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THURSDAY, SEPTEMBER 24, 1874

THE MIGRATION OF BIRDS

THE "silly season" has this year been marked by some discussion in the newspapers on the migration of birds. The various letters published have shown the normal want, if not of knowledge, yet of profundity; and I fear lest the subject, which really deserves the best attention from naturalists, should suffer in repute by the absurdities lavished upon it.

The discussion began, if I am not mistaken, with a theory of migration set forth by a Scandinavian poet, which treated that wonderful movement as an attempt on the part of birds to attain "more light." It proceeded on the hypothesis that the birds which are summer-visitors to northern climes, finding that the days grow shorter as summer advances, retire southwards to find "more light," and that the same desire prompts their return northwards in spring. To show the fallacy of this hypothesis it is sufficient to observe that the southward movement not only begins, but is with many species in great part accomplished, long before the autumnal equinox, when consequently the birds are journeying to increasingly shorter days; and in like manner their northward movement is set on foot before the vernal equinox, with of course the same result. Whether this theory was ever intended in earnest or was only a poetic fancy I do not know, nor is it really worth while to inquire. It is enough that it contains its own refutation.

I have no intention of commenting upon the whole discussion. Few, if any, of the letters which followed contain anything to the purpose either way. But one published in the *Times* of Friday, Sept. 18, seems to require special notice, since it professes to give "the latest accepted theory" on the subject; and the writer, without actually saying that it is received by a very great authority, whom he names, intimates that it does not meet with his disapproval. Of this "latest accepted theory" I must confess I never before heard; and now that it is before me, it seems to be not only unsupported by facts, but to amount to no explanation at all. After briefly touching upon the difficulty which the shorter-winged Birds of Passage must have in effecting their voyages, the writer says:—

"I believe it was only some twenty or thirty years ago that anything like a practical solution of the difficulty was arrived at. The birds congregating about the south coast are seized with a sudden impulse or mania to fly upwards. This is caused by some atmospheric change coinciding with a warm south wind moving in a high stratum, into which the birds soar with an involuntary motion of their wings. This motion (involuntary like that of the heart) is continued for many hours, and the birds fly blindly along until the paroxysm passes off, when they at once begin to descend, making many a fatal drop into the sea.

"The same phenomenon occurs in Africa and southern countries, where the migratory birds congregate for a northern flight about April. Experiments were tried here and in Africa which tended to corroborate the above facts. Migratory birds were kept in cages along the coast, and it was found that each was seized with a prolonged paroxysm coinciding with the time that the wild birds disappeared. Cages were constructed with silk at top and bottom to prevent the birds from killing themselves; and it was noticed that after the paroxysm had passed away, the birds began to look about them, to plume themselves, and eat and drink, apparently with a notion that they had arrived at their new home."

On reading these wonderful paragraphs, some questions naturally arise. How does the writer account for his "birds congregating about the south coast?" What brings them there, that they may be "seized with a sudden impulse or mania to fly upwards?" Who has ever observed the "atmospheric change" and coincident "warm south wind moving in a high stratum?" Do these remarkable meteorological phenomena occur but once in the whole season of migration, or is there a succession of them to suit the convenience of each migratory species? Who, moreover, has seen the birds soar into this peculiar current of air? and who of such fortunate persons knows that the motion of their wings under such conditions is "involuntary like that of the heart?" Finally, what is the cause of the "paroxysm"? for, without knowing that, to attempt to explain the observed facts of migration is an attempt to explain *obscurum per obscurius*.

When a satisfactory answer is given to these questions, it will be time to inquire whether this "latest accepted theory" of migration sets the matter in any clearer light, or whether it is not as arrant nonsense as was ever foisted upon an innocent public, even at the height of the "silly season." The last paragraph of the writer's letter, I may remark, has nothing in it of consequence. Granting that the migratory impulse is instinctive, it is, like other instinctive practices, followed as far as circumstances will allow.

Permit me now to point out to those interested in the solution of this mystery of mysteries the chief matters to which the attention of observers and theorisers should be directed.

I. *The original Cause or Causes of Migration.*—In some cases scarcity of food would seem to be a sufficient cause, and it is undoubtedly the most obvious one that presents itself to our mind. As food grows scarce towards the end of summer in the most northern limits of the range of a species, the individuals affected thereby seek it in other countries. Thus doing, they press upon the haunt of other individuals; these in like manner upon that of yet others, and so on, until the movement which began in the far north is communicated to the individuals occupying the extreme southern range of the species at that season; though, but for such an invasion, these last might be content to stay some time longer in the enjoyment of their existing quarters. When we consider, however, the return movement, at the end of winter, it is doubtful, I think, whether scarcity of food can be assigned as its sole or sufficient cause. But here we feel the want of knowledge. At present we are far too little acquainted with the physical peculiarities of those more equatorial regions, which in winter are crowded with emigrants from the north, to come to any final decision. It seems not too violent an assumption to suppose that though such regions are well fitted for the winter resort of the bird-population of the north, they may be deficient in certain necessaries for the nursery; and it seems still less of an assumption to suppose that even if such necessaries are not wanting, yet that the

COMMON WILD FLOWERS CONSIDERED IN RELATION TO INSECTS *

II.

THE Common Heaths (*Erica tetralix* and *E. cinerea*) offer us another very ingenious arrangement. In *E. tetralix* (the Cross-leaved Heath), for instance, the flower is in the form of a bell (Fig. 15), which hangs with its mouth downwards, and is almost closed by the pistil (*st*), which represents the clapper. The stamens are eight in number, and each terminates in two cells, which diverge slightly, and have at their lower end an oval opening. But though this opening is at the lower end of the anther cells the pollen cannot fall out, because each cell, just where the opening is situated, touches the next anther cell, and the series of anthers thus form a circle surrounding the pistil and not far from the centre of the bell. Each anther cell also sends out a long process, which thus forms a series of spokes, standing out from the circle of anthers. Under these circumstances, a bee endeavouring to suck the honey from the nectary cannot fail firstly to bring its head in contact with the viscid stigma, and thus to deposit upon it any pollen derived from a previous visit; and secondly, in thrusting its proboscis up the bell, it inevitably comes in contact with one of the anther processes, which acts like a lever and dislocates the whole chain of anther cells when a shower of pollen falls from the open anther cells on to the head of the bee. †

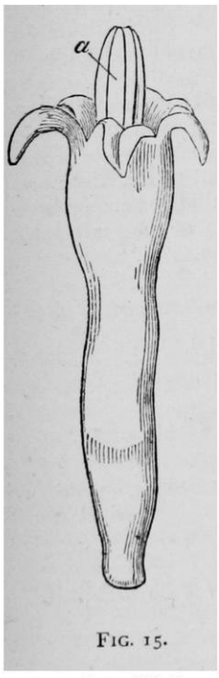

FIG. 15.

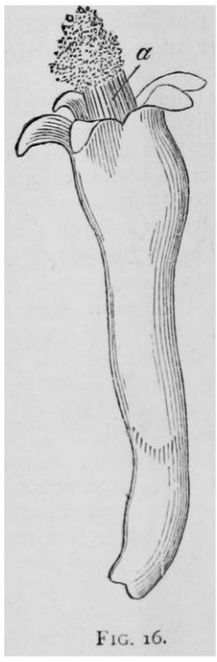

FIG. 16.

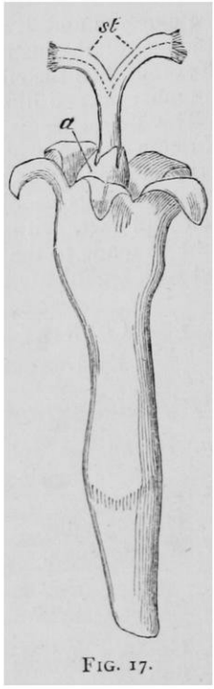

FIG. 17.

In the allied genus Vaccinium there is a similar arrangement, but the anther cells are closed, not by touching one another, but by resting against the style, so that the style itself closes the openings until the anthers are distributed by the proboscis of the bee. *V. uliginosum* is much larger than *V. myrtillus*, and consequently more conspicuous; *V myrtillus*, on the other hand, has the compensating advantage of being richer in honey.

The genus Arbutus also is said to agree in essentials with Vaccinium.

In many cases the effect of the colouring and scent is greatly enhanced by the association of several flowers on one branch or raceme, as, for instance, in the Wild Hyacinth, the Lilac, and othe rfamiliar instances. In the great family of Umbelliferæ this arrangement is still further taken advantage of, as in the common Wild Chervil (*Cherophyllum sylvestre*).

In this group the honey is not, as in the flowers just described, situated at the bottom of a tube, but lies exposed, and is therefore accessible to a great variety of small insects. The union of the florets into a head is, moreover, not only of advantage in rendering them more conspicuous, but also effects a considerable saving of time, as it enables the insects to visit a given number of insects more rapidly, and consequently renders their fertilisation more certain than if they had stood singly.

The self-fertilisation which, in small flowers such as these, would otherwise naturally occur, is provided against by the fact that the flowers are generally proterandrous, that is to say, the stamens ripen before the pistil, and the latter is not mature until the former have shed their pollen. In some cases, as, for instance, in Myrrhis, the flowers of one head are all firstly in the male condition, and subsequently in that with mature stigmas, none of them arriving at the second stage until they have all passed through the first.

In *Cherophyllum* the petals are not symmetrical, the outer ones being considerably larger than the others, and in many umbellifers the florets themselves on the outer edge of the bunch or umbel are considerably larger than the inner ones.

This distinction is carried still further in the Compositæ, where

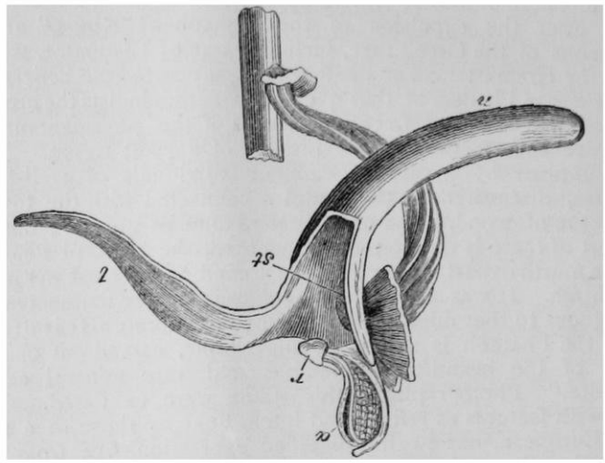

FIG. 18.

also the florets are so closely packed together that the whole umbel is commonly, though of course incorrectly, spoken of as a flower.

For instance, the heads of the common Daisy, as I need hardly mention, are not strictly speaking flowers, but bunches of flowers closely packed together on a common base or receptacle.

The advantages of this arrangement are:—

1. That the flowers become much more conspicuous than would be the case if they were arranged singly.

2. That the facility with which the honey is obtained renders them more attractive to insects.

3. That the visits of the insects are more likely to be effectual,

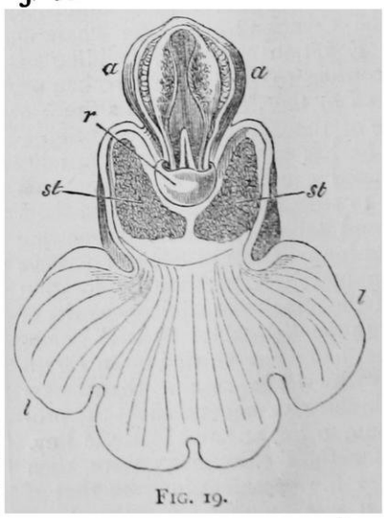

FIG. 19.

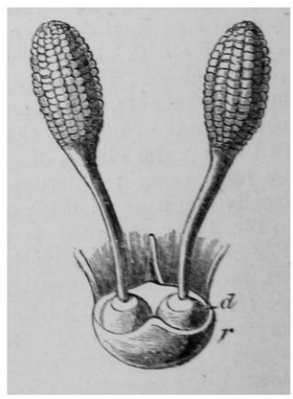

FIG. 20.

since the chances are that an insect which once alights, touches several, if not many, florets.

