These observations were made under various conditions with no more than usual care, and probably represent fairly the accuracy easily attainable. With further practice the errors could probably be reduced. In general, my observations seem to show that single sets of observations by this wedge-photometer are trustworthy to one or two tenths of a magnitude. If so, there is much that can be done by it; and as the simplicity, convenience, and inexpensiveness of the instrument are such as to recommend it, similar instruments could properly be a part of the outfit of every observatory.

The above errors are correct on the supposition that none of the stars examined were variable; and I found no evidence that they were. In the case of another star, however, either the star was variable, or the errors made were much larger than in the other cases, though the observations were made at about the same time. The star in question is 22°.2162. The average difference between it and 22°.2164 is 25.1 seconds for twenty-three sets; but the individual sets range from 28.0 seconds on the 15th, at 13h. sidereal time, to 22.3 seconds on the 19th, at 12h. The mean error of a single set is 1.34 seconds, and the probable error of the mean, ±0.58 second. As I believed I could trace with the eye a change in the brightness of the star, I think we have in this case a variable, with a range of about one magnitude, rather than observations much less accurate than others taken at the same time. M. W. HARRINGTON.

NOTES UPON THE FOETAL MEMBRANES OF THE OPOSSUM AND OTHER MARSUPIALS.

I RECENTLY had the good fortune to receive from Mr. Robert Speir of South Orange, N.J., a female opossum which had been captured within a few days after impregnation. I was thus enabled to make very satisfactory observations upon the foetal membranes, about which there has been so much uncertainty for many years. These embryos were in an early stage of growth, and, although they plainly showed very novel and unexpected features, no positive conclusions could be reached as to their later development. At this point a correspondence with Professor Wilder of Cornell resulted in his very generously sending me a quantity of marsupial material which he had procured from Australia. Among this material was a nearly perfect foetus in a late stage of development. An examination of this fully confirmed the observations upon the opossum embryos, and showed the relations of the foetal membranes at a later period. More recently Professor Chapman, of the Jefferson medical college, has kindly allowed a thorough examination of a valuable kangaroo foetus in his possession, which he has described in the proceedings of the Philadelphia academy for 1881. This foetus was in a stage intermediate between that represented by the opossum embryos and that of the foetus sent me by Professor Wilder: it showed the same features as the other specimens in an intermediate stage of growth.

In all these specimens the membranes are arranged very much as those of a kangaroo foetus which Professor Owen described in 1833. The peculiarity of the foetal membranes of this animal, which has ever since been used as a basis of classification distinguishing the marsupials from the higher mammals, is, that the allantois never attains a very great size, so that nothing like an allantoic placenta is formed; and the function of absorbing the maternal nutrition, during the short period of intra-uterine life, has always been considered to have devolved entirely upon the yolk-sac. Professor Owen, in the older of the specimens which he examined, found that the membranes were arranged as follows:[1] the foetus was enveloped in a large subzonal membrane, with folds fitting into uterine furrows, but *not adhering to the uterus, and without villi;* the embryo was enveloped in an amnion reflected over the stalk of the yolk-sac. This sac was large and vascular, and was connected with the foetal vascular system by a vitelline artery and two veins. There was a small allantois supplied by two allantoic arteries and one vein: it was quite free, and not attached to the subzonal membrane. The area of attachment of the yolk-sac to the inner surface of the subzonal membrane formed a disk bounded by the sinus terminalis, or circular venous trunk. When spread out, therefore, the yolk-sac formed the figure of a cone, of which the apex was the umbilical cord, and the base the sinus terminalis.

These valuable observations were confirmed by Professor Chapman in his paper referred to above. They are accurate so far as they go; but they leave us in doubt as to the real relations which exist between the foetus and the mother, inasmuch as they give no clew to the manner in which the embryo is nourished during its intra-uterine life, — a period of about

[1] This description is largely taken from Balfour's Comparative embryology, vol. ii. p. 199.

seventeen days in the opossum,[1] and thirty-eight days in the kangaroo.[2] My fortunate discovery of the early opossum embryos, and the subsequent examination of the two other marsupials, seem to throw a great deal of light upon this question, if they do not actually solve it. The principal facts which have been brought out may be briefly stated.

