Mitogenetic Radiation and the Theory of Nerve Excitation

Mitogenetic Analysis of the Excitation of the Nervous System

By Prof. A. G. Gurwitsch. Pp. ii + 114. (Amsterdam: N. V. Noord-Hollandsche Uitgeversmaatschappij, 1937.) 3.75 f.

THE outcome of Prof. A. G. Gurwitsch's latest monograph is a new 'chain reaction' theory of excitation, based, in its more concrete form, on the experimental results described in the body of the book. The peculiarity of the new theory is that it allows for the existence of many qualitatively different states of excitation, while ignoring completely the electrical, thermal and chemical phenomena studied by classical methods. The more general considerations which appear in the concluding chapter will perhaps receive better attention, and will doubtless awaken the sympathy of those who, with Gurwitsch, feel that the study of electrical changes in artificially stimulated nerve affords an inadequate basis for the comprehension of the "unlimited variability . . . and the continuity of functional states" of the nervous system. These ideas are derived from Driesch and from Gurwitsch's earlier work on the "cerebral field", and owe little to his study of mitogenetic radiation.

The experimental foundation of the new theory is somewhat as follows: Resting medullated nerve, in common with many other biological systems, is said to emit a complex ultra-violet spectrum of exceedingly low intensity, which originates in the nerve fibre itself. The medullary sheath, although highly opaque to ultra-violet radiation of macroscopic intensity, contrives to transmit the radiation emitted from the nerve fibre by a remarkable chain process of absorption and secondary emission, so that it can conveniently be observed externally by its effect on the rate of division of yeast cells—an aspect of the subject that has already been subjected to destructive criticism (see *Biol. Rev.*, **10**, 42 (1935); and NATURE, **133**, 860 (June 9, 1934)). "Biological" spectral analysis of the radiation, and comparison with that produced by enzyme reactions proceeding *in vitro*, suggest that it can be used as an index of the chemical processes occurring in nerve. It is found that whereas the resting sciatic emits radiation due to glycolysis, oxidation and proteolysis, the stimulated nerve gives a different radiation, the composition of which depends on the mode of excitation—mechanical, electrical, reflex, etc. Thus, in Gurwitsch's opinion, the existence of a qualitative variability of states of excitation is established. Sub-threshold stimuli, moreover, also give rise to a propagated disturbance, accompanied by characteristic chemical changes, so that the all-or-none law appears to be a mere artefact, ascribable to the too exclusive interest of classical physiologists in action currents, excitability, and so forth.

Not only does nerve show this variability of response to stimuli of the usual type; it also responds, with a propagated wave of chemical action, to intermittent exposure to mitogenetic radiation from some other source. This so-called "mitogenetic excitation" appears after a latent period of 0·001 sec., is transmitted at a rate of 30 m./sec., and its nature varies with the nature of the exciting radiation. A single line from the glycolytic spectrum, of wave-length 217–218$\mu\mu$, say, will set up a propagated disturbance involving emission of this same line, and, in addition, of other lines of the glycolytic spectrum—one, for example, at 190–192$\mu\mu$. An interesting case, as Gurwitsch puts it, of "antistokes". A pure glucose solution, it may be mentioned, shows a similar secondary excitation which travels through the solution at a rate of 10–12 m./sec.

With regard to the behaviour of the central nervous system, Gurwitsch has studied the radiation emitted from the surface of the optic chiasma, the optic lobes, the hemispheres and the medulla of a frog stimulated visually. He finds that the "visual act" is accompanied by emission of radiation from all these regions; the stationary spatial distribution intensities in the cortex are a function of the nature of the stimulus—varying, for example, when a white visual field is replaced by a moving black pattern on a white ground, although a half white and half black field gives the same pattern, whether the black or the white portion forms the upper half. The spectra from the optic nerve and the hemispheres are also different with stimuli of different colours.

Sufficient has been said to indicate the general nature of Gurwitsch's experimental evidence, although it is not possible in a short review to deal with all its complexities, and surely not necessary to indulge in any lengthy criticism. Gurwitsch's discoveries speak for themselves, and the reviewer may be forgiven for taking to heart the author's advice, in a footnote dedicated to his critics, "to act more cautiously in the future, in order not to find themselves in a ridiculous position". He may nevertheless be allowed to suggest that the discoveries in question are open to serious doubt on physical, chemical and physiological grounds.

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