VENUS' FLY-TRAP.

By THOS. A. G. BALFOUR, M.D., F.R.S.E., F.R.C.P.E.

(*Continued from* p. 67.)

July 1, 1874.—A bluebottle fly was made to walk slowly over the leaf of a fresh specimen of Dionæa without any contraction occurring; the leaf was again irritated by the fly and now began to contract at a very slow rate, so much so indeed that part of the body of the fly was above the margin of the blades when the ciliary hairs or spines pressed on its body; from which pressure, however, the fly soon freed itself. When the contraction of the leaf, about an eighth of an inch below the margin, begins, the ciliary spines gradually separate from each other and bend backwards, in consequence of the eversion or retroversion of the margins of the leaf.

How long does the contraction continue? This is very much influenced by the amount to be digested. Thus in two instances, where a fly was entrapped, the contraction was only for eleven days; where a large bluebottle fly was caught it was twenty-four days before the leaf opened: where a caterpillar was enclosed it was twenty-one days. In another case where a fly was caught it was sixteen days. In one instance with beef about the size of a fly it was fifteen days, while in another similar case it was not opened on the seventeenth day. Where a plant was gorged with meat more than twenty-four days were required. The average time of contraction seems to be between two and three weeks.

Do we know anything of the nature and cause of this contraction? My excellent friend, Dr. Burdon Sanderson, showed two years ago that the peculiar electrical effect, called a negative variation, which occurs when a muscle contracts, is also exhibited where contraction of the leaf of the Dionæa occurs. This observation is one of great interest, as pointing to some special analogy between the animal and vegetable worlds.

As regards the question, "How does the irritability lead to the contraction?" we must confess our ignorance. Is the impression conveyed to some central organ from which a centrifugal force is transmitted, and can any interruption to the transmission of this influence interfere with the closure of the leaf? I spoke of co-ordinating power in the closing of the two blades; now does this reside in the hypothetical central organ, and may we, under any circumstances, have this action interfered with? Mr. Darwin has stated that he can produce this condition (a kind of palsy, if I may so style it) by pricking with a sharp lancet a particular part of the plant. This observation of Mr. Darwin is still more interesting than Dr. Sanderson's, for it points to the possibility of even a higher analogy than his. I do not know whether the paralysed leaf was on the same side which was pricked, or whether there was a crossing of the influence which produced it. Given on the authority of such an able and careful experimenter, we need not hesitate to accept it, though it is only right to state that I have not as yet been able to discover the point referred to. I have made punctures in different spots, but have never seen the operation followed by non-closure of one blade.

On July 4 I pricked a Dionæa leaf near the central hair, and it closed naturally.

July 6.—Leaf open, and responded to stimulus by both blades closing.

Only the other day I pricked with a point of a knife a portion of the midrib, almost where the petiole joins it, but no paralysis ensued.

On July 4 I also tried if I could cut off the direct transmission of the impression made on the sensitive hair, and for this purpose I performed two experiments, one on the above date and one on July 22. I first cut one leaf of Dionæa below the sensitive hair nearest the midrib, but on July 6 the leaf was open, and responded to stimulus by again closing.

July 13.—Leaf that had been incised from the front was now cut from the back, and immediately closed; the incision was made with a probe-pointed bistoury right through the one blade and extended the same length as the sensitive hairs did, so as, if possible, to interpose between them and the hinge on the left side (looking from centre of plant).

July 14.—The leaf is closed, but not very firmly. The cut was extended to-day, and care was taken that the knife went quite through the left blade without injuring the right one.

July 15.—Leaf closed; healthy look.

July 16.—Leaf partially opened towards petiole end of leaf.

July 17.—Leaf decidedly more open at the petiole end, at the part beyond that at which the cut terminates.

July 20.—Part still open, but has been closed by irritation.

July 23.—Open at end again.

The blades in this case acted in harmony, and though the leaf did not open much, this seemed owing to the shock given to the plant.

On July 22, to test whether the influence might not be transmitted from the root, I cut the midrib of the petiole quite through at about one-third of its length from the leaf; the wings of the petiole were left entire. The leaf remained open after this operation, but was closed on irritation.

July 23.—Leaf open to only half the lashes to-day.

July 24.—At 3 P.M. leaf half open, closed on irritation.

