

THE PSYCHOLOGICAL REVIEW.

PSYCHOLOGY AND PHYSICS.¹

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The honor that you have conferred upon me in electing me to the presidency of the Association is one of which I am very sensible, and one that I shall not misprize to the extent of addressing you upon the details of experimental matters with which so far I have been chiefly engaged. I have therefore chosen as my topic some of the more general aspects of psychology and its relations to one of the other sciences, and given my paper the title that stands upon the program.

I have two chief points to make: (1) That psychological theory is influenced to a large, and perhaps at times to an embarrassing, extent by points of view and forms of expression derived from the physical sciences, and (2) that even in spite of this fact psychological theory is, and perhaps cannot well help remaining, distinctly anthropomorphic in its nature.

First then as to the influence of physics on psychology. A part of this influence is due not so much to the science of physics as to the fact that man dealt long with the outer world before he made much progress in introspection, and even now spends a considerable portion of his time in that sort of commerce. As a result his habits of thought are in large degree objective, and the language that he uses is saturated with physical connotations and metaphors. One need only recall the broadly material character of most of the forms of popular

¹ President's address, American Psychological Association, Washington meeting, December, 1902.

spiritualism to perceive what tricks this may play with the unwary. And indeed it is not easy for even the best of us to keep clear of this inveterate physical-mindedness and the subtle suggestions of language. We help out our thinking by material figures and feel a sort of dumb compulsion to make our psychological theories accord with physical requirements. Ebbinghaus notices the first of these tendencies in his address on the past hundred years of psychology before the last International Congress.¹ After describing the older psychology as distinctively 'mechanistic,' he continues: "Mental phenomena are connected with material processes; in order, one may suppose, that the difficult exposition of the first may take its bearings from our familiarity with the second, in other words, from the natural sciences. Of these Physics and Chemistry first won an assured completeness of content and method, and thus many physico-chemical analogies came to be influential in the older psychology. The return of images passed for a phenomenon of like nature with inertia, association was set parallel to attraction, the ego became an aggregate of ideas, spatial perception a chemical combination of sensations." This state of things continued in the ascendent, though not uncriticised, well on into the century, as witness the works of the two Mills, and the Herbartian mechanics of ideas; and even now "the color theory of Helmholtz and Wundt's space theory are comprehensible only on the basis of an essentially physical manner of thinking. Perhaps the last remnants of such manipulation of things by means of mechanical categories is even yet not overcome, but in essentials one may venture to say that Psychology has outgrown it. We realize that the soul is connected with the body, in particular with the nervous system. If material analogies and explanations are used for mental combinations they are drawn from the special elaborations of physico-chemical processes that we call physiological or biological. Here chiefly it is the notion, originated by Darwin and Spencer, of a development of the mental life, both as a whole and in its single aspects, like that of biological evolution, that has become the controlling and fruitful one for us."

¹ 'IVe Congrès international de Psychologie,' Paris, 1900, pp. 58 f.

Ebbinghaus is right, no doubt, and most psychological investigators are now sufficiently independent, at least in the immediate conduct of their investigations and in the extraction of their first generalizations. In the discussion of psychological theory, however, and especially in the borderland between Psychology and Philosophy, the influence of other sciences has not wholly disappeared, but on the contrary seems often to remain to make trouble for those who cross the border from the psychological side. I have in mind particularly the doctrine of the psychophysic parallelism and the assumptions upon which it rests. I do not propose to discuss this in detail — especially as to-morrow's program promises the treatment of it by several of our colleagues most expert in such questions — but I would ask you rather to review the field with me from an exclusively psychological point of view, and to see whether a restatement of the problem in purely psychological terms does not throw some light upon it.

