extracted and weighed from equal quantities of hair of the four several colours, because there is room for doubt as to the medium tints of those colours, and because those mediums may not be precisely the same in America as here. It seemed better to work the problem backwards, in the way to be easily understood from the following example. The [bay—bay] unions, according to Table I., produce 10 per cent. of chestnut offspring, 81 per cent. of bay, 6 per cent. of brown, and 3 per cent. of black. Therefore the quantity of red contained in each hundred offspring of [bay—bay] parents should be reckoned at

$$10 \times 0{\cdot}8 + 81 \times 0{\cdot}7 + 6 \times 0{\cdot}4 + 3 \times 0{\cdot}1 = 67{\cdot}4 \text{ units.}$$

Since this is the amount of red contributed by the *two* bay parents, the contribution from either bay parent singly will be only half as much, or 33·7.

Similarly the contribution of red from a single chestnut parent will be found to be 40·0; of a brown, 25·3; and of a black, 10·4. Consequently the quantity of red in each hundred offspring of [bay and brown] unions will, according to the theory, be reckoned at

$$33{\cdot}7 + 25{\cdot}3 = 59 \text{ units.}$$

This number has been entered in its proper place in Table III. as the "calculated" value, and may there be compared with the "observed" value obtained from the reciprocal unions of [*Dam*, bay—*Sire*, brown], and of [*Dam*, brown—*Sire*, bay]. Now, the former of these is seen in Table I. to have produced 1 per cent. of chestnut, 79 per cent. of bay, 14 per cent. of brown, and 6 per cent. of black, yielding by the method just described, 62·3 units of red; by a similar treatment the latter of these unions, namely [*Dam*, brown—*Sire*, bay] will be found to yield 59·2 units. The mean of 62·3 and 59·2 being 60·75, that is 61 when reckoned to the nearest integer, is also entered in a separate column in Table III.

TABLE III.—*Amount of Red in Offspring, observed and calculated.*

No. of cases	Offspring of		Red observed	No. of cases	Offspring of		Red observed	Mean observed	Calculated	Differences
	Dam	Sire			Dam	Sire				
407	Ches	Bay	71	366	Bay	Ches	70	70	74	+ 4
52	Ches	Brn	65	69	Brn	Ches	63	64	65	+ 1
72	Ches	Blk	64	57	Blk	Ches	55	60	50	− 10
221	Bay	Brn	62	450	Brn	Bay	59	61	59	− 2
156	Bay	Blk	57	268	Blk	Bay	52	54	41	− 13
55	Brn	Blk	35	6	Blk	Brn	35	35	36	+ 1

The general result of the comparisons is that calculation agrees with observation as closely as the rudeness of the statistics could lead one to expect. The average error between each of the six calculations and the corresponding means of each of the six pairs of reciprocal observations is about 5 per cent., while the greatest error barely exceeds 10 per cent. I therefore consider these results to corroborate that part of my theory of inheritance which they were intended to test.

Permit me to take this opportunity of removing a possible misapprehension respecting the scope of my theory. That theory is intended to apply only to the offspring of parents who, being of the *same variety*, differ in having a greater or less amount of such characteristics as any individual of that variety may normally possess. It does *not* relate to the offspring of parents of different varieties; in short, it has nothing to do with hybridism, for in that case the offspring of two diverse parents do not necessarily assume an intermediate form.

I am further desirous of drawing attention to an absurd error in my recent memoir quoted above, through the accidental transposition by me of the words Dam and Sire in the side columns of the Table II. of that memoir (which Table was constructed out of the Table I. that preceded it). The result was that the potency of the Dam to that of the Sire in transmitting colour was stated to have come out as 6 to 5, whereas the fact is the exact converse, namely, as 5 to 6. I ought to add that this strange blunder, which was detected and obligingly pointed out to me by two separate correspondents, had no effect upon the general conclusions of the memoir, because the ratio of 6 to 5 was treated as an insignificant disproportion, and the two sexes were dealt with on equal terms.

FRANCIS GALTON.

AERONAUTICAL ASCENTS FOR MEASURING THE ELECTRICAL FIELD OF THE AIR.

ON September 11, M. Lecadet, astronomer of the Lyons Observatory, made his fifth aeronautical ascent for testing the electricity of the air at high altitudes. This system of observation was invented by Dr. Exner, a member of the Vienna Academy of Sciences, who sent into the atmosphere a balloon directed by Lechner, on June 6, 1885. The balloon reached only an altitude of 600 metres, and the results of the reading, taken by an inexperienced observer, were of no value.

On September 27, 1892, M. Andrée, director of the Lyons Observatory, determined to ascend himself, with M. Lecadet as his assistant. The ascent ended in a total wreck.

In the following year M. Lecadet made two ascents at Meudon with the Government balloon, after having procured permission from the War Office. In the first trip (August 1893) the balloon was conducted by Captains Paul Renard and Julian, and ascended only to a very moderate altitude. The second experiment took place on August 9, and only one officer, Captain Hugot, was sent up with M. Lecadet. The experiments showed that the electrical field of the air gradually diminished, though the measures were executed with the cumbersome instrument designed by Dr. Exner.

