conduction of impulses have been described. The manner in which they pass through the body to be taken up by the electro-cardiograph at the extremities is another aspect.

This faculty of traversing unspecialized tissues so long as they are living is illustrated by a striking experiment. If the peripheral end of a cut phrenic nerve of a dog be laid upon the dog's heart, the whole diaphragm contracts with each beat of the heart. The impulses pass through the pericardium to reach the cut nerve, and the pericardium, beyond being composed of living cells, is not specially evolved for the conduction of impulses.

In noting these instances of the conduction of impulses, we see that there is something peculiar about the force which distinguishes it from any other force. In observing the effects it produces we gradually began to realize that it demonstrates peculiarities in the behaviour of the tissues. In its passage through the tissues it does not necessarily stimulate them.

The fact that impulses are so universal and readily permeate all living tissues raises the question how it comes about that only certain organs are stimulated. This has led to a review of the activity of cells and their susceptibility to impulses, and it has shown that this susceptibility varies in a manner that enables their activity to be regulated so that all organs, when they respond to impulses, do so in a fashion which enables their functions to be performed in a well ordered, purposive, and effective manner.

This inquiry has resulted in the discovery that the reception of impulses is governed by the law of fluctuation. The graded character of the response of the effector organ to impulse and stimulation and inhibition are dependent on this law of fluctuation.

THE INTERPLAY OF IMPULSE AND CELL.

In our investigations into the reaction of cells we find that all responses, whether physiological or the symptoms of disease, can be expressed in the terms of impulses and the susceptibility of the cells to stimulation. Hitherto many terms have been accepted as explaining reactions, because of some superficial character of the end-result, without any appreciation of what was really implied by the term. Stimulation and inhibition are terms of this sort, which, beyond indicating a seeming increased or decreased activity of an organ, yield no explanation of the processes which brought about the result.

In the same way terms have to be invented which suggest the existence of structures which do not exist. The term "centre" is spoken of as a definite entity, whereas it is but a figment of the imagination, created for the purpose of providing an explanation of reactions whose nature is not understood. So far as we have gone we see that some concept requires to be evolved that will express what is meant by a centre, based on the relation of the impulse to the receptors of neurones.

When we deal with disease, this way of looking at the phenomena enables us to obtain a far clearer insight into the nature of ill health. Already a great many symptoms which had baffled explanation are now capable of interpretation, and it needs but an extension of our knowledge of the susceptibility of cells to impulse for a great advance along the whole front of the attack on disease.

This will be grasped if we consider what constitutes disease. Disease has been defined as the reaction of the body to an injurious agent. The reaction means the effect produced by impulses upon cells. Ill health and death are but the outcome of the relation of the impulse and the cell.

The absence of a clear understanding has led to the use of terms which do little more than surround the reaction with an air of mystery. Such terms as "anaphylaxis" and "immunization" are in common use, but all attempts to explain them simply result in developing hypotheses impossible of proof. The clue to the explanation is to be found in this relation of the cell to the impulse. In our research into digitalis we have shown that there were conditions of the heart when the pulse rate could be reduced by digitalis from 150 to 30 or 40 beats per minute. In some such patients the pulse rate might rise suddenly to 70 or 80 beats per minute, and increased doses of

digitalis be without effect on the pulse rate. In the terms of the bacteriologist, the patient had become "immune" to the "toxin" of digitalis.

Such a result was a mystery until it was shown, with an abundance of evidence rare in medicine, that the reaction to digitalis is due to the interplay between the impulse and the cell. There was also indicated quite clearly the reasons why such startling differences could arise, and there is every reason for believing that investigation on these lines will lead to revealing the nature of all those reactions which are to-day obscured by the use of a pedantic terminology, descriptive only of end-results.

CONCLUSION.

