Here the heart was very seriously affected, and rapidly passed through various stages of great irregularity to stoppage.

Summary.—From the foregoing experiments it is evident that urechitin is a poison of a very active kind, which may be included in the digitalis group. Its action on the frog and frog's heart, the effect on dogs, the comparatively large doses necessary to affect rabbits, and its action on the circulation, point to a similarity between it and all other substances which have now been recognised as essentially resembling digitalis in their physiological actions. Urechitoxin may also, for the present, be included in the same group, which is, as now understood by pharmacologists,^{*} a pretty wide one, and embraces substances which are certainly not quite identical in action. The differences, however, have not been satisfactorily worked out. Urechitoxin, although essentially a muscle and heart poison, shows certain well-marked peculiarities in its action; these, and the finer details of the actions of both substances, I have made no attempt to work out at present, as the primary object of the research was to determine whether the marvellous stories told regarding its poisonous action were true or not. As in most tales of the kind there is a certain admixture of truth and falsehood. If a full lethal dose of the dried leaves, or any other preparation of the plant, be administered, symptoms of poisoning will certainly supervene within a limited period, and death will occur either in a few hours or in a day or two. The circumstances would most probably be such as to arouse a suspicion of poisoning. A single dose of the poison cannot be so administered as to be fatal "after the lapse of days or weeks."

On the other hand, if repeated minute doses can be given—doses insufficient to cause immediate symptoms—there seems to be no doubt, from Bowrey's experiments, that an animal (or man) may remain all the time in apparently good health, and then die suddenly. To effect this, however, these minute doses would have to be given frequently and regularly. It is conceivable that minute amounts of the dried leaves might be so administered without arousing suspicion, if the poisoner had daily access to the food of his victim, and it is quite probable that the Obeah poisoners were often enough able to do this.

The explanation of the long-delayed action and sudden death in such cases is to be found in the well-known cumulative action of digitalis and similarly acting bodies. These substances, after entering the circulation, are absorbed by the heart muscle, and most probably enter into chemical combination with it. The combination seems to be a close one, so that the poison is but slowly excreted. Small repeated doses cause an accumulation of the poison in the heart muscle until a stage is reached when the heart is so thoroughly poisoned that death ensues from cardiac failure. Clinically such accidents, although in a minor degree, are well known and recognised in the case of digitalis.

It is improbable that the urechites suberecta will ever prove to be of value as a cardiac tonic. I have made no observations in this direction, as it seems to possess in a high degree the objectionable cumulative properties which have been so often remarked in the case of digitalis.

REPORT ON

THE ABDUCTOR AND ADDUCTOR FIBRES OF THE RECURRENT LARYNGEAL NERVE.¹

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CLINICAL and pathological experience (Semon, Rosenbach) has shown that in organic and progressive affections of the recurrent laryngeal nerve the abductor fibres are prone to succumb before the adductor. Freezing the nerve (Gad and B. Fraenkel), the electrical excitability of the human laryngeal muscles after death (Jeanselmie and Lermoyez), and of

those of animals (Horsley and Semon)—all give a similar result; the exactly opposite effect is produced by ether reaching the laryngeal muscles through the circulation (Hooper, Horsley, and Semon). Semon has suggested that possibly the fibres and centres dominating over the two functions are strictly differentiated. Morell Mackenzie considered that possibly the proneness of the abductors to succumb before the adductors in affections of the nerve, especially compression by tumours, was due to the former fibres being superficially and circumferentially arranged in the nerve trunk. Experimental researches have been made by Hooper, Onodi, and Dionisio, and have been referred to at length in the full paper. The general plan on which my research² was conducted was as follows:—

1. The separation and isolation of the different bundles of nerve fibres of which the nerve trunk is composed, electrical excitation of each separate bundle, and observation of the effects produced on the vocal cords by such excitation.

2. Exposure of the different bundles of nerve fibres, under exactly similar circumstances, to the drying influence of the external air, with observation of the relative duration of vitality possessed by the different bundles.

3. (Control) Tracing by dissections, each bundle of nerve fibres separated in the nerve trunk to its termination in the mucous membrane, or in a muscle of the larynx.

4. (Control) Exposure of the muscles of the larynx immediately after death, and direct observation of them during excitation of the separate bundles of nerve fibres, this being controlled by occasional excitation of individual muscles themselves.

5. (Control) Observations of the muscular degenerations which followed division of one or other bundle of nerve fibres in the nerve trunk three weeks after such division.

The difficulties which attended this last set of experiments were very great, so that out of seven experiments three were unsuccessful; however, those that were successful yielded such striking results that, in view of the great difficulties attending them, further multiplication of these experiments has been considered unnecessary. Twice the abductor bundle of fibres was alone divided, and *post mortem* the abductor muscle on the same side as the injured nerve alone found atrophied and degenerated; once the adductor bundle was alone divided, and the adductor muscles on the same side alone found atrophied and degenerated; and once a sensory bundle was divided, in which instance none of the laryngeal muscles showed any sign of atrophy or degeneration.

The conclusions which are drawn from the results of these experiments are:

1. That the abductor and adductor fibres in the recurrent laryngeal nerve are collected into several bundles, the one distinct from the other, and each preserving an independent course throughout the nerve trunk to its termination in the muscle or muscles which it supplies with motor innervation—a condition of things the possibility of which was suggested by Semon more than ten years ago, from the evidence of pathological facts.

2. That while in the adult animal simultaneous excitation of all the nerve fibres in the recurrent laryngeal nerve results in adduction of the vocal cord on the same side, abduction is the effect produced in a young animal by an exactly similar procedure.