No wonder, therefore, that the Compositæ are the most extensive family among flowering plants, are represented in every quarter of the globe and in every description of station,* and contain nearly ten thousand species.

If we take, for example, the common Feverfew, or large white Daisy (*Chrysanthemum parthenium*), which has been well described by Dr. Ogle,† the flower-heads consist of an outer row of female florets, in which the tubular corolla terminates on the outer side in a white leaf or ray, which doubtless

* Continued from p. 406.

† *Popular Science Review*, April 1870.

* Bentham, "Handbook of the British Flora," vol. i. p. 408; Jour. Linn. Soc. 1873, p. 335.

† *Popular Science Review*, April 1870.

is useful in making the flower conspicuous. The inner florets are also tubular, but are small, yellow, and without rays. Each of these florets is furnished with stamens as well as a pistil. The stamens are united on their inner sides so as to form a closed tube, within which the pistil lies. They ripen before the pistil, and dehisce on their inner sides, so that the pollen is discharged into the upper end of the tube above the head of the pistil. When the flower opens the pollen is already ripe, and fills the upper part of the stamen tube. A floret in this condition is represented in Fig. 15. The pistil, however, also continues to elongate, and at length pushes the pollen against the upper end of the tube, which gives way, and thus the pollen is forced out of the tube, as shown in Fig. 16. The pistil itself terminates in two branches, which at first are pressed closely to one another, and each of which terminates in a brush of hairs (Fig. 17). As the style elongates this brush of hairs sweeps the pollen cleanly out of the tube, and it is then removed by insects. When the pistil

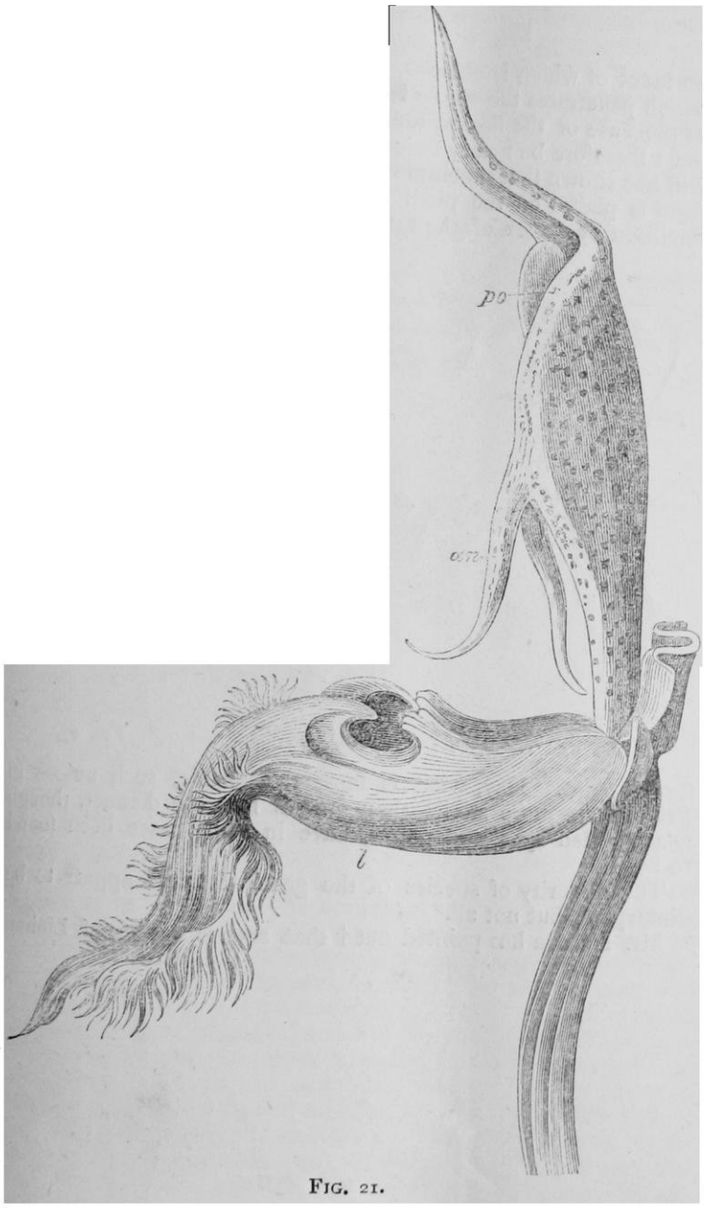

FIG. 21.

has attained its full length two branches open and curve downwards so as to expose the stigmatic surfaces (Fig. 17, *st*) which had previously been pressed closely to one another, and thus protected from the action of the pollen. From this arrangement it is obvious that any insect alighting on the flower-head of the Chrysanthemum would dust its under-side with the pollen of the younger flowers, which then could not fail to be brought into contact with the stigmatic surfaces of the older ones. As the expansion of the flowers begins at the outside and thence extends to the centre, it is plain that the pollen of any given floret cannot be used to fertilise one situated on its inner side. Consequently, if the outer row of florets produced pollen, it would, in the great majority of cases, be wasted. I have, however, already mentioned that these florets do not produce pollen, while the saving thus effected enables them to produce a larger corolla. It is also interesting to observe that in these outer flowers the branches of the pistil do not possess the terminal brush of hairs which, in the absence of pollen, would be useless.

In other Compositæ, as in the Marigold, while the ray flowers produce no pollen, the disc flowers develop stigmas only. In this case, as in the Feverfew, the pistil of the ray flowers does not require or possess the terminal brushes of hairs, as there is no pollen to be swept out. The central flowers, on the other hand, though they develope no stigmas, require a pistil in order to force the pollen out of the anther tube. Hence the pistil is present as usual, but the head is simple and not bifid. This complete alteration of the function of the pistil is extremely curious

Perhaps no group of flowers offers more remarkable adaptations than the orchids, which have been so admirably described by Mr. Darwin.* As an illustration of our English species, I shall take the common early purple orchis (*Orchis mascula*), as being one of the commonest, if not the commonest, species; and a fair example of some of the remainder, which however differs in many interesting and important points.

Fig. 18 represents the side view of a flower, from which all the petals and sepals have been removed, except the labellum (*l*), half of which has been cut away, as well as the upper portion of the near side of the nectary (*n*). The pollen forms two masses (Fig. 19, *a a*), each attached to a tapering stalk, which gives the whole an elongated pear-like form, and is attached to a round sticky disk (*d*), which lies loosely in a cap-shaped envelope or rostellum (*r*). This envelope is at first continuous, but the slightest touch causes it to rupture transversely, and thus to expose the two viscid balls (Fig. 20, *d*). Now suppose an insect visiting this flower; it alights on the labellum, and pushing its proboscis down the nectary to the honey, it can hardly fail to bring the base of the proboscis into contact with the two viscid discs, which at once adhere to it, so that when the insect draws back its proboscis, it carries away the two pollen masses. It is easy to imitate this with a piece of grass, and to carry away on it the two pollen masses and their stalks. If, however, the pollinium retained this erect position when the insect came to the next flower, it would simply be pushed into or against its old position. Instead however of remaining upright, the pollinia, by the contraction of the minute disc of membrane to which they are attached, gradually turn downwards and forwards, and thus when the insect sucks the next flower, the thick end of the club exactly strikes the stigmatic surface (*st*). The pollinium or pollen mass consists of packets of pollen grains, fastened together by elastic threads. The stigma, however, is so viscid, that it pulls off some of these packets, and ruptures the threads, without removing the whole pollinium; so that one pollinium can fertilise several flowers.

I cannot resist mentioning the case of Catasetum, one of the Vaudræ, which, as Mr. Darwin says, "are the most remarkable of all orchids." In Catasetum (Fig. 21) the pollinia and the stigmatic surfaces are in different flowers, hence it is certain that the former must be carried to the latter by the agency of insects. The pollinia, moreover, are furnished with a viscid disc, as in orchis, but from the large size of the flower, and the position of the honey, the insect has no inducement to approach, and in fact does not touch, the viscid disc. The flower, however, is endowed with a peculiar sensitiveness, and actually throws the pollinium at the insect. Mr. Darwin has been so good as to irritate one of these flowers in my presence: the pollinium was thrown nearly 3 ft., when it struck and adhered to the pane of a window. This irritability, however, is confined to certain parts of the flower of *Catasetum saccatum*, which is also shown in section in Fig. 22. In this figure it will be seen that the pollinium (*d p*) is curved, and in a state of considerable tension, but retained in that position by a delicate membrane. Now, insects alight as usual on the labellum of the flower (*l*), and it will be seen that in front of it are two long processes, or antennæ (*an*). In some species of Catasetum both these antennæ are highly irritable; in the present species the right-hand one is apparently functionless; but the moment the insect touches the left-hand one, the excitement is conveyed along it, the membrane retaining the pollinium is ruptured, and the latter is immediately jerked out of the flower by its own elasticity, with considerable force, with the viscid disc foremost, and in such a direction as to come in contact with the head of the insect which had touched the antenna.

I will only mention one other tropical flower, the very curious *Maregravia nepenthoides*, described by Mr. Belt in his interesting work, "The Naturalist in Nicaragua." The flowers are disposed in a circle, and beneath them are suspended some

* Fertilisation of Orchids.

pitcher-like vessels, which secrete a sweetish liquid, and thus attract numerous insects. These again bring birds, which can hardly fail to brush against the flowers, and thus convey the pollen from one to the other.

In the flowers hitherto described, while the several species offer the most diverse arrangements, we have met with no differences within the limits of the same species, excepting those dependent upon sex. I must now call attention to some cases in which the same species possesses flowers of two or more kinds, which sometimes, as in the Violet, are adapted to different conditions; but more frequently are so constituted as to ensure cross-fertilisation.

In some of the violets (*V. odorata, canina*, &c.), besides the blue flowers with which we are all so familiar, but which produce very little seed, there are other autumnal flowers, almost without petals and stamens, and which indeed have none of the appearance of true flowers, but in which the seeds are produced. As these curious flowers, however, have no relation to our present subject, I shall not now dwell on them.

I pass on to the genus Primula, which offers a most interesting case of dimorphism. The Cowslip and Primrose resemble one another in many respects, though the honey they secrete must be

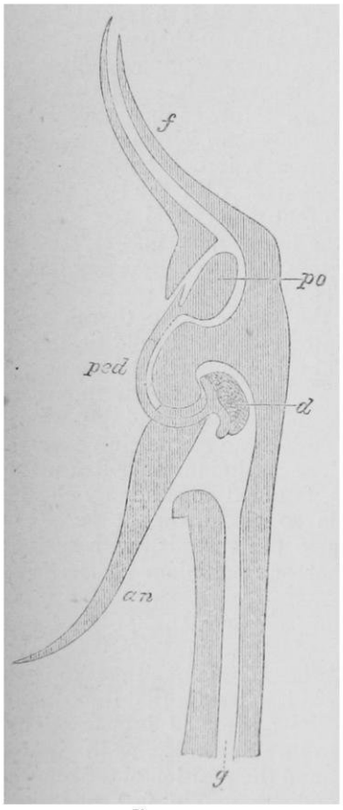

FIG. 22.

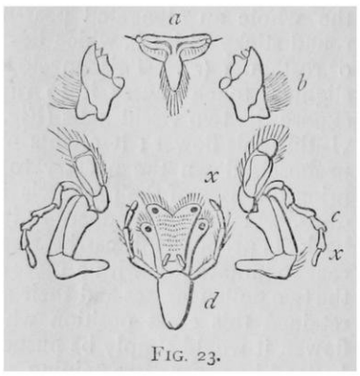

FIG. 23.

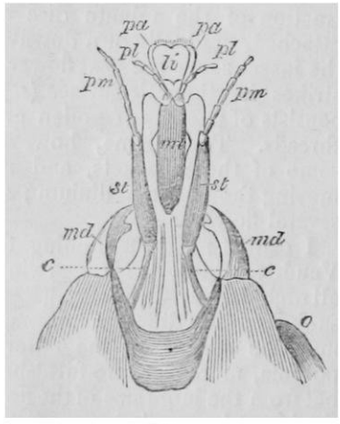

FIG. 24.

very different, for while the Cowslip is habitually visited during the day by humble bees, this is not the case with the Primrose, which, in Mr. Darwin's opinion, is fertilised almost exclusively by moths. (Jour. Linn. Soc., vol. x. p. 438.) This, however, is a digression.

