

EXPERIMENTAL PSYCHOLOGY

AND

THE PSYCHOLOGICAL LABORATORY IN

THE UNIVERSITY OF TORONTO

BY

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Experimental Psychology and the Laboratory in Toronto.

THE justification of the existence of any Science is complete when it has been shown that it investigates facts which are not investigated by any other Science. There may still be a difference of opinion with regard to the name which should be applied to the Science in question, but there can be no doubt that it has a field of inquiry essentially its own, and, this having been ascertained, the name is of very secondary importance.

I am led to make these preliminary remarks by two phases of criticism which are at times offered when one speaks of Experimental Psychology: the first phase is completely destructive of the so-called Science, because it contends that Experimental Psychology has no subject-matter for investigation, since it is impossible to experimentally examine mental states; the second phase arises only when one has been assured that Experimental Psychology investigates something, and the criticism is, briefly stated, "You shouldn't call it '*Psychology*.'"

I am not sure whether or not I should regard my task as covering the justification for the name of the Science as well as for the existence of it. If it does include it, I am disposed to waive the right of discussing this question at present (for, after all, it is a broader question than the one I am called upon to discuss), and to confine my attention rather to an attempt to show that what is at present called Experimental Psychology has a legitimate subject-matter which it endeavours to investigate—that it may at some future day be called by another name need not trouble us in the least. (It may be worth while noticing that Thomas Hobbes wrote his Psychology under the title of Physics, but that neither detracts nor adds to its value.) All that I ask is that my readers accept the name which is given to this investigation to-day, even if it be a misnomer, and leave the future to pass the verdict on the question of nomenclature.

In a short article, such as the present one must be, it is impossible to discuss every phase of the subject which suggests itself as appropriate and significant. I am, therefore, led to select for more exhaustive discussion some particular points and to merely refer to others. One of this latter class I shall touch upon at this point in the discussion as introductory to my special subject, and I hope my statements regarding it will not be taken as dogmatic and unsound merely because I do not discuss them. I premise as a fact which ought not to need discussion, that we know but *one* Nature, and that every Science which investigates natural phenomena deals with the same objects which all other

Sciences investigate. Manifestly I do not mean that in any one object there must be found a field for every Science, but I do mean that any object *may* be investigated by all the Sciences, each from its own standpoint. From this I believe that the following statement ought to be evident:—*It is the peculiar standpoint of each which distinguishes the Sciences, and not the specific objects they investigate.* I deem this fact of much importance, because a consideration of it ought to make clear to any one that it is utterly illogical to demand of a Psychologist that he produce a world of reality which is not touched at all by other Sciences. On that same ground, probably no Physical Science but Physics could justify its existence; at all events, if that be the test applied to Psychology, it may very well deny its ability to produce another Nature in which it may find some work to do. But it does not need to accept such a task as a justifiable one. It may very well claim that it has equal right with the Physical Sciences to exist, provided it can show that it investigates Nature from a standpoint peculiar to itself, and to the justification of the Science on this ground I now turn my attention.

Before, however, I take up the immediate discussion of this problem, I may refer briefly to Feeling and Volition, which, probably, would not be considered as falling under the term "Nature" which I have used. Personally, I should not exclude them from Nature, but any justification of that standpoint might take us too far afield, and, therefore, I shall merely mention, in passing, that the investigation of Feeling and Volition by means of experimental methods is a very necessary task before the Psychologist; and, further, it is one from which he does not shrink. As one problem in Volition which has received a good deal of attention in Experimental Psychology, I may mention the investigation of the so-called Reaction Time, a problem ceded to Psychology by the astronomers, under the head of "The Personal Equation." Then, under the head of Feeling, I may call attention to the problems of Aesthetics, which have been left until the present almost wholly without experimental research, but which are gradually being investigated by Experimental Psychology, with, I think I may say, gratifying results. The need for such work as this justifies the existence of any Science which will undertake it, and hence, if we go no farther we have shown the need of, and hence justification for, the Science which is called to-day "Experimental Psychology."

The question to which I devote myself in the greater part of this essay is the following: *In the investigation of Nature is there room and work for such a Science as Experimental Psychology?*

The reader will not fail to notice, after reading the preceding paragraph, that in thus stating the question, I recognize that I am unnecessarily restricting myself, but I do this because it is evident that if Experimental Psychology can be justified on this ground it will need no word of justification on any other; and, because, I may frankly state, I am desirous of showing that Psychology has a right to be regarded not only as a Science, and as a "Mental Science," but also, in the strictest sense, as a "Natural" Science.

