The Status of Psychology as an Empirical Science*

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AN empirical science is either one which, as the term implies, is supported by the evidence of the senses, or one which is built up out of the elements of experience. Physical science, beginning and ending in sensory phenomena, is an example of the first kind; psychology an example of the second. But the ordinary use of the term 'empirical' limits experience to that of a sensory nature. My plea is that this limitation is an arbitrary one and due to a philosophical prejudice. There is more in experience than sensory elements. Apart from the self and its states, affective and volitional, there are thought-things as well as sensed-things, relations as well as elements, correlates as well as original fundaments, in experience. The universe of physical science, for example, consists of thought-things; it is a conceptual universe erected on the foundations of a sensed one.

The external world, as presented to us by contemporary science, possesses none of the glamour and richness with which it is clothed in sensory experience. It has no colour, nor sound, nor odour, nor warmth, nor extension, nor shape, nor material substance. Yet the physicists would tell us that they are dealing with 'reality'; and that 'reality' in itself is not what we naïvely suppose it to be. The world that has successively been conceived as a world of extended and solid objects, a world of atoms, of electrons and protons, of wave motions, is more physically 'real' for physics than the everyday world in which we consciously live.

In directing attention, however, to the distinction, it is not with the view of appraising the relative degrees of 'reality' of thought-things and sensed-things. It is in order to point out that both do in fact occur in our experience taken as a whole. A perfect mathematical plane triangle, when an object of thought, although the result of a purely mental process, and never encountered in any sensory fashion whatever, is an experience just as much as a seen or felt (and mathematically imperfect) triangle cut out of wood or paper is. Each is referred to 'some thing'; but both are experiences, whereas the 'some things' are not.

EMPIRICAL AND EXACT SCIENCES

Just as the sciences of Nature, concerning themselves with sensed-things, make a selection from among our experiences, omit many, and abstract from the fact that they *are* experiences of ours, so other sciences, concerning themselves with thought-things, make another selection of experiences, and consider them as if they also were independent of us. The former sciences derive the force of conviction with which they impress us from the fact that they are ultimately based upon the evidence of our senses—'seeing is believing'. The latter likewise convince us by their proofs, because their conclusions evidently follow from their premises—'There is no proof like a mathematical proof'. The point to be stressed again, however, is that both these kinds of science are selective of their material and leave out of account much experience which, as such, is as good as any other. If seeing is believing, and mathematical proof convincing, the immediate living experience of myself knowing and feeling and willing is most impressive of all. Such experience is not merely believable or convincing; it is indubitable.

I suggest that these neglected experiences are necessary to explain the constructions of the empirical sciences of Nature; and I further suggest that it is psychology, concerned with the totality of experience, objective and subjective alike, and making no abstraction from the fact that it *is* experience, which provides an account of the empirical origin of principles of systematisation and explanatory concepts which are used in the other sciences. Though these principles and concepts are abstract, and indeed vary in degrees of abstraction, they are and must be abstracted from something; and if that something is not the sensory material with which physical science deals, then it must be discovered in some other region of experience.

To support this contention it is not necessary to have recourse to innate ideas; for it can be shown that observable mental processes, other than the apprehension of sensory experience, can account for the facts. These processes are the apprehension and abstraction of relations between any experiences, the production of correlates in respect of any experience, and the immediate awareness of the self energising, or being in one way or another busy with its objects.

CLASSIFICATION

The first step taken in any empirical science is to examine, describe, and classify the objects, or aspects of objects, with which it deals; such classification being made on the principle of similarity and difference, which does not involve inference, but depends upon the immediate experience of relations. The first step in psychology will accordingly be to observe, describe, and classify mental processes as such. Psychologists are fairly well agreed on the broad classification of these processes under the three heads of cognition, affection and conation, or knowing, feeling and willing, as aspects or actualisations of the self.

Classification, however, does not merely mean grouping together: it means separation as well. Thus cognitive processes separate into sensory perception, conception, judgement, reasoning and remembering, for each of which a different

* From the presidential address before Section J (Psychology) of the British Association, delivered at Leicester on September 8.

explanatory concept may be needed. Similarly, different concepts may be necessary to explain the experiences of desire, resolution, impulse and striving, whether they are classed under two heads or one, and no matter how closely one may be involved in the other.

