

structed is time, which has only one dimension. But not even as a systematic art of analysis or as an experimental doctrine can the empirical doctrine of the soul ever approach chemistry, because in it the manifold of internal observation is separated only by mere thought, but cannot be kept separate and be connected again at will; still less does another thinking subject submit to our investigations in such a way as to be conformable to our purposes, and even the observation itself alters and distorts the state of the object observed. It can, therefore, never become anything more than a historical (and as such, as much as possible) systematic natural doctrine of the internal sense, i.e., a natural description of the soul, but not a science of the soul, nor even a psychological experimental doctrine.³

Psychology, he was saying, lacked a mathematical base that is essential for all sciences. While it has the dimension of time, it has no spatial dimension, since mind is not spatial. And experiment is not possible without both dimensions. While still a part of philosophy, psychology could not hope to be a separate science. In denying the possibility of the experiments and the use of mathematics in the study of the mind, Kant's pronouncement effectively helped to delay the appearance of psychology as an experimental science.

HERBART ON IDEAS AS FORCES, THE THRESHOLD OF CONSCIOUSNESS, THE ESSENTIAL NATURE OF MATHEMATICS, AND THE SIGNIFICANCE OF APPERCEPTION

JOHANN FRIEDRICH HERBART (1776-1841), German philosopher, was led by his metaphysical assumptions to regard the philosophy of mind as the mechanics of the mind. Emerging from this analogy was the view that concepts, that is, actions or ideas as we would call them, are forces, that there is a threshold, at which level ideas appear in consciousness, and that the study of mind necessitates mathematical treatment. Many of his most important contributions to psychological thinking were given preliminary discussion in the opening chapters of his *Textbook of Psychology*, first published in 1816:

10. Concepts become forces when they resist one another. This resistance occurs when two or more opposed concepts encounter one another.

At first let us take this proposition as simply as possible. In this connection, therefore, we shall not think of complex nor of compound concepts of any kind whatever; nor of such as indicate an object with several characteristics, neither of anything in time nor space, but of entirely simple concepts or sensations—e.g., red, blue, sour, sweet, etc. It is not our purpose to consider the general notions of the above-mentioned sensations, but to consider such representations as may result from an instantaneous act of sense-perception.

Again, the question concerning the origin of the sensations mentioned does not belong here, much less has the discussion to do with the consideration of anything else that might have previously existed or occurred in the soul.

The proposition as it stands is that opposed concepts resist one another. Concepts that are not opposed—e.g., a tone and a color—may

exist, in which case it will be assumed that such concepts offer no resistance to one another. (Exceptions to this latter proposition may occur, of which more hereafter.)

Resistance is an expression of force. To the resisting concept, however, its action is quite accidental; it adjusts itself to the attack which is mutual among concepts, and which is determined by the degree of opposition existing between them. This opposition may be regarded as that by which they are affected collectively. In themselves, however, concepts are not forces.

11. Now, what is the result of the resistance mentioned?

Do concepts partially or wholly destroy one another, or not withstanding the resistance, do they remain unchanged?

Destroyed concepts are the same as none at all. However, if not withstanding the mutual attack, concepts remain unchanged, then one could not be removed or suppressed by another (as we see every moment that they are). Finally, if all that is conceived of each concept were changed by the contest, then this would signify nothing more than, at the beginning, quite another concept had been present in consciousness.

The presentation (concept), then, must yield without being destroyed—i.e., the real concept is changed into an effort to present itself.

Here it is in effect stated that, as soon as the hindrance yields, the concept by its own effort will again make its appearance in consciousness. In this lies the possibility (although not for all cases the only ground) of reproduction.

12. When a concept becomes not entirely, but only in part, transformed into an effort, we must guard against considering this part as a severed portion of the whole concept. It has certainly a definite magnitude (upon the knowledge of which much depends), but this magnitude indicates only a degree of the obscuration of the whole concept. If the question be in regard to several parts of one and the same concept, these parts must not be regarded as different, severed portions, but the smaller divisions may be regarded as being contained in the larger. The same is true of the remainders after the collisions—i.e., of those parts of a concept which remain unobscured, for those parts are also degrees of the real concept.

13. When a sufficiency of opposition exists between concepts, the latter are in equilibrium. They come only gradually to this point. The continuous change of their degree of obscuration may be called their movement.

The statics and mechanics of the mind have to do with the calculation of the equilibrium and movement of the concepts.

14. All investigations into the statics of the mind begin with the different quantitative factors, viz., the sum (or the aggregate amount) of the resistances and the ratio of their limitation. The former is the quantity which rises from their encounter, to be divided between the opposing concepts. If one knows how to state it, and knows also the ratio in which the different concepts yield in the encounter, then, by a simple calculation in proportion, the statical point of each concept—i.e., the degree of its obscuration in equilibrium—may be found.

