II. "Pelvic Characters of *Thylacoleo carnifex*." By Professor Owen, C.B., F.R.S., Director of the Natural History Department, British Museum. Received April 13, 1883.

(Abstract.)

In this paper the author selects from a series of fossils transmitted from Australia since the communication of the 1st February, 1883, the pelvis of a mature *Thylacoleo*, and gives results of a comparison of it with that of *Macropus major*, *Felis Leo*, and *Dasyurus ursinus*, incidentally referring to pelvic characters of the Wombat, the Koala, and the Phalangers.

The results are that the few correspondences with the Kangaroos relate exclusively to a common marsupial nature; to these, in the Dasyurines, are added other resemblances not found, save in Carnivorous Marsupials; and, finally, prominent characters are shown in which *Thylacoleo* exclusively repeats those presented by the pelvis of *Felis Leo*.

III. "On the Continuity of the Protoplasm through the Walls of Vegetable Cells." By Walter Gardiner, B.A., late Scholar of Clare College, Cambridge. Communicated by W. T. Thiselton-Dyer, C.M.G., F.R.S. Received April 16, 1883.

(Abstract.)

After quoting a passage from Professor Sachs' "Vorlesungen über Pflanzen-Physiologie," "every plant however highly organised is fundamentally a protoplasmic body forming a connected whole, which, as it grows on, is externally clothed by a cell membrane and internally traversed by innumerable transverse and longitudinal walls," the author suggests that any observations which demonstrate an actual continuity in organs of large extent must be of interest, as tending to show the truth of Sachs' statement in a sense somewhat more literal than his own. At the time that the above remarks were written, the instances of the existence of any protoplasmic continuity between adjacent cells were but few, being limited to sieve tubes and to Tangl's results with regard to the endosperm cells of Strychnos, Phœnix, and Areca. Then came the author's investigations upon the pulvini of Mimosa, Robinia, and Amicia, and subsequently to them, but previous to the present communication, appeared an important paper by Russow, in which he had proved that in the bast parenchyma cells and the phloem ray cells of numerous plants, *e.g.*, Populus,

Salix, &c., the closing membranes of the pits were perforated by fine protoplasmic threads. In the present paper the author details his results upon pulvini, treats of the methods employed, and gives an account of his investigations as to the structure of endosperm cells, which were undertaken with the object of controlling his previous researches. Since experiments showed that all preservative reagents were unsatisfactory, fresh material alone was employed. In investigating the subject of protoplasmic continuity the method of swelling the cell-wall and subsequent staining was adopted. Either sulphuric acid or chlor. zinc. iod. was used as the swelling agent; and, after washing, the sections were stained with Hoffmann's violet—in which case they were subsequently washed out with glycerine—or with Hoffmann's blue. The latter dye was found to be a particularly satisfactory reagent for staining the protoplasm alone, while methylene blue, on the other hand, especially stains the cell-wall. After the action of chlor. zinc. iod. and subsequent staining it was still found to be impossible to colour the protoplasmic threads running through the cell-wall, and since the author's experiments had led him to believe that this was merely due to phenomena of diffusion (the solution of the colloidal dyes diffusing but little into the colloidal protoplasm), he adopted the modification of dissolving the solid Hoffmann's blue in a 50 per cent. solution of alcohol saturated with picric acid, which was found to be perfectly successful as a stain.

Having shown that in its reactions the pit membrane differs markedly from the rest of the cell-wall, the author proceeds to give a detailed account of his results with pulvini. In Mimosa, Robinia, and Amicia, the parenchymatous cells of the pulvini were found to communicate with one another by means of delicate protoplasmic threads which perforated the closing membranes of the pits. In many instances it appeared as if the thread went bodily through the pits, but the author was disposed to believe that in reality a sieve-plate arrangement was present in every case. The protoplasm of the bast fibres also appear to communicate through the pit membrane by means of a sieve-plate-like structure. Thus from the epidermal cells right up to the last living bast fibre, which impinges on the first dead vessel, a direct continuity from cell to cell has been established, and such a pulvinus may be regarded as a connected whole. The author has observed that a means of communication between adjacent cells appears to exist in the pulvini of Phaseolus multiflorus, and Desmodium gyrans; in the cells of the leaf of Dionæa muscipula; in the stamens of Cynara Scolymus, and in tendrils; but in consequence of somewhat hurried observation, owing to the lateness of the season, he cannot regard these results as entirely conclusive, and intends to work over the subject in further detail on a future occasion.

