James Cockle's results' and his own. The object of this communication is to show that there is not only similarity but absolute identity, the two classes of functions considered by Professor Malet coinciding in every point with the ordinary and differential criticoids discussed by Sir James Cockle."

My object in writing this note is to call attention to the fact that, by the omission of the first part of my note, and his own comments on the partial extract he makes from it, Mr. Harley represents me as making a statement bearing an interpretation very different from that I meant it to bear.

Having done so, I will trouble the Society with the matter no further, and will leave it to those who may be interested, to judge if the general results of my paper are identical with Sir James Cockle's.

III. "The 'Paralytic' Secretion of Saliva." By J. N. Langley, M.A., F.R.S., Fellow and Lecturer of Trinity College, Cambridge. Received March 16, 1885.

It was shown by Claude Bernard that section of the chorda tympani nerve in the dog, causes, after an interval of about twenty-four hours, a slow "paralytic" secretion of saliva from the sub-maxillary gland; the secretion continues for several weeks, and is accompanied by a gradual diminution in the size of the gland. Heidenhain confirmed these observations, and he found further that the effect was not confined to the gland on the side of the body on which the nerve had been cut, but extended also to the corresponding gland of the opposite side of the body, so that section of *either* chorda tympani nerve caused a continuous secretion from *both* sub-maxillary glands. Since Heidenhain's paper in 1868, nothing has, so far as I know, been published on this subject. I purpose to give a brief account of some observations which were made by me several years ago, and which may serve to recall attention to certain curious facts touching both nerve and gland physiology.

Since the secretion, which takes place on the side of the body on which the nerve is cut, is called the "paralytic" secretion, we will call the corresponding secretion, which takes place on the opposite side of the body, the "anti-paralytic," or more briefly the "antilytic" secretion.*

I will consider first the paralytic and antilytic secretions during the first day or two of their occurrence. During this time the

* A fuller account will be published in the forthcoming number of the "Journal of Physiology."

paralytic secretion is stopped for several hours at least, by cutting the sympathetic nerve-fibres running to the gland; the antilytic secretion is made slower by cutting the chorda tympani, and is stopped by cutting, in addition, the sympathetic fibres on the carotid, that is, the secretion ceases in each case when the nervous connexions between the gland and the central nervous system are severed. From this it follows that the paralytic secretion in its early stage is caused by nervous impulses passing from the central secretory centre down the sympathetic nerve to the gland, and that the antilytic secretion is similarly caused by nervous impulses sent out from the central secretory centre, but passing in part down the chorda tympani nerve which is here intact.

Since the paralytic secretion is more copious than the antilytic secretion, it follows that the nervous impulses sent out by the secretory centre on the side of the body on which the chorda tympani is cut, are of greater intensity than those sent out by the secretory centre of the opposite side. Thus, section of one chorda tympani is followed by a change in the central secretory centre of such a nature, that it continuously sends out nerve-impulses tending to produce a secretion from the sub-maxillary glands; the change, however, is not equal on the two sides, but is more profound on the side of the body on which the chorda tympani has been cut.

That the central nerve-cells concerned in producing the secretion are not in their normal condition, can be shown in another way. It is well known that in a normal animal, dyspnœa causes, when the chorda tympani nerve is intact, a secretion of saliva from the sub-maxillary gland. Now, in the stage of the paralytic and antilytic secretion spoken of above, when they are produced by stimuli sent out by the central nervous system, dyspnœa causes a much more rapid flow of saliva, and causes it sooner than it does normally; moreover, the effect of dyspnœa is greater on the paralytic than on the antilytic secretion. Hence, then, section of one chorda tympani causes an increase of irritability in the central secretory centre, the increase of irritability being greater on the side of the body on which the chorda tympani nerve has been cut.