Before beginning, however, let me beg your indulgence while I try to anticipate two possible misconceptions. First, in what I am going to say I have no thought whatever of disparaging the other sciences or of belittling their importance or even their helpfulness in psychological investigation. On the contrary I hold them in the highest estimation, and believe the legitimate debt of psychology to them to be enormous. The criticism, if any is implied, lies against psychology and psychologists, not against other science or scientists. And second, I have no thought of recommending a new point of view from which to prosecute psychological investigation. Quite the contrary. I do believe, however, that a purely psychological point of view is a valuable one to take upon occasion in considering questions of psychological theory and of the interrelations of Psychology and the other sciences. As a traveler through the woods may now and then find it advantageous to climb a tree and look about him to discover the general direction of his path, or even for the mere enjoyment of the aspect of things from a new point of view, and yet would not, except under dire necessity, attempt to continue his journey like a monkey or squirrel direct from tree to tree, so I beg you to take for a few moments

a position from which things may be viewed in somewhat different relations from that in which they appear in the paths of ordinary reflection and investigation.

Our common working position is that of a double series of phenomena, a physical series in the world about us and a psychical series within us. Höffding divides the universe into two parts and gives one to Physics and one to Psychology.¹ "These two provinces," he says, "include everything that can be the subject of human research;" and psychologists generally, when in a working and not in a critical or contentious frame of mind, would raise no objection. When, however, we take the exclusively psychological point of view, we shall want to say that Psychology, as the science of conscious states and processes, has to do with all experiences of every sort whatsoever. Even those aspects of experience that we commonly call physical, if they are noticed at all or become in any degree matter for reflection, take their place *ipso facto* among conscious experiences and thus become appropriate matters for psychological investigation. From this point of view Höffding was much too modest; he should have claimed the universe entire. The other sciences then become but separate departments of psychology, sciences of special aspects of conscious experience. Physics is engaged in discovering the uniformities running through the group of psychical experiences that have to do with bodies in movement and at rest, with heat, light and electricity; Chemistry in discovering those that have to do with the composition of bodies, the nature of the elements and the laws of their composition; Biology with the group of experiences connected with living organisms; and similarly with all the other sciences of nature. Mathematics and Logic are still more intimately psychical, dealing as they do with certain actual or possible forms of thought in symbolic representation. All the phenomena dealt with by each and every one of the sciences, their laws and general formulas, and the ultimate philosophical conceptions to which they lead, are one and all conscious experiences and as such fit matter for psychological examination.

¹ 'Outlines of Psychology,' London, 1893, p. 1.

This is not idealistic metaphysics, though I confess that there are certain resemblances, and that an idealistic philosophy follows as naturally from an exclusive contemplation of psychical facts as a materialistic one from a like concentration upon the facts of the physical sciences. It is not metaphysics at all, but a simple description of the facts. Conscious states exist; they are all of them, and no others, the subject matter of psychological science, at least in the broad sense in which we are now using the term. What I am saying holds equally well with materialistic, idealistic or dualistic conceptions of ultimate reality. I am dealing exclusively with conscious experience, and such an exclusive point of view is equally possible with all. Furthermore, the legitimate distinctions between the sciences are not obliterated by regarding them in this way. All differences remain as from the beginning except that their terms of statement are changed. Even the difference between Psychology and Physics is not removed, as I shall hope to make clear presently.

But first let us look a little closer into Physics from our ultra-psychological point of view. The conscious experiences with which Physics starts (physical phenomena, as we commonly call them) are percepts or series of percepts belonging chiefly to the sense fields of sight, hearing and touch, including under the latter the kinæsthetic senses as well as pressure, heat and cold—the senses that mediate the ‘life of relation’ with the world outside our own bodies. For convenience I shall call them the ‘physical group’ of senses. Certain characteristics of these senses can be traced through all the elaborations and abstractions of physics up to and including the most remote. Taste, smell, pain, the general and organic senses—all having little external reference—are not mentioned at all in physics, or at most incidentally, as supplying certain supplementary data. And even among the physical senses themselves all are not of equal importance. Theoretical physics tends more and more to construe all phenomena in mechanical terms; and sound, heat, light and electricity are studied as varieties of wave motion. The special sense qualities fall into the background and the phenomena are restated in the terms derived from the senses capable of perceiving matter in motion, the kinæsthetic and a

part of the dermal senses and vision in its spatial function. No physicist would be materially hindered in the prosecution of researches in any branch of his science by the lack of smell, taste, pain or the general and organic senses. One without kinæsthetic and dermal senses, on the other hand, would find the science itself well-nigh inconceivable. This only means that for physicists as for other men these senses are those of last resort in matters relating to the external world.¹