It continued to do so on July 27 and August 1.

Dutrochet in reference to the Sensitive Plant believes that there are two kinds of cells, the one exhibiting the power of contraction and the other the power of distension, and that these are situated, though in a reverse order, at the swelling of the leaflets and the pulvinar of the petiole, the contractive cells being above in the one case and below in the other, and consquently the place of irritation is in the one case above and in the pulvinar below; and as the over distension of the other kind of cells is, in his view, the immediate cause of the movement, the leaflets are forced to take an upward direction, while the petiole falls down; and he thinks that his view is confirmed by the effects of cutting the lower part of the pulvinar, which would interrupt the process on which his theory is founded.

Dr. Carpenter adopts these views, and applies them to the explanation of the closing of the Dionæa leaf. But whatever we may think as to the Sensitive Plant,* it certainly seems to fail in the Dionæa; for I have in two instances cut off a considerable slice from the lower portion of the midrib and yet the leaf has closed, so that some other explanation than that of contractile and distensible cells is here necessary. Again, if we take the case of the Droseras, which are congeners of the Dionæa we find that in D. longifolia, Whitakerii, rotundifolia, &c., the mode of contraction is just a reversal of the circinate venation which they exhibited while being developed. Now if this process depends on these kinds of cells, are we to believe that they can perform directly opposite functions? Or do the two sets of cells change places? Or, thirdly, are no such cells necessary to effect the evolution of the plant? Then, I ask, why should they be necessary in the other case, *i.e.*, in its contraction? Besides, in the case of Dionæa how can the distensible cells at the lower portion of the midrib effect the closure of the marginal bristles, which are an essential part of this wonderful contrivance for entrapping insects?

No attempted explanation, of which I am aware, is satisfactory. If I might be allowed to throw out a suggestion, I should be inclined to look for the explanation of the closing rather to the spiral vessels, which are very abundant both in Dionæa and Drosera, and which from their distribution and arrangement seem to play an important part. I shall only instance the peculiar expansion of the spiral as it enters the glandular head of the hair of Drosera dichotoma or binata. We know that elasticity is an inherent property of the spiral, and that consequently it may either contract or expand according to the forces applied to it; and in the case of Drosera binata any shortening of the spiral would certainly cause the secreting head to bend. Of course I do not mean to say that spirals will explain all the phenomena, but they may hold a very important place. I have spoken of the abundant spirals in Dionæa and Drosera, and I take this opportunity of expressing my appreciation of the kindness of Mr. Sadler, who has given me invaluable aid in investigating the microscopic structure of these plants; and any one who knows his remarkable skill and ability in preparing objects for the microscope will understand the peculiar satisfaction which I feel in having him associated with me in my researches into the minute structure of these plants.

But to return from this digression, from the midrib of the Dionæa we have at short distances spirals passing off at right angles across the blades and entering the interior of the spines or marginal bristles. They proceed to the very end of the spines, but we have not yet made out how they terminate there. But even this relation might help us to understand how the double closure of blades and spines might be effected.

But while we contemplate the marvellous but secret connection between the irritability and contraction, and mark the matchless wisdom displayed in the whole contrivance, we have the unspeakable satisfaction of knowing, and of reverently exclaiming, that "This also cometh forth from the Lord of Hosts, who is wonderful in counsel and excellent in working."

3. *Secretion.*—Ellis believed that the viscous fluid secreted was a kind of nectar, to allure the insect to the sensitive part of the leaf; but this view is entirely negatived by the fact that it is not poured out till after the capture of the insect, and it sometimes does not occur till about thirty-six or forty-eight hours after that event, though it appears to me to be generally found at the end of twenty-four hours, if not sooner. Professor Dewar, who very kindly examined some of the secretion for me, informed me that it contained no sugar. Mr. Darwin showed that the secretion was acid, and Professor Dewar writes me that the acid which he discovered was "formic acid, and that the secretion also contained chlorides; that it was of a viscid nature, and on keeping did not decompose to any great extent."* I feel deeply indebted to him for the very kind way in which he undertook to examine the secretion for me; and when I inform you that the produce of some twenty-four or twenty-five leaves amounted to only about 1 or 1½ drachms, you will at once see the trouble and difficulty of making an analysis in such a case, and I can only add that I feel most grateful to him for having done so.