In the following month, in September 1893, two ascents were made from Tempelhof, with the balloons of the Prussian Government, by Dr. Bornstein, a member of the Berlin Society for Aerial Navigation. The results were about the same as those observed by Lecadet.

After carrying out these experiments, M. Lecadet devised a new instrument. The readings are taken with an Exner electrometer, but instead of being placed in equilibrium with the electricity of the air by two jets of water at a vertical distance of five metres from each other, the effect is obtained by two cylinders of paper impregnated with nitrate of lead, which, once being lighted, are burning without flame. They are placed each to the extremity of one single wire, whose length can be varied at will. The apparatus weighs 3 or 4 kilogs., instead of at least 50. Many experiments made at Lyons Observatory proved that there was no danger of ignition of the gas issuing from the balloon, but the Minister of War declined the proposal of authorising ascents from its balloon arsenal.

The first experiment with the new system was tried at Lyons a few months ago with M. Boulade, an able local aeronaut. The experiments were conducted with great care and success up to 1000 metres, and the electric field of the air was again found to gradually decrease.

As Lyons is in close vicinity with the Alpine district, it was considered unsafe to try an ascent at a great altitude under these circumstances. M. Lecadet therefore went to Paris, and secured the assistance of M. Besançon, a member of the international committee for the *Ballons Sondes*. The balloon had a capacity of 1700 cubic metres; it was a new one, in China silk. There was no cloud in the sky, and only some vapour near the earth's surface. The two aeronauts reached an altitude of 4200 metres. The wind was rather strong, as in five hours they ran about 220 miles in a W.S.W. direction. They landed at Aubigne (Marne et Loire) in a regular gale, but escaped unhurt, owing to the use of a special grapnel and tearing-rope invented by M. Besançon.

The readings taken were very numerous—about 300—and the results are a continuous decrease of the electric field from the level of the ground. Through the courtesy of M. Lecadet, we are enabled to give the summary of results, which will be laid before the Academy of Sciences by M. Mascart when all the calculations have been completed, which will require some time.

Altitude	$\frac{\Delta v}{\Delta x}$
Close to the earth	120 volts
1000 metres	39 ,,
4200 ,, ...	11 ,,

The results show that at about 6000 metres the $\frac{\Delta v}{\Delta t}$ will be almost 0. Then the balloon will have reached the surface of electrical equilibrium.

If the electrical tension at this altitude is supposed to be 0, the potential of the earth $\Sigma \frac{\Delta v}{\Delta x} = -160{,}000$ (about). The eminent director of the French Meteorological Service has expressed his satisfaction at the results obtained, and has suggested

that another experiment should be tried in winter time, with clear and cold weather. He has also promised to direct to these experiments the attention of the Parisian Committee for Scientific Aeronautical Ascents. But it is likely that funds will be supplied by Lyonnese scientific men and capitalists. The expense of this ascent was borne by M. Jacquemet, a country gentleman, whose estate is in the vicinity of the Lyons Observatory. It is but fair to add that these all-important investigations should not be conducted with electrical kites, as used so cleverly in America for obtaining the temperature of the air. W. DE FONVIELLE.

BOTANY AT THE BRITISH ASSOCIATION.

THE business of the Section was opened by the presentation of reports (1) on the preservation of plants for exhibition, and (2) the fertilisation of the Phæophyceæ. Since the interim report on the preservation of plants (B.A. Report, 1896), the Committee have continued their inquiries and investigations, and the result of their work has been largely to confirm the statements contained in their previous report. They express the opinion that alcohol on the whole yields the best results as a liquid medium for the preservation of specimens. Drying in sand, in cases where the specimens are not intended to be handled, is recommended as a method by which admirable results may be obtained.

The Committee appointed to conduct experiments on the fertilisation of the Phæophyceæ presented an interim report on the favourable progress of the work. In the course of the meeting a cablegram was received by Prof. Farmer, the Chairman of the Committee, from Mr. J. L. Williams, of Bangor, announcing the discovery of motile antherozoids in the genera *Dictyota* and *Taonia*.

PHYSIOLOGY.

A preliminary account of a new method of investigating the behaviour of stomata, by Francis Darwin, F.R.S. The instrument used by the author in the present researches is a hygroscope depending for its action on the extreme sensitiveness to watery vapour of certain substances. The best material consists of thin sheets of horn treated in a special manner, and known as "Chinese sensitive leaf." The other is what is used for the toys described as "fortune-telling ladies," "magical fish," &c. When either of these membranes is placed on a damp surface it instantly curves with the concavity away from the source of moisture. If one end of a strip of the material is fixed to the lower surface of a block of cork, and is placed on the stomatal face of a leaf, it is clear that only the free end can rise. It is on this principle that the hygroscope is constructed, the angle to which the hygroscope tongue rises being a rough indication of the degree of transpiration. Thus on a leaf having stomata only below, the index of the hygroscope remains at zero on the upper surface of the leaf, while on the lower side it instantly rises to an angle varying with the condition of the stomata. If they are widely open the angle will be 30° or 40° to a horizontal line; if the stomata are closed the reading will be zero on both surfaces of the leaf. The author is engaged in a general investigation of the behaviour of the stomata under varying conditions.