But the sensory basis of Physics is not the science itself. The science is the superstructure of generalizations, laws, hypotheses and theories, which have arisen in the effort of physicists to reach a simplified conception of the experiences occurring in the sense fields just mentioned. These in their finished form are generalized verbal descriptions of physical phenomena (*e. g.*, "every particle of matter in the universe attracts every other particle," etc.) accompanied in some cases, perhaps, by a more or less typical image. In this verbal form they are conveniently remembered and serve many useful purposes. They represent nothing more, however, than the final stage of a process of abstraction from phenomena actually observed or reported, and, as Ribot so ably demonstrates,² owe what value they possess to the possibility of a return from them to concrete phenomena. The concrete phenomena to which the physicist returns when he is pressed to make his law of gravity concrete are a group or sequence of images derived from the physical senses. He imagines again the falling ball, the swinging pendulum, the moon and planets in their orbits—whatever may at the moment best serve his purpose—or he actually sets up his apparatus and gives ocular demonstration of the law. He drops the ball and measures the spaces passed over in equal times, proving in the particular case the steady acceleration due to gravity. From our ultra-psychological standpoint once more the original phenomena are all of them percepts or series of percepts; and the more or less abstract formulations, leading

¹ Physiology, which is really a special branch of Physics and Chemistry, has to do with these senses and all the rest in a somewhat different way from that which we have been considering; to that I shall refer later.

² 'Evolution of General Ideas,' Chicago, 1899, p. 110 and elsewhere.

up to the concise verbal statements of physical laws, are convenient symbols, standing for the original perceptive experiences. A physical law and its possible concrete examples is a sort of fixed associational complex, or, as Charles Peirce might have called it, a habit¹—or as we might say, a special habit of thought with reference to conscious experience of a particular kind.

This is true not only for the ordinary laws of physics but also for the still more general and abstract principles of the permanence of matter and the conservation of energy, for these differ from the ordinary laws in nothing but their abstractness and in the tremendous sweep of their application. They exist in the mind of the physicist as an abstract form of words. If he is pressed to make them concrete or if he applies them, they show nothing but certain coincidences or groups or sequences of sensory images or percepts. The permanence of matter means only that as a result of a certain series of percepts the same original percepts with which we set out may be reached again. We hand a chemist a silver dollar. He dissolves it in acids and forms a solution from which he presently obtains precipitates. These he treats variously until at length he presents us with a little button of silver and another of copper which we can take to the mint and get recoined as a silver dollar again. In the same way the conservation of energy means that at the end of a certain series of percepts the same grouping of percepts from which we set out may be reached again—the same quantitatively in all particulars of state and arrangement.

And the same is true finally with the ultimate matter and energy themselves. Matter has the qualities of impenetrability and extension and betrays by its conditions and behavior the presence of various forms of energy. These qualities are allowed it because they characterize the original physical percepts from which the concept is derived. They are the skeleton that remains after all non-essentials have dropped away. Even if the concept is still further refined and atoms are conceived as without substance—mere centers of attraction

¹ 'Illustrations of the Logic of Science,' *Popular Science Monthly*, XII., 1878, p. 291.

and repulsion—these very attractions and repulsions are so accorded them that they give rise to the original sensations underlying perceptions of extension and impenetrability. And energy in its various forms: Kinetic and potential, heat, light, energy of molecular condition, radiant energy, electrical and magnetic energy—all of them betray their presence by the changes they produce in matter. In other words they are abstractions from experience of various sorts within the field of the physical group of senses—abstractions that have proved useful in the effort to unify these experiences. Indeed I may conclude as I began, by declaring that from the ultra-psychological standpoint Physics is a most elaborate development of one aspect of the Psychology of the dermal and kinæsthetic senses—a most interesting and valuable study of fixed associative groups of a limited sensory origin.