3. That when the abductor and adductor fibres are exposed to the drying influence of the air under exactly similar circumstances, the abductors lose their power of conducting electrical impulses very much more rapidly than the adductors; in other words, they are more prone to succumb than are the adductors—a fact which has long been recognised and insisted on by Semon as being the case in the human subject, and in support of the truth of which that observer has adduced many powerful arguments.

4. That, even in the young dog, the abductor nerve fibres, though preserving their vitality much longer than in the case of the adult animal, nevertheless in the end succumb before the adductor fibres.

5. That this death commences at the point of section of the nerve, and proceeds gradually to its peripheral termination, and does not take place in the whole length of the nerve simultaneously.

6. That it is possible to trace anatomically the abductor and adductor fibres throughout the whole length of the recurrent laryngeal nerve to their termination in one or other

² Dogs were, without exception, the animals used, and in every case ether narcosis was produced and continued throughout the whole course of the experiment, at the end of which the animal was killed by an overdose of the narcotic.

* Schmiedeberg, *Archiv f. expt. Path. und Pharmak.*, xvi, 149; *Beiträge zur Kenntnis der pharmakologischen Gruppe des Digitalins.*

¹ Part of the expenses connected with this experimental research have been defrayed by a grant from the Scientific Grants Committee of the British Medical Association. Details were given in full in a paper read before the Royal Society, March 31st, 1892.

group of laryngeal muscles, and that these fibres appear to bear a fixed relationship to each other throughout their course, the abductors being situated on the inner side of the nerve, or that next to the trachea, while the adductors are on the outer side.

7. That it is possible to so accurately separate these two sets of fibres in the nerve trunk that excitation of either of them evokes contraction of the abductor or adductor muscles, as the case may be, without evoking any contraction whatever in the muscle or muscles of opposite function.

8. That the bundle of nerve fibres concerned with one function may be divided without injury to that concerned with the opposite function, and that such division is followed by atrophy and degeneration of the muscles related to that function without any such changes being detected in the muscles related to the opposite function.

These results prove Mackenzie's theory of superficial and circumferential arrangement of the abductor fibres in the recurrent laryngeal nerve to be erroneous. As regards the different effects observed in the young and adult dog, possibly the reason why the abductor influence is in the ascendancy in the young animal is because the power of phonation is still imperfectly developed, and with it both the muscle and nerve fibres subserving this function are also imperfectly developed, while the function of respiration is from the beginning fully developed, and with it the muscle and nerve fibres connected with that function. That the reverse should be the case in the adult animal may well be due to the fact that phonation is perfectly developed, while respiration has become so automatic that very feeble stimuli are necessary to keep it going.

ACUTE LEUCOCYTOSIS PRODUCED BY BACTERIAL PRODUCTS.

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THE observations of Römer and others have of late attracted special attention to the changes in the blood during infective processes. Römer¹ experimented on rabbits, while Canon,² Botkin,³ Neusser,⁴ and Tschistowitsch⁵ studied the phenomena as they occur in hospital patients.

Broadly speaking, these investigations show that after the injection—intravenous or subcutaneous—of bacterial products or extracts the number of leucocytes in the blood is greatly increased, and the same also occurs in the acute infective diseases. That leucocytosis is a common phenomenon in acute fevers is an old-established fact; but this question has recently become more important on account of its bearing on phagocytosis and "chemotaxis."

Some few months ago Mr. Hankin and I began some experiments with a view to studying the leucocytosis and fever produced by intravenous and subcutaneous injections of sterilised or filtered cultures, and in January we read a short communication before the Cambridge Philosophical Society on the "Fever produced by Intravenous Injections of Sterilised Cultures of *Vibrio Metchnikovi*." We showed that after injecting small quantities into the ear vein of a rabbit, as Gamaleia pointed out, a considerable rise of temperature occurs, the maximum (40.5° to 41.0° C.) being generally reached after two or three hours. Subsequently the temperature gradually falls again, and after eight to ten hours as a rule has come down to normal. Examining the blood hourly, we showed that at first, during the rapid rise of the temperature, there is a marked diminution of leucocytes, which persists until the pyrexia has passed its climax, but that about four to six hours after the intravenous injection the number of leucocytes is greatly, and at times almost enormously, increased. This leucocytosis reaches its height at about the ninth hour, but persists, though in a lesser degree, for forty-eight to seventy-two hours, and at times even

longer. We represented these phenomena by the following diagram:—

Fig. 1.—Temperature and leucocytosis curves.

These observations agree with those of Römer, who, also working on rabbits, obtained a diminution stage followed by a great increase of leucocytes.

Besides the products of *vibrio Metchnikovi*, filtered yeast and pyocyanus cultures have been employed with uniformly the same result. The immediate effect of the intravenous injection is fever, the nature of which may be best seen from the three appended charts:—

Fig. 2.—A, 4 c.c. of sterilised pyocyanus culture into ear vein at 11.0 A.M. B, 1 c.c. of sterilised *vibrio Metchnikovi* culture into ear vein at 12. C, 4 c.c. of filtered yeast culture into ear vein at 11.0 A.M. The leucocytes behaved in the same manner as after injection.

¹ *Berliner klin. Wochenschr.*, 1891, No. 36; *Virchow's Archiv*, 1892, No. 128, 1.

² *Deutsch. med. Wochenschr.*, 1892, No. 10.

³ *ibid.*, 1892, No. 15.

⁴ *Wiener med. Presse*, 1892, Nos. 3, 4, and 5.

⁵ *Berliner klin. Wochenschr.*, 1891, No. 34.