Structural Analysis

The next step consists in the finer structural analysis of the phenomenological data. In psychology, this means the further splitting up of the products of mental processes. On analogy with the procedure of the chemist, who analyses a chemical compound into its constituent elements, or of the anatomist, who dissects out the fibres of a nerve trunk, the psychologist analyses a percept, memory, emotion or will-act. The proverbial seen orange yields in such an analysis sensory factors of an elementary kind—colour, odour, sapidity, smoothness, and the like. It cannot be said, however, that these are all actually seen, any more than the thinghood with which the orange is invested in our thought. Apart from the shape and colour, all the rest comes from other experience than visual. It has been objected that such analysis destroys the mental 'whole' so analysed, just as chemical analysis destroys the compound or anatomical dissection the preparation. Indeed, even though we are unable to separate one sensation from another in a percept, and can only distinguish them in our thought, this objection holds good. For, if we think the sensations separately, and then attempt to add them together conceptually, we discover that the mere sum of sensations is not the equivalent of the percept. This objection has been urged particularly against the work of the introspectionist schools, as if they were concerned only to find the mental elements out of which all consciousness was once supposed to be compacted. But introspection has discovered more than the mere sensations that have been distinguished. It has found relations which obtain between the sensations, as well as relations obtaining between abstract concepts, and between concepts and percepts also.

A similar consideration might be developed in respect of the psychology of volitional processes. The elements that enter into processes of resolution and attainment, and of choice, are analysed. But it would be a mistake to think that these elements, so analysed, when conceptually put together again, are the equivalents of the will-processes. Here also are discovered relations which obtain between them ; among which is that most important of all real relations, namely, that of cause, which is so closely identifiable with the self. It is in virtue of this relation that a will-act from beginning to end is constituted as a temporal whole. If one keeps in mind the fact that both in spatial and temporal 'wholes' neither the sensory and volitional elements nor the relations occur in isolation, this procedure of structural analysis is justified.

Functional Analysis

A further step is to discover by functional analysis the conditions or laws of occurrence of the various events with which the science is concerned. In psychology, this has meant in the past the attempt to relate physical stimuli and their intensities with psychological occurrences, as in the case of Weber's Law ; or to relate physiological events with psychological ones, as in the localisation of sensory and motor functions in definite areas of the cortex, or conative and emotional changes with the physiological disturbances indicated by the pneumograph, sphygmograph or psychogalvanometer. The establishing of such relations between physical properties and physiological processes, on one hand, and psychological processes, on the other, requires, however, that we shall already have taken a step away from the empirical point of view in the first sense of the term ; for here we are trying to equate a sensory experience with a thought-object, physical or physiological. This involves much conceptual and inferential procedure.

These inferential procedures, however, are thoroughly justified if we admit, as I think we must, that not only sensory experience but also all experience must be taken into account ; and then we must concede a like right of citizenship to whatever we are able to discover within it. As we have seen, we find thought-objects as well as sensed-objects and relations both ideal and real. Above all, we find an active self busy with all these mental objects and relations in the various ways of sensing, thinking, feeling, willing, striving, and the like. It is in this complete, unselected experience that we discover the experiential grounds for all our inferences.

Explanatory Concepts

The last step is to find explanatory concepts to cover all the data. Like the conditions and laws of occurrence—for indeed they are reached by the same process of functional analysis—these may be physical, physiological or psychological. For the most part those that have been advanced have been physiological—special sensory organs, local cortical areas, inhibition centres, association fibres, resistance at synapses, drainage of neural energy, and so on. There can be no doubt that some of these concepts are illuminating for psychology, but again at the price of abandoning the purely empirical point of view in the first sense of the term, and borrowing from experience other than sensory in order to make explanatory use of them. Indeed the experience from which the loan is taken is precisely that for which no physiological explanatory concepts are available. While we may accept engrams as the physiological reading of retentiveness, association fibres as correlated with the linkages between ideas, and the like, there is no suggestion forthcoming from physiology as to what may be the physiological

bases of becoming aware of experience, abstracting relations, producing correlates, the volitional control of mental process, or the intimate and immediate awareness of self.

