January 21, 1897.

Sir JOHN EVANS, K.C.B., D.C.L., LL.D., Vice-President and Treasurer, in the Chair.

A List of the Presents received was laid on the table, and thanks ordered for them.

The Right Hon. Sir John Eldon Gorst, a member of Her Majesty's Most Honourable Privy Council, was admitted into the Society.

The following Papers were read:—

I. "On *Cheirostrobus*, a new Type of Fossil Cone from the Calciferous Sandstones." By D. H. SCOTT, M.A., Ph.D., F.R.S.

II. "Experiments in Examination of the Peripheral Distribution of the Fibres of the Posterior Roots of some Spinal Nerves. Part II." By C. S. SHERRINGTON, M.D., F.R.S., Holt Professor of Physiology, University College, Liverpool.

III. "Cataleptoid Reflexes in the Monkey." By C. S. SHERRINGTON, M.D., F.R.S., Holt Professor of Physiology, University College, Liverpool.

IV. "On Reciprocal Innervation of Antagonistic Muscles. Third Note." By C. S. SHERRINGTON, M.D., F.R.S., Holt Professor of Physiology, University College, Liverpool.

"Experiments in Examination of the Peripheral Distribution of the Fibres of the Posterior Roots of some Spinal Nerves. Part II." By C. S. SHERRINGTON, F.R.S., Holt Professor of Physiology, University College, Liverpool. Received November 12, 1896,—Read January 21, 1897.

(Abstract.)

This paper is in continuation of one brought before the Society in 1892, and published in 'Phil. Trans.,' B, vol. 184. In that communication the peripheral distribution of the sensory nerve-roots of the sacro-lumbar and the thoracic regions was examined. In the present the examination is extended to the cervical and brachial sensory

roots, and to the skin distribution of the cranial nerves. The communication is divided into four sections. In Section I the field of peripheral distribution of each root is described from the Vth cervical to the lower end of the brachial region. The description given is taken in each case from one particular experiment, which has proved a typical one for the root in question, and then deviations from this type are appended to it in the form of annotations. Particular attention was paid to the question of the skin-fields of the several divisions, ophthalmic, maxillary, and mandibular of the cranial Vth, in order to see if the fields possessed the characters of segmental skin-fields, or those of peripheral nerve-trunk skin-fields. They were found to conform with the latter, not with the former. A curious relation of the posterior edge of the field of the Vth to the external ear is found to exist, indicating that the position of the visceral cleft is still adhered to as a boundary line for the field of the trigeminus. The sense of taste as well as of touch is found to be destroyed in the anterior two-thirds of the tongue after intracranial section of the Vth; this makes it extremely doubtful whether the corda tympani can have gustatory functions in the monkey, as has been believed in some cases in man. No loss of eye-movements, or interference with them, has been found to result from intracranial section of the Vth.

The results obtained on the various successive nerve-roots cannot well be abstracted. The glossopharyngeal field on the tongue has been successfully delimited.

After cranial Vth and all the upper cervical posterior roots have been severed, there still persists a small field of sentient skin, which includes the external auditory meatus and a part of the pinna. This field, although not corresponding to the situation given by anthropotomists to the distribution of the auricular branch of the vagus, comes either from it or the glossopharyngeal. It presents interest as being the only field representing the whole cutaneous distribution of an entire nerve, which does not conform with the rules of zonal distribution holding good in the case of each of the other nerve-roots examined, and these now include the whole series. The posterior root of the Ist cervical nerve has a skin-field in the cat which includes the pinna. The posterior root of the same nerve in Macacus has no skin-field at all, its skin-field having apparently been included in the IInd cervical of Macacus, not in the cranial Vth. The root fields contributing to the surface of the brachial limb are IIIrd, IVth, Vth, VIth, VIIth, and VIIIth cervical, and Ist, IInd, and IIIrd thoracic. Of these, the VIIIth cervical is the only one which includes the whole of the surface of the free apex of the limb; its distribution in this respect closely resembles that of the VIth lumbar sensory root in the pelvic limb.