The presence of formic acid in the secretion of Dionæa is peculiarly interesting. Of course most of you know that this acid derives its name from having been first found in ants, specially in the species Formica rufa; and Will has shown that the poisonous principle in certain caterpillars, especially in Bombyx processionea, consists of this acid, and that it occurs in a concentrated state in all the parts of this creature. It is also regarded as highly probable that the irritation caused by the stings of various insects is due to the same acid. In man it has been found in the blood and in the juices of muscles and of the spleen, also in the thymus gland. It is the principal volatile constituent of the sweat, and has been found in the urine, and, what is specially interesting to us, in vomited matters.

But it has also been found in plants, for it occurs in Stinging Nettles, and in some species, *e.g.*, Urtica urentissima, the effects produced by the sting are, as the name implies, peculiarly severe. In the plants in which it is found it is generally regarded as the result of decomposition, and this seems confirmed in the case of Pinus Abies, by the fact that it is found in larger amount in the needles which have fallen off than in those which are dried while fresh. As might have been expected from this circumstance the acid is also found in oil of turpentine; and when this has been kept in leaden vessels crystals of formate of lead are sometimes found.

When the fruit of Sapindus Saponaria and that of Tamarindus indica are distilled with water and sulphuric acid, formic acid is obtained as one of the products. Gorup Besanez thinks that it may be formed by oxidation of tartaric acid originally present in the fruit; and Döbereiner has actually obtained formic acid by distilling ten parts of tartaric acid with fourteen parts of binoxide of manganese and from thirty to forty-five parts of water.

Formic acid can easily be obtained from vegetable products; thus, starch and sugar when oxidised by manganese and sulphuric acid yield it. It is also got by the action of oil of vitriol on ligneous tissue, also by distilling oxalic acid with sand and glycerine, and also from carbonic acid in water, by passing through it a current of electricity. But though it might easily be formed in plants, it has not as yet been often found, and hence one of the sources of interest in this case.

Mr. Andrew Murray, in an article in the *Gardeners' Chronicle* for September last year, takes Dr. Hooker to task for his views regarding the carnivorous habits of the Dionæa, and he thinks that he (Dr. Hooker) has attached too great weight to the statements of Ellis. As a solution of the difficulty, he suggests two questions which seem to me very reasonable: the first is, "Is the secretion never present until after an insect has been captured?" In answer I may say that I do not remember of having seen it under other circumstances, and, as I said above, it is always some little time after the insect has been caught before it appears. His second question is, "Whether it is always present after an insect has been secured?" My experience is that if the plant be healthy it is always so. I am speaking of living insects. Is this fluid a real secretion or is it merely the exudation of the juices of the plant which are distinctly acid? There can be no doubt that it is truly a secretion. Its viscid nature would itself prove that the juices must have undergone some change. But I have better evidence, for I tried whether mere pressure would cause this fluid to appear.

(*To be continued.*)

* I have tried some experiments on the upper and lower parts of the attachment of the petiole, and I must own that though they have been far from being quite confirmatory of Dutrochet's view, there was one instance which seemed to support it: a portion of the upper part of the petiole was cut away and some days afterwards on touching the pulvinar the petiole did not descend to the same length as the others did, though from the weakening of the base of the petiole we should have expected it to have gone down further than any of them.

* The name of Professor Dewar is the best guarantee for the accuracy of this analysis.

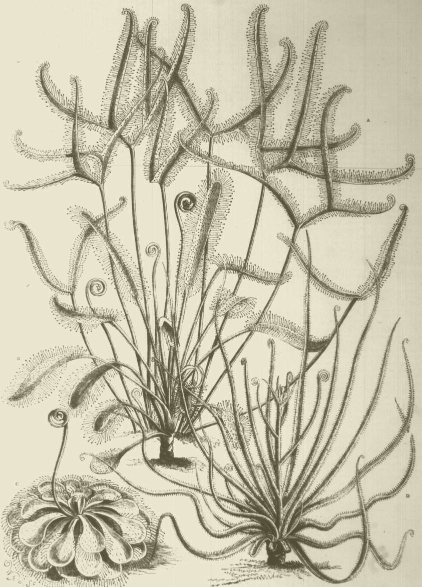

FIG. 20.—GROUP OF DROSERAS AT MESSRS. VEITCH'S.
A, Drosera dichotoma. B, Drosera capensis. C, Drosera spathulata. D, Drosophyllum lusitanicum.