Corresponding differences occur in the Polyanthus and Auricula, and had long been known to gardeners, and even to school children (by whom the two kinds of flowers are known as "pin-eyed" and "thumb-eyed"), but it was reserved for the genius and perseverance of Mr. Darwin, to explain * the significance of this curious phenomenon, and the important part it plays in the economy of the flower. Now that Mr. Darwin has pointed this out it is sufficiently obvious: an insect thrusting its proboscis down a primrose of the long-styled form would dust its proboscis apart, which, when it visited a short-styled flower would come just opposite the head of the pistil, and could not fail to deposit some of the pollen on the stigma. Conversely an insect visiting a short-styled plant would dust its proboscis at a part further from the tip, and which, when it subsequently visited a long-styled flower, would again come just opposite to the head of the pistil. Hence we see that by this beautiful arrangement insects will carry the pollen of the long-styled form to the short-styled, and *vice versâ*.

There are other points in which the two forms differ from one another: for instance, the stigma of the long-styled form is globular and rough, while that of the short-styled is smoother, and somewhat depressed. The pollen of the two forms is also dissimilar, that of the long-styled being considerably smaller than the other, 7-7000ths of an inch in diameter against $\frac{10-11}{7000}$ or nearly in the proportion of three to two; a difference the im-

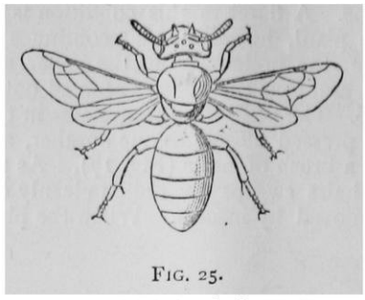

FIG. 25.

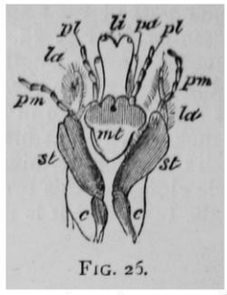

FIG. 26.

portance of which is obvious, for each has to give rise to a tube which penetrates the whole length of the style, from the stigma to the base of the flower, and the tube in the long-styled form must therefore be nearly twice as long as in the other. Mr. Darwin has shown that much more seed is set if pollen from the one form is placed on the pistil of the other, than if the flower is fertilised by pollen of the same form, even if taken from a different plant. Nay, what is most remarkable, such unions in Primula are more sterile than crosses between distinct, though nearly allied species of plants, have in some cases been found to be.

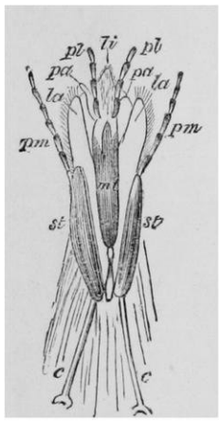

FIG 27.

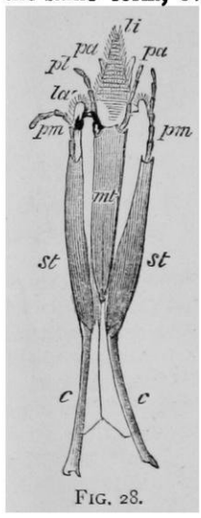

FIG. 28.

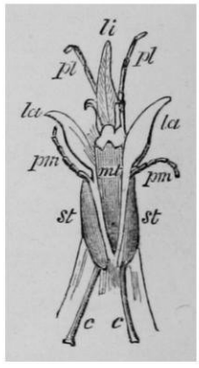

FIG. 29.

The majority of species of the genus Primula appear to be dimorphic, but not all.*

Mr. Darwin has pointed out † that several species of Linium

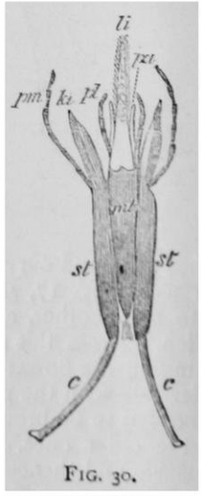

FIG. 30.

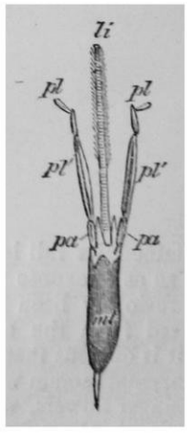

FIG. 31.

are dimorphic in the same manner as the Cowslip and Primrose. *Lythrum salicaria*, however, ‡ is even more remarkable, since as was remarked by Vaucher, but first explained by Mr. Darwin, it presents us with three distinct forms (each contain-

* *Linnean Journal*, 1862, p. 77.

* Scott, Proc. Linn. Soc., vol. viii., 1864, p. 80.
† Jour. Linn. Soc., 1863, p. 69.
‡ Linn. Jour. 1864, p. 169.

ing a pistil and two groups of stamens), which he calls, from the relative lengths of their pistils, the long-styled, mid-styled, and short-styled. In this species, also, it is remarkable that the seeds of the three forms differ from one another, 100 of the long-styled seeds being equal to 121 mid-styled or 142 short-styled. The pollen grains also not only differ in size (the long stamens having the largest-sized pollen grains, the middle-sized stamens middle-sized pollen grains, and the short stamens small pollen grains), but also in colour, being green in the longer stamens, and yellow in the shorter ones; while the filaments are pink in the long stamens, uncoloured in the shorter ones. Mr. Darwin has also proved by experiment that this species does not set its seeds, if the visits of insects ares prevented; in a state of nature, however, the plant is much frequented by bees, humble-bees, and flies, which always alight on the upper side of the flowers in the stamens and pistil.

He has also shown that in this species, as in Primula, perfect fertility can only be obtained by fertilising each form with pollen from stamens of corresponding length. This case is indeed most complex, as the pollen of each set of stamens, when applied to the same stigma, acts most differently, and it would appear that the greater the inequality in length between the pistil and stamens, the greater the sterility.

The genus Lythrum is also remarkable for the great differences existing between different species. *L. græfferi*, like *L. salicaria*, is trimorphic; while *L. thymifolia* is dimorphic; and *L. hyssopifolia* is homomorphic.

Let us consider the manner in which the bees are adapted to the flowers. Although we may in one respect say that the general organisation of the insect is modified with reference to these

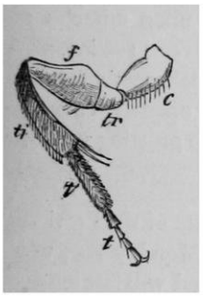

FIG. 32.

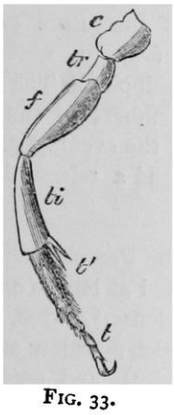

FIG. 33.

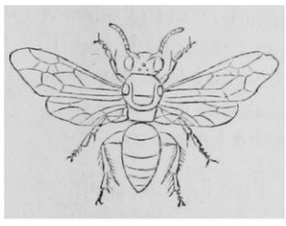

FIG. 34.

relations, still, as Müller, from whom the following facts are mainly taken, has well shown, the parts which have been the most profoundly modified are the mouth and the legs. If we are asked why we assume that in this case the mouth-parts and legs have been modified, the answer is that they depart greatly from the type found in allied insects, and that between this type and these modified examples various gradations are to be found.

The mouth of an insect, say of a wasp (Fig. 23), is composed of (1) an upper lip, *a*, (2) an underlip, *d*, (3) a pair of anterior jaws or mandibles, *b*, and (4) a pair of posterior jaws or maxillæ, *c*. These two pairs of jaws work laterally, that is to say, from side to side, and not as in man and other mammalia, from above to below. The lower lip and maxillæ are each provided with a pair of feelers or palpi (*c* and *d*, *x*). The above figures represent the mouth-parts of a wasp, in which, as is very usually the case, the mandibles are hard and horny, while the maxillæ are more delicate and membranous. In the different groups of insects these organs present, however, almost infinite variations.

Fig. 24 represents the mouth-parts of a bee, Prosopis (Fig. 25). The bees belonging to this genus construct their cells in sand, or in dry bramble sticks, lining them with a transparent mucus, which they smooth down with their trowel-like lower lip and which hardens into a thin membrane. That the mouth of Prosopis probably represents the condition of that of the ancestors of the hive-bees before their mouthparts underwent special modifications, may be inferred from the fact that the same type occurs in other allied groups, as is shown in Fig. 26, which represents the mouth of a wasp (Polistes), also seen from below.

We may therefore consider that Prosopis shows us special adaptation for the acquirement of honey, and in fact though the bees belonging to this genus feed their young on honey and pollen, they can only get the former from those flowers in which it is on the surface. In Andrena (Fig. 27), Halictus (Fig. 28), Panurgus (Fig. 29), Halictoides (Fig. 30), and Cheiostoma (Fig. 31), we see various stages in the elongation of the lower lip until at length it reaches the remarkable and extreme form which it now presents in the hive- and humble-bees, and which enable them to extract the honey from most of our wild flowers, though no bees have the proboscis so much elongated as is the case with some butterflies and moths; perhaps as Hermann Müller has

FIG. 35.

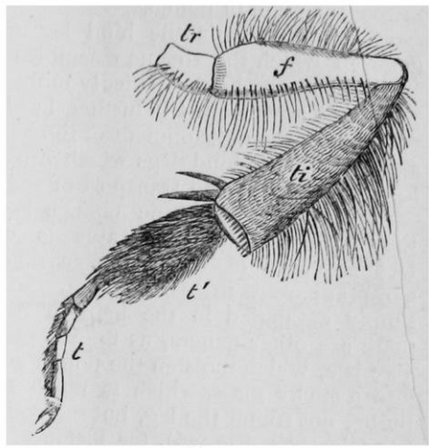

FIG. 36.

suggested, because the necessity of using their mouths for certain domestic purposes has limited its specialisation in this particular direction.

There are several flowers which are inaccessible to hive-bees, and to *Bombus terrestris*, which has a shorter proboscis than some of the other species belonging to that genus. Hermann Müller mentions, for instance, that he has often seen *Bombus terrestris* endeavouring, in vain, to suck the flowers of the Oxlip (*Primula elatior*). Having satisfied themselves that they were unable to do so, but not till then, they proceeded to cut a hole in the base of the tube, and thus arrived at the honey. This seems to show, he observes, that they act upon the results of experience, and not by what is called mere instinct. Indeed any one who has watched bees in greenhouses will see that they are neither confined by original instinct to special flowers, nor do they visit all flowers indifferently. Müller mentions several cases in which he has seen honeyless flowers visited by insects; *Genista tinctoria*, for instance, is frequently visited by insects in search of honey although it does not contain any.

Certain insects, on the other hand, confine themselves to particular flowers. Thus, according to H. Müller,

Andrena florea	visits exclusively	*Bryonia dioica*,
Halictoides	,, ,,	species of *Campanula*,
Andrena hattorfiana	,, ,,	*Scabiosa arrensis*,
Cilissa melauara	,, ,,	*Lytterum salicaria*,
Macropis labiata	,, ,,	*Lysimachia vulgaris*,
Osmia adunca	,, ,,	*Echium*.

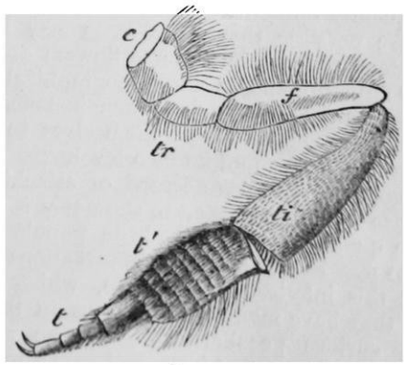

FIG. 37.