All the facts which Physical Science investigates in Nature are expressed, or can be expressed, in terms of motion ; light, heat, sound, electricity, chemical action, the processes in living organisms, etc., are all alike phenomena of motion as they are considered and studied by a Physical Scientist. He has his facts, he takes a certain point of view from which to regard them, and in the light of which he investigates them, and as a result we have the magnificent achievements of Physical Science ever since the days of Galileo. Let us not fail to observe that this advance began with the adoption of motion as the pass-word through which entrance was to be had to the Physical Scientists' world. Indeed, some would say that this latter statement should not be limited at all, for they contend that all facts whatsoever are to be regarded as nothing but motion. This contention, however, cannot be allowed, as we shall see later.

In order to limit the subject somewhat, I shall refer now to certain particular phenomena in Nature in which there seems room, and, indeed, need, for an investigation other than those undertaken by the Physical Sciences, and which, as a matter of fact, is being carried on to-day by the Science which is called "Experimental Psychology."

It cannot be denied that if there had never been Sensations of Sight and of Sound, there would never have been the Sciences of Optics and Acoustics. The movements of ether and of air might have been as active as possible, and yet, unless colour had been seen, and sound heard, no one could have thought of them except as heat, or as more or less gentle pressures. And yet, let us not forget that the Scientist who investigates these motions of ether and of air could write a complete text-book on Optics or Acoustics and never use the name of a colour or of a tone ; all he needs for colour is a certain designation of the position in the spectrum and the frequency of the vibration of the ether particles, and for tone similarly, the frequency of the vibration of the air particles. That all comes to this—a physicist investigates the motions which occur where we experience, for example, a colour, but he does not investigate the seeing of colour, or the colour sensations which we experience, and which, after all, contain the fundamental possibility of this Science (Optics).

But I am reminded that this is the task of the Physiologist ; he it is who investigates the seeing of colour and the colour sensations. Let us glance for a moment, then, at the work of the Physiologist to see if this be true. A Physiologist deals with those processes which take place in the human body, but he finds there nothing but chemical processes, physical processes of pressure, of heat, etc. With the possible exception of nervous transmission he finds no process not common to bodies in general ; and even nervous transmission he conceives as a movement of the particles of a nerve, and as akin to the transmission of electrical force. He, too, could express all the facts of his Science in terms of motion and position, and, so far as the seeing of colour is concerned, he can only tell us what processes take place in the retina, the optic nerve,

and the visual centre in the brain, *when* we see such and such a colour, but he makes no attempt to discuss the sensations of light and colour as they are actually experienced, as red, orange, yellow, green, etc. Let us, then, at this point attempt a brief summary of the relations of Physics and Physiology to the facts of Light and Colour: Physics attempts to tell us what vibrations of ether take place *where* we see a certain colour; Physiology attempts to tell us what processes take place in retina, nerve and brain *when* we see a certain colour, but neither of these sciences investigates the colour as seen, which is of a certain quality or tone (red, orange, yellow, etc.), and is not in any sense motion, no matter how much it may depend upon motion. Now, this colour certainly belongs to Nature, and therefore in the facts of light and colour in Nature there is room for an investigation not carried on by any Physical Science. This investigation may include several definite questions:

- (1) What are the facts of light and colour as they are seen or experienced?
- (2) Upon what do these facts depend?
- (3) Under what conditions do they combine with one another?

In connection with the second question it must be noticed that it is purely gratuitous to assume, even when we have discovered that definite sensations of light and colour depend upon so and so many vibrations of ether, and such and such a chemical process in the retina, etc., that they depend upon these alone, for it can easily be shown that we have these sensations when that definite vibration of ether, and that specific process in the retina, are not present.

There is room, then, in the investigation of the facts of colour, for a science which will carry on research on the lines of the questions above suggested, and, as a matter of fact, that Science is called to-day "Experimental Psychology;" as I have said before, it is entirely irrelevant for my purpose whether or not the name be appropriate; it at least has a standpoint peculiar to itself from which it investigates Nature, and as such its right to a place among the sciences cannot be seriously questioned.