While immense progress has been made and is being made in the knowledge of inorganic matter, little advance has been made in the knowledge of living matter beyond the accumulation of an enormous mass of reactions or end-results. The reason for the great progress in the one case was due to the recognition of the forces in nature which produced effects upon inorganic matter. The reason for the lack of progress in respect of living matter has been the absence of a knowledge of a vital force comparable to those of gravity, electricity, and magnetism.

The recognition of this vital force permits the same lines of investigation to be followed which has yielded such a rich harvest in the inorganic world. Although our attempts have as yet achieved but a small measure of success, we see it needs but time and experience to obtain a great addition to our knowledge of both physiological and pathological processes which will enable us to understand the nature of ill health. Now that we see the interplay between the impulse and cell, and recognize the effects produced, we realize how the absence of this kind of knowledge has rendered it impossible to explore such fields essential to medicine as the great system of afferent nerves and the processes and structures concerned in regulating the functions of organs.

OCCLUSION OF THE POSTERIOR INFERIOR CEREBELLAR ARTERY.

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ALTHOUGH a number of cases of occlusion of the posterior inferior cerebellar artery have been reported, the symptom-complex manifested by this lesion is not yet widely known. This, together with the realization that these cases provide a unique opportunity for amplifying our knowledge of the functions of the tracts and nuclei found in the retro-olivary region of the medulla, renders it a duty to place on record the results of investigations of all patients suffering from this condition.

The patient described in this paper exhibited most of the typical features seen after obstruction of the posterior inferior cerebellar artery and also presented a few points of special interest.

Charles C., aged 64, whilst following his usual employment as a painter, became suddenly dizzy and experienced a "hot flush" in the left side of his neck and head. He did not lose consciousness and was able to summon his workmates to assist him, as he was unable to walk without support. Within a short time of the onset he complained of abdominal pain and suffered from vomiting, but neither of these symptoms persisted long. After being taken home in the ambulance and put to bed, he was seen by Dr. Moreland of Cheetham Hill, and was given soda and milk, when it was found that he was unable to swallow, the fluid returning through his nose. When admitted to the Manchester Royal Infirmary a week later he was still unable to swallow and complained of difficulty in coughing, and the dizziness prevented him from walking without support.

Nervous System.

Cranial Nerves.—The left pupil was smaller than the right, but both reacted to light and accommodation. Lateral nystagmus was present, which was more marked on looking to the right. The patient did not complain of diplopia and the ocular muscles acted perfectly. There was no weakness of any facial muscles, nor did the tongue when protruded deviate to either side. All the special senses, including taste, were normal. The left side of the palate was paralysed, but Dr. D. Lindley Sewell found no affection of any of the laryngeal muscles, on kindly making a laryngoscopic examination for us. Analgesia and thermal anaesthesia were found over the greater part of the distribution of the ophthalmic and superior maxillary divisions of the left trigeminal nerve. The recognition of painful and thermal stimuli was defective over the left half of the palate. A small patch of herpes was present in the left malar region.

Sensation.—In addition to the dissociated sensory loss on the upper part of the left side of the face, analgesia and thermal anaesthesia were found over the right half of the neck, trunk, and both extremities on this side. There was no disturbance of any other form of sensation. The precise extent of the dissociated sensory loss is represented in Fig. 1.

FIG. 1.—Showing the distribution of the analgesia and thermal anaesthesia.

Muscular System.—Movements of the left arm and leg exhibited marked ataxia, but no paralysis or paresis of any muscle could be discovered.

Reflexes.—The reflexes of the superior extremity were normal. The knee-jerks and Achilles-jerks were present, but not very easily elicited. There was no ankle clonus and the plantar response was flexor. Abdominal reflexes were absent.

The general examination revealed evidence of very general arterio-sclerosis, but the Wassermann test was negative. Albumin was present in the urine; the systolic blood pressure was 185 and the diastolic 120. A blood urea estimation, kindly made by Dr. G. E. Loveday, gave 76.0 mg. urea per 100 c.cm. of blood.

After-History.

