

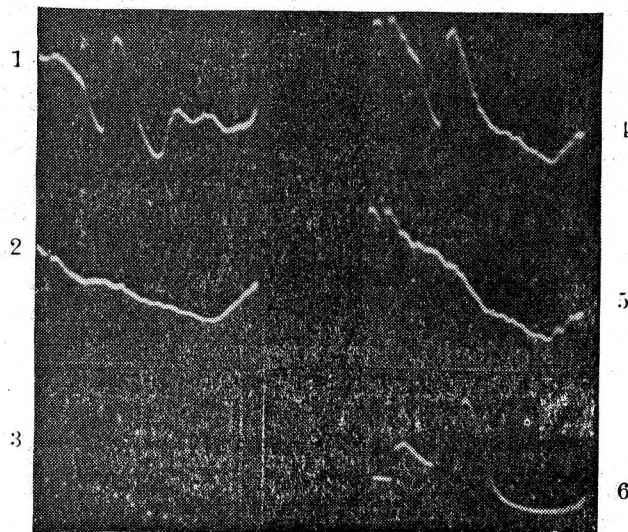
Single-Fibre Response from an Intact Animal

It is rather difficult to obtain electrical records of the activity of a single nerve fibre, because there are usually present some hundreds of other nerve fibres the contribution of which must be eliminated, and because the shunting of the active fibre by inert tissues or tissue fluid reduces the available action potential to vanishing proportions. It is therefore essential in most cases that the recorded fibre be fairly well isolated both physiologically and electrically, and we are not aware that any records have hitherto been published showing single fibre responses obtained from an animal which has not been dissected nor operated upon in any way.

The median giant fibre in the nerve cord of the common earthworm, *Lumbricus terrestris* L., is especially favourable for such a record, for it may be physiologically isolated from other structures and it has such a large cross-section area that a fair amount of shunting may be tolerated¹.

If a normal lively worm is used the nerve activity is accompanied by muscular action which complicates the record, but if the worm lies in a glass tube just large enough to contain it, it remains quiescent and the record is fairly simple. The nerve is stimulated by a shock applied to the anterior end of the worm, and the record is obtained from leads passing through the glass tube and making contact with the worm's body in the middle region. These leads connect through a balanced amplifier to a cathode ray tube with time base synchronized with the nerve stimulus.

The first record shows the effect of a just threshold stimulus; the least diminution of stimulus gives the



second record. The response therefore exhibits the all-or-none relation to stimulus-strength, it also persists unfatigued by a tetanus of 20 per sec. and is conducted at the same rate as the impulse in the median giant fibre of the nerve cord. This result therefore strongly favours the view that the wave in record (1) is the action potential of the median giant fibre or of structures connected therewith. The grounds upon which we believe that the record does contain the action potential of this fibre itself are these.

The area of cross-section of the median fibre is 0.01 sq. mm., that of the worm filling the glass tube 20 sq. mm. Assuming the mean specific conductivity of the worm to be half that of the giant fibre, the electrical shunting would reduce the recorded wave to 1/1,000 of the nerve membrane potential of 0.1 volt. Hence the recorded wave should be 0.1 mv., which is seen to be of the right order from record (3), which gives a calibration wave of 1,000 cycles at 0.1 mv., peak-to-peak.

The worm is now withdrawn from the tube, opened by a longitudinal incision, and the nerve cord is carefully dissected out and placed in Ringer's fluid. The carcass is replaced in the tube and stimulated as before, but the record shows no wave and is not here reproduced. The carcass is now withdrawn and the nerve cord replaced in it and re-inserted in the tube. The physiological connexions from nerve to worm are now, of course, all destroyed, but the electrical shunting is approximately the same as initially, and records (4) and (5) show the effects of a shock just above and just below threshold, with recording conditions the same as in record (1). The main wave of the first record is repeated, but the subsequent small waves are absent. Finally the carcass was removed, and the nerve cord alone stimulated to give the last record taken at much reduced amplification.

Now this last record is certainly the wave from the median giant fibre, as may be shown by microdissection². Thus the wave in record (4) is clearly the same, but more highly shunted by the carcass. Hence the main wave of record (1) is simply the action potential of the single median giant nerve fibre, and this is followed in the intact animal by other waves with which we are not here concerned.

W. A. H. RUSHTON.

H. B. BARLOW.

Physiological Laboratory,
Cambridge.
Oct. 24.

¹ Eccles, J. C., Granit, R., and Young, J. Z., *J. Physiol.*, **77**, 23P (1933).

² A paper including the identification of potential waves in the worm's isolated cord is being prepared by one of us.