It would also appear that individual bees differ somewhat in their mode of treating flowers. Some humble bees suck the honey of the French Bean and the Scarlet Runner in the legitimate manner, while others cut a hole in the tube and thus reach it surreptitiously; and Dr. Ogle has observed that when he followed any particular bee she always proceeded in the same manner; some always entering by the mouth, others always cutting a hole. He particularly mentions that this was the case with bees of one and the same species, and infers, therefore, that

they differ from one another in their degrees of intelligence; and his observations, though of course not conclusive, are interesting and suggestive.

If again we examine the hind legs of bees, we shall find similar gradations. In Prosopis (Fig. 32) they do not differ materially from those of genera which supply their young with animal food. Portions of the leg, indeed, bear stiff hairs, the original use of which probably was to clean this burrowing insect from particles of sand and earth, but which in Prosopis assist also in the collection of pollen.

Fig. 33 represents the hind leg of Sphecodes (Fig. 34), a genus in which the tongue resembles in form that of Halictus. Here we see the hairs decidedly more developed, a modification which has advanced still further in Halictus (Fig. 35), in which we see that the development of the hairs is most marked on those segments of the hind legs which are most conveniently situated for the collection and transport of pollen.

In Panurgus the same change is still more marked, and the pollen-bearing apparatus is confined to the tibia and first segment of the tarsus, a differentiation which is even more apparent in Anthophora. In these bees the pollen is simply entangled in the hairs of the leg as in a brush, but there are other genera, as for instance the humble bees and the hive bee, which moisten the pollen with honey, and thus form it into a sticky mass, which is much more easy to carry, and is borne, not round the leg, but on one side of it. In the humble bee (Bombus, Fig. 36), for instance, the honey is borne on the outer side of the hinder tibiæ, which are flattened, smoothed, and bordered by a row of stiff curved hairs, which thus constitute it a sort of little basket. Lastly, in the hive bee (Fig. 37), the adaptation is still more complete, the hairs on the first tarsal segment are no longer scattered, but are arranged in regular rows; and the tibial spurs inherited by Bombus from far-distant ancestors have entirely disappeared.

In some bees the pollen is collected on the body, and here also we find a remarkable gradation from Prosopis, which has only minute and simple hairs, like a wasp; through Sphecodes, a Nomada, in which the longer hairs are still few, and generally simple, though some few are feathered; to Andrena and Halictus, where the hairs are much more developed; a change which is more marked in Sarapoda, Colletes, and Megachile; still more so in Osmia and Anthophora; until we come to the humble bees, in which the whole body is covered with long feathered hairs.

Although flowers present us with all these beautiful and complex contrivances, whereby the transfer of pollen from flower to flower is provided for and waste is prevented, yet they are imperfect, or at least not yet perfect, in their adaptations. Many small insects obtain access to flowers and rob them of their contents. *Malva rotundifolia* can be, and often is, sucked by bees from the outside, in which case the flower derives no advantage from the visit of the insect. In *Medicago sativa*, also, insects can suck the honey without effecting fertilisation, and the same flower continues to secrete honey after fertilisation has taken place, and when apparently it can no longer be of any use. Fritz Müller has observed that, though *Posoqueria fragrans* is exclusively fertilised by night-flying insects, many of the flowers open in the day, and consequently remain sterile.

It is of course possible that these cases may be explained away; nevertheless, as both insects and flowers are continually altering in their structure and in their geographical distribution, we should necessarily expect to find such instances. Animals and plants constantly tend to adapt themselves to their conditions, just as water tends to find its own level.

I have been good-humouredly accused of attacking the little busy bee, because I have attempted to show that it does not possess all the high qualities which have been popularly and poetically ascribed to it. But if scientific observations do not altogether support this intellectual eminence, which has been ascribed to bees, they have made known to us in the economy of the hive many curious peculiarities which no poet had ever dreamt of, and have shown that bees and other insects have an importance as regards flowers which had been previously unsuspected. To them we owe the beauties of our gardens, the sweetness of our fields. To them flowers are indebted for their scent and colour, nay, their very existence in its present form. Not only have the brilliant colours, the sweet scent, and the honey of flowers been gradually developed by the unconscious selection of insects, but the very arrangement of the colours; the circular bands and radiating lines, the form, size, and position of the petals, the arrangement of the stamens and pistil, are all arranged with reference to the visits of insects, and in such a manner as to ensure the grand object which renders these visits necessary.

Thus, then, I have attempted to point out some of the relations which exist between insects and our common wild flowers; the whole subject is one, however, which will repay most careful attention, for, as Müller has truly said, there is no single species the whole history of which is yet by any means thoroughly known to us, and while, with reference to the regions of thought brought before us by the president on Wednesday evening, few can hope themselves to assist in the progress of truth, the case is very different with reference to my subject of this evening, in which every one of us by care and perseverance may fairly hope to add something to the sum of human knowledge.

NOTES

We hear that it is most probable that Dr. T. Lauder Brunton, F.R.S., whose investigations in the science of therapeutics have made him so well known to physiologists and pathologists generally, will undertake the editorship of the *Practitioner*, rendered vacant by the death of Dr. Anstie.

The forty-seventh congress of German naturalists and physicists opened at Breslau on Sept. 18. The proceedings were opened by the eminent chemist, Prof. Loewig, who expressed his satisfaction at seeing so many foreigners, whose presence in that assembly, he added, was a living testimony to the truth that science was of no country. Capt. von Dechen read a paper upon the present state and the future prospects of geology. After him, Prof. Virchow, of Berlin, spoke upon miracles regarded from the scientific standpoint. The several sections were then constituted, and the members of the congress afterwards adjourned to a banquet. In the evening an open-air entertainment was given by the city, and a telegraphic greeting was sent to the Emperor.

The fortieth congress of the French Institute of the Provinces, *Les Mondes* informs us, opened at Rodez on Monday last, under the presidency of M. de Toulouse-Lautrec, and will last ten days. There are five sections, in which questions are discussed connected with the mathematical, physical, and natural sciences, agriculture, industry and commerce, anthropology and the medical sciences, history and archæology, philosophy, literature, the fine arts, and social economy. This is certainly comprehensive enough.

The last expedition for observing the transit of Venus is now on the point of leaving England for Egypt. It has developed into one of considerably greater magnitude than was at first intended. The Government expedition organised by Sir George Airy, instead of being located at Alexandria, will have its headquarters at Cairo, the longitude of which city is to be found by exchange of telegraph signals with Greenwich, for which purpose a branch station will be established for a time at Alexandria: For the actual observation of the transit, Cairo, Thebes, and Suez are selected, the longitude of the last two being obtained by exchanging telegraph signals with Cairo. The photographic branch of the enterprise will probably be at Thebes. Private expeditions have been organised, all of them in concert with the English Government one. The whole may be enumerated as follows:—English Government Expedition.—Chief captain, C. Orde Browne; photographic branch, Capt. Abney; astronomers, Mr. S. Hunter and Mr. Newton. Prof. Döllen, the Russian astronomer, and Col. Campbell have organised private expeditions to Thebes. Dr. Anvers proposes to be either at Cairo or Thebes, and Admiral Ommanney may also join the English party as an associate astronomer. The whole of the telescopes and huts from Greenwich are now on board the Peninsular and Oriental vessel *Hindostan*, which is to leave Southampton on the 1st proximo.

MR. LOUIS SERRHOHM, one of the chief photographers who embarked on the *Scotara* in June last as a member of the American Transit of Venus expedition, died at Bahia on July 22. He had been extremely ill during the voyage, and was ordered home by the medical officer of the vessel, but died of fever before he could be removed.

THE October number of Petermann's *Mittheilungen* will contain a valuable paper by Prof. H. Fritz on the geographical extension of the Aurora Borealis; the accompanying map, which contains the magnetic meridians, shows by a system of curves the places on the earth's surface from which the light is seen with equal frequency. Also a fine map of Haiti on the scale of $\frac{1}{1100000}$, with accompanying description; and the continuation of Dr. Nachtigal's contribution on the tributaries of the kingdom of Baghirmi, in which he gives some account of the fauna and flora of the region and of the manners, customs, and condition of the people. There is also a paper translated from the Russian of L. Kostenko, giving a personal account of the country between Khiva and Fort Kasala on the Sir-Daria.

A MOVEMENT is on foot among the students of the University of St. Andrews with the object of electing Mr. Darwin to the Rectorial chair in the room of Lord Neaves, who retires in November. On the last occasion a large number of the students were favourable to the election of a scientific man in the person of Prof. Huxley, and as he lost his election by only three votes, the Darwinians are encouraged to prosecute the candidature of their nominee. The election will take place on the fourth Thursday of November.

THE *Daily News* of Saturday last has a letter, dated Kandavan, Aug. 8, from its correspondent with the *Challenger*, giving an account of a short cruise from Wellington, New Zealand, which was left on July 6, to the Fiji Islands. The trawling and dredging was very successful, and many zoological and botanical specimens have been obtained. Among the treasures obtained by the trawl was a live nautilus, the only one caught alive since the ship left England. The *Challenger* was to proceed to the New Hebrides and Torres Straits, where it was expected to arrive about the beginning of this month.

M. CORENWINDER has contributed to a recent meeting of the Société des Sciences of Lille an exhaustive series of observations on the processes of respiration and nutrition in plants. He supports M. Claude Bernard's view, that the process ordinarily known as the respiration of plants—the decomposition of the carbonic acid of the atmosphere—is really a process of digestion, and that simultaneously with this, plants carry on, by day as well as by night, a true process of respiration, similar in all respects to that performed by animals, consisting in an oxidation of the carbonaceous matters of their tissues. By a very careful series of analyses, performed mainly on the lilac and maple, M. Corenwinder determined that the proportion of nitrogenous matter in the leaves gradually and progressively diminishes from the time that they emerge from the bud till their fall; the proportion of carbonaceous matter increases very rapidly during April and May, and then remains nearly stationary till October; while that of incombustible substance increases during the whole period of vegetation. He distinguishes, therefore, two periods in the vegetative season of the plant—the first period, when nitrogenous constituents predominate, is that during which respiration is the most active; the second, when the proportion of carbonaceous substance is relatively larger, is the period when respiration is comparatively feeble, the carbonic acid evolved being again almost entirely taken up by the chlorophyll, decomposed, and the carbon fixed in the true process of digestion.

PROF. H. HOFFMANN of Giessen has made some interesting experiments on the permanence of varietal and specific characters in the case of the French Bean and Scarlet Runner (*Phaseolus vulgaris* and *multiflorus*). A very large number of attempts to fix special varieties which were casually produced invariably failed, the tendency towards reversion to the ancestral form being apparently irresistible. On the other hand, no one of the characters which are ordinarily relied on to distinguish the two species from one another is constant, but is liable, under certain circumstances, to disappear. Dr. Hoffmann has also made a similar series of experiments on the Common Red Poppy (*Papaver Rhœas*). Constant cultivation for six years produced no perceptible variation; but in the seventh year several varieties in the colour, and in the next year in the form of the petals, made their appearance, tending towards an assimilation to *P. dubium*.

THE *Gardener's Chronicle* announces a new material for paper in a well-known American grass, *Zizania aquatica*. It is stated that the Zizania yields fully as much of the raw material as esparto, and has the great and peculiar merit of being comparatively free from silicates. Paper made from it is quite as strong and quite as flexible as that made from rags; it is easily bleached, economical in respect of chemicals, pure in colour, and remarkably free from specks and blemishes. It is especially recommended for the manufacture of printing paper. The grass grows in enormous quantities in our Canadian Dominion, on the shores of Lakes Erie, St. Clair, Ontario, &c., and it is affirmed that a supply of 100,000 tons annually may be looked on as certain. Its habitat is swamps, ponds, and shallow streams, where it grows to a height of from 7 to 8, or even to 12 and 14 ft. The structure is similar to that of rice, except that the flowers are unisexual. The grains are largely used as an article of food by the native Indians, some tribes depending on them to a large extent for their subsistence. The flavour is said to be superior to that of most other cereals, and it has long been known from these properties as "Canada Rice."

