Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Physico-Chemical Experiments on the Amphibian Organiser

THE process of induction by organisers, discovered during the last twelve years by Spemann and his collaborators, is now recognised to be among the most important morphogenetic factors in early embryonic development. The exact nature, therefore, of the organising influence exerted by the dorsal lip of the blastopore on surrounding regions, is a subject of peculiar interest. Recent experiments[1,2,3,4] have given strong support to the view that induction is due to a definite chemical substance, since the organiser tissue can be narcotised, crushed, dried, frozen, or boiled, without loss of its inductive power. Holtfreter[5], indeed, has shown that regions of the newt embryo, such as the ventral ectoderm, which do not normally possess inductive power, acquire it after being boiled.

We have now succeeded in obtaining inductions in *Triton* gastrulæ from extracts of whole neurulæ. The cell structure was completely destroyed by crushing, and the lipid-protein granules of the yolk, together with other debris, removed by centrifuging. Since the neurulæ are crushed in as small a volume of water as possible, the cell-free extract is concentrated, and can, owing to its contained protein, be coagulated by pouring on to a warm glass plate. This solid material, when implanted into the blastocœle cavity of a gastrula (*Einsteckung*), will induce the formation of neural tube, and, more commonly, of unorganised but histologically recognisable neural cells.

Although the fatty material in the cell-free extract collected at the surface on centrifuging, a complete separation of the fatty and aqueous phases was not possible. But by grinding neurulæ with anhydrous sodium sulphate, and extracting the mass with ether or with petrol-ether in a micro-Soxhlet apparatus, we succeeded in obtaining active material which induced the formation of neural tubes or, more commonly, solid rods, and other masses of tissue which were probably neural in character. As there is reason to believe, partly from older work[6,7], that the inductive power is also contained in the organs of larval or adult Amphibia, we prepared petrol-ether extracts of the viscera of the adult newts, and although, owing to the ending of the season, our experiments had to be left off, we have obtained strong positive indications that the active substance is present there also. Experiments in which the unsaponifiable portion only of the ether extract was employed, have not yet given clear results, and must be continued at the earliest opportunity.

The number of perfect inductions so far obtained with all these extracts is small in relation to the number of embryos which survived the operation, but it must be remembered that the surface relationships of the active substance are destroyed by the chemical processes of isolation, and that the implantation takes place into a living system, in which, owing to its lack of circulation, rather long-range diffusion processes are probably the limiting factors. A large number of control experiments, in which other substances were implanted, for example, agar, celloidin, egg albumen, pure triglycerides, and mixtures of triglycerides with sterols, gave no induction effects. The positive results with embryo extracts cannot, therefore, be attributed to mechanical stimulation.

It is probable that the action of the primary organiser has two aspects, first, the induction of an embryonic axis in competent ectoderm, and secondly, the determination of the regional character of the axis[8,9]. On the evidence at present available, only the first of these two aspects is exhibited by dead organisers or organiser extracts. This first aspect, the 'induction-as-such' of an embryonic axis, is brought about in different cases by rather widely distributed agents, as is shown by heteroplastic transplantations between urodeles and anurans[10], and between birds and mammals[11].

In our opinion, the evidence now brought forward indicates very strongly that in the Amphibia this agent is a definite chemical substance, certainly soluble in ether, and probably of a lipoidal nature.

C. H. WADDINGTON.
JOSEPH NEEDHAM.
DOROTHY M. NEEDHAM.

Abteilung für Entwicklungsmechanik
(Prof. Otto Mangold),
Kaiser-Wilhelm Institut für Biologie,
Berlin-Dahlem.
July 2.

[1] Spemann, H., *Ver. deutsch. zool. Gesell.*; 1931.
[2] Bautzmann, H., Holtfreter, J., Spemann, H. and Mangold, O., *Naturwiss.*, **20**, 971; 1932.
[3] Marx, A., *Archiv. Entwicklunsgmech.*, **123**, 333; 1931.
[4] Waddington, C. H., NATURE, **131**, 275, Feb. 25, 1933.
[5] Holtfreter, J., *Archiv. Entwicklungsmech.*, **128**, 584; 1933.
[6] Mangold, O., *Archiv. Entwicklungsmech.*, **117**, 586; 1929.
[7] Holtfreter, J., *Archiv. Entwicklungsmech.*, **117**, 421; 1929.
[8] Spemann, H., *Archiv. Entwicklungsmech.*, **123**, 389; 1931.
[9] Waddington, C. H. and Schmidt, G. A., *Archiv. Entwicklungsmech.*, **128**, 522; 1933.
[10] Geinitz, B., *Archiv. Entwicklungsmech.*, **106**, 357; 1925.
[11] Waddington, C. H., unpublished work.

Behaviour of Electrons and 'Holes' in Cuprous Oxide

IT is a remarkable feature of electron conductivity that an insulating crystal becomes conducting so soon as one section of it is illuminated by active light. The same phenomenon was found both in the experiments of Kikoin and in our own investigation on multicrystalline cuprous oxide plates. At liquid air temperature the current between E and F (Fig. 1) increases a hundredfold if a small section, S_1 S_2, be illuminated. Thus not only have we a stream of electrons from the illuminated section to the anode,

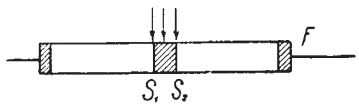

FIG. 1.

but necessarily a supplementary stream between the cathode and S_1 S_2 also; the latter must be ascribed to the movement of free 'holes' in a fully occupied band of electron levels, which is equivalent to a stream of 'positive electrons'.

Since the mechanism of the current is different on the two sides of the section S_1 S_2, we expected a distinction in specific conductivities. To test this, we illuminated a section adjacent to the electrode E.