteristics and the uneven would remain negative ('inhibitory')

Such a language would not just borrow 'by analogy' some mathematical features Once we take structure into consideration,—and linguistic issues represent an adjustment of structure—when a systematic analogy is found, it has always structural implications which should be used for testing structure There can be no serious objection to the statement that mathematics is, at present, a limited language of which the structure in 1933 is similar, or the most similar we have, to the known structure of the world and our nervous system The use of such language must be always desirable, as it is a test of structure and so leads to further discoveries of the unknown structure of this world. To the best of my knowledge, the above is a novel, very general, *structural* use of mathematics considered as a prototype of languages Our emphasis is now on the *structure* of mathematics, and not on the numerical solutions of equations, the *possibility and usefulness* of which is precisely due to the fact that equations express relatedness, and so necessarily give us structural glimpses

From a structural and linguistic point of view, the historical development of mathematics shows that it is a first successful attempt to develop a language with a structure similar to the empirical structures, and shows the ideal conditions of producing languages

When we had only positive numbers, we could add two and three and make five, we could subtract two from three and have the remainder

one, but we could not subtract three from two Yet the structure of this world is such that a further development in the structure of the language was imperative Thus, if an object moves in a given direction with the velocity two feet per second, and some external factor imparts to it a velocity of three feet per second in the opposite direction, the original direction of motion will be reversed, and the object will move with the velocity of one foot per second in the opposite direction Or, to give another example, some one has two units of money and he buys something which costs three units of money He is then in debt one unit

Such facts necessitated the introduction of negative numbers and so made subtraction always possible If the motion in one direction or the amount of money in our pocket was called 'plus two' units, and we subtract from it three units, the results were 'minus one', meaning a conventional reversal of direction, or sense, for motion, or a debt, instead of a possession, for money.

Experimental facts of division again necessitated the expansion of this language Thus, fractions were introduced so as always to allow of linguistic division. The 'imaginary' number, $i = \sqrt{-1}$, was introduced to allow, in all cases, the extraction of roots, For a long 'time', the number $i = \sqrt{-1}$ was considered almost mystical, but, of late, when a physicist or an engineer finds it in his equations, it is almost an unmistakable indication for him to look for some wave-motion in the world More extended observation of the empirical world and structure required further structural adjustment of our languages

In the vector calculus we have the so-called scalar product which obeys the ordinary laws of multiplication and $a\,b = b\,a$ where the order of the factors is of no importance The vector product does not follow these rules, as the order becomes important, thus, in a vector product, $a\,b = -b\,a$ In the newer quantum mechanics, to account structurally for the experiments, still newer numbers were introduced Instead of the old arithmetical $qp = pq$ or $qp - pq = 0$, we introduce new numbers where $qp - pq = \frac{ih}{2\pi} 1$

It is very significant that a similar linguistic evolution appears justifiable in the case of the function of the nervous system in general and in the structure and function of the conditional reactions in particular As experience and theory show, the fundamental structures and functions we find in life are not 'plus' affairs, but represent some higher-degree functions of a non-additive character. The typical functioning of the human nervous system (time-binding) is represented by an exponential function of 'time'.[13] Now we see that the reversal of the sign

of negative excitation also follows exponential rules, and experiments show that the change in order of abstractions which, by necessity, must be passing from even to uneven numbers of orders or vice versa, also reverses the sign of the reaction (see Part VII).

In the case of positive excitation, there is also a structural parallel with the newer languages of mathematics, but we do not need to analyse it here, because the foundation of the more flexible, adjustable responses begins with a negative effect, and, in this case, the language I suggest is fully justified without further explanations The neurological importance of 'consciousness of abstracting' is based precisely on the fact that it automatically involves a fraction of a second of psycho-logical delay, and thus is fundamentally based on, and introduces in training, a wholesome 'inhibition'.