Some considerations upon the functions of stomata, by Prof. C. E. Bessey. Prof. Bessey summarily reviewed the structure of stomata, and discussed the needs of aquatic, terrestrial, and aerial plants as to their getting of food, and the means by which they resist the drying of their tissues. The author concludes (1) that one of the functions of stomata is the admission of carbon dioxide to the chlorophyll-bearing tissues of the plant, for use in the formation of the carbohydrates. (2) That the loss of water by terrestrial plants was originally hurtful, and is so now in many cases. (3) That if plants have utilised this constant phenomenon, it is for the supply of food matters of secondary importance, as the salts in solution in the water of the soil.

Report upon some preliminary experiments with the Röntgen rays on plants, by Prof. G. F. Atkinson. The experiments were conducted for the purpose of testing the effect of the Röntgen rays on plants exposed during a considerable period of time. After a few preliminary experiments with leaves of *Caladium*, flowers of *Begonia*, and various seedlings exposed for one to ten hours, in which no perceptible injury resulted, a run was made in which several seedlings were exposed for a total of forty-five hours in a dark room. The plants behaved exactly as plants grown in a dark room. On removing the seedlings from the dark room they all became slowly green, but those which were under the influence of the Röntgen rays recovered the green colour more slowly; this suggests that the rays may have a slightly injurious effect on the chloroplastids. No other influence could be detected. Experiments were made on the absorption of the Röntgen rays by plants. Species of *Mucor*, Bacteria, and *Oscillatoria* were exposed to the action of the rays, but no influence was exerted on their growth or movement.

One morning session was devoted to a joint discussion with Section I, on the chemistry and structure of the cell. Prof. Meldola contributed an important paper on the rationale of chemical synthesis, and Prof. J. R. Green gave an account of his investigations on the existence of an alcohol-producing enzyme in yeast.

Dr. Armstrong exhibited a series of diagrams, which showed in a comparative manner the principal results of fifty years experimenting on the growth of wheat at Rothamsted.

Dr. Saunders, the Director of the Dominion Experimental Farms, contributed a paper on the results of some experiments in cross-fertilisation. He dealt chiefly with the efforts that had been made to introduce fruits suitable for the climate of the North-west Territories of Canada. Experiments were described on hardy apples from Northern Russia, and other regions; and Dr. Saunders referred to two forms of Siberian crab-apples from which promising crosses have been obtained. The author expressed the opinion that it will be possible in a few years to supply the North-west Territories with apples capable of withstanding the severe climate.

On the structure of a hybrid fern and its bearings on hybridity in general, by Prof. J. B. Farmer. This paper dealt with the characters, both macro- and micro-scopic, of *Polypodium Schneideri*, a hybrid between *P. aureum* and *P. vulgare*, var. *elegantissimum*. The facts elicited from a study of this plant were compared with those of analogous cases, and served as the basis for a discussion as to the nature of hybrids and of hybridisation.

THALLOPHYTA.

Prof. Marshall Ward (President) contributed a paper on *Stereum hirsutum*, a wood-destroying fungus.

The author cultivated this fungus from the spores, on sterilised wood blocks, and traced the action of the mycelium week by week on the elements of the wood. He obtained spore-bearing hymenia, and worked out the life-history very completely. Hartig, in his "Zersetzungserscheinungen des Holzes," examined the wood-destroying action of this fungus, but used material growing in the open, and therefore not pure. Brefeld attempted its culture, but failed to make it develop any fructification or spores.

The fertile hymenium arises in about three to four months. The author examined the development very thoroughly, and referred to discrepancies in the existing descriptions. The details of its destruction of the wood were fully described; the fungus delignifies the inner layers of the walls of the wood-elements, and in three months' cultures and upwards these turn blue in chlor-zinc-iodine, and are shown by other reagents to undergo alteration to cellulose-like bodies before their final consumption by the fungus.

On the mycelium of the witches' broom of Barberry caused by *Æcidium graveolens*, by Prof. P. Magnus. The author of the paper criticised the work of Dr. Eriksson on this parasitic fungus. The intracellular mycelium, described by Eriksson in the cambium cells of the host-plant, is regarded by Magnus as the plasmolysed cell contents. The latter author finds that the mycelium is always intercellular, and that it puts out branches into the cells of the pith, medullary rays, and cortical parenchyma of the host.

The nucleus of the yeast plant, by Harold Wager. In *Saccharomyces cerevisiæ* the nucleus can be easily demonstrated by careful staining in hæmatoxylin, Hartog's double stain of nigrosin and carmine, or by staining in aniline-water solution of gentian violet. It appears to consist, in the majority of cases, of a homogeneous substance, spherical in shape, placed between the cell-wall and the vacuole. On the whole, it resembles more than anything else the fragmenting nuclei in the older leaf-cells of *Chara*; that is, it consists of deeply-stained granules embedded in a slightly less stainable matrix.

The process of budding in a yeast cell is accompanied by the division of this nucleus into two. The division is a direct one,