wide separation of species apparently very closely allied. Thus *Ornith. Haliphron* and *O. Amphrysus*, Cram., are radically different in the forms of their respective harpes. *P. Demoleus* and *P. Erithonius*, so very consimilar in the shape, colours, and patterns of their wings, are quite unlike in their harpes. *P. Bromius*, *P. Nireus*, and *P. Phorcas* have the harpe of a quite different *type* and *plan* in each! On the other hand, *P. Machaon* and *P. Arcturus* are consimilar in armature; while *P. Agavus* and *P. Hector* are as wide as the poles apart!

It must not be forgotten that the armature of not more than a sixth part of the 400 and upward described *Papiliones* is here represented. A further prosecution of the inquiry will certainly bridge-over many gaps, and supply other characteristic forms.

IX. "On the Propagation of Inhibitory Excitation in the Medulla Oblongata." By Dr. H. KRONECKER and Mr. S. MELTZER, Candidate in Medicine, Berlin. Communicated by Dr. BURDON SANDERSON, F.R.S. Received October 18, 1881.

In the Royal Academy of Science of Berlin, on the 24th January, 1881, a communication from us, "On the Mechanism of Deglutition and its Inhibitory Nerves," was read by Professor E. du Bois-Reymond. The experiments described were performed by means of a slightly inflated caoutchouc ball, fastened to the blind end of an œsophageal tube, the other end of which was connected with a Marey's tambour, whose lever recorded the movements on the blackened surface of a rotating cylinder. The ball was introduced, for varying distances, into the œsophagus, and the movements recorded resulting from the swallowing of small quantities of fluid.

It has previously been shown (Falk and Kronecker) that, in man and in the dog, the act of deglutition proper is accomplished by the quick contraction of the *striated* muscles, and that the draught reaches the stomach even before the œsophageal contraction can make itself effective. In one of our former investigations, Mr. Meltzer, by experiments performed on himself, showed that a mouthful of water reaches the stomach in less than 0·1 second after being swallowed, but that the peristaltic action does not appear in the uppermost part of the œsophagus sooner than about 1·0 second after the beginning of the act of deglutition, and does not reach the stomach till 5—6 seconds later. In the communication mentioned above, the results of still more recent investigations were given. It was found that in the uppermost portion of the œsophagus of man, extending about 6—8

centims. from the lower border of the pharynx, the contraction lasted 2—3 seconds, and in the deep portion, about 12 centims. in extent from the cardia, 8—9 seconds, and that the transition from the region of shorter to that of longer contraction occurred in a short portion, about 4 centims. long, about the level of the manubrium sterni. It is a physiological characteristic of this region that in it the transition from the striated to the smooth muscles occurs (E. Weber).

In determining the period of latent stimulation for the purpose of measuring the speed of propagation of the peristaltic waves, it was found that the period increased not gradually but by bounds. Thus, in the upper portion of the œsophagus, 8 centims. long, measuring from the beginning, the period of latent stimulation amounts to from 1 to 1·5 seconds; in the following portion, 8 centims. long, from 3 to 3·5 seconds, and in the undermost portion, from about 5·5 to 7 seconds. From these researches it appeared highly probable that the reflex ganglia of deglutition are arranged in three groups connected with one another. But the experiments seemed also to show that there must be a fourth group, placed near to the other three, through which the first reflex of the act of swallowing occurs. This uppermost group is more closely related with the lower three than these with one another, since we have found that the three regions of the œsophagus can contract, from above downwards in orderly sequence, without a first act of swallowing having occurred. This happens in consequence of "eructation," which effects a separate irritation on the three lower ganglion groups of deglutition.

When one makes a series of acts of swallowing quickly one after the other, as in drinking a glass of water, the registering ball shows that *one* œsophageal contraction follows, and that only after the last of the series; and its occurrence is timed, in reference to the last draught, as if it had been produced by a single act of swallowing. It therefore appeared:—

I. *That the beginning of every act of swallowing not only* excites *the œsophageal contraction related to it, but, at the same time,* restrains *the contraction, excited shortly before, but which has not yet occurred. This inhibition is capable of preventing the contraction even immediately prior to its appearance.*

It is therefore to be concluded that the restraining excitation, traversing the direct motor tracts, outruns the motor excitation, advancing through the ganglion groups.

If a second act of swallowing occurs when the œsophageal contraction, following the first, has already begun, this contraction can no longer be restrained. In such a case, however, the contraction corresponding to the second act begins as late as if this second act had not been performed till after the completion of the first contraction. In other words:—

II. *The second motor irritation is effective only when the contraction following the first has passed.*

The anatomical tracts, along which this inhibition is conducted, we have found to be the ramifications of the ninth pair of cranial nerves, the Nn. Glossopharyngei.

III. *If the trunk of the glossopharyngeus is irritated, no movement of deglutition results, in spite of the strongest excitation to deglutition, produced by filling of the pharynx with fluid, or by stimulation of the Nn. laryngei superiores. Both the first reflex act of swallowing and the œsophageal contraction are for the time in abeyance.*

IV. *If the pharyngeal branches only are irritated, then the inhibitory phenomenon appears in the cervical or in the thoracic portion of the œsophagus.*

The pharyngeal branches of the N. Glossopharyngeus are not unfrequently distributed in company with the pharyngeal branches of the N. vagus, so that as a complete anatomical separation of the ninth and tenth nerve pairs cannot be effected; neither can a physiological.

V. *If the N. glossopharyngeus be cut through, the œsophagus falls into tonic spasm, which may last longer than one day.*

It was in continuation of these researches, that the following new and noteworthy observations were made.

The excitations, which reach their centre in the medulla oblongata through the N. glossopharyngeus, exert an inhibitory influence, not only on the origins of those vagus fibres which supply the œsophagus, but also on the ends of the vagus fibres which *excite* the movements of respiration and *restrain* those of the heart. Lastly, the inhibitory influences extend also to the centre in the medulla regulating the blood-vessels. This can be shown in normal living man. One can, by swallowing, easily observe the following:—

I. *During each act of swallowing the pulse frequency increases.*

II. *During a series of acts the need of respiration decreases.*

III. *During each act of swallowing the blood pressure falls in the aortic system.*

This remarkable proposition, therefore follows: *that excitations, which are conveyed to the centre along the tracts of the inhibitory nerves, extend in the character of inhibitions to neighbouring centres.*

Continued researches on the operation of these newly discovered inhibitory nerves promise specially interesting disclosures, for this reason, that they can be set into activity through normal excitations, voluntarily produced, while the observations on the working of the N. vagus, the chief representative of the inhibitory nerves, can be performed only by means of artificial irritation, whose correspondence with natural irritation has by no means been admitted by all.