We come thus to a weighty structural conclusion that the fundamental processes of the nervous system are not only non-plus processes but that they follow the exponential rules of signs. As soon as we realize that from a structural point of view 'structure' and 'function' are only different types of language in which to speak about two aspects of what is going on, on the silent un-speakable level, and that on this level these two aspects *can never be divided,* we must also build a *non-el* language. Such a language is found in *dynamic structure,* out of which arises function, and even macroscopically relatively enduring structures as special aspects, and the exponential character of the fundamental activities of the nervous system becomes a necessity

In modern mathematics numbers can be interpreted as operators , which, in our case, suggests great freedom of structural use, and widens the application of these notions

To put the problems as simply as possible all the more subtle forms of adjustment in organisms, 'intelligence', so-called 'civilization', our 'ethics', 'happiness' , and, finally, *sanity,* which is the evidence of semantic adjustment or proper evaluation on human levels, are based on the neurological interplay, the number, and multi-dimensional order of superimposed (not added) positive and negative excitations The positive, or the direct and obvious, responses are the more primitive; the negative, resulting in not always obvious consequences, are the result of further structural complexities, which reach their culmination in the normally developed highly cultured man

Such indefinitely superimposed negative excitations are found physiologically in the hierarchy of higher and higher orders of abstractions, which are able to reverse the sign of the *s r,* and so, structurally, make these considerations extremely workable and neurologically sound,

and justify their introduction and use This accounts for the fact that what was evaluated as tragic or painful, or joyful, or shameful , to one generation or culture, does not seem so to another. Our personal difficulty usually is that, at present, we copy animals in the relative unconditionality of our responses, because we are not acquainted with this semantic mechanism We are not prepared to change in one single generation the sign from a minus to a plus, or vice versa, without a great amount of struggle and semantic discomfort

Now, such discomforts are usually harmful to the human nervous system, but the structural understanding of this mechanism helps us to eliminate these semantic pains, and so leads toward nervous balance and sanity.

It seems that the neurological mechanism operating in this connection is similar to the one formulated by Pavlov, thus: 'Two facts relating to the central nervous activities stand out clearly. The first is that the extraneous stimulus acting on the positive phase of the reflex inhibits, and acting on the negative phase dis-inhibits, in either case, therefore, reversing the nervous process prevailing at the time. The second is that the inhibitory process is more labile and more easily affected than the excitatory process, being influenced by stimuli of much weaker physiological strength '[14]

Negative reactions or 'inhibition' must be interpreted as the neurological foundation of 'human mentality', and the result of external and internal stimulations. Because of structural interrelations, the main factor of building human 'mentality' and developing internal 'inhibition' must be more labile and must be influenced by stimuli of much weaker physiological strength.

This explains also why the solution of our problems in education, social life , must be not the animalistic external 'inhibition' alone, but must become, in the main, special internal 'inhibition', effective and yet harmless to the individual nervous system. All of us possess this most general nervous mechanism The problem is to discover the means to operate it. We shall see later that in consciousness of abstracting we find a workable semantic solution, allowing an automatic change of sign of the reaction It should be recalled here that all stimuli and all responses are complex, the word 'simple' being structurally false to facts On the human, and particularly on the linguistic level, it is practically never possible to ascertain an 'absolute' order of abstraction, or the degree or order of an excitation These are often the results of racial time-binding, and extremely complex, nervous processes, and every superimposition of a new neurological process (not addition) may fun-

damentally alter the whole character of the *s r* and reverse the sign In negative excitations, the passing from one degree to another changes the sign of the reaction. In practice, we are only interested in two neighbouring levels of abstractions or in two neighbouring degrees of negative excitation, simply because these involve, by necessity, a passing from an even to an uneven degree or vice versa—in both cases reversing the sign of the *s.r.*

The general organismal adjusting mechanism of the 'investigatory reaction' responds positively to a new stimulus, but with very important survival value acts negatively on established positive conditional reactions in animals It is, at present, much weakened and often ineffective with man, resulting in non-survival, non-adjustment and 'mental' ills for man It is a well-established fact that different stimuli either interfere with each other, resulting in modified behaviour, or reinforce each other and have cumulative effects On the human level, different 'mental' factors play the role of internal positive or negative excitatory semantic complexes, which, because of verbal conditions (and all doctrines are *always* connected with an *affective* background), may reinforce a given stimulus, thus making its physiological effect variable and of different strength Under such conditions a new stimulus does not produce the investigatory reaction with all its beneficial results This mechanism is, perhaps, responsible for the well-known fact that primary instincts with humans are, by far, weaker and more variable than with animals, whence it comes that *humans seldom know by themselves, without science, what is best for them*

We should not be surprised to find that under these more complex conditions human investigatory reactions may be of different types, culminating in the *typically human* investigatory reaction, which would introduce the natural, yet more important, *delay in an immediate reaction* to a former stimulus We shall find, later, that consciousness of abstracting is such a distinctly human and very useful investigatory reaction that on the human complex semantic level brings relatively as much benefit to the human organism as it does on the animal level to animals

It seems that the nervous mechanisms of both types are similar, except for the fact that on the human levels we have more factors which are external and internal stimuli than on the animal level If we copy animals in our nervous processes, we are, in reality, worse off than the animals, because, with our more complicated nervous system, it means for us a pathological condition.

