

and in any further investigation the first step must be to ascertain under what interpretation these can best be reconciled with subsequent measures, it being evident that all cannot be accepted as registered. Sir John Herschel considered the angles of 1792 and 1795, especially the former, must be affected with considerable error. These angles are respectively  $355^{\circ}74$  and  $354^{\circ}9$ , or by a mean  $355^{\circ}3$  for 1793.76, but if we suppose that they should have been registered in the north-following quadrant, instead of the north-preceding one, the mean would become  $4^{\circ}7$ , an angle in much better accordance with the progression shown by the observations of 1782, 1802, 1804, and those of Struve, Herschel, and South about 1821. It might be worth while to determine how far this alteration would lead to a more admissible orbit. At the same time we have to bear in mind Sir W. Herschel's remarks with respect to his observation, 1792, April 20, in *Phil. Trans.*, 1804, p. 367. And equally are we to take into consideration for our guidance the same observer's estimations of distance in 1782 and 1804.

**DIAMETER OF VESTA.**—At the opposition of 1855, this brightest of the minor-planet group, which during the last spring, as in previous favourable oppositions, was discernible with the naked eye, was observed by Prof. Secchi to present a diameter but little inferior to that of the first satellite of Jupiter, “ma molto più debole di luce, e di colore ranciato carico,” and he estimated it at  $0^{\circ}8$ ; this we find corresponds to a true diameter of 450 miles. The least distance of the planet from the earth in 1855 was 1.26.

**PIGOTT'S COMET OF 1783.**—On the night of November 19, 1783, a comet was discovered by our countryman, Pigott, at York, well known as having also detected the remarkable variable stars, R Coronæ Borealis, R Scuti, and  $\eta$  Aquilæ. Pigott notified his discovery to Mechain, who observed the comet at Paris on the 26th of the same month, and, in conjunction with Messier, determined its positions until December 21. It was at no time visible without the telescope. Elements were calculated by Mechain and Saron, though without satisfactory results on a parabolic hypothesis. Subsequently Burckhardt investigated the orbit without this assumption, and finally arrived at elliptical elements, with a period of revolution of 5.61 years. But the most precise determination of the orbit from the Paris observations has been made by Prof. Peters, of Clinton, U.S., who reduced the observations anew, and introducing Hansen's Tables for the earth's positions, found elements which “represent the whole series to satisfaction.” These elements are published in the “Astronomical Notices” issued by Prof. Brünnow, while in direction of the Observatory at Ann Arbor, Michigan (No. 19), but as this periodical is comparatively little known in this country, having been continued for a short time only, we transcribe the orbit here:—

Perihelion Passage, 1783, Nov. 19.93685 M.T. at Paris.

Longitude of perihellon ... ..	$50^{\circ} 17' 25.4''$	} M.Eq. 1783 0
“    ascending node ... ..	$55 40 30.5$	
Inclination ... ..	$45 6 53.8$	}
Angle of eccentricity ... ..	$33 32 8.4$	
Log. semi-axis major ... ..	$0.5133056$	
Period of revolution ... ..	$5.888$ years.	

In this orbit the perihelion distance is 1.4593, and the aphelion distance 5.062.

The comet has not been found since 1783. As remarked by Prof. Peters, a major-axis differing but little from the above would have sufficed to bring the comet into close proximity to the planet Jupiter, at one or other of the subsequent aphelion passages, whence it is possible great perturbations may have resulted, even of magnitude sufficient to effect an entire change of orbit. Indeed with the above elements we find the distance of the comet

when in aphelion, from the orbit of Jupiter, is only 0.42. Independently of this, there is another cause which might have long operated to prevent the re-discovery of the comet: in 1783 it appeared under nearly the most favourable circumstances possible for observation, yet as before stated it was at no time visible to the naked eye, and while approaching pretty near the earth, did not exceed 8' in diameter, presenting throughout the appearance of the great majority of telescopic comets.

The orbit of Pigott's comet passes very near to that of the planet Mars: in heliocentric longitude  $55^{\circ}2$ , we find the distance is only 0.032, and it is to be remarked that this close approach takes place in one of the regions where the orbit of the lost comet of De Vico also comes into such near proximity to that of the planet; still after M. Leverrier's statement with reference to past perturbation of De Vico's comet by Mars, we are not to suppose that the bodies can be probably identical.

With respect to the introduction of Pigott's comet into our system, small variation in the major-axis assigned by Prof. Peters would have caused a very close approach of the comet to Jupiter at the aphelion passage immediately preceding the comet's appearance, or early in 1781.