What I have here said regarding light and colour is equally applicable to other sensations also, such as sound, heat, cold, pressure, taste, smell, etc. No Physical Science investigates these, as we actually experience them, for the very basis of all such sciences to-day is motion, and this standpoint does not include colour, or any sense quality, as experienced. It is manifest that red, yellow, violet, hot, cold, hard, soft, sweet, bitter, etc., etc., are not motion, and it is absolutely meaningless to say that, *e.g.*, the sensation red is 330,000,000,000 vibrations per second or any such—the sensation red is *red*, and not movement.

What I have already said ought to convince, at least, the careful reader that there is work for Experimental Psychology to do in the investigation of the sense qualities and their relations. There are, however, even wider fields of work for the Psychologist to attempt by the aid of experimental methods.

The Science of Geology, as we know it to-day, has much to do with

time; in fact, were it not for our sense of time, Geology could not exist in its present state. It uses time with perfect assurance, and yet it does not in any way investigate man's sense of time, as some call it. The same is equally true of all the Physical Sciences. All Nature is studied as motion or change, and yet the basal fact which alone renders such a conception as change possible; in fact, which is, in one sense, simply another word for change, is not studied at all. Were time not a necessary form of human experience there could not be the Physical Science which we know to-day. Any research, then, which adds to our knowledge of time as a form of experience is valuable, since it thereby adds directly to our knowledge of Nature. Experimental Psychology carries on this investigation; and, indeed, the Psychological Laboratory of the University of Toronto has contributed somewhat largely to this problem in recent years.

Then there are the various investigations with regard to localization in space which are not touched by any Science but Psychology. As all Nature is in space, any information we may gain with regard to our localization in space is directly applicable to our knowledge of Nature, and is an addition to it.

It would seem to me that these considerations amply justify the existence of the Science which investigates these facts, and, as it is evident that these investigations cannot be carried on except by the application of experimental methods, I presume I need not say a single word by way of justification for the use of experiment in such research. One might still be in doubt as to whether such a Science ought to be called Psychology, but, as I have already intimated, I do not intend to discuss that question further than I have done; that is, further than showing that it cannot be called Physics or Physiology, as we understand these Sciences to-day.

Even at the risk of making this discussion somewhat tedious I shall mention what seems to me the fundamental justification of the Science of Experimental Psychology, as it was the first investigation which was actually carried on by it. I refer to the problem of Quantity, as it is considered in Physics, or of Intensity, as it is considered in Psychology.

It is a well-known fact that increments can be added to any quantity without any change being noticed. That is, a stimulus may be increased by certain definitely known quantities and yet no change occur in our experience or consciousness of that quantity. For example, in a room lighted by 100 gas flames, the addition or subtraction of one or two flames would not be noticed from any change in the amount of light; or, the full electric illuminating power in a city may be turned on at noon-day, and yet the streets be not noticeably one bit better lighted; and so on, examples might easily be multiplied, but each one may do that for himself. Now, if I ask the question: "Just how much would I have to add in any particular case in order that I may just notice a difference?" I have clearly a problem which demands experimental research for its solution, and yet I have a question which cannot be answered by either

Physics or Physiology, the two Sciences most immediately concerned with it. When the question is investigated, a remarkable fact is discovered, viz., it is found that that amount which must be added before a difference can be noticed bears a constant relation to the stimulus to which it is added; that is, the same quantity is not always noticed as a change, as it ought to be if the question were solely one of the sensitiveness of the sense organs, for, physically, if the sense organs can just discriminate the difference between 10 and 11, surely they ought to do likewise between 20 and 21, but they cannot—it must in that case be between 20 and 22—that is, *it will be the same relation as formerly, which must be added or taken away, but not the same quantity.*

There is another phase of the problem of Intensity, which is, I think I may say, startlingly instructive. We not only estimate quantities to be greater, equal or less than others, but we also estimate the difference between two quantities to be greater, equal or less than the difference between two other quantities; that is, if we are shown three lights of somewhat widely different intensities we can judge when one is midway in brightness between the other two, or, differently stated, we can tell when the difference between the lights "a" and "b" is equal to the difference between "b" and "c." Now, when this is carefully done an astonishing result is found, viz., when we make the judgment $b-a = c-b$, it is found that according to physical measurement the lights stand in the following relation:—

$$\frac{a}{b} = \frac{b}{c}$$

$$\text{or } b^2 = ac$$

$$\text{i.e. } b = \sqrt{ac}$$

Supposing now that "a" and "c" be respectively 10 and 1,000, "b" will be 100 when we estimate the lights as being separated by equal differences. Throwing the conclusion in one sentence we may say: *We estimate differences as equal when physically the ratios are the same.* The relation of this to the foregoing statement is evident.