(*Refugium Botanicum*, sub t. 308), we join together Coburgia and Stenomesson, we can scarcely separate the plant on this account. I incline, therefore, to regard it as the type of a new section to be called Odontopus. The plant was purchased by Mr. Green, of Reigate, at a sale amongst a quantity of Andine bulbs, and he knows nothing more of its origin. He flowered it at Reigate this present spring, and had it under the specific name which I have adopted.

Bulb ovoid, above an inch thick, with dry brown membranous tunics produced 3 or 4 inches up its long neck. Leaves fully developed in May, in two tufts of three to four each in the specimen seen; bright green, rather fleshy in texture, acuminate, a foot or more long, 3—4 lines broad, without any distinct midrib, but with about fifteen rather raised parallel main veins. Flowers produced early in April. Scape slender, ancipitous, bearing a few-flowered umbel. Spathe valves linear, as long as the pedicels. Pedicels cernuous at the top, 9—12 lines long. Perianth 1¼ inch long, with a green obconic trigonous ovary as broad as deep, a very short narrowly funnel-shaped tube, and six oblanceolate acute segments permanently conniving in a narrow funnel. Segments an inch long, under a quarter of an inch broad a third of the way down, pale at the border, closely many-ribbed down the back, keeled with green in the upper quarter, and the rest with bright red. Filaments filiform, all six inserted on a level at the throat of the tube, just as long as the segments, furnished with a pair of sharp linear erecto-patent teeth above the middle. Anthers oblong, yellow, versatile, ⅙ inch long. Style filiform, 1½ inch long, with a small capitate stigma. *J. G. B.*

VENUS' FLY-TRAP.

By Thos. A. G. Balfour, M.D., F.R.S.E., F.R.C.P.E.*

My attention was specially directed to the subject of Dionæa, Drosera, &c., by certain articles which appeared in different journals, containing interesting accounts of what had been done in regard to these plants, and of the curious results which had been obtained. Some of these notices had an air of truth about them, while others seemed indebted for their existence rather to the vivid imagination of the writer than to careful scientific observation. The interest, however, attaching to the whole subject was such that I felt most anxious to test for myself the truth or otherwise of the observations recorded.

My observations are not complete, and though in some cases they refer to points which have been already carefully studied by others, the present paper also contains some original and independent observations, and hence may not be altogether wanting in scientific interest.

In dealing with my subject I shall regard the Venus' Fly-trap (Dionæa) as a carnivorous plant, and I feel warranted in doing so by the opinions expressed by those who have made this plant the subject of careful study. Ellis was one of those who, about 100 years ago, brought the peculiarities of the plant under the notice of Linnæus, &c. His letter to that famous botanist gave an excellent description of the structure and functions of the leaf, erring only in one or two points, such as in believing that the fluid secreted by the leaf was a kind of nectar to allure insects towards the sensitive part of the leaf, and in attributing to the hairs the power of transfixing the body of the captured insect. His opinion, however, was that the insect was made subservient to the nourishment of the plant.

Dr. Curtis seems to have been the next observer. He resided at Wilmington, North Carolina, where he had abundant opportunities of observing the plant in its native habitat. About forty years ago he gave an able and accurate account of it, and while he corrected Ellis' mistakes regarding the time when the secretion was poured out, and showed the sensitiveness of the plant to reside in the hairs, he believed with Ellis that the plant fed on the entrapped insect.

Mr. Canby, about seven years ago, while living at Wilmington also, confirmed the opinion of Ellis and Curtis as to the animal diet of the Dionæa.

Mr. Darwin holds a similar view, and when we know that for six or seven years this distinguished naturalist has been studying this subject, and recall his wonderful and minute powers of observation, his great practical sagacity, and the fertility of his resources in devising experiments, we must attach no ordinary importance to the researches which I trust he may soon give to the world. Dr. Hooker has also stamped this opinion with the weight of his deservedly great name in the address which he delivered in August last to the British Association. In speaking of the carnivorous habits of the Dionæa muscipula, I shall divide the subject into the five following heads:—1. Irritability; 2. Contraction; 3. Secretion; 4. Digestion; 5. Absorption, including assimilation. It may seem unphysiological to place secretion and digestion under separate heads, but there are some who admit the existence of the former, but deny the latter; hence I treat of them separately.

