THE CORTICAL LOCALISATION OF SPEECH; 1. An Analysis of Preliminary Difficulties

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INTRODUCTION.

The initial premise of the discussion is that a lack of an accepted and relevant analysis of language, as an aspect of human behaviour and experience, has necessarily caused a diversity in the classification, description and explanation of partial language defects produced by localised cerebral damage.

The formulation of the previous sentence reveals that a strong element of tautology may lie within it. Hence advocates of any particular description of aphasic defects might agree that the premise essentially is a tautology, but assert that they possess the only relevant analysis of language; alternatively they could deny both the validity and the tautologous nature of the premise on the grounds that an accepted and adequate analysis of language is not lacking (or perhaps is unattainable) and that diversity of terminology depends solely on disagreement concerning the physiological or psychological mechanisms whereby cerebral damage leads to partial failure of the language process. The latter opinion seems untenable since the various terms applied to the aphasia reflect a divergence in the approach to language behaviour rather than a disagreement on cerebral mechanisms; "sensory" (aphasia) and "motor" (aphasia) presuppose an analysis of language in the manner of clinical neurology, "expressive" and "receptive" aphasia (Weisenberg and MacBride (10)) are a product of psychology, while "nominal" and "syntactic" are adjectives borrowed from the schoolroom study of grammar. Such fundamental differences of approach preclude even a preliminary discussion of physiological mechanisms since the initial step in any scientific investigation, namely the formulation of a problem in relation to specific techniques, has as yet been left undone. Two examples (one hypothetical, another historical) derived from the neurological description of sensation illustrate and further emphasise the site of "pathology" in those clinical descriptions of language defects which presuppose on everyday familiar analysis of language:—

Imagine the incredible difficulty which would result if the ascending fibre tracts in the spinal cord should have to be described without the analysis of sensation offered by the everyday words "pain," "sight" (vision), "touch" etc. The outcome could only be an anatomical description of nerve processes and pathological lesions, on which much useless philosophical comment could well be raised. However, confusion is averted because an analysis of sensation does exist; moreover the analysis is both adequate and relevant since it is incorporated within every language and thus can only be criticised as being too subjective if it be supposed that the whole of humanity is deluded. The second example concerns the deleterious effect on the physiology of sensation caused by the introduction of the two descriptive terms "epicritic" and "protopathic" sensation. Walshe (9) has displayed the logical non sequiturs that are implied in the original definition of their terms and also the errors in clinical and physiological interpretations that may result from their use. The two terms are based on an evolutionary, and thus necessarily hypothetical, interpretation of certain clinical findings following nerve lesions; they belong to abstract theory and not to observation nor convention; they must stand or fall on an empirical test of their usefulness to neurophysiology and they are discarded because they are neither an adequate nor a **relevant** addition to the analysis of sensation.

The argument that any particular classification of the aphasia is based on an adequately instructed analysis of language can only be refuted by showing that the analysis in question is not acceptable because it is not relevant. It is suggested that relevance in this case can be equated with the notion "useful for physiological or experimental psychological investigations." Thus an analysis of language must at least contain terms definable by direct observation or by precise logical deduction from direct observation, and the formal statement of the analysis must have intrinsic logical

cohesion; once the latter criteria are met, there remains the empirical test of whether there is enough useful correlation between the formal analysis and the processes of language as revealed in normal and aphasic subjects. The result of the empirical test determines the adequacy and relevance of the analysis.

It follows from the two preceding paragraphs that no purely introspective or "mentalistic" description of language is acceptable because it must lack definitions based upon impersonal observation and because it has not peculiar authority, possessed by the terms for subjective sensations, of incorporation within the everyday language of all people. The apparent insight wisdom and complexity of these theories represent a very real intellectual danger since, like all "supraterrestrial edifices," their castles in the air can be suitably moulded to fit successively the earthy environment of diverse and discrete observations. No less dangerous are theories which openly eschew "introspection" but forthwith rise to the even more rarefied atmosphere of "total cerebral function," "oragnism as a whole" and "integrated personality."

A **second premise** may now be stated as follows; the analysis of the content, logical form and everyday use of language belongs to the field of modern logic.