#### THE SELF-FERTILISATION OF PLANTS

MR. THOMAS MEEHAN, one of the most acute and thoughtful of American botanists, has several times during the present year brought before the Philadelphia Academy of Natural Sciences the subject of the fertilisation of plants. He has observed that there are plants with conspicuous and attractive flowers, which are as much adapted to secure self-fertilisation as other flowers are for cross-fertilisation. One of his examples is the green-house annual, *Browallia elata*, belonging to the order Scrophulariaceæ, having an attractive blue flower. Not only does it produce abundance of perfect seeds without insect aid, but also the entrance of an insect would ensure self-fertilisation. The style is nearly as long as the corolla-tube, and the slightly longer stamens are arranged closely around it. Two of the anthers are inverted over the stigma, and their connective is densely bearded, appearing like petaloid processes, completely closing the tube of the corolla. No insect can thrust its proboscis into the tube except through this mass; and if it has foreign pollen adherent to it, it will be cleaned off by the beard. Furthermore, the very act of penetration will thrust the anthers forward on to the pistil, and aid in rupturing the pollen sacs, and securing self-fertilisation.

Another phenomenon, the “sleep” of plants, or closing of the flowers at nightfall, has been found by Mr. Meehan to have reference to self-fertilisation in *Claytonia virginica* (order Portulacacæ) and some buttercups, which seed abundantly, without being visited by insects. In *Claytonia*, the stamens, on expanding, fall back on the petals expanded during daylight. At night, when the flower closes, the petals carry the anthers into close contact with the stigmas, and actual fertilisation only occurs in this way. In many cases, the stamens recurve so much as to be considerably doubled up by the nocturnal motion of the petals; thus the anthers are not brought into contact with the stigmas, and the flowers are barren.

In *Ranunculus bulbosus*, in the evening following the first day's expansion of the flower, Mr. Meehan has found the immature anthers and the young stigmas covered with pollen-grains. This would naturally be supposed to be the consequence of insect visits; but no insect visits had taken place in the cases examined. However, on carefully studying the flower it was found that coincidentally with its expansion, a single outer series of stamens shed their pollen into the petals, from which it easily fell to the immature anthers and the stigmas when the flower closed for the night. Another equally remark-

able instance of self-fertilisation occurs in *R. abortivus*, whose petals do not close at night. It seeds profusely, yet is wholly neglected by insects, notwithstanding that it possesses large nectariferous glands. Instead of the flower closing, the slender pedicels droop at night, inverting the flower, and thus allowing the pollen to fall from the petals, on which it is shed, upon the stigmata. Mr. Meehan concludes that some deeper purpose than has yet been conceived governs the fertilisation of plants. In view of these examples, nature cannot "abhor" in-and-in-breeding, and it can hardly be that colour, fragrance, and honeyed secretion in flowers have been developed solely to secure cross-fertilisation. Evolutionists will await with interest further researches by Mr. Meehan, and confirmatory evidences from other inquirers.

### THE BRITISH ASSOCIATION REPORTS

Mr. Chrystal read the following summary of a Report upon a *Comparison of the B.A. Units of Electrical Resistance* that had been performed by himself and Mr. S. A. Saunder.—The experiments, of which I have here an account, were undertaken for the purpose of comparing the British Association Standards of Resistance now deposited in the Cavendish Laboratory at Cambridge. In the account of the work Mr. Saunder and myself have endeavoured as much as possible to enable anyone who consults it to judge by internal evidence of the accuracy of the comparison.

The experiments were so arranged as to give a check on their own accuracy.

In work of this kind the limit of accuracy is much sooner reached in the temperature than in the electrical measurements. It is to them therefore to which the greatest attention has to be given.

We took advantage of an extremely convenient source of nearly constant temperature in the tap-water of our experimenting room, which we found by careful observation to remain constant within the tenth of a degree centigrade for a sufficiently long time. By means of this we could find the differences between the resistances of the several coils at temperatures all near 10° C. The method used for obtaining these differences was a very convenient one, described by Prof. Carey Foster in the October number of the *Journal of the Society of Telegraph Engineers* for 1874.

To obtain the co-efficients of resistance-temperature variations it was necessary to make resistance measurements at a higher temperature. The temperature chosen was 16° C.

The coils were brought to this temperature by careful nursing for an hour or more.

The results of these experiments combined with those at the lower temperature gave the variation co-efficients. The differences at any given temperature could then be calculated.

Lastly, a series of direct comparisons were made, and the result compared with calculation in order to get an idea of the accuracy of our work.

There is a difficulty in giving a comparison between our results and those of the last measurements given in the British Association Report on Electrical Standards. This arises from a want of definite information about these last measurements.