During a stay in hospital of seven weeks the dysphagia disappeared, the ataxia became less marked so that the patient was able to walk about, and less difficulty was experienced in obtaining the knee-jerks, but the other manifestations persisted.

The clearly defined syndrome renders the anatomical localization of the lesion fairly simple (Fig. 2). The sudden onset in a patient suffering from well marked arterial disease assists in arriving at a pathological diagnosis, but it is less easy to determine with certainty which vessel is affected, and some observers have frankly stated that it is impossible clinically to distinguish between occlusion of the vertebral and the posterior inferior cerebellar arteries. An anatomical study¹ has failed to solve this difficulty, but has provided the following information which may be of considerable value:

(a) Any paresis of the trunk, limb, or tongue muscles definitely denotes involvement of the vertebral or anterior spinal arteries.

(b) Crossed and dissociated sensory loss unassociated with dysphagia and laryngeal paralysis is most likely to be due to vertebral occlusion, since the spino-thalamic tract is never supplied by the posterior inferior cerebellar artery below the caudal extremity of the nucleus ambiguus.

(c) Rarely branches of the vertebral may replace the bulbar branches of the posterior inferior cerebellar, and occlusion of the former, at the point where these branches arise, may produce the characteristic syndrome which we associate with the latter without any paresis of trunk or limb muscles.

Three points of special interest are illustrated by this case.

1. Since the occluded vessel supplies a considerable part of the spinal tract and nucleus of the trigeminal nerve and never contributes any branches to the nuclei of this nerve in the pons, and since the loss of sensation on the same side of the face as the lesion is dissociated, it is believed that the spinal nucleus receives only pain and thermal fibres.

2. Anatomical investigation has proved that the more caudal part of the spinal nucleus and tract is most constantly supplied by the posterior inferior cerebellar artery, and that, when the bulbar branches of this vessel are reduced in number, it is the cephalic extremity which escapes. In the case reported in this paper it is significant that the sensory loss was confined to the upper part of the face, which confirms the opinion expressed by Spiller² that the ophthalmic division of the fifth nerve descends to a lower level than the other two branches and that the fibres of the inferior maxillary division pass to the cephalic part of the nucleus.

3. On anatomical grounds it appears that in our patient the bulbar branches of the artery are less numerous than usual, which leads to a reduction in a cephalic direction of the retro-olivary region generally supplied. This results in

FIG. 2.—Section of the medulla at the mid-olivary level. The black line marks out the typical area of the medulla supplied by the bulbar branches of the posterior inferior cerebellar artery. R.B.=Restiform body. Sp. Tr.=Spinal tract and nucleus of trigeminal nerve. N.A.=Nucleus ambiguus. Sp. Th.=Spino-thalamic tract.

escape of the upper part of the nucleus ambiguus as well as the cephalic extremity of the spinal nucleus and tract. Since no paralysis of laryngeal muscles was found, this case supports the view that it is the upper part of the nucleus ambiguus which supplies fibres for the innervation of the muscles of the larynx, whilst the caudal part gives origin to the efferent fibres to the palate and striated muscles of the pharynx.

In conclusion, we desire to acknowledge our indebtedness to Dr. A. Coleman, house-physician, for assistance in taking the notes.

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SPRUE AND PERNICIOUS ANAEMIA.

BY

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I READ Dr. J. L. Priston's communication, published in the *JOURNAL* of February 2nd, with much interest. In this country we rarely see cases of sprue; but two very marked cases, both of which proved fatal, came under my observation in the years 1895 and 1899, and I was much impressed with the close resemblance between some cases of sprue and pernicious anaemia. In pernicious anaemia, glossitis and gastro-intestinal symptoms, which are such prominent features of sprue, are often present. In sprue, anaemia may be very marked, and, as Dr. Priston points out, in the advanced stages of that disease may present all the characteristic features of pernicious anaemia (high colour index, poikilocytosis, megalocytosis, etc.). Dr. Philip H. Manson-Bahr, in his article on sprue in Byam and