It is probably true that many neurologists and speech therapists have never even considered the significance of the specific analysis of language as a separate field of investigation; the term language behaviour may indeed seem unreal, unnecessary or even misleading. The clinical neurologist has approached speech via the spinal cord and brain-stem, thus, not unnaturally, talks of "motor" and "sensory" aphasia. Unfortunately the terms "motor" and "sensory" possess but a fraction of their "spinal usefulness" for even the simplest problems of cortical physiology; they are necessarily even less effectual as descriptive elements of the cortical mechanisms underlying languarge. Modern electrophysiological research on the cerebral cortex has produced a terminology which is so specific to the experimental operations employed that it can have no application to the analysis of aphasia. Moreover electrophysiology is an aspect of biophysics rather than clinical neurology and its techniques and terms are even less comprehensible to the clinician (who is not trained specifically as a scientist nor as a physiologist) than are the methods of logic. The speech therapist, on the other hand, approaches cerebral mechanisms from the more detached discipline of psychology (which assertion is not derived from first hand experience and is open to correction). The logopaedic approach, while more promising, would do well to avoid introspective analyses of language and especially to avoid the presumption that clinical neurologists are in any way better equipped to analyse language in the normal or the abnormal; to which, surely, the medical literature on aphasia is testimony enough.

There are several relatively recent publications by competent logicians dealing especially with the analysis of language processes. Those of Morris (6, 7, and 8), Carnap (2, 3 and 4),Bloomfield (1) and Langer (5) are particularly relevant to the theme. Within their works there is general agreement on the framework of the logical analysis of language; the scope and the precision of development of ideas show convincingly that this field of logic is not one into which an amateur may stray without much purposeful effort. To quote from Bloomfield (1, p. 54-55):—

"The subject matter of linguistics, of course, is human speech. Other activities, such as writing, which serve as substitutes for speech, concern linguistics only in their semiotic aspect, as representations of phonemes or speech-forms. Since the meanings of speech cover everything (designata, including denotata; syntactic relations; pragmatic slants), linguistics, even more than other branches of science, depends for its range and accuracy upon the success of science as a whole. For the most part, our statements of meaning are makeshift. Even if this were not the case, linguistics would still study forms first and then look into their meanings, since language consists in the human response to the flow and variety of the world by simple sequences of a very few typical speech-sounds.

Linguistics is the chief contributor to semiotic. Among the special branches of science, it intervenes between biology, on the one hand, and ethnology, sociology, and psychology, on the other: it stands between physical and cultural anthropology.

Language establishes, by means of sound waves and on the basis of communal habit, an ever ready connection between the bodies of individuals—a connection between their nervous systems which enables each person to respond to the stimuli that act upon other persons. The division of labour, civilization, and culture arise from this interaction. Popularly and even, to a large extent, academic-

ally, we are not accustomed to observing language and its effects: these effects are generally explained instead by the postulation of "mental" factors. In the cosmos, language produces human society, a structure more complex than the individual, related to him somewhat as the many-celled organism is related to the single cell."

Evidently there has been no lack of effort on the part of logicians. Therefore it seems to me significant that I can find no reference to such work in clinical descriptions of speech defects, and that in teaching neurology to logopaedic students there have been none who have heard of the logicians quoted above. At least an attempt at correlation would be interesting if not fruitful.

FORMULATION SUITABLE FOR THE EMPIRICAL INVESTIGATION

The development of semiotic, the science of signs and languages, has been extended by Morris (1938, 1946) in the vigorous manner of mathematical logic and also in the empirical tradition of objective psychology. In the following paragraph some of the terms from semiotic are explained briefly, but there will be no attempt to follow the precision characteristic of Morris or Carnap (1943).

The description of language processes (i.e., semiosis) may be divided into the related spheres of semantics, syntactics and pragmatics. Semantics deals with any empirical observation or logical analysis concerning the relationships (i.e., the semantic relationships) existing between a linguistic expression and the object or event to which that expression refers; syntactics is concerned with the relations (i.e., syntactic relations) between two or more of the numerous symbols (generally words) within a language; pragmatics describes relationships (i.e., pragmatic relation) between linguistic expressions and the overt behaviour of such individual(s) who may utter or respond to the expressions. It is submitted that these notions constitute a preliminary analysis of language which does not outrage common sense and which presumably satisfies the logical criteria for a potentially "useful" analysis since it is a produce of competent logicians.

It gives power, within limits, of abstracting three groups of entities (i.e., "objects of the physical world," "words," "human behaviour") and providing objective descriptions of relations existing within or between the groups. That a process of abstraction is involved is admitted, indeed it is axiomatic, but the abstractions are made deliberately and are well controlled; surely it is unreasonable to insist always that the process of language "must be considered as a whole" simply because it is impossible to do so.

Applying the three primary divisions of semiotic to descriptions of partial language defects resulting from localised cerebral damage,it seems that any description in which specific reference can be confined to the relations between words and objects to which they refer belongs to the field of descriptive semantics; any description in which specific reference can be confined to the relations between linguistic expressions (e.g., in the formulation of sentences) belongs to the sphere of descriptive syntactics, while descriptions in which specific and necessary reference must be made to the patient's response to words (e.g., his understanding of words) belong to descriptive pragmatics. In any discussion of a partial language defect, it is, therefore, important to decide whether reference to the patient (by name or personal pronoun) is incidental or whether it is a necessary part of the description. The test situation should prompt the decision; if, for example, an object is shown and the patient names it, then the fact that the name is pronounced by the patient could be noted by several independent individuals and could be described without reference to a particular patient; if, on the other hand, the patient's response to a written or spoken word is such that he apparently does not understand that world, then the defect can only be described by reference to the patient's behaviour.