15. The sum as well as the ratio of the mutual limitation depends upon the strength of each individual concept which is affected in inverse ratio to its strength, and upon the degree of opposition between the two concepts. For their influence upon each other stands in direct ratio to the strength of each.

The principle determining the sum of the mutual limitation is, that it shall be considered as small as possible, because all concepts strive against suppression, and certainly submit to no more of it than is absolutely necessary.

16. By actual calculation, the remarkable result is obtained that, in the case of the two concepts, the one never entirely obscures the other, but, in the case of three or more, one is very easily obscured, and can be made as ineffective—notwithstanding its continuous struggle—as if it were not present at all. Indeed, this obscuration may happen to a large number of concepts as well as to one, and may be effected through the agency of two, and even through the combined influence of concepts less strong than those which are suppressed.

Here the expression "threshold of consciousness" must be explained, as we shall have occasion to use it. A concept is in consciousness in so far as it is not suppressed, but is an actual representation. When it rises out of a condition of complete suppression, it enters into consciousness. Here, then, it is on the threshold of consciousness. It is very important to determine by calculation the degree of strength which a concept must attain in order to be able to stand beside two or more stronger ones exactly on the threshold of consciousness, so that, at the slightest yielding of the hindrance, it would begin to rise into consciousness. . . .

17. Among the many, and, for the most part, very complicated laws underlying the movement of concepts, the following is the simplest:

While the arrested portion (*Hemmungssumme*) of the concept sinks, the sinking part is at every moment proportional to the part unsupported.

By this it is possible to calculate the whole course of the sinking even to the statical point.

NOTE.—Mathematically, the above law may be expressed:

$\sigma = S (t, \sigma')$ in which $S =$ the aggregate amount suppressed, $t =$ the time elapsed during the encounter, $\sigma' =$ the suppressed portion of all the concepts in the time indicated by t .

As the latter quantity is apportioned among the individual concepts, it is found that those which fall directly beneath the statical threshold (16) are very quickly driven thence, while the rest do not reach exactly their statical point in any given finite time. On account of this latter circumstance, the concepts in the mind of a man of most equable temperament are, while he is awake, always in a state of gentle motion. This is also the primary reason why the inner perception never meets an object which holds it quite motionless.

18. When to several concepts already near equilibrium a new one comes, a movement arises which causes them to sink for a short time beneath their statical point, after which they quickly and entirely of themselves rise again—something as a liquid, when an object is thrown into it, first sinks and then rises. In this connection several remarkable circumstances occur:

19. First, upon an occasion of this kind, one of the older concepts may be removed entirely out of consciousness even by a new concept that is much weaker than itself. In this case, however, the striving of the suppressed concept is not to be considered wholly ineffective, as shown above (see 16); it works with all its force against the concepts in consciousness. Although its object is not conceived, it produces a certain condition of consciousness. The way in which these concepts are removed out of consciousness and yet are effective therein may be indicated by the expression, "They are on the mechanical threshold." The threshold mentioned above (16) is called for the sake of distinction the statical threshold.

20. Second, the time during which one or more concepts linger upon the mechanical threshold can be extended if a series of new, although weaker, concepts come in succession to them.

Every employment to which we are unaccustomed puts us in this condition. The earlier concepts are pressed back of the later ones. The former, however, because they are the stronger, remain tense, affect the physical organism more and more, and finally make it necessary that the employment cease, when the old concepts immediately rise, and we experience what is called a feeling of relief which depends in part upon the physical organism, although the first cause is purely psychological.

21. Third, when several concepts are driven in succession to the mechanical threshold, several sudden successive changes in the laws of reciprocal movements arise.

In this way is to be explained the fact that the course of our thoughts is so often inconsequent, abrupt, and apparently irregular. This appearance deceives in the same way as the wandering of the planets. The conformity to law in the human mind resembles exactly that in the firmament....

22. The easily conceivable metaphysical reason why opposed concepts resist one another is the *unity of the soul, of which they are the self-perservations*. This reason explains without difficulty the combination of our concepts (which combination is known to exist). If, on account of their opposition, they did not suppress one another, all concepts would compose but one act of one soul; and, indeed, in so far as they are not divided into a manifold by any kind of arrests whatever, they really constitute but one act. Concepts that are on the threshold of consciousness cannot enter into combination with others, as they are completely transformed into effort directed against other definite concepts, and are thereby, as it were, isolated. In consciousness, however, concepts combine in two ways: First, concepts which are not opposed or contrasted with one another (as a tone and a color) so far as they meet *unhindered, form a complex*; second, *contrasted concepts* [e.g., red and yellow], in so far as they are effected neither by accidental foreign concepts nor by unavoidable opposition, become blended (*fused*).