1. *Irritability.*—This is a wonderful property, not confined to Dionæa, but existing in the leaves of many plants, specially of the natural order Droseraceæ, to which the Dionæa belongs; also in the Leguminosæ, especially in the common Sensitive Plant of our hot-houses (Mimosa pudica), and among the Oxalidaceæ, but in a peculiar degree in the sensitive Oxalis (Biophytum sensitivum). In the Dionæa, however, this irritability is, as first pointed out by Curtis, resident in six delicate hairs, which are placed three on each blade in a triangular form, with the apex pointing downwards; each has a peculiar bulging at its attachment to the blade. The position of these hairs is such that it is well nigh impossible for an insect to avoid touching them while crawling over the leaf.

To test the accuracy of this opinion I took a needle and touched almost every portion of the surface both above and below, and also the marginal hairs, and no response was given; but no sooner did I apply the needle point to the top of one of the six hairs than immediate closure of the leaf followed.

In the Sensitive Plant this property seems to have no apparent relation to the wants of the system; in the Dionæa, however, such a relation seems to exist, for when a certain amount of animal food has been consumed, the irritability disappears, at least for a considerable time.

On July 3, 1874, at 2.30 P.M., a large bluebottle fly was placed on a large Dionæa leaf; the diet was peculiarly acceptable, and was at once secured. Twenty-four days were required for digesting it, and when the remains were removed on the 27th the hairs were stimulated repeatedly, but no signs of irritability were manifested. On July 28, 29, 30, and on August 1 the same was tried, with a like negative result.

A similar result followed in the case of other leaves after sumptuous repasts of caterpillars and raw meat and spiders; but these will again come before us.

This irritability is also more or less influenced by sunshine and shade, though, so far as my experiments go, not in the manner that one would naturally expect.

On July 20, 1874, four plants of Dionæa were selected—two to be placed in the shade, and the other two to remain in the sunshine. Of those in sunshine, one plant had two leaves closed by irritation, and the other had three similarly dealt with. Of those in the shade one had four leaves closed by irritation, and the other had two thus treated.

July 21, 12.30 P.M.—All act equally well on irritation; only one of the plants in the shade had not its leaves quite so open as the others.

July 22, 3 P.M.—In sunshine all open, and respond readily and fully to irritation. In shade one plant has two leaves half open, and the other plant has two fully open, but all respond languidly and more or less fully.

July 23, 4 P.M.—The two plants in sunshine are not quite open but close well on irritation. The two plants in shade have their leaves scarcely half open (the lashes are touching), but they close pretty well.

I need not weary you with details, so I pass on to the record of August 1, when the plants were, in sunshine, all about half open, but closed on irritation; while in shade two were half open, but would not close by irritation of any amount. My appended note is—"The want of sun seems here to have impaired irritability."

Again, in some cases the nature of the substance applied seems to influence to a considerable extent this property of irritability. On July 16 chloroform was dropped on the sensitive hairs of a leaf of Dionæa, and it instantly closed exactly as an eyelid would have done had chloroform been applied to the eye. To test whether it was the peculiar nature of the fluid, or simply the fluid touching the hairs, that had caused the closure, another Dionæa leaf was chosen, and a large quantity of water was let fall on it, at first drop by drop, and afterwards in large quantity, but there was no sign of closing; but when chloroform was added, the closure ensued in two or three seconds. These plants had not been in direct sunshine.

On July 17 new experiments were made. One or two Dionæas which were in bright sunshine were held below a watering pan, and at first drops of water, and then a full stream, were directed on the sensitive hairs, and the leaves closed at once. This experiment, so different in result from the last, seemed entirely owing to the direct rays of the sun in which it had been placed; for on taking another Dionæa, which had not been so exposed, we found that, in this case, no amount of water would cause it to close, but the smallest amount of chloroform did so at once. Here, then, so far as the experiments go, was a distinct evidence of the irritability being in some instances dependent on the nature of the irritant. Only the other day (June 7) I saw the leaf of a Dionæa nearly full of water, in contact with all the sensitive hairs, and yet no closure had been effected, but on my touching a hair with the point of a knife immediate closure resulted.

