"The pear-shaped Figure of Equilibrium of a Rotating Mass of Liquid." By G. H. DARWIN, F.R.S.

"Sur la Stabilité de l'Équilibre des Figures Pyriformes affectées par une Masse Fluide en Rotation." By H. POINCARÉ, For. Mem. R.S.

The following Papers were read:—

I. "On Skin Currents. Part II.—Observations on Cats." By Dr. A. D. WALLER, F.R.S.

II. "The New Biological Test for Blood in Relation to Zoological Classification." By Dr. G. H. F. NUTTALL. Communicated by Sir M. FOSTER, Sec. R.S.

III. "Observations on the Cerebral Cortex of the Ape. Preliminary Communication." By A. S. F. GRÜNBAUM and Professor SHERRINGTON, F.R.S.

IV. "On the Inheritance of the Mental Characters in Man." By Professor K. PEARSON, F.R.S.

V. "On the Process of Hair turning White." By Professor ELIAS METCHNIKOFF, For. Mem. R.S.

"The New Biological Test for Blood in Relation to Zoological Classification." By GEORGE H. F. NUTTALL, M.A., M.D., Ph.D. University Lecturer in Bacteriology and Preventive Medicine, Cambridge. Communicated by Sir M. FOSTER, K.C.B., Sec. R.S. Received November 2,—Read November 21, 1901.

In recent publications which have appeared in the 'British Medical Journal'* and in the 'Journal of Hygiene'† I have described the technical methods whereby the so-called specific anti-sera may be produced, and in the article in the latter journal, the reader will find the literature on the subject exhaustively treated. The anti-sera are produced briefly as follows: Assuming that we wish to obtain an anti-serum for human blood, we inject human blood intra-peritoneally into rabbits. After about five injections, given at intervals of three or more days, the rabbit is bled to death, and its blood-serum collected. The serum of this rabbit will be found to have acquired the remarkable property of producing a precipitation immediately on its being added in small quantity to a dilution of

* 'Brit. Med. Journ.,' 1901 (11th May), vol. 1, p. 1141; (14th September), vol. 2, p. 669.

† 'Journ. of Hyg.,' 1901 (1st July), vol. 1, p. 367–387.

human blood-serum. If allowed to rest, the precipitated substance gravitates to the bottom of the tube. I have now tested upwards of 230 bloods obtained from animals of all classes of vertebrates with such anti-serum for human blood, and have, with the single exception of monkey bloods, obtained negative results throughout. Similarly, if rabbits are treated with the blood of the horse, dog, ox, sheep, &c., anti-sera are formed which produce precipitations only in the bloods of the animals whose blood was used for treatment, or, to a lesser extent, in the bloods of nearly allied animals.

The importance of the test from a medico-legal standpoint has been fully realised, and we can safely look forward to the test being put to practical use in the detection of crime. Whilst Uhlenhuth has proved that dried blood-stains can be used for the test, a solution of the dried blood being made for the purpose, I have shown that human blood which had putrefied for two months is capable of giving a reaction with its homologous anti-serum. I have, moreover, shown that human blood can be detected in a mixture of five or six different bloods brought into solution so that each blood is present but in the quantity of 1 : 500 or 1 : 600.

As stated above, the only bloods which gave a reaction similar to that of human bloods have been the bloods of different species of monkeys. Since my papers appeared I have had occasion to test eighteen kinds of monkey bloods. The reaction obtained with monkey blood only differs from that obtained with that of the human subject in degree. Monkey blood gives a feebler reaction than human blood with the anti-serum for human blood.

Accepting the classification of the Primates given by Flower and Lydekker,* we find that they are classified into two groups, the Lemuroidea (Lemurs) and Anthropoidea (Man and the Apes). As stated by the authors named, the view that the Lemurs belong to the Primates is largely traditional; they think they should, perhaps, be grouped in a distinct order. There are facts for and against this. Taking the Anthropoidea, we find them divided into the five families, Hapalidæ, Cebidæ (New World Apes), Cercopithecidæ, Simiidæ (Old World Apes), and Hominidæ (Man). According to Darwin, the Old World apes are more closely related in many respects to the Hominidæ than are the New World apes. And it is a striking fact, brought out by the tests I have made, that the New World monkeys give a less marked reaction with the anti-serum for human blood than do the Old World monkeys. On the other hand, the test gave a negative result when applied to the blood of two species of lemur (*L. xanthomystax*, *L. rufifrons*).