CHAPTER XXIII

ON CONDITIONAL REACTIONS OF HIGHER ORDERS AND PSYCHIATRY

In the dog two conditions were found to produce pathological disturbances by functional interference, namely, an unusually acute clashing of the excitatory and inhibitory processes, and the influence of strong and extraordinary stimuli. In man precisely similar conditions constitute the usual causes of nervous and psychic disturbances (394) I P PAVLOV

The fact that the maximum disturbance in the central nervous activity does not appear immediately on administration of the causative stimulus, but after one or more days has been observed in many animals (394)
I. P PAVLOV

Psychiatrists will readily understand the structurally false to facts and harmful implications of the term 'inhibition' on the *neurological* level, when they consider that often 'pain', 'fright', and different 'prohibitions' and 'inhibitions' on the psycho-logical level result in nervous processes which are not *passive, eliminated factors,* but remain what they were originally—exciting semantic factors 'repressed' on human levels—and become very active and potent causative factors in many 'mental' and physical ailments

If the *non-el* point of view and language are seriously applied, there seems to be no escape from the conclusion that the future physician, on perfectly scientific, structural, physico-chemical, and colloidal grounds, will never attempt to divide the 'physical' from the 'mental', and different nervous processes now called 'inhibition' will come prominently to the fore as active, to be taken care of and *never* to be disregarded

That the mechanism of conditional reactions in animals bears an astonishing resemblance to the mechanism of 'mental' ills in humans, because of the relative unconditionality of both, is exemplified practically throughout the whole work of Pavlov, although he did not point out this particular connection As soon as this is understood, we shall find that some of the experiments of Doctor Zavadzki, made in Pavlov's laboratory *twenty-five years ago,* disclose a neurological mechanism which underlies practically all psychotherapy, and which, therefore, appears very important and to deserve special discussion

I do not know the percentage of the successful application of psychotherapy of any scientific school, or of extra-medical cults, because the many cases of failure are very seldom recorded We usually forget, or do not realize, that the successful cases teach us, structurally, *less* than the failures, because there is always an infinity of ways in which we can account for a positive result, which is structurally entirely invali-

dated as such by a single failure, if the possibility of it is not foreseen by the structural flexibility of the general method

From what I gather (though I may be mistaken) of every hundred patients who seek relief in psychotherapy, fifty fail completely The remaining fifty can, perhaps, be divided into two groups, the first one of, say, ten, who become entirely relieved, the other remaining forty, who improve in different degrees The analysis in the present work may, perhaps, explain why the percentage of failures is so high It seems that no school of psychotherapists has analysed 'mental' ills from the general *non-el* structural and semantic point of view, and, although the physicians struggle in every case to abolish the relative unconditionality of the reactions, their methods are neither neurological, nor physiological, nor fundamental enough

The language used in these scientific theories includes such terms as 'conscious', 'unconscious', 'repression', 'inhibition', 'transfer', 'complex', There seems no doubt that some such terms cover a few of the facts we know from experience and observation, and that they may be structurally correct on the psycho-logical level The nervous mechanism involved, although discovered twenty-five years ago, has not generally attracted the attention of physicians, and the postulated theories, lacking neurological foundations, are often called 'far-fetched speculations', a fact which is ultimately harmful to the whole psychotherapeutic and semantic hygiene movement