If this be found generally true regarding water, we can see how admirably provision has been made to guard the plant against the frequent closure of its leaves after every shower, which would deprive it of many chances of a good meal. Nor does the closure of the one which had been in bright sunshine at all militate against this view, for in most instances we have the sun obscured by clouds for some time before any continuous rain begins.

Again, this property seems to exist in different degrees of intensity in different plants of Dionæa and sometimes in different leaves of the same plant. Thus I have found that the slightest touch of the top of a hair has been followed by instant closure, while in another leaf of the same plant this effect was only obtained after touching a hair twice.

How long is this irritability retained? The period seems to vary even in different leaves of the same plant, so that it is impossible to give a definite answer. On July 7 three leaves of one plant of Dionæa were closed by irritation; they were very lively and closed at once.

July 8.—Oopen by 10 A.M. at least; at 3 P.M. they were again closed at once on irritation.

July 10.—At 12 noon two leaves quite open, one leaf only half open, and closes languidly.

July 11.—One still close which was *closed* yesterday; the other two, which are open, responded somewhat languidly to irritation by a glass rod.

July 14.—Only closed very languidly; the other two responded better to stimulus, and closed firmly.

July 15 and 16.—One closes languidly; other two close at once vigorously.

July 20, 3.30 P.M.—All closed with slight languor.

July 21 and 23.—All closed slowly.

On July 25 the irritability is much exhausted.

From some of them remaining closed after this it was impossible to test further before August 1, when I left town.

We see from these dates that the irritability in one leaf began to show signs of diminution on the third day, and that the other two leaves did so on the day following. On the seventh day these two temporarily regained their irritability, and retained it till the eighth and ninth day, but it became again gradually impaired, till on the eighteenth day it was much exhausted.

No great importance can be attached to these experiments, as the irritation was only practised once a day, and sometimes, though rarely, once in two days.

Of the nature of this property we cannot, of course, speak, for we know of its existence only by the effect produced, viz., the contraction of the leaf; but there seems to be a co-ordinating power in connection with the irritability, for though one or more hairs on only one blade of the leaf be irritated, both blades will close synchronously. I shall have occasion to return to this subject under the second heading, and I now, therefore, proceed to speak of the effect of the irritability.

(*To be continued.*)

THE COFFEE-LEAF FUNGUS.

In his report on the Botanic Gardens at Péradeniya and Hakgala for 1874, which we have just received, Dr. Thwaites writes, concerning the Hemileia vastatrix, described and figured by Mr. Berkeley in our columns, p. 1157, 1869:—

"It seems desirable that the present opportunity should be used to offer a statement of the result of further investigations made by Mr. Abbay and by myself into the nature and development of the leaf-fungus (Hemileia vastatrix) which has for several years so seriously affected the Coffee trees of the island. Infinite satisfaction would it have afforded me could I have reported anything to indicate its probable disappearance. Though requiring careful inspection for its detection, still it is unfortunately present upon all the Coffee trees I have examined. With the help of the microscope it is found at all times to pervade the greater part of the stems and older leaves in the form of very fine branching filaments (mycelium), its effects being apparent in the numerous somewhat translucent spots which may be observed when holding one of the older leaves against the light. These spots are no doubt due to the action of the fungus-filaments in drawing their nourishment from the substance of the leaf. The direct injury so caused to the Coffee tree is, however, probably very slight, as compared with the effect produced when the fungus attacks the young leaves, causing them to fall prematurely.

"As the presence of the fungus-filaments in such abundance on the outer surface of the tree is quite sufficient to account for phenomena which I at first thought must be attributable to the poisoning of the juices of the tree by an absorption of the fungus matter through its roots, I am constrained to give up the latter idea, and to consider the disease as external, except when it appears

ovario obconico-trigono; tubo brevi infundibulari; limbi anguste infundibularis segmentis lanceolatis acutis superne viridulo-inferne rubro-costatis; filamentis segmento æquilongis utrinque supra medium dente parvo lineari instructis; stylo breviter exserto.

* Condensed from a paper read at the June meeting (10th) of the Botanical Society of Edinburgh.

out; and though the frames are well stocked at all seasons, shading had, in most cases, taken the place of the lights.

