The matter is discussed in an article on metrology, by Mr. Sears, which will appear in the forthcoming volume of the "Dictionary of Applied Physics."

R. T. GLAZEBROOK.

Coton End, 63 Grange Road, Cambridge, September 9.

On the Reality of Nerve-Energy.

IF I have understood Prof. Fraser Harris's letter in NATURE of September 9, p. 342, it is a plea for the more widespread use of the term "nerve-energy" by physiologists and for the investigation of it as a special manifestation of energy like heat, light, or electricity. It is no doubt quite true that the term has a definite and useful meaning in psychology and psycho-pathology, though "mental energy" would probably do as well in most cases.

As a physiological concept, however, "nerve-energy" has little to recommend it. Some idea of the difficulties which are likely to attend its use may be seen even in Prof. Harris's letter; moreover, there is very little need to postulate a special kind of energy to explain the nervous impulse and its conduction, for of all the different activities of living cells that of conduction can be most readily described in terms of physics and chemistry.

The momentary change which makes the nervous impulse seems to consist in a depolarisation of the surface layers of the nerve fibre, a resulting increase in permeability, and an escape of ions from the interior of the fibre. The movement of ions brings about an increase of permeability in further sections of the fibre and a decrease in the sections previously active, so that the disturbance spreads but does not last for more than a brief time at any one point. The process is so simple in its essentials that Prof. Lillie has been able to construct model nerve fibres of iron wires coated with a film of passive iron and immersed in nitric acid. These models copy the behaviour of a nerve fibre with surprising fidelity.

For some time past, evidence has accumulated in favour of this explanation; it would be quite misleading to suggest that every detail of the conduction of the impulse is understood, but the broad outlines of the "membrane theory" have not been seriously challenged. The energetics of the process were worked out by Bernstein. The system loses free energy when the ions escape from regions of high to regions of low concentration, and ultimately this must be replaced by the metabolism of foodstuffs in the fibre. The splitting up of a large molecule into a number of smaller ones would suffice to restore the concentration differences upon which the movement of ions depends, and at various stages heat may be given out or absorbed from the surroundings. In no part of this scheme is there any need, or any opportunity, for the introduction of a special form of energy peculiar to nerves.

If the term "nerve-energy" is to be retained it might be used to mean the total potential energy in the neurone available for use in the transmission of impulses, but it is doubtful whether much would be gained by the measurement of this quantity. Prof. A. V. Hill has shown that the energy expended in the passage of a single impulse is extremely small, and the neurone is able to replenish its stores continually from the nutrient fluids which surround it. When failure of conduction occurs it seems to be due more often to a failure of the surface reaction than to an exhaustion of the store of potential energy in the fibre.

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Interspecific Sterility.

IN his letter on this subject (September 2, p. 312), Mr. Harrison states some interesting facts regarding the chromosome numbers in Salix. This appears to be the first case in plants where tetraploidy is accompanied by very little external change. Both tetraploid and hexaploid numbers in a genus have long been known, for example in Musa, but the point of my remark regarding interspecific sterility in crosses between diploid and tetraploid forms appears to have been missed. It is not that there is any difficulty in making such crosses in the first place. Usually they are easily made, but the result is a triploid form with an unstable chromosome content.

If such crosses between a diploid and a tetraploid species occur in Nature, they cannot lead to a permanent, stable form, except by apogamous reproduction. The hybrid may cross back with either parent, but this leads again to new and irregular chromosome numbers, with the result that, in the absence of apogamy, stability will be reached only when the extra chromosomes have been lost and the number has reverted to the diploid, or possibly in some cases to a balanced intermediate number. The two parental species, respectively diploid and tetraploid, will in the meantime each have carried on its own line of descent.

It follows that if a tetraploid form arises from a diploid species in Nature, it will continue to breed true, while its hybrids with the parent species will not give rise to a permanent line of descent unless there is apogamous reproduction. This is, for practical purposes, a condition of physiological isolation. *Spiranthes cernua* is a probable example of this sort, and there are many others. Once two such independent lines of descent are established, the divergence between them may go on increasing as fresh variations occur in each series.

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Micro-Chemical Methods in the Practical Teaching of Chemistry.

IN view of the strenuous efforts now being made by education authorities in this country to economise on educational expenditure, considerable interest attaches to Prof. Egerton Grey's letter on the application of micro-chemical methods in the teaching of chemistry (NATURE, September 2, p. 309). During the War we conducted a course of practical instruction in chemistry in the Internment Camp for Civilian Prisoners of War in Ruhleben, and the difficulty of procuring large quantities of reagents led to the adoption of "Micro" methods wherever possible. Although we had at times forty students preparing for university examinations, the consumption of chemical reagents was extremely small in comparison with what would be required in the ordinary way. To give just one example, half a litre of nitric acid—a precious liquid in the camp—was found sufficient to supply the needs of these students for several months. One enterprising student fitted for himself a fully equipped "micro" laboratory in a tiny corner of his loft and undertook interesting research work.

A further advantage of the method is that the quantities involved are so small that the students can study the chemical properties of many of the rarer elements with great advantage to themselves and small expense to the laboratory. We are in hearty agreement with Prof. Grey as to the economic and educational advantages of the micro-chemical methods.

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