This principle has had such ample verification that a "Law" has been formulated which embodies and expresses it. The so-called "Law of Weber" is the fundamental fact which was at once the origin and the inspiration in Psychology of the Science of Psycho-Physics, which is a strong sub-department of Experimental Psychology. This Law of Weber holds practically true (so far as the matter has been investigated) in the case of all the ordinary Senses, and for the extensive range of medium intensities, and its expression brings out the characteristic of experience which it represents, viz., the relativity of our estimation of quantity or intensity. (All physical quantities are experienced as intensities.) There are several statements of this Psycho-Physical Law, but the following will answer our purpose here:—"In order to increase sensations by just noticeable quantities, the quantity of the stimulus must

be increased by relatively the same quantity"; or, "In order to estimate differences as equal, the relation of the stimuli must be the same"; or, again,—Fechner's concise expression of the Law—"The intensity of sensation is proportionate to the logarithm of the quantity of the stimulus." Now, it is through that research known as Experimental Psychology that this principle has been discovered, and since there can never be a quality which has not some quantity, we are compelled to admit that Psychology, in this case, has discovered a problem which bears on all our experience of Nature, and, therefore, which ought to be known by all who investigate Nature. Here, again, Experimental Psychology justifies its existence as a Natural Science, or as a Science of Nature.

I consider that I have already said quite enough by way of showing the nature of the problems which an Experimental Psychologist has to investigate, and I now proceed, therefore, to the second part of my essay, which is more closely occupied with the Laboratory in Toronto. Before, however, I say a few words with regard to the Psychological Laboratory in the University of Toronto and the work being carried on there, I wish to make one or two pointed statements with regard to the attitude of the Department of Psychology, under the direction of Professor Kirschmann, to some much discussed topics.

The first of these topics is the relation of Psychology to Hypnotism, Telepathy, and such phenomena. In one word, we do not devote much attention to these phenomena, because they do not yet seem ripe for experimental investigation, at least, as yet, no *exact* experimental methods have been found generally practicable for such a research. (We leave out of account here the fundamental question: Is it justifiable for any man to hypnotise another, especially for amusement or experiment?)

The second of these topics is the relation of Psychology to Physiology. In the first place we do not regard it as justifiable to attempt to do what a Physiologist can do far better; *i.e.*, investigate the processes taking place in the human body, and especially in sense organ, nerve and brain. That work belongs distinctly to Physiology, and we are quite content to keep it out of our Laboratory and to accept the Physiologist's results as we do the verified conclusions of any other Scientist. (It must ever be the aim of Experimental Psychology to work hand in hand with all other sciences, and especially with its nearest sister sciences, Physics and Physiology, in solving the problems of Nature. There are problems which they, in accordance with the character of their subject, cannot solve, and we should like to aid in the solution of these, and thus return, so far as possible, the help which Psychology has always received from them.) In the second place, if the reader has caught the spirit of my justification for Experimental Psychology, he will not have failed to observe that I do not regard it as more necessary for a Psychologist to be an expert Physiologist than it is for a Physicist or Chemist to be such. This is the unhesitating stand of our Department on the subject, and this alone ought to be sufficient to clear from people's minds the still too often heard, but nevertheless nonsensical opinion, that an Experimental Psy-

chologist must be a Materialist in Philosophy. On the contrary, we hold that psychical facts cannot be "explained" by bodily processes. Physiological Psychology is really two distinct Sciences, viz., Physiology and Psychology, and all that is done in it is to correlate bodily processes with conscious facts; that is, to attempt to discover what bodily processes are occurring when we experience or are conscious of certain facts. Even this work, important as it may be, has not the prominence in Toronto which it has in many laboratories. *Experimental Psychology* and *Physiological Psychology* are by no means synonymous terms, even if we are indebted to books bearing the title "Physiological Psychology" for some of the most important work in the literature of the subject.

