parative, child psychology, and abnormal psychology. Here belong, also, hypnotic investigations.

More or less opposition in view-points also exists between Descriptive and Genetic, Pure and Applied psychology. During the last two decades the applications of psychology have been numerous and it has been brought into close connection with pedagogy, psychiatry, jurisprudence, national economy, art and language, research and theology. One of the most recent sensational applications of experimental psychology is the application of the association method in the service of justice. In the October number of McClure's, Prof. Münsterberg gives an account of his experiments with the criminal Harry Orchard. Cohnstaedt has, however, raised serious objections as to the validity of results obtained by this method.

In the more modern psychology are also certain oppositions dependent upon the different directions taken by investigation. These are the oppositions between Phenomenal and Functional psychology, between Nativism and Empiricism, Atomistic and Unitary, Voluntaristic and Non-voluntaristic, Apperception and Association, Normal and Abnormal psychology. THEODATE L. SMITH.

Die Cellularphysiologische Grundlage des Gedächtnisses, von MAX VERWORN. Zeitschrift der Allgemeinbiologie, Vol. 6, 1906, pp. 118-139.

Ueber die materiellen Veranderung bei der Assoziationsbildung, von Geh. Medizinalrat PROF. DR. GOLDSCHEIDER in Berlin. Neurologisches Centralblatt, Vol. 25, 1906, pp. 146-157.

Both Verworn and Goldscheider look upon "nerve-paths," whether of memory, association, or habit, as nutritive effects of functional exercise. In nerve-cells, as well as in muscle or gland-cells, the catabolism of exercise is followed by the anabolism of rest, which not only restores the cell to its original size and strength, but increases it somewhat. Within limits, the exercise of the function creates the mass of the cell. The millions of undeveloped cells in the brain would develop if only they were sufficiently exercised.

This increase in the mass of the protoplasm in the cell results in greater instability and in a correspondingly heightened power of functional discharge. A large cell discharges more powerfully than a small one for the same reason that a large amount of gunpowder produces a greater explosion than a small amount. Because of its greater instability, the large cell has a lower threshold and is therefore more easily discharged than is a small unexercised one.

At birth the cortical cells are yet embryonic. Sensory cells are the first to be exercised by incoming stimuli. In the beginning they lack the size and strength necessary to discharge into the adjacent cells with sufficient intensity to set off the latter. Exercise confers the power to break through the cell-separation and to discharge the next cell in the chain; its discharge causes it to grow through exercise until it also has acquired the capacity to discharge a still further one in the chain; and so on indefinitely. Thus association chains are formed. The "paths" which impressions leave in the nervous system are therefore only increased growth-effects in the exercised elements. The "path" is the line of least resistance through the developed cells of low threshold and high power of discharge. The impulse once started along the line cannot run off into other previously unexercised cells because of their higher threshold and their lower power to carry forward the impulse to further cells.

These "traces" are latent for consciousness so long as the cells are at rest; but if any stimulus whatever starts the chain of discharges,

these will occur in the way the cells have been previously exercised,—the same neural series, the same mental accompaniments. Lack of exercise leads to atrophy of nerve-cells just as it leads to atrophy of any other kind of cells. Forgetting is therefore a nutritive effect; unexercised cells finally become too feeble to break through the points of cell-separation with sufficient intensity to set off the next cells in the chain and thus arouse the memory.

So far Verworn. He is indisposed to admit any factors except those nutritive ones that apply to all kinds of living cells. He regards the greater instability of the protoplasm of the developed cells as the result only of greater mass with the consequently greater tendency to break down. He admits the possibility of changed chemical structure in the exercised protoplasm, but considers it problematical and unnecessary to an explanation of the phenomena.

Goldscheider lays more emphasis upon changed molecular structure. In this connection he makes use of Verworn's *Biogenhypothese* and Ehrlich's *Seitenkettenhypothese*. He also ascribes greater importance to the fibres. He thinks those fibres and portions of fibres that are exercised will acquire greater functional instability than the unexercised ones. An incoming impulse will therefore tend to discharge along those fibre-branches that have been rendered most permeable by exercise, and to avoid those more stable non-exercised fibre-branches. He makes much of the neurone-ends where the impulse passes across from one neurone to another, regarding the protoplasmic molecules of these regions as particularly unstable. His view may be illustrated as follows:

An object presented before the eyes, for example, simultaneously arouses a number of cells in the visual area. Where a fibre from one aroused cell is in functional contact with a fibre from another aroused cell, the activity in each fibre affects the catabolic changes going on in the other, resulting in a greater chemical disintegration in each fibre than would have been the case if the other had not been active at the same time. This greater catabolism leads in the following state of rest to greater anabolism, and, consequently, greater instability in these adjacent exercised fibres than in any of the other fibres which may have been just as near but which were functionally inactive at the time. Thus are formed associative lines of least resistance through fibres simultaneously stimulated (*Knotenpunktlinie. Kraftlinienresultante*). Frequent repetition of the simultaneous stimulations accentuates the effects and renders the lines of conduction more permeable and more permanent.

In the same way fibre-lines of low resistance and high powers of influence are formed by functional exercise between dissimilar sensory areas, between these and motor areas and the like. There may be many intermediate cells and neurone tracts. The one important factor is the nutritive result all along the line of high potential energy due to mass and molecular structure, and the low threshold of both cells and fibres due to a heightened instability in the protoplasm. At first the lines will possess unequal degrees of development at different points along their course; the result will be deflections, inaccuracies and error. Practice will have a cumulative nutritive effect, producing in time a uniform permeability in all parts with attendant ease, rapidity and precision. J. F. BOBBITT.

Die Mechanik des Geisteslebens, von MAX VERWORN. Leipzig, B. G. Teubner, 1907. pp. 104.

This little book gives the practically unchanged text of a series of five popular lectures on the 'mechanics of the mental life.' Lecture