THE will of the late Girolamo Ponti, of Milan, which has just been published in the *London Gazette* by order of Lord Derby, is likely to give rise to some trouble before it can be carried into effect. The testator has bequeathed a considerable portion of his property to the "Academies of Science of London, Paris, and Vienna," to be divided among them in equal proportions, for the purpose in each case of founding, with the proceeds resulting from investment, two competitions yearly on the subjects of Mechanics, Agriculture, Physics and Chemistry, Travels by Sea and Land, and Literature. The committees to be appointed by the societies are instructed to give preference to those competitors who will have advanced any of the subjects mentioned by original discovery. The relatives of Signor Ponti are to dispute the will, and those London societies that think they have claims upon the legacy are urged to bring them forward at once. There can be no doubt which societies are meant in the case of Paris and Vienna; and at first sight there appears to be little doubt as to what body the title of "Academy of Science of London" would most appropriately apply.

AT the meeting of the Paris Academy of Sciences held Sept. 14, Dr. A. W. Hofmann announced that his two students, MM. Tiemann and Haarmann, who had obtained vanilline (the aromatic principle of the vanilla bean) from pine sap, propose to manufacture this substance on a large scale. The sap of a tree of medium height gives vanilline to the value of 100 fr., and the wood is not injured by the extraction of the sap. This will be the second vegetable product manufactured by purely chemical methods.

THE first fungus exhibition held in Scotland was opened in Aberdeen on Friday. The idea of the exhibition was first suggested by the Rev. Mr. Ferguson, of New Pitsligo, in the *Scottish Naturalist* for April. The suggestion was readily taken up by fungologists and men of science, and the result was an exhibit

which those entitled to speak with authority say was never equalled in this country. The specimens numbered about 7,000. Almost every county in Scotland made large contributions, while England and Wales sent a number of exhibits. In fact, almost every fungologist in Britain contributed specimens.

IN an address on Education at Rochdale on Saturday, Mr. Jacob Bright urged the claims of Owens College, Manchester, to assistance from the national exchequer, and hinted that a time was approaching when the enormous revenues of Oxford and Cambridge would be made more productive to the country.

THE members of the *Tegethof* Austrian Polar Expedition have arrived at Hamburg. They everywhere in Norway met with a very cordial welcome. The new country, as far as explored, comprises five islands, and contains hares and foxes. When rescued, the members of the expedition were in rags, and for a fortnight had been short of provisions and of firing. They were compelled to shoot all the sledge dogs, as the animals showed signs of madness. The members of the expedition will, it is expected, reach Vienna to-morrow.

A NOTICE has been issued from the Science and Art Department that the Classes in Chemistry (Prof. Frankland), Biology (Prof. Huxley), Physics (Prof. F. Guthrie), and Applied Mechanics (Prof. Goodeve), have been tranferred to the new buildings, South Kensington, where they will open in the beginning of October.

MR. ANDREW MURRAY writes to the *Gardener's Chronicle* that he has, within the last few weeks, made some observations at the Ochil Hills, Kinross-shire, on *Pinguicula* and *Drosera*, with reference to the fly-digesting powers they are asserted to possess. He states that he found the leaves of *Pinguicula* close, quite independently of the fact of a fly being in them or not. "The leaves are found with their margins in all stages of curling over, some with no insect on them much more curled over than others with several." The secretion which Dr. Hooker states kills a captured insect he finds is glutinous, and he believes it does not fall on to the insect, but that death results from the secretion adhering to and closing up the spiracles by which the insect breathes. With regard to Dionæa, he suggests that it should be carefully noted (1) whether the secretion is never present until after an insect has been captured; (2) whether it is always present after one has.

AMONG the recent additions to the Manchester Aquarium is fine specimen of the Monk or Angel Fish, between five or six feet in length, and weighing at least one hundred pounds. With the exception of an example of very similar dimensions brought to the Brighton tanks about a year ago, but since dead, it is one of the largest yet recorded as taken on the British coasts. This specimen was captured at Colwyn Bay, near Conway, and is still in the most healthy and perfect condition. A number of young herring, of which fish the Manchester Aquarium now possesses many hundreds, were consigned last week by the curator, Mr. W. Saville-Kent, to the aquarium at the Crystal Palace; most of these arrived in safety, and are of especial interest as being the first of the species successfully introduced at that institution.

THE additions to the Zoological Society's Gardens during the past week include a Chimpanzee (*Troglodytes niger*); a Bay Antelope (*Cephalophus dorsalis*), and three Royal Pythons (*Python regius*), from West Africa, presented by Mr. C. B. Mosse; a King Vulture (*Gypagus papa*) from South America, presented by Mr. G. I. Brumschweiler; a Grey Ichneumon (*Herpestes griseus*) from India, presented by Capt. Hallett; two Little Bitterns (*Ardetta minuta*), European, presented by Mr. A. A. van Bemmelen; an Alligator (*Alligator mississippiensis*) from Demerara, presented by Capt. Turner; a Yellow-fronted Amazon (*Chrysotis ochrocephala*) from Guiana, deposited.

MARITIME CONFERENCE

THE conclusions come to by the recent Conference on Maritime Meteorology have been forwarded to us with the following letter:—

"Sir,—I have the honour to inform you that the Permanent Committee of the International Meteorological Congress at Vienna (1873), at whose suggestion the recent Conference for Maritime Meteorology was held in London, has resolved to forward the Resolutions adopted at that Conference for publication at once, thus anticipating the publication of the full Official Report of the Conference. The Permanent Committee will feel deeply obliged if you can find space for them.

"ROBERT H. SCOTT,
"Secretary to the Permanent Committee."

Resolved—"That there should be but one form of Meteorological Register for the Navies and Merchant Services, and that those who cannot fill the log should keep part of it."

Questions.	*Resolutions.*
I.—OBSERVATIONS—	
Columns 1 to 6.*—*Date and Position of the Observations.*	
Is it your opinion that a fresh column should be added headed "Course and distance by the log in every watch of four hours?"	That an additional column should be given in the log for "Course and distance." That the course should be expressed in degrees, and not in points. That the question of hours, 4-hourly periods, as proposed by Captain Toynbee, should be, adopted.
Columns 7 and 8.—*Currents.*	
	That observations on the "direction and rate" of currents be transferred to the column for Remarks.
Column 9—*Magnetic Variation.*	
Is it desirable to give an additional column for the "Direction of ship's head"?	That an additional column be given in the log for the direction of the ship's head, and the amount of heel to port or starboard. That the total compass-error and not variation only be given. That the Conference expresses its opinion that the lettering on the English compass should be adopted by all nations for meteorological purposes.
Columns 10 and 11.—*Wind Direction and Force.*	
Is it possible to employ an anemometer at sea, so as to give trustworthy results?	That a decided answer to this question cannot at present be given, but it is desirable that various anemometers should be tested by special ships, and that a special form of four extra columns should be prepared for the purpose of recording such observations.
Can the use of the Beaufort scale be made universal?	That the use of the Beaufort scale should be continued, with the addition of the amount of sail which Beaufort's ship would have carried had she been rigged with double topsails. Also that the direction and force of the wind should be recorded at the *time* of observation, and not estimated for a certain number of previous hours. Also, that they should be recorded every two hours.
Columns 12 and 13.—*Barometer.*	
To what degree of minuteness is it necessary to observe this instrument?	To one-hundredth of an inch at sea, or its equivalent in the metric scale.

The numbers of the columns refer to the Brussels Abstract log.

Columns 14 and 15.—*Thermometers, Dry Bulb and Wet Bulb.*

Should these observations be required from all ships?	That wet and dry bulb observations are desirable, and should be obtained whenever possible.

Column 16.—*Forms and Direction of Clouds.*

Is this column sufficient, or should any notice be taken of more than one stratum of clouds?	That the upper and lower clouds should be recorded in separate columns, and that the direction from which *upper* clouds come should be recorded when possible.

Column 17.—*Proportion of Sky Clear.*

Is it not advisable to substitute for this heading "Proportion of sky clouded"?	That it is preferable to give the proportion of sky clouded instead of the entry "proportion of sky clear," as recommended by the Brussels Conference.

Column 18.—*Hours of Rain, Fog, Snow, &c.*

Is it desirable to retain this heading, or to substitute for it and No. 23, a column headed "Weather by Beaufort Notation"?	That it is desirable to retain this heading, but that the use of Beaufort's Notation may be continued by those accustomed to it.

Column 19.—*State of the Sea.*

Should this be given according to a numerical scale?	That a numerical scale (0 – 9) be adopted, and that an extra column should be given to the observation. The direction of the sea swell, or the different swells, to be given in the original column.

Columns 20 to 22.—*Temperature of Sea Surface, Specific Gravity, Temperature at Depths.*

Is it desirable to retain these columns, or can the observations when taken be inserted in the column for "Remarks"?	That the first two columns should be retained. That sea temperatures at depths should not be required from all ships, and should be recorded in the "Remarks."

Column 23.—*Weather.*

Vide the resolution on Col. 18.

Column 24.—*Remarks.*

That the "Remarks" as asked for by the Brussels Conference should be adopted, with the exception of the observations of temperature with coloured bulbs at sea.

II.—INSTRUMENTS.

What patterns of instruments should be employed for any observations which may require them?	That the question of the precise pattern of instruments is not of very great importance, so long as they satisfy the tests applied at the several central Institutions and are compared with standard instruments; but it is recommended that they shall be of a pattern as easy as possible for reading.
Is there any reasonable possibility of introducing the metric and centigrade systems for general use at sea?	The recommendation respecting the use of the metric and centigrade systems as expressed at the Vienna Congress was approved, and it was recommended that a table of conversion should be entered in each log to enable Captains to compare barometers which have different scales.

III.—INSTRUCTIONS.

Is it possible to devise a general form of Instructions to ensure uniformity in regard of methods of observation and registration?	That the Instructions should be suited to the log now proposed by the Conference, but modified to meet the various requirements of different nations.

The Conference requested that Capt. Toynbee's proposed form of log should be lithographed and the English "Instructions" printed for circulation amongst its members.

IV.—OBSERVERS.

What control should be exercised over the Observers as to their instruments and registers?	That it is necessary that all instruments used should be compared with standard instruments, either at the central or the filial institutions (if such exist), before and after the voyage; and that the corrections and date, &c., of the comparison should be entered in the log.
Is it desirable that all instruments employed should be the property of the central establishment, and *lent* to the observers?	That it is desirable that the instruments should be the property of the central office. That it is necessary that a careful examination should be made into the quality of the observations recorded, and that the attention of the observers should be specially directed to any errors which may have been detected.

V.—CO-OPERATION OF THE ROYAL NAVY.

To what extent can ships of war assist in forwarding the ends of meteorological inquiry?	The Royal Navy can furnish more complete observations than are possible on board merchant ships, as, *e.g.*, Deep-sea soundings and temperatures. Observations in unfrequented parts of the sea. Special experiments. It is most desirable that the duty of observing should be intrusted to some responsible Officer. It is therefore resolved that the Authorities of the Navies shall be requested to continue to give such assistance to the prosecution of meteorological science as circumstances shall permit.

A Report was handed in which had been drawn up by a number of the members who were in the Naval Services of some of the countries represented, and it was decided that the following resolutions which it contained should be adopted in lieu of those given above:—

1. "It is very important that the organisation of meteorological inquiry as regards the Navies of all countries should be arranged in accordance with the principles and stipulations laid down by the Conference for Marine Meteorology generally; and it is further important that the results of all observations made on board ships of war in any country should be rendered accessible for discussion by the central station for maritime meteorology in that country without prejudice to any subsequent publication by the respective Naval Authorities."

2. "The Conference, while admitting that the introduction of measures calculated to improve the condition of meteorological inquiries in the Navy must be left to the Authorities of the respective Navies, is nevertheless of opinion that all care should be taken to secure uniformity as to mode of observation, and especially to provide for the comparison of all instruments used with the respective standard instruments of the Central Institutes."

3. "The Conference considers it to be its duty to request that those entrusted with the management of scientific affairs on board men of war will lend their strenuous support in securing from the Naval Authorities in each country such regulations as will place meteorological inquiry on board such ships in as favourable a position as may be deemed consistent with the execution of the ordinary duties of the Service, and will also induce the commanders to render to such inquiries all the assistance and furtherance in their power. The Conference, knowing that such regulations must be framed according to the requirements of each country, expresses, nevertheless, its opinion that, inasmuch as meteorological observations require considerable experience, they should be entrusted to experienced Officers on board suitable vessels."