Complexes may be complete; blendings (fusions) from their nature must always be (more or less) incomplete.

NOTE.—Of such complexes as are partially or almost complete, we have remarkable instances in the concepts of things with several characteristics and of words used as signs of thoughts. In the mother-tongue the latter, words and thoughts, are so closely connected that it would appear that we think by means of words. (Concerning both examples more hereafter.) Among the blendings are especially remarkable, partly those which include in themselves an aesthetic relation (which, taken psychologically, is created at the same time with the blending), partly those which involve succession, in which serial forms have their origin.

23. That which is complicated or blended out of several concepts furnishes an aggregate of force, and for this reason works according to quite other statical and mechanical laws than those according to which

sciousness change according to the complex or blending (fusion), so that on account of a combination a concept of the very weakest kind may be able to remain and exert an influence in consciousness.¹

With the very first sentence of this excerpt, a distinctive and important addition is being made to the earlier, rather passive British ascensionism. Concepts (ideas) are forces that resist one another. Herbart also considers attraction of ideas and ideas that neither resist nor attract. Ideas may be suppressed. Ideas, once in consciousness, may no longer be available, but by shifts in the patterns of ideas, return to consciousness. This return to consciousness results in introducing the concept of a threshold to conscious experience which he expresses in the formula in the excerpt (p. 92). However, there are many others throughout the rest of the work. It is important to realize that these formulas, while mathematical, were not made quantitative by use of actual data. They were expressions of the way Herbart *thought* the factors considered would relate to one another. Nevertheless, Herbart was insisting that mathematics is essential to the science of psychology in the face of the very formidable and contrary position of Kant (p. 87).

Early in life, he had been influenced by the teachings of Johann Pestalozzi, a prominent Swiss educator of the late eighteenth century. They became one of the themes of his thinking. Most noteworthy was his promulgation of the concept of *apperceptive mass*.

39. From the foregoing, it may, in a way, be perceived that after a considerable number of concepts in all kinds of combinations is present, every new act of perception must work as an excitant by which some will be arrested, others called forward and strengthened, progressing series interrupted or set again in motion, and this or that mental state occasioned. These manifestations must become more complex if, as is usual, the concept received by the new act of perception contains in itself a multiplicity or variety, that at the same time enables it to hold its place in several combinations and series, and gives them a fresh impulse which brings them into new relations of opposition or blending with one another. By this, the concepts brought by the new act of perception are assimilated to the older concepts in such a way as to suffer somewhat after the first excitation has worked to the extent of its power, because the old concepts—on account of their combinations with one another—are much stronger than the new individuals which are added.

40. If, however, already very strong complexes and blendings with many members have been formed, then the same relation which existed between the old and the new concepts may be repeated within between

and new concepts. Weaker concepts, which, according to any kind of law enter into consciousness, act as excitants upon those masses before mentioned, and are received and appropriated by them (apperceived) just as in the case of a new sense-impression; hence *the inner perception* is analogous to the outer. Self-consciousness is not the subject of discussion here, although it is very often combined with the above.

41. In what has been said, lies that which experience confirms, viz., that the inner perception is never a passive apprehension, but always (even against the will) active. The apperceived concepts do not continually rise or sink according to their own laws, but they are interrupted in their movements by the more powerful masses which drive back whatever is opposed to them although it is inclined to rise; and in the case of that which is similar to them although it is on the point of sinking, they take hold of it and blend it with themselves.

42. It is worth the trouble to indicate how far this difference among concepts—which we might be inclined to divide into dead and living—may be carried.

Let us recall the concepts on the statical threshold (16). These are indeed, in effect nothing less than dead; for, in the condition of arrest in which they stand, they are not able by their own effort to effect anything whatever [oward rising into consciousness]. Nevertheless, through the combination in which they stand, they may be reproduced, and, besides they will often be driven back in whole heaps and series by those more powerful masses, as when the leaves of a book are turned hurriedly.

43. If the apperceived concepts—or at least some of them—are no on the statical threshold, then the apperceiving concepts suffer some violence from them; also the latter may be subject to arrest from another side, in which case the inner perception is interrupted; through this uncertainty and irresolution may be explained.²

He is saying that information is acquired most easily when it is introduced through articulation within an already familiar pattern of ideas. Lesson planning on this basis has become a standard educational practice to this very day.

Turning to his overall significance, despite the lack of actual measurement, his endorsement of mathematics applied to psychological problems did serve as an object lesson to later model builders and, more specifically, encouraged Fechner in his combination of mathematics and experience (p. 107).