It is time that I justify my remark that this ultra-psychological point of view does not remove the legitimate differences between Psychology and Physics. The method of Psychology is in its broad outlines not essentially different from that of Physics. Its phenomena are conscious experiences of various sorts, including all those with which Physics sets out, but also along with them experiences involving pain, organic and general sensations, feelings, emotions, memories, images, volitions, processes of reasoning—indeed everything in experience at all. The generalizations of Psychology, like those of Physics, are abstractions of varying degrees of refinement, generally used in verbal form, but convertible on demand into terms of concrete experience. The characteristic difference lies in their standpoints or attitudes. Even in dealing with the same original experiences with which Physics deals, Psychology selects somewhat different aspects and looks for a different set of uniformities. These different standpoints or attitudes are themselves, in psychological terms, differences in the direction of attention with all that implies.

The mighty gap which has sometimes been assumed to separate the realm of Physics from that of Psychology is thus seen to be of no very extraordinary nature. It is an arbitrary separation made for convenience and not worthy to excite

special admiration. One might as well express surprise over not being able to pass by insensible gradations from *A* to *not-A*, or from one territorial jurisdiction to another, as over finding no place of transit by easy stages from things physical to things mental.

A second point of difference is the greater variety of experience covered by Psychology, Physics dealing with what we call outer experiences only, Psychology in our present sense with both inner and outer. As I have tried to show, Physics comes at last to work with terms derived exclusively from the kinæsthetic and parts of dermal and visual experiences. Generalizations derived from these sense fields can never fully explain experiences belonging to other fields, because of the difference in sense modality. One cannot describe or explain a taste in terms of vision nor general sensations in terms of moving particles. The same is the case with the more complex experiences involving sensations not of the physical group.

A third difference—not an essential one, but one fraught with manifold practical consequences—is the greater simplicity of physical experiences. This gives them a great hold upon the imagination and is one of the reasons for the dominating influence of the physical sciences, of which I spoke in beginning.

Psychology itself, as it appears from our ultra-psychological point of view, deserves a little consideration. In many cases Psychology is able to trace fairly well-connected sequences in its special aspect of experience, *e. g.*, in the members of a practiced train of mnemonic associations; but in others it is not able to do so. Among experiences of all grades instances occur in which, so far as we can see, the antecedent condition does not at all account for the phenomenon that develops. Let us take some concrete examples. I see a boy touch a lighted match to a rocket, which presently goes off with a hiss, and leaving a train of fire, bursts in a shower of stars which sink and disappear. In such a series there is no break. The statement from our present point of view would be simply that we had experienced a series of percepts beginning with the touching off of the rocket and ending with the disappearance of the falling stars. The psychical series of experience differs from the physical series only in the aspect regarded, and each member

of the series is a sufficient reason for the presence of the next. The case is not so simple when attention is otherwise directed and the new sensation bursts in upon an unrelated series—if, for example, when seated in reverie, I hear a sudden explosion out of doors. There is now nothing in the conscious train to introduce the sudden sound; as far as that is concerned, the sound is wholly unaccountable. To leave it unaccounted for is to admit just so much chaos into the mental world, and we therefore relate it forthwith to some other order of occurrences independent of our consciousness, in which it may be lodged safely between antecedent and consequent—in other words, we assume the physical series.

It is not absolutely necessary that we identify this needed independent series with the series coming to us through the physical group of senses—we might assume some sort of an ‘unconscious’; but the intercurrent experiences generally come to us through one or the other of the physical senses; the physiology of the senses makes the connection seem close; and we make it readily because at other times we have followed with attention a full series that led up to a similar explosive sound; we have seen the boy touch a match to the fuse of the fire cracker, have seen the spark creep along the fuse and finally heard the report. We assume that something similar has happened again, though we were not there to see, and we say the sound was due to an external stimulus; and, extending the idea, arrive finally at an independent external world constantly in existence and frequently furnishing us with sensations by means of stimuli administered.¹ This assumption is, as I have said, in the nature of a theory or hypothesis, like the atomic theory or the hypothesis of an ether, and has the same sort of justification—the only possible justification, other than immediate conscious experience—to wit, that it harmonizes an immense number of facts and has not met an irremovable exception.