The eighteen monkey bloods tested were as follows: Hapalidæ (*Hapale pygmœa*, *Midas œdipus*), Cebidæ (*Mycetes seniculus*, *Uacaria*

* 'Mammals, Living and Extinct,' 1891.

rubicunda, *Cebus albifrons*), Cercopithecidæ (*Macacus assamiensis*, *M. cynomolgus*, *M. rhesus*, *M. ocreatus*, *Cercopithecus campbelli*, *C. patas*, *C. diana*, *C. lalandi*, *C. melogenys*, *C. callitricha*, *Semnopithecus entellus*), Simiidæ (the chimpanzee, *Anthropopithecus troglodytes*, and Ourang-outang, *Simia satyrus*).

All of these bloods reacted to the anti-serum for human blood, the New World monkey bloods less, and least of these the bloods of the Hapalidæ. I am at present attempting to estimate quantitatively the differences in the amount of reaction obtained.

When the experiment was tried with the anti-serum for dog's blood, the only bloods besides those of the domesticated dog which were found to react were those of other Canidæ (*C. aureus*, *C. mesomelas*, *C. procyonides*, *C. cerdo*). Similarly, the anti-serum for horse blood only gave a reaction with the blood of the horse and donkey. The anti-serums for ox and sheep blood have given reactions, which indicate the existence of a "blood relationship" between certain of the true ruminants. Whereas the anti-serum for ox blood acted powerfully on the blood of the ox and other members of the bovine section, it also produced reactions, but to a lesser degree, with the bloods of several species of the ovine section (Sheep and Goat), with the blood of several species of deer, the antelope and gnu. The anti-serum for sheep's blood gave almost as powerful a reaction with the blood of the closely related goat as it did with that of the different species of sheep, and also produced lesser reactions with the bloods of the other ruminants above mentioned.

The above experiments, which are being prosecuted on a large scale, the attempt being made to obtain a variety of anti-sera, indicate with certainty that we possess in this test a most valuable aid in the study of classification of animals. I am at present engaged in producing anti-sera for monkey blood, one of the objects being eminently practical. Just as in the case of the anti-serum for ox blood, which acts powerfully on ox blood and feebly on sheep's blood, and *vice versâ*, we shall by means of both the anti-serum for human blood and the anti-serum for monkey blood be able to differentiate the blood of man and monkey conclusively. This would scarcely have any practical application in this country, but it might very well be a matter of great medico-legal importance in countries where there are monkeys. Thus, I recently received a letter from Mr. E. H. Hankin, of Agra, stating that a case had come before him where it appeared essential to make a test to determine if certain blood-stains were caused by human or monkey blood. In such cases it would be necessary to prepare anti-sera for the most prevalent genera or species of monkey.

The more powerful the anti-serum obtained the greater is its sphere of action upon the bloods of related species. For instance, a weak anti-serum for human blood produced no reaction with the blood of the

Hapalidæ, whereas a powerful anti-serum did produce a reaction, and proved what I may be permitted to call the "blood relationship" in the absence of a better expression.

Referring to the anti-serum for human blood, I may state that I have successfully produced it in rabbits by injections of old human pleuritic exudate preserved in a bottle with chloroform for five to six months. Similarly, some old anti-diphtheritic horse serum preserved for two years and seven months in the laboratory by means of trikresol also yielded an anti-serum for horse blood. The anti-sera produced in these cases was feebler than that which is produced by injections of fresh serum. Dilutions of these old preserved fluids gave the characteristic reactions with their homologous anti-sera. I have also found that the anti-sera may be preserved for months with chloroform, although there is no denying that they lose in power. Anti-serum which had been preserved for over seven months in sealed capillary tubes was likewise still effective, although less potent.

Through the kindness of Mr. Frank E. Beddard, F.R.S., Prosector of the Zoological Society's Gardens, and numerous friends, who are generously aiding me by sending blood-samples from various parts of the world, I am gradually gathering together considerable material for study. Wherever possible the fluid sera are being sent me preserved with chloroform. Dried sera, on the other hand, are sent on slips of pure filter-paper, upon which appropriate data are noted in pencil.

The results of the investigation indicate the necessity of not limiting the work to vertebrates alone, and many questions naturally suggest themselves, the solution of which may be attained by means of the biological test.

The assumption seems justified that we may, for instance, be able at some future date to determine chemical differences in the blood of the various races of man. We no longer need to rely solely upon morphological characters for the differentiation of species.

It is impossible to enter into details concerning the nature of the reaction here described; it is a subject for further study. Suffice it to say that it is exceedingly complex, but at the same time the most delicate of tests known.

"On the Inheritance of the Mental Characters in Man." By KARL PEARSON, F.R.S., University College, London. Received November, 2,—Read November 21, 1901.

(1.) Mr. Francis Galton, in his 'Natural Inheritance,' first, I believe, endeavoured to give a quantitative appreciation of the inheritance of the mental characters in man. Mr. Galton's data