The physiological phenomena, like the physical ones, do not contain the principles of their own explanation within themselves. When we examine the segmentation of a cell under a microscope, we conceive of it as a process going on in an existent, material and unitary thing. Whence do these concepts of existence, matter, unity and thinghood come? When we stimulate the nerve of a nerve-muscle preparation and notice a contraction of the muscle, we conceive of the event as a causal one. Whence did we derive our notion of cause? When we measure the intake and output of a living organism, we do so in terms of energy. From what experience is that concept of energy taken? The ground of none of these concepts is to be found in any one, nor in the sum total of observations made. All these and like beliefs are inferences from the phenomena, made in virtue of experiences of another kind. Physiology, accordingly, like physics, is an empirical science in the first sense because it concerns itself with certain selected sensory data; in so far as it is explanatory, it is an inferential science. It is none the worse for that, however, even if it must borrow some of its concepts from psychology. The point is that, generally without acknowledgment, it does so borrow from psychology in order to establish the very constructions it offers to reloan to that science as explanations of mental events.

(*To be continued.*)

Progress in Electrical Communication

IT is becoming almost commonplace to remark that the growth of modern civilisation has been dependent to a very considerable extent upon the progress made in the art of communication, and, in particular, upon the facilities provided by electrical communications in linking together portions of the earth geographically remote from one another. The British Empire, with its widely distributed interests, has special need of efficient long-distance communication, and it is perhaps, therefore, significant to recall how large a part Great Britain has played in the development of that special branch of science which has nowadays earned the title of "communications engineering".

On the occasion of the ninth annual Norman Lockyer lecture of the British Science Guild, delivered on Thursday, November 23, Prof. E. V. Appleton gave a discourse on "Empire Communication" in which he outlined the growth and development of both wire and wireless communication as employed to meet Imperial needs (British Science Guild, 6 John Street, Adelphi, London, W.C.2. 1*s*.). At the beginning of the lecture, the audience was reminded that the first two great pioneer achievements in long-distance communication were concerned with the linkage of Great Britain with her oldest colony, Newfoundland. For, in August 1858, cable communication was first established between Valencia in Ireland and Trinity Bay, Newfoundland; while in December 1901, Marconi's signals from Poldhu, in Cornwall, were successfully received across the Atlantic by means of a kite-aerial at Signal Hill, also in Newfoundland. In this manner was demonstrated the potentialities of the two methods of electrical communication, one making use of an electric current guided along a copper conductor, while the other utilises the propagation of free electric waves. In spite of the intense controversy which has at times taken place on the relative advantages of communication by submarine cable and by wireless transmission, experience has shown generally that each system, in its own particular sphere, supplements rather than competes with the other.

EMPIRE CABLE SERVICES

With its advantageous start of nearly half a century, it is natural to find that the submarine cable had practically interlinked all parts of the British Empire by the time that wireless communication was able to offer a practicable alternative. Following the laying of several Atlantic submarine cables, similar links were established between England and India, Australia, New Zealand and all parts of Africa, in the development of Imperial communication. More than half the world's long-distance cables now forms part of the great British merger known as Cables and Wireless, Ltd. (the holding company), and Imperial and International Communications, Ltd. (the operating company).

Lord Kelvin was responsible for initiating the electrical methods and many of the instruments used in submarine cable telegraphy; and essentially the same basic principles, of course with vastly improved technique, are still employed to-day. In the early days, sending was done with a special form of Morse key, whereas to-day automatic methods are employed at both ends for the transmission and reception of messages. Much of this terminal equipment is, of course, equally adaptable to wireless telegraphy stations, and in this sense the younger branch of the communication family has benefited by the experience and technique developed by its senior members.

After it was thought that the speed of signalling, and thus the message-carrying capacity, of the submarine cable had reached a limiting value, the development of high permeability nickel-iron alloys opened up further possibilities which have been rapidly exploited. The Western Electric Co. of America produced the first experimental continuously-loaded cable, in which permalloy was wrapped round the core of the cable in the form of a thin narrow ribbon. Another alloy, called