4. "Although the Conference is of opinion that, as far as the general scope of meteorological inquiry goes, the same form of register should be supplied to merchant ships as to men of war, it declares it will be most desirable that, besides the regular observations, a more extended scale for scientific inquiry should be adopted on board ships of war, as in such cases there is a large number of suitable officers, as well as more means for carrying on the service. As examples of observations which are of importance for the development of Maritime Meteorology, over and above the regulations embodied in the scientific instructions given to Naval expeditions for the special purpose of the advancement of science, the following suggestions may be enumerated :—

(*a*) "Possibility of carrying out accurate observations on the velocity of the wind by anemometers at sea.

(*b*) "Possibility of employing rain-gauges satisfactorily at sea.

(*c*) "Observations with Regnault's and other hygrometers, and experiments on the best mode of observing wet and dry thermometers, and the best position to place them in on board ship.

(*d*) "Currents at the surface and at depths to be observed with great minuteness, with the special object of defining their limits.

(*e*) "The comparison of various instruments, among which are expressly mentioned that of aneroids with mercurial barometers. It is further deemed very desirable that frequent comparisons should be instituted between the instruments used at sea and meteorological stations on shore in various countries.

(*f*) "Deep-sea soundings and temperatures, with specimens of water.

(*g*) "The collecting of information on Ocean Meteorology at outlying stations.

(*h*) The furnishing of synchronous observations at oh. 43m. G. M. T., in accordance with the suggestion and request of the United States Signal Office."

VI.—Discussion.

Can general suggestions be thrown out as to the most profitable mode of discussing the observations?	That it is desirable that every Institution should publish the observations and results in such a manner that every foreign institute can incorporate them with its own observations and results in the easiest way possible; that is, by preserving the number of observations, together with any means derived from them, for single square degrees. That it is further desirable that, whatever charts be published, the results for single square degrees should be published in a tabular form. That it seems desirable for the use of the sailor that each chart should have reference to only one element, or, at least, only to elements closely related to each other.

VII.—Subjects of Inquiry.

To what extent can a division of labour, as regards subjects of inquiry, be carried out in a spirit of fairness to the collecting and discussing establishments respectively?	That the division of labour, as regards investigations, can only be carried out by mutual agreement between the several institutions; and each institution should announce to other institutions what investigations it proposes to undertake. It is very desirable that such divisions of labour should be effected.

VIII.—Sailing Directions.

In how far are purely practical investigations, such as the preparation of sailing directions, admissible for a scientific institution?	That the sailor wants the result of experience alone, and he must receive assurance that his observations have been turned to use. When these results of experience have been given, the theorist may point out the reason why certain routes are the best.

It was resolved, that Capt. Toynbee's remarks on the programme should be printed in full, with extracts from the remarks of other gentlemen, should they contain important suggestions.

THE BRITISH ASSOCIATION

Reports

Report of the Committee on Luminous Meteors, by Mr. Glaisher.

The appearance of meteors noticed in published journals, and otherwise ascertained by the committee during the past year, include some striking examples of such remarkable exhibitions, discussed and investigated very ably by astronomers, as well as of others passing almost unobserved excepting by accidental gazers. A few such large meteors were doubly observed in England. Some have been visible in the day-time, while many other large and small fire-balls have been described to the committee, of which it is to be regretted that notices have hitherto only reached them from single observers. The months in which these phenomena have been most abundant were September, December, and January last, April, June, and again quite recently, the last few days of July and beginning of August of this year. The report contains descriptions of the brightest of these meteors, and an account of Prof. Galle's calculations and inquiries regarding the real cause of two large meteors which passed over Austria on the 12th and 19th of June last, with the probable path that he assigned to them. If a mass of burning sulphur found on the ground immediately after the disappearance of the latter meteor is not considered presumably meteoric, no occurrence of a fall of aërolites, as far as the committee is aware, has taken place during the past year.

The annual star-showers have been watched for with the usual attention of observers in correspondence with the committee; and the results of their combined observations are described, with accounts of some other occasional star-showers, at some length in the descriptive part of the report. Although little important information was thus added this year to our present well-known star-showers of January, April, and October, and the cometary meteor-showers of November 14 and 27, connected with Tempel's and with Biela's comet, all of which, in spite of very favourable weather for their observations, were this year most remarkable by their non-appearance; yet the fluctuating intensities of these showers at their successive periodic dates are an important element to record; and in the case of the star-showers of August 10 and December 12 of the past year, the watch was at least attended with more positive success. Duplicate observations of meteors were obtained in them, and the general centre of divergence of each of these two meteor-currents was pretty exactly ascertained. Bright meteors were more frequent on each of these two nights than is at all usual in ordinary exhibitions of those showers. It will be found among these observations that the return of Biela's meteor-shower on the 27th of November last disappointed expectation, and the small extent and rapid departure of that meteor-cloud from the earth's neighbourhood is clearly shown by its visibility as a star-shower only for a single year.

The duplicate observations described in former reports have been reduced at the request of the committee by Mr. T. H. Waller, whose report of these calculations is added, and whose conclusions of their real heights and velocities are without doubt very accurate and complete.

The publication of Capt. Tupman's observations of shooting stars in the Mediterranean during the years 1869-71, with the list of radiant points obtained from them and shown on a pair of charts accompanying them by Capt. Tupman, is now brought to a close, and the catalogue and charts have been sent to astronomers and correspondents of the committee in England and abroad, and in America, and discussions of these in foreign scientific journals have appeared, showing the important light in which the appearance of this valuable new meteor catalogue has been regarded. Its principal part, the comparative catalogue of his meteor-showers with those of other observers, and the charts on which they are projected, are presented in this report, with Dr. Schmidt's similar catalogue (the remaining two principal meteor-shower lists, of which no account has yet appeared in these reports), thus placing before readers of recent volumes of these reports all the material contributions to this branch of meteoric astronomy that have yet been made.

They are summed up in a very concise catalogue at the end of this report by Mr. Greg, who has selected, to corroborate such observations already published in his former lists, the greater

part of Dr. Schmidt's and Capt. Tupman's observations, and has included them with his own former collection, thus forming a very extended catalogue founded on all the similar work of his contemporaries and predecessors, and omitting but few genuine meteoric showers, chiefly in the southern hemisphere, which have only been observed by Dr. Neumayer in Australia.

Following the method of Dr. Weiss, viz. to calculate the radiant points of those comets of early and recent times whose orbits are believed to pass near the earth, a list of such comets for both the northern and southern hemispheres is annexed to Mr. Greg's catalogue, and the cases where they corroborate each other are pointed out. Many important and well-known comets are found to have meteor-showers as their present representatives, as would, perhaps, be still more apparent if more reliable orbits of comets could be used; but the coincidences are, however, numerous enough and sufficiently exact to render desirable the further cultivation of cometary astronomy by the help of star-shower observations.

Report on Isomeric Cresols, by Dr. Armstrong.—Little has been done by the committee during the past year. *Para* and *ortho* cresols have been obtained from ordinary cresylic acid, but it has not been with certainty determined whether the *meta* cresol is likewise present, or whether these are the sole constituents of this substance.

Report of the Committee for the Utilisation of Sewage, by Prof. Corfield.—The committee has been unable, from want of funds, to carry on the quantitative experiments as they would have wished. Of the total nitrogen supplied to the farms during the year March 25, 1873, to March 24, 1874, 37·7 per cent. was recovered in the crops, during the preceding year 41·7 per cent. was recovered, while during the first year of the experiments the nitrogen recovered amounted to 26 per cent. The committee will be enabled, through the liberality of a gentleman, to carry on their investigations during another year.

SECTIONAL PROCEEDINGS

SECTION A—MATHEMATICS

On the Construction of a perfectly Achromatic Telescope, by Prof. G. G. Stokes.

At the meeting of the Association in Edinburgh, in 1871, it was stated that it was in contemplation actually to construct a telescope by means of discs of glass prepared by the late Mr. Vernon Harcourt, which should be achromatic as to secondary as well as to primary dispersion. This intention was subsequently carried out; and the telescope, which was constructed by Mr. Howard Grubb, was now exhibited to the Section. The original intention was to construct the objective of a phosphatic glass containing a suitable percentage of titanic acid, achromatised by a glass of terborate of lead. The percentage of titanic acid was so chosen that there should be no irrationality of dispersion between the titanic glass and the terborate. As the curvature of the convex lens would be rather severe if the whole convex power were thrown into a single lens, it was intended to use two lenses of this glass, one in front and one behind, with the concave terborate of lead placed between them. It was found that provided not more than about one-third of the convex power were thrown behind, the adjacent surfaces might be made to fit, consistently with the condition of destroying the spherical as well as the chromatic aberration. This would render it possible to cement the glasses, and thereby protect the terborate, which was rather liable to tarnish. At the time of Mr. Harcourt's death two discs of the titanic glass had been prepared, which it was hoped would be good enough for employment, as also two discs of terborate. These were placed in Mr. Grubb's hands. On polishing, one of the titanic discs was found to be too badly striated to be employed; the other was pretty fair. As it would have required a rather severe curvature of the first surface and an unusual convexity of the last to throw the whole convex power into the first lens, using a mere shell of crown glass behind to protect the terborate, Prof. Stokes thought it more prudent to throw about one-sixth of the whole convex power into the third or crown-glass lens, though at the sacrifice of an *absolute* destruction of secondary dispersion, which by this change from the original design might be expected to be just barely perceptible. Of the terborate discs, the least striated happened to be *slightly* muddy from some accident in the preparation; but as this signified less than the striæ, Mr. Grubb deemed it better to employ this disc. The telescope exhibited to the meeting was of about 2½ in. aperture, and 28 in. focal length, and was provided with an objective of the ordinary kind, by which the other could be replaced, for contrasting the performance. When the telescope was turned on to a chimney seen against the sky and half the object-glass covered, in the case of the ordinary objective, vivid green and purple were seen about the two edges, whereas with the Harcourt objective there was barely any perceptible colour. It was not, of course, to be expected that the performance of the telescope should be good, on account of the difficulty of preparing glass free from striæ, but it proved to be quite sufficient to show the possibility of destroying the secondary colour, which was the object of the construction.

On Cyclone and Rainfall Periodicity in connection with the Sunspot Periodicity, by Charles Meldrum.

The catalogue of cyclones experienced in the Indian Ocean, from 1847 to 1873, submitted last year, indicated that during this period the number of cyclones in the space between the equator and 34° S. lat. and the meridians of 40° E. and 110° E. are much greater in the years of maximum than in the years of minimum sunspot frequency.

It will now, and in subsequent reports, be shown that not only the number of cyclones, but their duration, extent, and energy, were also much greater in the former than in the latter years, and that there is a strong probability that this cyclonic fluctuation has been coincident with a similar fluctuation of the rainfall over the globe generally.

The present communication is confined to the twelve years 1856-67, comprising a complete sunspot cycle.

With regard to the cyclones of the Indian Ocean, the investigation is based upon the extensive collection of observations made by the Meteorological Society of Mauritius on the assumption that the observations are so numerous that no cyclone of any considerable extent or violence can have escaped detection.

A chart has been prepared for noon on each day of the period during which a cyclone lasted. The chart shows the positions of the vessels, the directions and force of the wind, the state of the weather and sea, &c. In this way the position of the centre of the cyclone is ascertained for each day; then, by examining the several charts, the duration, extent, &c. of the cyclone are determined.

The number of cyclones thus examined for the twelve years is 113, and their tracks have been laid down on six charts.

The total cyclonic area in 1860 and 1861 was about twelve times greater than in 1856 and 1857, and nearly eight times greater than in 1867; in short, all the factors were greater in the years of maximum sunspot frequency. It is evident from the table that the cyclonic area increased rapidly from 1858 to 1860, and diminished slowly from 1861 to 1866. The registers for the years 1856, 1857, 1866, and 1867 have been examined with special care in order that nothing might be omitted; and, to give the utmost possible weight to those years, every instance of even an ordinary gale has been taken into account. In 1856 there was no great hurricane at all, and the same may be said of 1857, 1866, and 1867. From the chart for 1866 it will be seen that in April of that year there was a number of small cyclones. The south-east trade-winds and north-west monsoon were in collision for a considerable time, and several cyclonic eddies of short duration were formed.