The 'psychologists' and the psychiatrists are very much divided as to the role 'introspection' plays This is due to the confusion of the orders of abstractions Animals may 'feel', may 'suffer', but they cannot *describe* Humans differ in this respect, the given person may feel pain, the pain is very *objective* to the given individual, and it is *not words (objective level)*, but we can describe it, this description being valid on the *descriptive level,* a higher order abstraction than the objective level (which is un-speakable for the given individual) If we *ascribe* this process to others, this is no longer a description but an inference, or a still higher order abstraction, which statements have to be verified by averaging Scientifically (1933), psycho-logics are impossible without the *description* of internal processes, and, therefore, some 'introspection', so that the United States Behaviourism becomes a very naive discipline The Behaviourists mean well, methodologically, without realizing fully what scientific methodology is They completely condemn 'introspection', yet they continually use it Consciousness of abstracting solves the riddles of pro- or anti-behaviouristic attitudes, because, when we are fully

conscious of abstracting, we should never confuse description with inference, neurologically processes of different order

Any discipline, to be a 'science', must start with the lowest abstractions available, which means descriptions of some objective, *un-speakable* level In *human* psycho-logics, 'introspection' is the only *possible descriptive level,* all other methods being inferential

The experiments of Doctor Zavadzki were conducted to investigate the mechanism of the so-called 'delayed reflexes' Speaking roughly, in experiments in which the interval between the conditional stimulus and the reinforcement by food or acid is short, say, one to five seconds, the salivary secretion follows nearly immediately after the application of the conditional stimulus If the delay between the two is longer, say, several minutes, the appearance of salivary secretions is also delayed, the length of this delay being proportional to the length of the interval between the two stimuli

In these experiments there were two phases· the one in which the conditional stimulus has apparently no effect, the other in which the conditional stimulus becomes effective The investigation was continued to discover what becomes of the excitation due to the conditional stimulus during its apparent inactivity

New experiments finally disclosed an astonishing mechanism A tactile stimulation was used for three minutes as a conditional stimulus for acid, and reinforced, as usual, by the application of acid, and a stable, delayed conditional reaction was obtained But when a perfectly neutral stimulus, say, the sound of a metronome or a noiselessly rotating object, never connected with any alimentary stimulation, was superimposed upon the original conditional stimulus, immediately a copious secretion of saliva, together with the motor reactions peculiar to a given stimulus, were obtained . .

We see that the excitatory process in the nervous system existed all the time in a concealed, non-manifest form and was released by an extra and neutral stimulus [1]

Similar experiments show clearly that the structure and function of the central nervous system is such that some stimulations can be concealed and become macroscopically seemingly inactive, giving no obvious manifestation or response, yet preserving their active exciting characteristics which, by proper treatment, can be released at will In physics, we have a similar phenomenon in the case of 'frozen' light, galvanic and storage batteries, pear-shaped drops of glass resulting from melting, which explode when the end is broken off, and many others, although probably the sub-microscopic mechanisms are different

It does not take much explanation to see that the nervous mechanism revealed in the experiments of Doctor Zavadzki accounts on human levels for a great many 'mental' manifestations, including 'recall', 'unconscious', 'repression', 'complexes' , and allowing a further generalization, that a slight nervous disturbance of 'recall', in the sense of negative unconditionality, may be closely connected with a pathological semantic 'complex'

Another experiment has close connection with the problems of the human 'unconscious', 'repressions', and 'complexes' The positive conditional reactions were usually obtained by combining under certain conditions a formerly neutral stimulus with food or with a mild defense reaction to acid. If the neutral stimulus is not reinforced, it loses its significance for the organism, no secretion is obtained, and it becomes from this point of view a negative stimulus If, with a given animal, a negative reaction is established, it can, under certain conditions, be transformed into a positive one by reinforcement In the experiment we are describing, a dog was used, with a well-established negative alimentary reaction to the beats of the metronome at the rate of sixty beats per minute, while the rate of one hundred and twenty beats per minute was used as a positive stimulus Both reactions were constant and precise The process of transformation from negative to positive went slowly, after the seventeenth application with reinforcement, a small secretion of saliva was obtained, after the twenty-seventh reinforcement, the secretions of saliva were already considerable. No definite disturbances in other positive reactions were observed except for a tendency to the equalization of strong and weak conditional stimuli

