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, *s.r* 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.

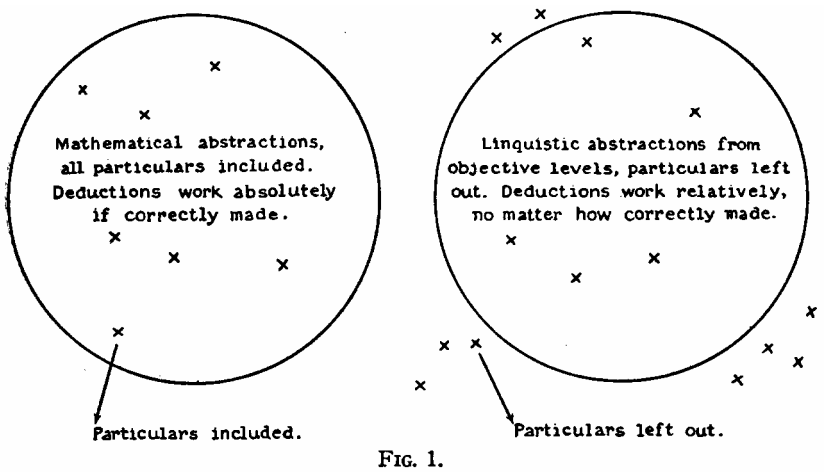

FIG. 1.

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* 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 $\overline{A}$-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 $\overline{A}$-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 psycho-logical 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.