

and at the latest periods of growth is effected entirely by the ossification and reproduction of the intermediate cartilage between the shaft and the epiphysis.

In their applications to the explanation of the growth of bones, experiments with madder are thus proved to be conclusive: with a knowledge of the principles on which they depend, and with a careful avoidance of some sources of fallacy that have been pointed out, they may be employed with entire confidence; they afford to the observer the means, as it were, of branding with his own mark every particle of phosphate of lime that is deposited during a given time.

Their applications to the general doctrine of nutrition are less certain: for, in the first place, it is not clear that the laws which govern the production and maintenance of the earthy and inorganic matter of bones are applicable to the nutrition of soft parts; and if they be, the result of the madder experiments is at present in this point of view entirely negative, if not opposed to the idea of a constant mutation of particles. Seeing that the blood containing madder has no evident influence on the phosphate of lime already deposited in the bones, and that, on the other hand, blood not containing madder does not possess any chemical power to abstract the colour from the coloured phosphate of lime, it would appear as if there were no influence exerted during the state of health between the contents of the capillary system and the earthy matter already existing in the bones. And as, moreover, the bones of old animals are coloured by madder only to that degree which appears explicable by their increase of density, it would seem as if, in the state of health, or in what I would call the state of *nutritive equilibrium*, the earthy matter of bones undergoes no change.

compared the blood-discs of some of the rarer animals in the Zoological Gardens, and give, in the present communication, the result obtained from the following species:—

Order PACHYDERMATA.—Elephant (*Elephas Indicus*), male, nearly full grown.

— Rhinoceros (*Rhinoceros Indicus*), male, full grown.

RUMINANTIA.—Dromedary (*Camelus Dromedarius*), male, full grown.

— Giraffe (*Camelopardalis Giraffa*), male, nearly full grown.

— EDENTATA.—Armadillo (*Dasypus 6-ciuctus*), male, full grown.

The blood-discs were examined as they floated in the serum; also in a portion of blood thinly spread and rapidly dried upon slips of glass; lastly, as preserved in a solution of common salt of the strength of ordinary serum.

The observations were made by a Ross's Wollaston's doublet of a 1.8th inch focus, with Dujardin's illuminator, in the compound microscope belonging to the Royal College of Surgeons, and repeated, by the kind permission of Dr. Arthur Farre, with the same power and illuminator in the excellent microscope lately completed by Mr. Ross for that gentleman.

I have also to return my best thanks to Mr. Youatt, medical superintendent to the menagerie of the Zoological Society, for his prompt and obliging aid in obtaining the blood for my examination.

The blood from the *Elephant* was taken from a small vein on the side of the ear.

The red particles presented the usual figure characteristic of the mammiferous class, viz., the circular, flattened, slightly biconcave disc: their size varied more than usual, but that of the greatest number exceeded, by about one-fourth, the average-sized human blood-disc, which I take for the present comparison at 1-3000th of an English inch\*.

\* This is, perhaps, somewhat less than the true standard; but the difficulty of arriving at this is increased by the variation in the size of the average-sized blood-discs of different individuals, as well as by the difference which the blood-discs of the same individual present. I have been favoured by Mr. Bowerbank, whose great skill and accuracy in microscopic investigations are well known, with the following results of his examination of the blood-discs in four individuals, three male, and one female:—

CONTRIBUTIONS  
TO THE  
COMPARATIVE ANATOMY  
OF THE  
BLOOD-DISCS, OR RED PARTICLES  
OF THE  
VERTEBRATE ANIMALS.

By RICHARD OWEN, Esq. F.R.S. &c.

[For the London Medical Gazette.]

In answer to an appeal from my friend  
Prof. W. Owen I have examined and

The largest blood-discs of the elephant were twice the size of the ordinary sized human blood-disc; the smallest equalled them in diameter: hence, the blood-discs of the elephant are of a larger size than those of any other mammiferous animal hitherto examined; but I need hardly observe that this relation of the size of the blood particles to the bulk of the individual is by no means constant in the *mammalia*, and that the discrepancy in this respect is still more remarkable in the lower classes.

The action of the salt solution upon the blood-discs produced a slight diminution of their size; and the number of those which presented the concave, or basin-shaped figure, was greater than in the recent blood. A few of the minute chyle (?) or lymph (?) particles were present, but I could not distinguish, in any of the portions of the elephant's blood examined, that variety of form in the blood discs which Prof. C. H. Schultze has described in the blood of an elephant, killed at Potsdam, by means of hydrocyanic acid, and which induces him to describe the blood of this mammiferous animal as containing in itself all the various forms of particles which characterize, respectively, the blood of insects, mollusks, fishes, reptiles, and mammals\*.

*Rhinoceros*.—The blood of this animal was obtained by a small incision in the upper lip, and was consequently of a mixed arterial and venous nature. The huge creature being attracted by a favourite dainty presented to him by his keeper, seemed quite insensible to the operation, and quietly allowed the blood to be collected as it trickled down.

The blood-discs presented the usual mammiferous form, and a less variety of size than in the elephant. The average diameter is one-sixth less than that of the human blood-disc. The largest sized blood-discs of the rhinoceros have a diameter of 1-3800th of an inch; the smallest, 1-5200th.

Among the accidental circumstances

was, in fractions of an English inch, 1-3687, the extremes being 1-4645 and 1-3279.

In the second individual, a female, the average size was 1-3474, the extremes being 1-3e91 and 1-3106.

In the third individual, the average size was 1-3344, the extremes being 1-3922 and 1-2754.

In the fourth individual, the blood-discs presented the remarkably large average-size of 1-2861, the extremes being 1-4106 and 1-1862.

\* Muller's Archiv. for Phys. 1839, p. 252.

observed in the examination of the blood of the rhinoceros, I may mention, that although that portion spread on glass was dried under the same circumstances as were the portions of blood obtained from other animals, a far greater number of the particles presented the granulated or mulberry character than was observed in the blood of the other quadrupeds. Some of the particles examined while floating in the serum, likewise presented the granulated contour.

*Dromedary*.—In inspecting the blood of this animal, which was obtained from a slight incision in the skin of the leg, I had the gratification of appreciating the accuracy of Dr. Mandl's recent interesting discovery of the elliptical form of its blood-discs. These present fewer differences of size than in the rhinoceros, but among the elliptical particles there were a few which presented the circular form. The long diameter of the average-sized elliptical discs was 1-3800th of an inch, the short diameter, 1-6500th.

*Giraffe*.—The blood of this animal,—mixed arterial and venous,—was obtained from an incision in the integument of the face, and presented the particles of the circular form, as in the ox, and ordinary ruminants, and in the mammiferous class generally. The average size of the particles was nearly one-third smaller than those of the human subject; the largest, which were few in number, measured 1-4000th; the smallest, 1-4800th of an inch; the average size, 1-4500th. The result of the examination of the blood of the largest of the ruminating tribe is interesting, inasmuch as it indicates that the size of the blood particles relates to the condition of the whole organization, rather than to the bulk of the species. It would appear, from the examination of the blood-discs in the goat, sheep, and ox, that an unusually small size of the blood-discs was associated with the peculiarities of the ruminant structure.

*Armadillo*.—The blood-discs of this little quadruped rather exceed in size those of the rhinoceros; but the varieties and size in different particles or vesicles have a more limited range. They present the usual mammiferous form. The average diameter is 1-3300th of an English inch.

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