If we could obtain good values of the mass of air in motion and the velocity of the wind, it would probably be found that the ratios of cyclonic energy were greater than those of cyclonic area, for in the maxima years the cyclones were much more violent than in the minima years. Assuming the mass to be nearly proportional to the area, and the velocity of the wind in a strong gale to be 55 miles, in a whole gale 70 miles, and in a hurricane 85 miles an hour, the amount of cyclonic energy in 1860 was about eighteen times greater than in 1856, the squares of the velocities being as three to five.

Although the results are necessarily rough approximations, yet the fact that the number and violence of the cyclones of years of maximum sunspot were far greater than in the years of minimum sunspot is beyond all doubt.

When a great hurricane takes place in the Indian Ocean, the disabled ships are obliged to put into the nearest port, and the newspapers in their shipping intelligence announce the arrival of the vessels, the dates and localities of the bad weather, and the amount of damage sustained. For upwards of twenty years the *Commercial Gazette* of Port Louis has published all arrivals of vessels and all maritime events which have been reported by them. Considering, then, the geographical position of Mauritius,

a cyclone periodicity, if one exists, should be traceable in the shipping intelligence. Now, from Table II., which gives the published reports for 1856, 1860, and 1867, it will be seen that the number of storms and the damage sustained in 1856 and 1867 were insignificant compared with the long list of hurricanes and disasters in 1860.

Table III. gives as complete a list of hurricanes and storms experienced in Mauritius as I have hitherto been enabled to prepare. The list comprises only such storms as from the violence of the wind committed considerable damage.

Table IV., which contains a list of Bourbon (Réunion) hurricanes and gales from 1733 to 1754, shows also the number of hurricanes that occurred in the maximum and minimum sunspot years.

For the two islands the number of cyclones in the maxima years was thirty-six, and for the minima years nineteen. This result is favourable.

It would appear also from M. Poey's researches, and from investigations made at Mauritius in 1872, that the cyclones of the West Indies are upon the whole subject to the same periodicity. The rainfall for the twelve years under discussion is given in Tables V. to IX. It thence appears from the rainfall at sixty-seven stations that the maximum fall was in the years 1859 to 1862, and the minimum in the years 1857, 1858, and 1864. We thus find a certain degree of correspondence between the cyclone and rainfall fluctuations; and it is possible that if we had returns from America the correspondence would be much greater; for it would appear from researches by Mr. G. M. Dawson, that the level of the American great lakes was considerably less in 1867–68 than in 1859–61. (The year 1867 has been almost the only exception to the rule in Europe since the commencement of the century, and as most of the stations are in that part of the world the results for 1856 and 1857 are not so favourable as for previous cycles).

A large number of additional rainfall returns has been received from Europe and other parts of the world, and the results, which will be communicated in another report, afford fresh evidence of a rainfall periodicity.

(The paper was accompanied by several elaborate tables).

SECTION B—CHEMICAL SCIENCE

On some Opium Derivatives, by Dr. C. R. A. Wright.—The action of free chlorine on codeine is to produce higher polymerides, especially tricodeine, from which again, by the action of hydrochloric acid, apocodeine is formed. This apocodeine may be looked on as three molecules of codeine *minus* six molecules of water. Narceine is feebly basic, but it has a strong attraction for hydrochloric acid, giving rise to the crystallisable hydrochloride $C_{23}H_{29}NO_9 + HCl$. If the salt is dissolved in boiling water, crystals are obtained containing six molecules of $C_{23}H_{29}NO_9$ plus one molecule of HCl. Basic chlorides, probably not definite compounds, have also been obtained. With excess of hydrochloric acid at 100° the elements of water are removed from narceine, and we get $C_{23}H_{27}NO_8$. The hydrochloride of this base is non-crystallisable. By the action of glacial acetic acid on codeine there is produced diacetyl codeine, $C_{36}H_{40}2(C_2H_3O)N_2O_6$. Acetic acid acts in a similar way on morphine, a considerable quantity of triacetyl morphine being also produced. Acetic anhydride gives rise to the formation of an isomeric diacetyl morphine. We have, therefore,—

α diacetyl morphine — crystallisable
and β ,, ,, — non-crystallisable.

Butyric and benzoic acids give analogous compounds; so also do acetic acid and strychnine. The following general formulæ for the morphine and codeine salts are given:—

$$M + nHX - nH_2O,$$
$$C + nHX - nH_2O,$$

when HX a monobasic acid.

On a Phenomenon noticed on boring a Well, by Dr. Andrews.—The author described a remarkable jet of almost pure marsh-gas, obtained on boring a well near Belfast. The borings first descended through about 33 ft. of silt, and then reached a gravelly deposit 7 ft. in thickness, interspersed with organic *débris*. It was from this deposit that the marsh-gas was evolved.

Reaction of Hydrogen, Peroxide, &c., by Mr. Fairley.—The author believes that he has succeeded in preparing hypochlorous acid according to the equation $H_2O_2 + Cl_2 = 2HClO$. By the action of hydrogen peroxide on bleaching powder, and on other hypochlorites, oxygen is evolved; thus, with potassium hypochlorite, $KClO + H_2O_2 = KCl + H_2O + O_2$. Chloric acid has no action on hydrogen peroxide; neither has sulphuretted hydrogen in the absence of air. By the action of ozone on hypochlorous acid there seems to be produced perchloric acid.

On the General Equations of Chemical Decomposition, by Prof. Clifford, F.R.S.—This paper was also read before Section A. The author thinks that chemical equations may be brought under a general formula. Thus, $H_2 + Cl_2 = 2HCl$. If we assume that there is a structure common to the hydrogen and the chlorine atoms, also a structure confined to the hydrogen and likewise a structure confined to the chlorine atoms, we may represent this equation thus: $XYY + XZZ = 2XYZ$, when X represents the common structure and Y and Z the structures which are confined to hydrogen and chlorine respectively. So $2H_2 + O_2 = 2H_2O$ may be represented thus: $2XY + XXZZ = 2XXYZ$. These equations involve no hypotheses, because the fundamental facts of the molecular theory are now firmly established. Reasoning from these and similar equations, the author deduces the result that the ordinary equations of chemistry, such as those just stated, are expressive of facts, and that the hydrogen molecule really consists of two equal atoms.

On the presence of Cyanogen in Commercial Bromine, and a means of detecting it, by Dr. T. L. Phipson.—The author states that commercial bromine often contains cyanogen; by adding an equal weight of iron filings and four to five times its weight of water to the bromine, stirring, filtering, and allowing the filtrate to remain for twenty-four hours in a closed bottle, a precipitate of *Prussian blue* is thrown down if cyanogen is present.

On a Sesqui-sulphide of Iron, by Dr. Phipson.—The author describes a greenish black salt having the composition Fe_2S_3. This salt is produced by precipitating a ferric salt by means of ammonium sulphide in the presence of a free chlorite or hypochlorite. The salt is soluble in hot water, also in ammonia, giving an emerald green liquid.

On the Chlor-Bromides and Brom-Iodides of the Olefines, by Prof. Maxwell Simpson, F.R.S.—The author described various substances obtained by acting on ethylene, &c., with iodine chloride, with bromine chloride, with bromine iodide, &c. In the case of ethylene the substance C_2H_4BrI, C_2H_4ClI, and C_2H_4ClBr, were described. These bodies may also be obtained by agitating the chloride bromide or iodide of ethylene with a solution of iodine or bromine chloride: thus, $C_2H_4Br_2 + BrI = C_2H_4BrI + Br_2$. The reaction $C_2H_4Cy_2 + BrCy = C_2H_4CyBr + Cy_2$ would not take place; indeed, the author was totally unable to prepare the brom- or iodide cyanide corresponding to the salts just mentioned.

On an Aspirator, by Dr. Andrews, F.R.S., and *On another form of Aspirator*, by Prof. Delffs, could not well be understood without drawings.

SECTION C—GEOLOGY

The Geological Structure of the Tyrone Coal-field.—Mr. Hardman, after describing the position of these beds, remarked that the carboniferous rocks of this district appear to resemble somewhat those of the northern counties of England. The coal-bearing beds are true coal measures. The underlying limestone is split up by numerous sedimentary beds, and, on the whole, agrees with the Ballycastle coal-field, which beds Prof. Hull assigns to the same horizon with those of the Scotch coal measures. The author referred in detail to the thickness and position of the beds. With reference to the Dungannon coal-field, which extends from near Dungannon to beyond Coalisland, he remarked that though small in area it was rich in coal seams, possessing twenty-four coal-beds, of which at least thirteen were workable. They are highly bituminous, and two of the beds contain valuable seams of cannel coal. The chemical analyses show that these coals are valuable, possessing from 37·5 to 47 per cent. of volatile matter for gas manufacture. In the upper measures we have valuable deposits of fire-clay, which are extensively used for the manufacture of bricks and tiles. The iron-stones are not sufficiently abundant to be worked, yet they yield as much as 21·7 to 35·5 per cent. of metallic iron. There must be from 30,000,000 to 40,000,000 tons of coal yet untouched. If we count the smaller beds we shall have at least 9,000,000 more. The coal-field is bounded on the north-west by a large fault, which brings down the coal measures on the south against the calp and lower limestone. It must have a downward throw of 2,000 feet. Northwards, the limestone is covered by trias,

without any intervening coal measures, for three-and-a-half miles, when a small trough of the middle coal measures, with four of the upper Coalisland beds, rise up. This field is but two-and-a-half miles long, and a quarter wide, and yet it must contain the whole series of the middle and lower coal measures, the millstone grit and Yoredale beds. Here, the author calculates, there are 800,000 tons of coal. The author proceeded to explain when and how the two coal-fields became isolated from each other; and why, in the immediate vicinity of these coal measures, the Permian rocks are found reposing directly on the limestone. At the close of the carboniferous period the rocks were forced into flexures, ranging east and west, owing to forces acting from the northwards, as Prof. Hull shows acted in England. Denudation following, we had a set of plains, or edges of limestone, and troughs of coal measures, all of which were overlapped by the Permian and Trias. On subsequent denudation and post-triassic faults occurring, some portions of the coal measures would be laid bare or saved beneath the newer formations. As the whole district is cut up by faults, and the rock exposures few, the evidences of these flexures are obscure.

SECTION D—Biology

Department of Zoology and Botany

Dr. Williams read a paper *On Specimens of Alga from Jersey*. The paper referred to the large number of species of marine algæ to be found at Jersey, and to the favourable position of the island for their development. Dr. Williams produced a splendid collection of algæ preserved by a lady residing in Dublin.

Prof. Lawson read a paper *On certain peculiarities in the Indian Ampelideæ*. He remarked that many of the species were climbers, with their branches interlacing in the tops of the highest trees. In the stems of all were to be found numerous very large ducts, and these ducts were filled with intra-cellular vesicles, in which, at a certain time of year, abundance of starch was developed. He also remarked that in the fruit most important differences might be found, but that these afforded no means by which to divide the genus into natural sections. With respect to the inflorescence, he said there was great variety of form. Two species only reached the eastern coast of Africa, most being confined to India, though some few were common throughout the Malayan Archipelago.

On the Growth of Tree-ferns, by D. Moore.—The general conclusions arrived at in this paper were (1) Some of the kinds of tree-ferns grow with greater rapidity and form their stems in a much shorter period than is generally supposed to be the case; (2) After they attain a certain height the acrogenous buds are formed much closer together, one above the other, than they are lower down on the stem; hence their elongation is much slower; (3) Some of the sorts which at first form short rhizomatous stems before they take an upright position require a considerable number of years to perfect the early parts, but after the stem has been formed and an upright position taken, the growth is much quicker and the elongation advances rather rapidly compared with it, while the stem remains in a rhizomatous state.