1. In the opossum the yolk-sac spreads out over about one-third of the inner area of the subzonal membranes, and forms a highly vascular disk, the *false chorion* of the placental mammals. This disk is ventral to the embryo; and among the numerous embryos which were examined *in situ*, these disks were found to be *invariably placed in a long uterine furrow*, while the remainder of the enveloping membrane floated free in the cavity of the uterus. The use of the word 'attachment' would be misleading in this connection, as a slight touch with the needle was sufficient to remove the embryos from their position. The outer surface of the subzonal membrane, all over the area to which the yolk-sac was adherent, was found to be covered with minute villi, which were just visible to the naked eye. These villi are simple upgrowths of the subzonal epithelium, shaped like little hillocks, and confined to this area. At this early stage they are hollow.

2. In Professor Wilder's specimen,[3] villi were found to be scattered over the same area of subzonal membrane; but in this case their development had proceeded much farther, and, although they were extremely minute, each was found to be provided with a solid papilla, which arose from the epithelium of the yolk-sac. A closer examination showed that the cap of subzonal epithelium was composed of flattened cells, and that the papilla was provided with capillary branches derived from the vessels of the yolk-sac. These villi conform, therefore, to what Professor Turner has described as the simplest type of allantoic villi, the nearest approach to which, among the placental mammals, is found in the pig.

3. In the kangaroo foetus the villi could be seen without a lens. They were, however, so minute, that it is not at all surprising that they have been overlooked hitherto. They were spread over the highly vascular portion of the yolk-sac, which is loosely attached to the subzonal membrane. A close examination into their structure has not yet been made.

4. The allantois in the opossum embryos was found in various stages of growth, but in none was it attached to the subzonal membrane. In Professor Wilder's specimen it was highly vascular, and appeared to show a *disk-like area of attachment to the subzonal membrane*. This area showed no traces of villi. The subzonal epithelium consisted of flattened cells. In the kangaroo it was an extremely small vascular sac.

5. Owing to an accident, one horn of the uterus in which the embryos were preserved *in situ* was destroyed, so that no satisfactory study of the uterine wall could be made.

The presence of villi over that portion of the subzonal membrane which is in contact with the uterine wall renders it highly probable from analogy that minute crypts are present upon the latter. At all events, we now have data sufficient to establish the following facts: that the so-called *false chorion* of some of the lower orders of placental mammals, formed by the spreading of the yolk-sac over the inner surface of the subzonal membrane, in the marsupials functions as a *true chorion*, developing simple villi, by which the maternal and foetal blood-vessels establish a feeble interchange: in other words, the functions of the allantois in the placental mammals are, in a rudimentary way, performed by the yolk-sac in the marsupials. Finally, some genera of the marsupials probably show the attachment of the allantois to the subzonal membrane, which is the first step towards the establishment of an allantoic placenta.

These facts naturally give rise to a number of interesting questions, which will be discussed in a paper to be published in the *Quarterly journal of microscopical science* for July.

I wish to express my indebtedness to Professors Wilder and Chapman, without whose aid these observations would have been very incomplete.

HENRY F. OSBORN.

Morphological laboratory,
Princeton, May 11, 1883.

[1] See Bachman, Proc. acad. nat. sciences Philad., 1848, 44.
[2] See Owen, Comp. anat. and phys. of the vertebrates, iii. §400.
[3] The genus cannot be ascertained, owing to a misplaced label. The foetus undoubtedly belonged to one of the smaller Australian genera.

RAINFALL AT PANAMA.

IN the *Comptes rendus* for Feb. 26, M. de Lesseps publishes some interesting observations of rainfall for four years (1879–82) at the Isthmus of Panama. The accompanying table gives these observations, together with like observations at stations along the Pacific coast, which are added for the purpose of comparison.

M. de Lesseps remarks that the rainy season lasts about six months, from May to November, with an interruption at the end of June and beginning of July. He assigns as a cause for these peculiarities the advance of the (overhanging) sheet of rising air which