Several other interesting points which might be discussed are omitted as unessential, and because the limits set for this article have already been exceeded.

My concluding subject is an interesting one to all lovers of the University of Toronto, and I trust it will not be found uninteresting even to those who do not call her "Alma Mater"—it is "The Psychological Laboratory of the University of Toronto."

The Psychological Laboratory in Toronto was established, through the liberality of the Ontario Government, by Professor J. Mark Baldwin, in 1891,* and three rooms and a private room, were at that time set apart and fitted up for the work. These rooms, 1, 2, 3, 4, in the following plan, were used at first chiefly for demonstrations. Actual research work by students, however, really began with the installation of Dr. A. Kirschmann as head of the Department of Psychology in 1894. Dr. Kirschmann had been trained in Germany and had been Professor Wundt's assistant in Leipzig for some time; he, therefore, came to Toronto with a thorough knowledge of what the then best Psychological Laboratory in the world was. From the very first year actual research work has been done by the men in the Senior year in the Department of Honour Philosophy, and by numerous graduates, and the comparatively large number of published reports of our work bear witness to the fact that this research has always been along lines calculated to advance our knowledge of the facts of consciousness. If the people of Toronto or of Canada do not know of our work it is to be regretted, but whether the reports of the work done are read here or not, we have the satisfaction of knowing that they are well known, and, in practically every case, very favourably reviewed in Germany, France, Switzerland, England and elsewhere.

The first publication from the Laboratory was made in 1895, and it appeared, as did also several subsequent articles, in *The American Journal of Psychology*.

* It may not be generally known that the late Professor George Paxton Young had desired to have a Psychological Laboratory opened in Toronto, and that he had, some time before Professor Baldwin was appointed, urged one of his students, J. G. Hume (now Professor Hume), to study under some of the prominent Psychologists in preparation for such work. Professor Young's death and Professor Baldwin's appointment simply hastened matters, therefore; they did not fundamentally change the plans of the Department in this regard.

With the expansion of the University, and the growing spirit of research on the part of Faculty and Senior students, it was felt that we ought to have a publication for such work in connection with the University, and, as a result of this feeling, *The University of Toronto Studies*, was begun. The first publications were along historical lines, but soon a "Psychological Series," among others, was started, and in the present month there will appear the last number of Volume I. of this series. This volume is composed of three numbers: the first, which appeared in the spring of 1898, reports research carried on regarding the Space-Threshold of Colours and its dependence upon contrast,—a very interesting case of colour-blindness is also reported in this number; the second number reports work done on certain Time relations of experience, and on the Time relations of English poetical metres; and number three, contains reports of an admirable piece of research work on Colour-Æsthetics, and of an investigation of the colour-sense of school children. Perhaps I cannot bring the idea of the Department, in the publication of this Psychological Series, before the reader, better than by quoting a few words from Professor Kirschmann's introduction to Volume I., the last number of which is, as I have already intimated, at present in process of publication. He says:—"With the present volume we do not so much desire to augment the number of psychological periodicals as to inaugurate an exponent of psychological research in Canada, which has hitherto been without a representative publication. The Psychological Series of *The University of Toronto Studies* will appear at irregular intervals, and will represent, for the most part, the results of research in the Psychological Laboratory of the University of Toronto, although contributions from elsewhere may be accepted."

In referring to the publications from the Laboratory, I have not referred to the articles, etc., of Professor Kirschmann, because I wished to emphasize especially the fact that our students, undergraduate as well as post-graduate, are carrying on the research work to which I have referred. That the undergraduates in their advanced work participate in actual research is only the carrying out of the Director's opinion that no experimental work of advanced students should be done for the mere sake of practice, but that it should contribute to the solution of some problem. Of Professor Kirschmann's own writings since he has been at the head of the Toronto Laboratory, I need only say that they are somewhat numerous, and that they have commanded the most respectful attention.

It will thus be seen that during recent years our Laboratory has been doing work of worth, and I am not speaking whereof I do not know, when I say that the Psychological Laboratory of the University of Toronto is recognized abroad as, at least in point of research work, of no second-rate importance.