Since a venosity of blood greater than normal, will, in a normal animal, serve as a stimulus to the central nerve-cells, and cause a flow of saliva, it is probable that if the irritability of the nerve-cells be increased, the normal venosity of the blood will serve as a stimulus to the nerve-cells, and cause a flow of saliva. Hence I think it is not unreasonable to suppose that the paralytic and the antilytic secretions in their early stages are essentially similar to the dyspnœa secretion of the normal animal, and that they are proximately caused by the central nerve-cells, in their state of increased irritability, being stimulated by the blood supplied to them. This view is confirmed by

the effect of apnœa; during apnœa both the paralytic and the antilytic secretions stop.

The antilytic secretion is, as far as I have observed, solely of central origin, since it ceases on severing the nerves connecting the gland with the central nervous system; according to Heidenhain, however, it continues after the nerves have been severed.

The paralytic secretion is only in its early stage of central origin, very soon local changes come into play, rapidly increase in intensity, and continue long after the central changes have ceased to be effective to produce a secretion. Thus, then, the paralytic secretion in its later stages continues undiminished after section of all the sympathetic fibres running to the gland. When the chorda tympani and sympathetic fibres are simultaneously cut, the paralytic secretion which follows is of course of local origin only. There are two ways in which the secretion of local origin might be brought about, either by a change in the gland-cells of such a nature that in their abnormal nutritive conditions they secrete continuously, or by a change in a local secretory centre analogous to that which takes place in the central secretory centre. Heidenhain is inclined to adopt the former view, and, on general grounds, it does not seem to me unlikely that gland-cells, normally secreting in response to nervous impulses only, should in certain circumstances secrete continuously without such impulses; but in this particular case there are I think fair grounds for believing that the secretion is caused by nervous impulses sent out by a local secretory centre.

These grounds I will briefly state. On the course of the nerves between the lobes and lobules of the gland there are many nerve-cells. It is highly probable that some at any rate of these nerve-cells are connected with the secretory nerves, since the chorda tympani nerve-fibres, unlike the nerve-fibres of the skeletal muscles and those sweat glands, degenerate very slowly after severance from the central nervous system. In the cat the chorda tympani fibres on the duct, near its entrance into the sub-maxillary gland, produce a secretion when stimulated, two to three weeks after the nerve trunk has been cut.*

Further, the secretion of local origin is increased by dyspnœa, is stopped by apnœa, and by anæsthetics when given in considerable excess. That is, the paralytic secretion, when it is produced by

* Pilocarpin causes a secretion for more than six weeks after section of the chorda tympani, but no conclusion with regard to the condition of the nerves can at present be drawn from this, since it is possible that pilocarpin acts directly on the gland-cells.

During the paralytic secretion produced by section of the chorda tympani, stimulation of sympathetic nerve causes a flow of saliva very much as if the gland were normal.

changes occurring locally, is affected by dyspnœa, by apnœa, and by anæsthetics in the same way as it is when produced by nervous impulses sent out from the central secretory centre; and this strongly suggests that the secretion in the former case also is brought about by nervous impulses, proceeding in this instance from a local secretory centre.

I conclude, then, that section of the chorda tympani causes an increase in irritability, both in a central and in a local secretory centre, during which increase of irritability the blood passing through the centre serves as an effective stimulus. The central centre in no very long time recovers its normal state, the local centre does not. Probably it and the gland eventually atrophy unless the chorda tympani regrows.

Although the secreting cells of the sub-maxillary gland steadily diminish in size during the paralytic secretion, they undergo only slight histological changes; they become somewhat more mucous. The demilune cells and the serous cells, which are present in considerable number in the sub-maxillary gland of the cat, do not show any obvious change, except their diminution in size; the increase in the number of these cells, which is stated by Heidenhain to occur, I have not observed. That the cells, in spite of the paralytic secretion, are in a "resting" and not in an "active" condition, is further shown by the cells being, in the fresh state, granular throughout. On the side of the antilytic secretion the gland-cells are rather less mucous than in the normal "resting" gland.