Unfortunately on most of the coils the brass labels have never been completed as was intended, and although we think we managed to identify the coils described in the report with one exception, yet still more definite information is desirable. It is because we have felt this want that we have made our own report more minute than might otherwise have seemed necessary.

We hope that no ambiguity will exist when the coils are compared again either now to check our results or some ten years hereafter to find whether the standards have varied relatively to each other.

With this caution I give a series of temperatures at which the standards are equal to each other according to our measurements side by side with one of the temperatures given in the report.

		Last found.	B.A. Report.
Pt. Ir.	2	16.1	16.0
"	3	15.8	15.8
Au. Ag.	58	15.3	15.3
Pt.	35	16.0	15.7
"	36	15.8	15.7
Pt. Ag.	29	18.2	15.2

We have laid these measurements before the British Association in the hope that they will be found useful and be made accessible to those interested in such matters.

*Report of the Committee for effecting the Determination of the Mechanical Equivalent of Heat.*—Progress has been made with the experiments undertaken by Dr. Joule on behalf of the Committee. Friction of water is the method employed, and the average result of upwards of sixty experiments is 772.2 in British gravitation units at Manchester. The greatest deviation from the above average is  $\frac{1}{200}$ .

Experiments have yet to be made on the capacity for heat of the brass of which the calorimeter is constructed, which has provisionally been calculated from the results of Regnault for this alloy. The greatest possible error which may have arisen in this way is believed to be  $\frac{1}{1000}$ th. Dr. Joule also proposes to compare his mercurial thermometers with the air thermometer with a view to obtain accurate boiling points, and thus correct values of the thermometric scale. The greatest correction which it may be found needful to apply on this account amounts to about  $\frac{1}{1000}$ th. These maximum corrections, if taken in the same direction, would necessitate the addition or subtraction of 4.5 from the equivalent above named. The experiments made by Him on the friction of water have led him to the number 786; but the average of his results, derived from the friction, boring, and crushing of metals, gives 774.

Assuming that the above experiments and those made by Dr. Joule for the Committee on Standards of Electrical Resistance are to be relied on, the unit issued by it would appear to have a resistance one-fortieth too small. Inasmuch as the locality in which the experiments for that unit were conducted was open to objection, it appears desirable that they should be conducted under more favourable circumstances.

*Report of the Committee on the Distribution of Erratic Boulders.* Read by the Rev. H. W. Crosskey, M.A.—One hundred and sixty-five additional erratics have been catalogued west and south-west of Birmingham, of which 105 have travelled from considerable distances. West and south-west of the midland table-land a large proportion of the blocks are portions of highly indurated ash-beds. To the north and west granite is much more abundant.

Between the 400 and 500 ft. contour lines at Bothel (North Cumberland) is a large block which has been transported from the north-west portion of Dumfriesshire, about forty miles from N.N.W. to S.S.E. Fragments of Shap Fell Granite occur near Dufton (Westmoreland), 800 feet above the sea-level. The east and north-east boundary of the Arenig dispersion may be roughly defined as extending from Chirk by Cefn, Ruabon, Wrexham, Caergwile, Mold, and the east side of Halkin Mountain to Holywell, and thence in a westerly direction to the Vale of Clwyd. This line nearly coincides with the boundary of the great Northern Granite drift. The Welsh and the northern drifts have to a slight extent crossed the average boundary, and a few Arenig boulders have crossed the estuary of the Dee into the peninsula of Wirral, where they become mixed with the very abundant northern drift from the Lake district and the south of Scotland. The felspathic blocks from the Arenig range have radiated to great distances over an area extending from N.N.E. to E., and to short distances from east to south-east; and have found their way across valleys and over watersheds and high mountains. The direction of the glacial striæ on rock surfaces in the eastern part of North Wales as well as in the Arenig mountains, agrees in general with the course taken by the boulders.

The Committee invoke the assistance of geologists in carrying on their investigation. Schedules indicating the particulars required, may be had from the secretary. The rate at which the boulders are disappearing, owing to agricultural and building operations, makes it desirable to register their occurrence without delay.

The report of the Close Time Committee gave an account of the steps which led to the passing of Mr. Chaplin's Bill for the Preservation of Wild Fowl last Session, and included a circular extensively distributed by the Committee to further that object. Lord Walsingham, Mr. Chaplin, and Mr. Rodwell were warmly thanked for their exertions in the matter. The Committee thought it possible that something further might be done to regulate the proceedings of bird-catchers; but the difficulties in the way appear so serious, that immediate success is not expected. The Sea Birds Preservation Act continues to work satis-