The IInd section of the communication deals with the degree of conformity between the distribution of the spinal ganglion fibres in the skin and their distribution in the underlying deep tissues of the limb. It is shown that, although the skin fields of the ganglia are in the middle of the limb region dislocated from the median line of the body, the distribution of the fibres of the root ganglion is nevertheless, when its deep distribution is taken into account, to a complete ray of tissue extending in an unbroken fashion from the median plane of the body out along the limb to (in the case of the nerves, extending farthest into the limb) the very apex of it. This distribution conforms, therefore, with that shown in a previous paper to be typical of the distribution of the ventral (motor) root. The distinction is not, therefore, as between afferent and efferent, but as between cutaneous and muscular. A detailed analysis of the distribution of the deep sensory fibres is in this paper carried out for the VIth lumbar spinal ganglion of *Macacus rhesus;* this ganglion was chosen because its skin-field, occupying the free apex of the lower limb, is one as far dislocated from the median line of the body as any in the whole spinal series, and presents, therefore, the greatest apparent discrepancy between the distribution of its afferent and efferent roots. A comparison of the distribution of the afferent and efferent roots in this (VIth lumbar) nerve was made by means of the Wallerian method; the results show the peripheral distribution of the two to be minutely similar. From this, and from other observations given, the rule is put forward as a definitely established one that the sensory nerves of a skeletal muscle in all cases derive from the spinal ganglion (or ganglia) corresponding segmentally with that (or those) containing the motor cells, whence issue motor nerve-fibres to the muscle. The reflex arc, in which the afferent and efferent nerve-cells innervating a muscle are components, need not, therefore, as far as anatomical composition is concerned, involve irradiation through more than a single spinal segment.

Section III deals with general features of arrangement recognisable in the distribution of the roots; for instance, the determination of the position of the primary dorsal and ventral lines of the limbs, the examination of the asserted rotation of the limbs and of the asserted torsion of the limbs, and of the asserted homologies between muscles, &c., of the brachial and pelvic limbs respectively, by the criteria for re-examination of such questions provided by the facts elicited in the course of the work; the cross-lapping of the skin-fields across the median line of the body, the overlapping of component parts of a single field, the serial overlapping of adjacent fields, the degree of overlapping in different regions of the body, the degree of overlapping in peripheral nerve-trunk fields, the amount of overlapping of spinal ganglion-fields compared with that of peripheral

nerve-trunks, the comparison of sensory overlapping with motor overlapping, the relation of overlapping to acuteness of sensation; individual variation, its extent and frequency, as far as can be judged from the skin-fields. Comparison between the human brachial plexus and that of Macacus is made, and it is pointed out that the human plexus is slightly prefixed, as compared with that of Macacus.

Finally, in Section IV, "shock," and various spinal reactions are examined, especially with reference to their effects upon the size and other features of the areas of the root-fields, &c., and the results collated and discussed.

"Cataleptoid Reflexes in the Monkey."

By C. S. SHERRINGTON, M.A., M.D., F.R.S., Holt Professor of Physiology, University College, Liverpool. Received December 29, 1896,—Read January 21, 1897.

A phenomenon came under my observation in the course of experiments upon monkeys at the commencement of the present year which seems sufficiently interesting to merit record here. Its occurrence, so long as certain conditions of experiment are maintained, appears regular and predictable.

Although the character of the movements executed by the skeletal muscles when excited reflexly through the medium of the isolated spinal cord is variable, one feature common to them is their comparative brevity of duration. Many of them are, as pointed out by Fick and by Wundt years ago, hardly distinguishable in several particulars from the simple twitches elicitable from an excised muscle, so brief and local and inco-ordinate do they appear to be. Others are more prolonged, and, as I have described in a paper recently communicated to the Society, exhibit various forms of sequence or "march" (Hughlings Jackson). Without recapitulating the conclusions there drawn from the data given in that paper, I wish here to merely point out that of movements due to purely spinal reflex action, although some are fairly extensive, most are quite short-lasting, and not so prolonged as the longer of those that can be elicited under appropriate conditions from the cortex cerebri; also that if prolonged they, like the final phase of prolonged movements initiated from the cortex, tend to become clonic, or to exhibit that kind of action which in the paper referred to above I have designated "alternating."

The reflex movements, the subject proper of this note, are, on the contrary, of extremely prolonged duration, and absolutely devoid of clonic character and of alternating character. If the cerebral hemi-