At present there are approximately one hundred students taking lectures and doing work in Honour Psychology. If we deduct from this number probably forty, who are taking the Honour work of the Second year but

who are not registered in the department of Honour Philosophy, we have still sixty students regularly engaged in the study of Scientific Psychology. When this is taken into account it will not be surprising that, recognizing the needs of the department, more space has been provided for its use. In this connection we are deeply indebted, as is every department in the University, to the foresight and interest of President Loudon, who has done so much during the years of his Presidency to foster and advance the highest academic work possible. Some years ago the use of the Ethnological Museum and adjoining rooms was secured, and these have been constantly used since 1896-97. Last year it was decided to utilize the First House of the Old University Residence for scientific purposes, and it was accordingly divided between the Departments of Physics (Electricity) and Psychology. All the rooms at our disposal are being used this session, and they are being fitted up as rapidly as possible for the research which is to be carried on in them. Most of these rooms are, indeed, fully occupied at present.

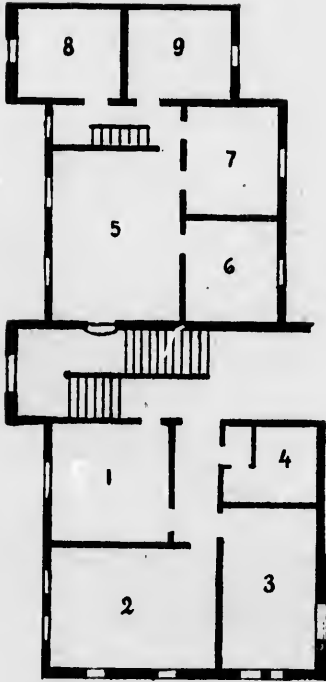
The accompanying ground-plan shows the rooms which are at the disposal of the Laboratory, and the following Index will tell to what purpose they are at present being put:—

- No. 1. Old Lecture Room, at present used for Research in Psychological Optics.
- No. 2. Old Laboratory Room, at present used for Class Demonstrations and for Research in Time and Space Relations of Mental Phenomena.
- No. 3. Director's Private Room.
- No. 4. Dark Room, used for Photographical purposes, etc.
- No. 5. New Lecture Room.
- No. 6. Store Room for Demonstration Apparatus.
- No. 7. Library and Reading Room.
- No. 8. Assistant's Private Room.
- No. 9. Research Room, at present used for the investigation of Colour-Saturation.
- Nos. 10-11. Research Rooms, at present used for experiments on Photometry, etc.
- No. 12. Temporarily loaned as a Private Room for a Lecturer in another Department.
- No. 13. Research Room, at present used for the investigation of the Influence of the Sense of Sight on the estimation of Lifted Weights.
- No. 14. Ethnological Museum, used at present for Research in Colour Aesthetics.
- No. 15. Acoustical Research Room.
- No. 16. Used for Research in Psychological Optics (with annexes).

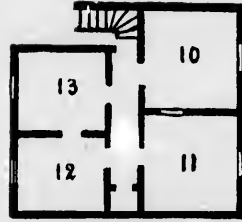
It should not be inferred from the comparatively large number of rooms in use that the Laboratory has great space at its disposal, for six of these rooms (Nos. 8 to 13) are but small attics, and Nos. 15 and 16 are very small and out of the way. Our equipment is still very modest, and leaves much to be desired.

[It may not be quite superfluous to refer very briefly to the relation of the work in Experimental Psychology to the Honour course (for B.A.) in Philosophy.

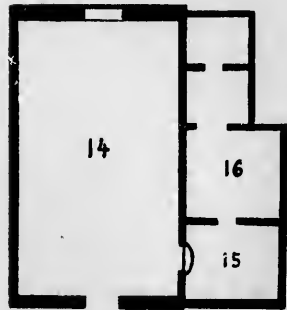
The Honour Course in Philosophy includes Psychology, Logic, Theory of Knowledge, Ethics, History of Philosophy and Metaphysics. This work is arranged to cover three years of the Undergraduate course. Psychology, Experimental and General, covers about one-third of the work in Philosophy; and in Psychology the Experimental part of the work is about one-third in the first year (Sophomore students), and two thirds in the second year, while in the final year all the Psychology takes the form of research work.]



FIRST FLOOR



OVER 5, 6 & 7



SECOND FLOOR

Plan of the Psychological Laboratory of the University of Toronto.

Scale 1 : 300.