The difference between the growth of most things when planted out and the same kept in pots, unless they have the most regular and careful attention, is very great, and the saving of time and trouble is even greater. A fine lot of Tritomas, or Kniphofias, as it seems they should be called, are included in this collection, among them a new one from Abyssinia, which bids fair to rival K. caulescens in size and beauty.

Another most remarkable plant I saw in flower was Arnebia echiodes, from Armenia, figured in the *Botanical Magazine*, pl. 4409. This belongs to the family of Boragineæ, and is a dwarf yellow-flowered plant, having five black spots on each flower. Its peculiarity is that though in the morning the spots are very conspicuous they gradually fade away, till in the evening they are no longer visible. Disa grandiflora is very well grown by M. Leitchlin, who keeps it closely shaded in the greenhouse. Isias triloba, a curious natural hybrid between Serapias and Orchis longicorne, which has been very rarely found along the Riviera, was also here, though past flowering.

Many choice kinds of Colchicum, Fritillaria, Xiphion, and Tulip were now being lifted, for though M. Leichtlin does not hold it in all cases necessary to take the bulbs up every year, yet in some cases it is a great advantage to do so, and if they are kept in pots of sand and planted early they are never injured by it. With the bulbs of most Amaryllidaceous plants it is, however, very different; their roots are thick, fleshy, and do not perish, so that, though it is necessary in most cases to give them a season of rest and drought, it is better to disturb the roots as little as possible. The culture of bulbs, though very much gone out of fashion in England, is one extremely well adapted to all amateurs whose aspirations rise beyond the common "bedding decorative stuff." They require none of the training, pruning, syringing, and constant trouble which many greenhouse plants give. They take up very little space, and though their flowers are not as a rule very lasting, yet there is a constant succession at all seasons. If one can only learn when and how to water them, the secret of their culture is in most cases attained, but watering too much at one season and too little at another is, I believe, the cause of death in nine cases out of ten.

I must not omit to mention two species of Tulip which have been introduced by M. Leichtlin through the agency of his Russian friends. Tulipa Greigi, which, from what I have seen of it, I should say is the finest Tulip in cultivation, surpassing in its wild and uncultivated state many of the most splendid Dutch varieties. It was shown at one of the early meetings of the Horticultural Society this year, though not in a condition to give a right idea of its beauty. The other Tulip, named Eichleri, is also a fine species, allied to Oculis solis, which I was lucky enough to flower for the first time in England this spring. It will, however, be impossible for me to enumerate a tithe of the remarkable plants I saw in and out of flower. Those which admit of cultivation will be grown and increased by M. Leichtlin's skilful care, if it is possible for any one to do so, for propagation is his strong point, and, like most things that one can do well, he is fond of it.

I would only say that, after going carefully through the list of known Lilies, we came to the conclusion that only three or four species, which are all accessible, remain to be introduced, though of varieties, no doubt, there are many. Hoping that in the interest of horticulture and science, every reader of the *Gardeners' Chronicle* who may by any means have the opportunity of getting them will not lose the chance, I will mention them :—

Lilium nepalense.—Belonging to the longiflorum group, which is found in the Himalayas from Kumaon to Nepaul. This plant could be easily procured by many tea-planters or residents in Mussoorie or Almorah.

L. oxypetalum..—A small Fritillaria-like plant, figured in the *Bot. Mag.*, pl. 4731; also found in the Himalayas, but ranging more to the north-west, and at higher elevations.

L. medeoloides.—A rather small-flowered and not very showy plant, having the habit of the Martagons, and an erect flower, found in damp woods of North Japan near Hakodadi, and in the Corean Archipelago.

L. avenaceum, which has also the leaves and habit of a Martagon, with small spotted and pendulous flowers, and a very loose tender bulb, composed of scales which resemble grains of Oats. This is found in North-West Siberia, Kamschatka, and the Kurile Islands, possibly also in Japan, though of this I am not sure. Owing to the delicacy of its bulbs, seed would be the most likely means of introducing it.

L. callosum of Sieb. and Zucc., not the L. callosum of gardens, which is a distinct plant. The real one may be known by its curious double stipular or bracteal appendages, shown in Siebold's plate, and also in the one copied from it in the *Flore des Serres*. It is found abundantly in the high mountains of Japan, and may possibly be in cultivation already; if so, I should be glad to hear of it; but all that I have seen are wrongly named.