In an entirely similar way, wholly unrelated ideas at times break into our trains of thought or reverie. Often in such cases

¹ I am here speaking of the logic of the thing, of course. As a matter of fact the whole system of the outer world is built up and in use in the mind of the child long before he ever introspects or takes consciously any theoretical attitude toward his experience at all.

more careful examination shows some unnoticed association or intruding sensation to account for the break, but there are some cases where no such explanation is discoverable and they remain inexplicable in psychical terms. In such cases we find it necessary to appeal once more to the activity of something outside the conscious series, and we speak of 'unconscious cerebration' or simply of 'the unconscious.' In the case of these higher psychical processes our knowledge is less perfect and the connection with the physical series is less patent; consequently we feel the compulsion less strong to identify our hypothetical unconscious series with the physical series. As our knowledge of cerebral physiology increases we shall probably find the tendency increasingly greater, and we shall speak less of 'the unconscious' and more about 'unconscious cerebral processes.'

Let no one think we have a quarrel against these assumptions. We have none; they are useful and we are forced to make them. We only desire to recall once more that the physical series which they assume is based upon the physical group of sensations and has been elaborated according to the usual psychical processes of perception, association, abstraction and generalization.

What we have just been considering has brought us to the problem of the relation of mind and body, one which I believe has been obscured — at least as far as psychological theory is concerned — by the preponderance of forms of statement and points of view derived from the physical sciences.

The problem as it appears from our purely psychological standpoint is simply this: How can we best utilize the physical series that we have been obliged to assume? And the natural answer seems to be the assertion of some sort of interaction. The physical series must influence the psychical series or it will not fulfil the purpose for which it was assumed. And the psychical series must influence the physical, if we are to explain the cases of voluntary movement, where we can follow distinctly a psychical series leading up to a predictable physical result. For psychology as a natural science, the hypothesis of interaction seems quite sufficient.

That this seems to run counter to the physical principle of the conservation of energy, is in itself no greater argument against the theory of interaction—provided that that theory is otherwise the best from the psychological point of view—than it is against the principle of the conservation of energy itself. That principle was reached from the consideration of a certain group of facts; it is by no means necessary that it should apply when other facts are brought into consideration. It is possible that we may in the end strike some form of conception that shall show that the theory of interaction contains no real denial of the principle of the conservation of energy—perhaps on the lines of the ‘genetic modes’ of our colleague, Professor Baldwin,¹ or along the line suggested in Dr. Bawden’s paper before the Philosophical Association,² perhaps in some one or other of the other suggestions that have been made. But in the meantime it seems to me a crying example of the over-reverence for physics of which I am speaking, that a physical principle should be cited as an objection to a psychological one otherwise valuable.

The current answer to the problem is, as everybody knows, not interaction, though that has been supported by the brilliancy of both James and Stumpf, but that of the psycho-physic parallelism in its various forms. That this theory, which is surely not so natural and simple as interaction, should be the current theory of the day is not to be accounted for by reasons lying in the province of psychology. The mere assertion of the parallel (with the implication that the two series are independent) and no further explanation of the nature of the relation, is distinctly inferior to interaction. It makes necessary the assumption of all kinds of unconscious actions, or interferences of some sort, to account for the above-mentioned irregularities of sensation and reflection, while it gets no corresponding advantage. Very often the parallels are not thought of as independent, but a greater permanence and reality is attached to the physical side. It is asserted that there is no psychical action without action in the

¹ ‘Development and Evolution,’ N. Y., 1902, pp. 300 ff.

² ‘Proceedings of the First Meeting of the American Philosophical Association, 1902,’ *Philosophical Review*, XI., 1902, p. 270.

higher cerebral centers, but the counter proposition, that there is no action in the higher cerebral centers without psychical action, is denied. The currency of the theory in this form is due, I believe, to the glamour of the physical sciences. I agree entirely with our colleague, Professor Münsterberg, that the determination of standpoints on this question rests upon extra-psychological considerations,¹ and I believe that it is in the predetermination of these considerations that the influence of the physical sciences is most exercised.