Mosses of the North of Ireland, by S. A. Stewart.—Turner, in 1804, enumerated as Irish 230 species of mosses; Dr. Taylor, in 1836, mentions about the same number; and Dr. D. Moore, in 1872, gives a list of 385 Irish species, to which the author of the present paper adds four others, viz., 389, or more than two-thirds of the British mosses. Thus, relatively to the British Flora, Ireland has quite as large a proportion of mosses as she has of flowering plants, proving that Irish muscology has not been neglected. No separate lists of the mosses occurring in the northern counties have been published; but after consulting the records of Dr. Taylor in the "Flora Hibernica," and the valuable list of Irish mosses by Dr. Moore, also some detached papers on the subject, the author ascertains that the number of species occurring in the district amounts to 195, or more than one-half of the Irish mosses. The district is defined to consist of the counties of Down and Antrim, with a small portion of Co. Derry, bordering on Antrim. The list includes a large number of rare mosses. The following have not been previously recorded as Irish, viz.:—*Fissidens incurvis* Schw. var. *Lylei*, found only on a greensand rock on the Black Mountain, near Belfast; *Tayloria serrata*, in small quantity, near the summit of Benbradagh Mountain, Co. Derry; *Mnium subglobosum*, in wet peat bog on Cave Hill, near Belfast, and in a similar habitat on Carrickfergus Common; *Seligeria calcarea*, on Black Mountain, near Belfast, appearing like black specks on small lumps of chalk in the grass. Mr. C. P. Hobkirk, of Huddersfield, has been kind enough to identify the specimens of the above-named mosses.

Prof. Dickson exhibited specimens of an abnormal form of the ox-eye daisy (*Chrysanthemum leucanthemum*), in which the outer florets of the ray (normally ligulate and female) exhibit an irregularly tubular corolla, not very unlike that in the neuter florets in certain Centaureas. Structurally these abnormal florets are hermaphrodite, but appear always to be functionally neuter or sterile.

Mr. Bentham remarked that similarly abnormal tubular florets, structurally hermaphrodite, and functionally neuter, occur in certain varieties of *Chrysanthemum indicum* and *Dahlia*.

Mr. G. Bentham, F.R.S. read a report *On the recent progress and present state of Systematic Botany*, commencing with a summary sketch of the state of science in 1830, when the natural method of Jussieu was beginning to supersede the sexual system of Linnæus; of its progress from that year to 1859, when the study of the general affinities of plants had entirely superseded the classing them according to single organs; and of the great advance effected since 1859, owing to the explanation of affinities given by the adoption of the doctrine of evolution. After some notes on the language to be preferred, systematic works were then considered under the six several heads of *Ordines plantarum*, *Genera plantarum*, *Species plantarum*, Monographs, Floras, and miscellaneous descriptions. Under each head the particulars required were specified, the principal recent works glanced over, with a short mention of the chief desiderata now recommended to the attention of systematic botanists.

Prof. Thiselton Dyer referred to the paper as evidencing the labour necessary to acquire a proficiency in the knowledge of botany. Some people thought botanical study was a kind of pastime, but the paper just read proved the contrary.

Sir John Lubbock believed that *mutatis mutandis* a great deal of what Mr. Bentham said with regard to systematic botany would apply equally to zoology.

Prof. Dickson gave the results of his investigations on the embryogeny of *Tropæolum peregrinum* and *Tropæolum speciosum*. In these species the principal peculiarity consists in the constant penetration of the carpellary tissue by the extra-seminal root-process. In *Tropæolum majus* the extra-seminal root-process developed from the outer side of the base of the suspensor. After perforating the seed-coat it becomes elongated, and finishes its course in the cavity of the seed-vessel. In rare cases, however, this process has been found to penetrate by its very extremity the carpellary tissue. In *Tropæolum peregrinum* the extra-seminal process penetrates the carpel after having run in the cavity of the seed-vessel half-way. In *Tropæolum speciosum* this process dips into the carpel immediately after emerging from the seed. Dr. Dickson remarked that some would be disposed to look upon the abnormality in *Tropæolum majus* and the normal form in *Tropæolum peregrinum* as forms representing what might be viewed as stages in the evolution of such a species as *Tropæolum speciosum* from some form analogous to *Tropæolum majus*. In regard to this, Dr. Dickson adversely criticised the Darwinian hypothesis, as, in his opinion, inapplicable to the case under consideration.

Mr. A. W Bennett read a paper *On the form of pollen-grains in reference to the fertilisation of flowers*. He stated that although not unfrequently a common form of pollen-grain runs through a whole group of plants, yet more often the form is found to be adapted to the requirements of the species, and varies even within a small circle of affinity. In those plants which are fertilised by the agency of insects, there are three general modes in which the form of the grain is adapted for the purpose. We have, firstly—and this is by far the most common form—an elliptical grain, with three or more longitudinal furrows, as in *Ranunculus ficaria*, *Aucuba japonica*, and *Bryonia dioica*; secondly, spherical or elliptical, and covered with spines, as in many Compositæ, Malvaceæ, and Cucurbitaceæ; and, thirdly, where they are attached together by threads or a viscid excretion, as in *Richardia Æthiopica*. In those plants, on the contrary, which are fertilised by the agency of the wind, as most grasses, the hazel, and *Populus balsamifera*, the pollen is almost perfectly spherical and unfurnished with any furrows, and is generally, moreover, very light and dry. The genus Viola supplies two very markedly different forms, one of which, the section to which *V. canina* and *V. odorata* belong, the grains have the ordinary elliptical

three-furrowed form, and where every point of the structure of the style and stigma is favourable to fertilisation by bees; the other, the section to which *V. tricolor* belongs, where they are very much larger and either pentagonal or hexagonal, and the style and stigma are adapted for fertilisation by Thrips. In all Cruciferæ hitherto known the pollen has the most common form. *Pringlea antiscorbutica*, the "Kerguelen's Land cabbage," has been shown by Dr. Hooker to be wind-fertilised, from the following considerations: the absence of petals, the absence of honey-glands, the exserted style, and the stigma being covered with long papillæ. The form of the pollen supports the same view, being very small and perfectly spherical, extremely different therefore from every other plant of the order. In the cowslip and primrose there is a uniform difference in size between the pollen belonging to the two dimorphic forms, that of the short-styled being always considerably larger than that of the long-styled form. An interesting discussion followed, in which Dr. Hooker, Prof. Dickson, Sir J. Lubbock, Prof. Balfour, and Mr. W. E. Hart took part.

SCIENTIFIC SERIALS

Memorie della Società degli Spettroscopisti Italiani, June.—This number contains a very interesting account of the theories of the cause of formation of comets' tails, by Schiaparelli. The author seems to have no doubt that a repulsive force is in action, and that the only two acceptable theories are that the force is due to electricity or the repulsive power of the sun's heat.—Tacchini contributes a note on the polarisation of the zodiacal light, in which he corroborates Wright's observations of polarisation, and the presence of reflected sunlight. He also adds position observations of Coggia's comet in June.—Prof. Lorenzoni contributes a paper On some theoretical researches for a manner of rendering the whole of the solar chromosphere visible at once.

Bulletin de l'Académie Royale de Belgique, tome 37, No. 6.—This number contains an article by M. P. J. Van Beneden, On the whales of New Zealand. He refers to the fact that Dr. Gray of the British Museum has recognised three species in the New Zealand district, *Neobalæna marginata*, *Caperea antipodium*, and *Macleayius australiensis*, and urges that among the right whales there should be but one genus, *Balæna*. Those genera were established on imperfect data, and now that we have more material, several supposed diagnostics are found not to exist, and those that are established are of no great importance. As regards the skeleton at the Museum at Paris, studied by Prof. Lilljeborg, being without the ear-bone, that had been removed to be figured, and had not at the time been replaced. It is reported, however, as safe. Dr. Gray, believing that Van Beneden's drawing of the ear-bone was from some other source, erected it into a new genus.—MM. Cornet and Briart draw attention to some little known beds of phosphate of lime in the cretaceous beds of Hainault, and urge their being worked commercially.—M. Gluge gives a short note on tonic muscular contraction being converted into rhythmic contraction. His observations were on the sphincter ani muscles of rabbits, and he refers to similar experiments by M. Goltz on a dog. He believes that such experiments may lead to the explanation of the rhythmic contraction of the heart.

SOCIETIES AND ACADEMIES

PARIS

Academy of Sciences, Sept. 14.—M. Bertrand in the chair.—The following papers were read: Science before grammar, by M. E. Chevreul. A considerable portion of the paper (which is but an abstract of a more lengthy memoir) is devoted to a discussion of the word "*fact*." The author also draws a parallel between psychic and chemical analysis, the former separating simple ideas perceptible by the mind, and the latter ponderable simple substances perceptible by the senses. The difference between the moral and political sciences and the sciences of the domain of natural philosophy is pointed out, and in an appendix the author states his reasons for dissenting from scepticism and materialism.—On a particular toxic action exercised at a distance by *Colchicum autumnale* at the time of flowering; extract from a letter from M. Is. Pierre to M. Dumas. The hand, when held near the anthers of the flowers without coming into actual contact with them, changes in a few seconds to a livid greenish-yellow colour. The natural colour returns about ten seconds after the removal of the hand. The author believes that this remarkable action is chiefly exerted during or near the period of fertilisation, and proposes to examine further the nature of the substance emitted.—New conditions for the production of the silent electrical discharge; its influence on chemical reactions; by M. A. Boillot. The author concludes, from his experiments, that the space traversed by the silent discharge can be considerably augmented without a diminution in the chemical effects produced.—On some tungsten minerals from Meymac (Corrèze), fourth note, by M. Ad. Carnot. The minerals now described are wolfram (containing $FeWO_4$ and $MnWO_4$) calcareous scheelite (containing $CaWO_4$), and hydrated tunstic acid, to which the author assigns the formula $2WO_3, 5HO$, or $WO_3, 2HO$ (old notation).—On the supposed migration of winged *Phylloxera* to *Quercus coccifera*, by M. Balbiani. The author states his belief that the species seen by M. Lichtenstein on this tree is not identical with *Phylloxera vastatrix*. The following species of *Phylloxera* are recognised in addition to *vastatrix*:—*P. quercus*, especially inhabiting *Quercus pedunculata*, and *P. coccina*, inhabiting *Q. robur*. The species found by M. Lichtenstein on *Q. coccifera* it is proposed to name *P. lichtensteinii*.—Experiments on the employment of alkaline sulpho-carbonates for the destruction of *Phylloxera*; a letter from M. Mouillefer to M. Dumas.—On new points attacked by *Phylloxera* in Beaujolais; a letter from M. Rommier.—On the actual state of the invasion of *Phylloxera* in the Charente provinces; extract from a letter from M. Maurice Girard.—Employment of the water used in purifying gas for the destruction of *Phylloxera*; a letter from M. G. Beaume.—Note on the action exercised by the soil of vine fields on sulphuretted gases, and memoir On the propagation of *Phylloxera*, by M. Cauvy.—Other communications were received on the same subject from various authors, and M. Dumas gave a *résumé* of M. Balbiani's observations, and stated that in future the sending of living specimens of the insect to Paris would be interdicted.—The Minister of Foreign Affairs forwarded to the Academy a communication from the French Consul at Messina, relating to the opening of new vents of eruption in Etna, and on some earthquakes felt at Messina.—On a transformation of the equations of celestial mechanics, by M. Allégret.—On the causes which modify the setting of plaster, new cements with plaster and lime bases, by M. Ed. Landrin.—Action of heat on phenylxylene, by M. P. Barbier. The products are anthracene, benzene, and xylene, produced thus—

$$2C_{14}H_{14} = C_{14}H_{10} + C_6H_6 + C_8H_{10} + H_2.$$

—On a case of decomposition of chloral hydrate, by M. Tauret. By the slow oxidation of this substance, carbonic oxide is liberated. The author thinks this furnishes a new explanation of the action of chloral upon the system, and accounts for the accidents occasionally resulting from its use.—On the development of red vapours during the boiling of saccharine juices in manufacture, by M. E. J. Maumené. The author attributes these to the action of nitrates. On the rôle played by gas in the coagulation of the blood, by MM. E. Matthieu and V. Urbain.—Synthesis of purpurine, by M. F. de Lalande. This was effected by the action of oxidising agents on pure alizarine.—During the meeting, a communication was read from his Majesty the Emperor of Brazil, offering his thanks to the Academy for adding a young Brazilian astronomer to one of the Transit of Venus expeditions.

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