In order to clear up certain doubtful points with regard to his work

on pulvini, and to set his investigtions on the firmest possible basis, the author now commenced the study of endosperm cells, since in them the cells were exceptionally large, and the pit membrane being very thick, the presence of any threads running through its substance would be likely to be clearly seen. Having confirmed Tangl's results with Strychnos, Phœnix, and Areca, he examined in detail the seeds of some fifty species of palms, and besides those of typical representatives of the following orders:—Leguminoseæ, Rubiaceæ, Myrsineæ, Loganiceæ, Hydrophyllaceæ, Iridaceæ, Amaryllidaceæ, Dioscoriaceæ, Melanthaceæ, Liliaceæ, Smilacæ, and Phytelephasieæ—in all of which he found that the cells were placed in communication with one another by means of delicate threads passing through the walls of the cells. In unpitted cells, *e.g.*, Tamus and Dioscorea, the threads traversed the whole thickness of the wall. In the greater number of instances the cells were pitted, and the threads passed across the pit membrane; and in certain cases, *e.g.*, Bentinckia, Kentia, Howea, Lodoicea, and Asperula, communication was established both through the thickened walls and through the pits. The endosperm cells displayed in their structure every possible modification, both of thickness or thinness of the pit membrane, of clearness or difficulty of observation, and of degree of development of the middle lamella. The development of the endosperm was not worked out in any case, but the cells were shown to communicate with one another at a very early period. When sections of living endosperm tissue were treated with sulphuric acid, and stained with Hoffmann's blue, the same results were obtained as with pulvini, only here everything was on a much larger scale. Thus both the methods and results received every confirmation.

The author then treats of his investigations on the subject of Plasmolysis, in which he had established that when the plasmolytic condition is induced in a cell the contracted primordial utricle does not lie free in the cell-cavity, but is connected on every side to the cell-wall by means of numerous fine protoplasmic threads. His experiments lead him to the conclusion that the above phenomena do not give any definite assistance or confirmation to the study of perforation of the cell-wall, for as often as not the threads bear no relation to the pit, the only significance implied being that the protoplasm and the cell-wall are intimately connected the one with the other.

Finally, the author remarks that, although he is aware of the danger of rushing to conclusions, yet that when his results, which were foreshadowed by Sachs and Hanstein when they demonstrated the perforation of the sieve-plate, are taken in connexion with those of Russow, it appears extremely probable that the communication between adjacent cells not only takes place in the parenchymatous cells of pulvini, in the phloem parenchyma cells, in the cells of

endosperms, and in the prosenchymatous bast fibres, but is of much wider if not of universal occurrence. At any rate we were now in a position to get a clearer insight into such phenomena as the downward movement of a sensitive leaf upon stimulation, of the wonderful action of a germinating embryo on the endosperm cells, even on those which are most remote from it, of the action of a tendril towards its support, and of a series of phenomena in connexion with general cell mechanism, which were too numerous to mention, and could not be treated of in his present paper.

The paper is accompanied by forty figures, which illustrate the principal instances of protoplasmic continuity referred to in the text.

IV. "On the Dependence of Radiation on Temperature." By Sir William Siemens, F.R.S., D.C.L., LL.D. Received April 25, 1883.

Sir Isaac Newton held that the radiation of heat from a hot body increased in arithmetical ratio with the difference of temperature between it and the surrounding bodies. This law forms a rough approximation to the truth over a very limited range of temperature. MM. Dulong and Petit carried out an elaborate experimental research on the rate of cooling of hot bodies by radiation, extending to somewhat higher temperatures, and deduced from their observations the empirical formula—

$$\text{Rate of cooling} = m(1{\cdot}0077)^{t}(1{\cdot}0077^{T-t}-1).$$

Here T is the temperature of the hot body in degrees Centigrade, t the temperature of the surrounding matter, and m is a constant depending on the nature of the radiating body. This formula agrees very fairly with experimental results for ordinary temperatures, but, like Newton's law, it has been shown that it cannot be applied for a wider range.

The anomalous results which Newton's law and the formula of MM. Dulong and Petit lead to, when applied to the cooling of bodies at a very high temperature, are well illustrated by the attempts at deducing therefrom the temperature of the solar photosphere. Waterston and Père Secchi (in his work entitled "Le Soleil"), following Newton's hypothesis, obtained 10,000,000° C. as the probable solar temperature, and Captain J. Ericsson, on the same hypothesis but assuming other constants, arrived at a temperature between 2,000,000° and 4,000,000° C. Strangely contrasting with these determinations are those of Pouillet in 1836, and Vicaire in 1872,