So much for my first point, to which I have perhaps given too large a portion of my time. My second was that Psychology is an essentially anthropomorphic science (and I should say here, parenthetically, that I am now using the word Psychology in the narrow and ordinary sense, and the word 'anthropomorphic' in contra-distinction to mechanical). I doubt if any one would contest the proposition. Just as Physics retains to the end certain characteristic features of the sense fields in which it originates, so we may expect Psychology to bear the marks of its derivation from conscious experience as we know it. In normal adult psychology the anthropomorphism is too much a matter of course and too little disadvantageous — indeed too fully justified — to be much noticed, but one has only to open his eyes to realize its anthropomorphic character. This indeed might not be worth notice were we not tempted beyond the bounds of introspection to enter upon comparative psychology. Are we justified in using our own psychical experience as a basis of interpretation with reference to the behavior of animals, very little children and the feeble-minded? Were it not better if we declined to go beyond the immediate facts of observation and were content with a purely objective science of animal or child or idiot behavior? Such a course might be possible, but I doubt if any one has ever seriously contemplated it in the case of the higher animals, or could carry it to fruitful results if he should undertake it. Nor would any one seriously propose to treat the behavior of his fellow men in the same way, *i. e.*, to refuse to credit them with conscious experience in the main like

¹*Grundzüge der Psychologie*, Bd. I., 402 ff.

his own, though this would seem to be required logically, unless one can show an essential difference in the conditions under which he judges of human and animal activities. The fact is that as soon as actions become at all complicated the concept of mechanism breaks down. It does not simplify the phenomena, nor unite them without violence with other groups of phenomena. It loses therefore the only justification which it ever had, namely its usefulness. Another concept and this the anthropomorphic one (*i. e.*, interpretation in terms of human experience) makes the facts observed more intelligible, and enables us to group them in larger unities and thus establishes its propriety. Our justification in assuming a psychic life of some kind in animals or little children or low idiots is of the very same nature as our assumption of a material world which furnishes the excitants of sensation, or of the mechanical principles that govern its phenomena — of the same kind, though less certain of course, because the facts covered are more complex and less easy to observe.¹

I trust that no one will understand me as holding that because we must cast our conceptions of the psychic life of animals in human terms we need do so rawly, and in the identical terms in which we experience our own. By no means. Exactly as the theoretical mechanics of the physicist is not the mechanics of any particular body, but an abstraction of the features common to all mechanical phenomena, so our ultimate psychoses must be the fundamental ones common to all conscious experiences. Just what these ultimate psychoses ought to be we are perhaps not fully ready to say, but we seem to require a sensory awareness, colored by original liking or disliking and a tendency of these sensory impressions to remain for a brief period. This simple consciousness must also be effective in some way in altering existing tendencies to movement.

How far down in the animal series this shall be assumed to go is purely a question of utility in thinking, and can be settled

¹ It is perhaps worth noting in passing that those who argue from experiments on animals that cerebral changes induce psychical changes, are not in a position to deny the existence of psychical experiences to animals.

only by gathering facts and trying to explain them. It will be conceded that the hypothesis of some sort of mind in animals is required at the upper end of the scale; it is equally conceded that a mechanical explanation may suffice at the lower end of the scale—though conservative biologists would perhaps regard it as probable rather than proved. Usefulness in thinking must decide where the line shall be drawn, or if the two series—psychical and physical—must be assumed to act conjointly throughout.

This assumption of mind in animals almost inevitably draws after it some form of belief in interaction. It is hard to believe that consciousness has not been a helpful possession in the evolution of man and higher animals, and if so it must have made his behavior different from what it would have been if consciousness had not existed. I do not insist upon this point, however, lest some one accuse me of introducing Biology into psychological theory when I cast out Physics.

This anthropomorphic character of Psychology stands in sharp contrast with the mechanical tendency of Physics. In the wider conception of Psychology which I used in the first part of my address, the mechanism of Physics would have to be included as a partial aspect of the general anthropomorphism but with the narrower and current definition of the science the distinction is radical. The ultimate perfection of psychology is reached in an abstract consciousness in which state follows state according to known laws, that of physics in an abstract mechanism in which everything is formulable in terms of moving particles. Neither anthropomorphism nor mechanism, though growing steadily more refined and abstract, can lose its essential quality and yet serve its purpose. The former must carry the marks of its derivation from human introspection; the latter of its origin in the physical senses. For this reason no attempt to explain experience in physical terms can ever be thoroughly satisfying, nor one that tries to get rid of the necessary assumption of the physical series. Any philosophical system that hopes to pass from the ultimate principles of science to a satisfying grasp of all phenomena must treat both these ultimates with equal favor.