It is submitted that the common tests for aphasia and verbal agnosias can be classified into three groups which test the integrity of semantic, syntactic and pragmatic relationships respectively. Further, the character of the test (the stimulus) and the observed response can be formulated so that an objective description may be given of any defect which is revealed. Hence the terms **semantic aphasia, syntactic aphasia** and **pragmatic aphasia** are suggested on the grounds that they are readily and rather precisely defined from the test situation, and because they are derived from an adequate analysis of language. It then is necessary to decide if the analysis of language, and the terminology of language defects derived from it, is not only adequate but also relevant. This is a matter for empirical investigation which must determine whether the proposed nomenclature "fits" defects actually encountered in clinical neurology.

ELEMENTARY EMPIRICAL TESTING

This section must be the least complete within itself, for the field of possible amplification and application of terminology to clinical conditions is immense.

One amplification will be introduced at once; each of the three primary types of application can be revealed by stimuli directed to the patient by one sensory channel (i.e., sight, hearing, touch) alone). It is thus possible to recognise visual, auditory and tactile varieties of **semantic aphasia;** visual and auditory subdivisions of **syntactic aphasia,** and visual and auditory varieties of **pragmatic aphasia.** The mode of subdivision is very similar to that used by Nielsen (8) for types of agnosia and in the latter application has been proved very useful. A further amplification on the basis of the site of pathology will not be attempted since there is no space to present the evidence for cerebral localisation of the lesions producing each type of aphasia; another amplification based on the type of "words" used in the test situation (i.e., "nouns" or "abstract words") suggests itself but I am not competent to apply the idea.

The one application, which is chosen because it seems conclusive, is simply that types of aphasia which would fall under the categories **semantic, syntactic** and **pragmatic** do occur in clinical neurology. **Semantic** aphasias are described by Nielsen (8) as amnesic aphasias; **syntactic** aphasia is equivalent to the latter author's formulation aphasia, while **pragmatic** aphasia is called semantic aphasia by Nielsen. The use of "semantic" by Nielsen and his predecessors is indeed unfortunate and depended on the older and wider sense of the word semantic by which it included the whole of semiotic (i.e., it included semantics, syntactics and pragmatics). The case for renaming the older semantic aphasia, now calling it **pragmatic** aphasia, rests on the more authoritative claim of the modern analysis of language and hence of "meaning."

In my experience, the use of the proposed terminology gives a neater view of speech defects; it gives also further insight into the physiological mechanism of speech in the cerebral cortex, which insight is a powerful weapon upon the view that speech processes possess no precise cortical localisation; while finally it gives the most hopeful promise of clearing the "jargon" by which many descriptions of aphasia induce a marked degree of pragmatic aphasia among the audience. "Pure" aphasias are very rare, but surely then, when they do occur, they should be studied by the best possible techniques among which the logical analysis of language is certainly to be numbered.

BIBLIOGRAPHY.

1. Blomfield, L.—"Linguistic Aspects of Science." International Encyclopaedia of Unified Science, Vol. 1, No. 4. Chicago. University of Chicago Press, 1939.
2. Carnap, R.—"Foundations of Logic and Mathematics.' International Encyclopaedia of Unified Science, Vol. 1, No. 3. Chicago. University of Chicago Press. 1939.
3. Carnap, R.—"Formalisation of Logic.' Cambridge. Harvard University Press, 1943.
4. Carnap, R.—"Meaning and Necessity.' Chicago: University of Chicago Press, 1947.
5. Langer, S. K.—"Philosophy in a New Key." Cambridge: Harvard University Press.
6. Morris, C.—"Foundations of the Theory of Signs." International Encyclopedia of Unified Science. Vol. 1, No. 2. Chicago: University of Chicago Press, 1938.
7. Morris, C.—"Signs, Language and Behaviour." New York: Prentice-Hall, Inc., 1946.
8. Nielsen, J. M.—"Agnosia, Apraxia, Aphasia." New York: Paul B. Hoeber, Inc., 1946.
9. Walshe, F. M. R.—"The Anatomy and Physiology of Cutaneous Sensation. A critical review." Brain. Vol. 65: 48-112, 1942.
10. Weisenberg, T. H. and MacBride.—"Aphasia.' Brattleboro: E. L. Hildreth and Co. Inc., 1935.