But the secretory reaction to the transformed stimulus of sixty beats did not remain constant, in spite of reinforcement, it diminished, and after the thirtieth application fell to zero It was noticed, further, that immediately after the application of the metronome at the rate of sixty beats per minute, practically all the older positive reactions disappeared After further experimenting, some of the positive effects of the metronome at sixty returned, but its negative or depressing effect on the positive reactions persisted In all cases where the metronome at sixty was not used, all the positive conditional reactions maintained their strength, except that the weaker stimuli had an inclination to produce lesser effects toward the end of the experiment Although the metronome at sixty or one hundred and twenty produced salivary secretions in varying quantities when used alone, whenever the metronome was used there followed a disturbance of all conditional reactions, varying from complete extinction to a diminution of secretions. The formerly positive stimulus

of one hundred and twenty beats of the metronome produced greater disturbances than the formerly negative of sixty Further experimentation disclosed that the disturbance of the cortex was profound, and that it could not withstand any kind of stronger stimuli without producing completely negative results It became, also, obvious that the maximum disturbance in the central nervous activity in animals (and in man) does not appear immediately after the application of the injurious factor but after a delay.

Since other auditory stimuli acted during these experiments, Pavlov concludes that 'the disturbance must be regarded as a result of a strictly localized functional interference in the acoustic analyser, a chronic functional lesion of some circumscribed part, the stimulation of which produces an immediate effect upon the function of the whole cortex, and finally leads to a protracted pathological state', and, that 'it is obvious that the localized disturbance of the acoustic analyser is again the result of a clash between excitation and inhibition', which this particular nervous system finds difficult to adjust [2]

These experiments were conducted upon a dog which had served in the laboratory for a long time and belonged to the type which has a very negatively excitable nervous system Experiments on dogs with very positively excitable nervous systems, although different in details, led to similar general results, namely, that a clashing of the two antagonistic nervous processes led, usually, to a more or less protracted disturbance of the function of the cortex, in the form of a lasting predominance of one of the processes [3]

Experimenting on the conditional reactions in animals, such as a dog, by inducing pathological states of the nervous system, gives us, in a *simplified form,* a means to understand the mechanism which underlies some of the human 'mental' illnesses, provided we realize the fundamental fact that these experiments on dogs correspond, in their simpler form, to 'mental' ills, and not to 'mental' health, in man The above experiments would be impossible with a healthy person, yet they depict exactly what happens in the case of 'mentally' ill The experiments started with a healthy animal, and they ended with a pathological case If similar experiments were undertaken with a healthy person, no pathological results would follow, owing to the larger conditionality of reactions , but similar pathological results are produced in humans by different means, the confusion of orders of abstractions being a standard semantic mechanism to bring about the 'clash' between the positive and negative excitations which the nervous system of man cannot resolve so easily

The experiments of Pavlov disclose, also, a fact which, on human levels, introduces serious complications, namely, that some animals have highly excitable nervous systems, and that some have less excitable ones. Experiments conducted on some individuals produce one effect, similar experiments performed on individuals with different nervous systems produce different results In some instances, the nervous systems are so sturdy that no disturbances appear at all

To anticipate a little it appears that under the present linguistic, educational, social, economic , conditions, nearly all of us suffer from nervous and semantic disturbances, produced by copying animals in our nervous responses This last condition occurs because the larger conditionality of human responses has not been taken into consideration; its mechanism is unknown, and we do our best to teach and enforce the animalistic responses As yet, we have had no physiological and simple methods by which to train in this larger conditionality This is a simple explanation of our failure Only a few of us have such sturdy nervous systems that they do not become semantically disturbed in any marked degree, and these are exceptions Obviously, even an attempt to build a general theory dealing with these semantic problems may be useful, for the very mistakes made may serve others as an incentive for further enquiries in a field which is practically unexplored and extremely large.

In the formulation of the present general theory, theoretical considerations suggested necessary neurological mechanisms, yet the standard books on physiology and neurology did not give enough data In the recent work of Pavlov, I found sufficient experiments and data to illustrate the neurological mechanisms which underlie the present theory It seems likely that the work of Pavlov and the experiments described, together with the theoretical issues raised in the present system, will be of value to psycho-logicians and psychiatrists, provided that they pay attention to the semantic non-confusion of orders of abstractions, without which it is practically impossible to translate experiments dealing with nervous responses of animals to the human levels and escape verbal fallacies The language of the structure, as introduced in the present work, is essential in this respect, in fact, the present writer could not have carried out his analysis without it

Pavlov also suggests some applications to human pathological cases which are recognized as such, the average person being assumed 'normal' The present work is an independent theoretical enquiry, and the results are much more general, as they show that the general neurological mechanism allows an almost universal misuse of our nervous systems, because of the disregard of structural, linguistic, and semantic issues