In conclusion, I will thank M. Leichtlin in the name of all plant lovers for the many beautiful additions to our gardens which he has introduced, and hope that he may long be able to continue his labour of love. *H. J. Elwes.*

VENUS' FLY-TRAP.

By Thos. A. G. Balfour, M.D., F.R.S.E., F.R.C.P E.

(*Continued from* p. 8.)

2. *Contraction*, or closure of the leaf and of its marginal spines or cilia.

This property of contractibility, like that of irritability, has a distinct relation to the wants of the plant. No doubt almost any substance, whether suited for food or not, will, if placed on one of the sensitive hairs, be followed by contraction; but it is only when the material so introduced is capable of giving nutriment to the plant that the contraction continues. This peculiarity of the contraction is exhibited in the following instances :—

On July 4, at 3 P.M., a piece of wood was placed on a large leaf of a Dionæa, which instantly grasped it. It was, however, too large to be concealed, so that the wood was seen with the marginal spines embracing it.

July 6.—At 11 A.M. the leaf is quite open. At 3 P.M., however, it was found closed, which was apparently owing to the wood being so light as to be easily knocked against the hairs by the draughts in the greenhouse. This to a certain extent vitiated the experiment.

On the same day (July 4), at 3 P.M., a piece of dry plaster which had fallen from the wall, was put on another leaf of the same plant, and it was at once caught and concealed.

July 6.—At 3 P.M. the leaf was quite open, but was closed by irritation.

July 7.—At 3.30 P.M. leaf again open.

On the same (July 4), but on the leaf of another active Dionæa, a piece of iron nail was placed, which was grasped instantly and vigorously.

July 6.—At 3 P.M. leaf quite open, but on pressing the iron against the sensitive hairs the leaf again closed.

July 7.—At 3.30 P.M. leaf quite open again.

On July 7 a piece of the leaf of a Fuchsia was placed on a Dionæa leaf, and caught by it.

July 8.—At 2 P.M. leaf quite open.

For the same reason we find that when insects have lost their nutritive power (either from having been too long kept or from having been previously digested) we have a similar action on the part of the leaf.

Thus in the case of the Fuchsia leaf just referred to, after the Dionæa leaf had opened a fly was placed beside the piece of Fuchsia, *i.e.*, on July 8, at 2 P.M.

July 10.—Leaf open; closed by irritation.

July 11.—Leaf quite open again.

July 13.—Fuchsia leaf taken away and fly alone left and leaf closed by irritation.

July 14.—Leaf again open.

July 15.—Fly looked a very shrivelled one, so I removed it and put on the leaf a bluebottle fly (which had been dead for fully a week). Leaf closed by irritation.

July 16.—Leaf quite open (probably from fly being a dried up one).

July 17.—Leaf again open. On examining bluebottle fly it was found to be quite dry and brittle, and nothing could be squeezed from it. It was removed and a living fly introduced; the leaf closed and remained so till the 28th, by which time the fly was quite exhausted of its substance. Linnæus believed that it was in consequence of the struggles of the living insect that the contraction continued, and that after its death the leaf opened, but this view is erroneous, for, even in this case, which at first sight might seem to favour it, the insect was dead very long before any opening of the blades occurred.

So in the case of a fly previously digested by a Dionæa.

On July 15 a fly of this description was placed on a very healthy leaf of a Dionæa, which instantly closed by irritation by knife; the lashes also were at right angles.

July 16.—The leaf was open so far that the lashes were not touching, and the previously digested fly was removed and a freshly caught fly was put alive into the trap.

The leaf now remained quite closed till the 24th, *i.e.*, for eight days, and was not entirely open till the 27th instant.

Again, we have similar instances where the leaves have contracted by the hairs being irritated without any foreign body being entraped; we have seen examples of this under irritability, so that it is needless to cite them again, for in these cases the leaves always opened till the irritability was exhausted.

I now tried if I could deceive my friends, and so make sure that they would keep what I had offered them, just as in the case of a little rebellious patient the fond mother often envelopes the pill with jam and hopes to attain her end. I therefore added a tempting fly to the leaf with the plaster, which I have already instanced as refusing to remain closed on it. On July 7 I added a dead fly to the leaf with the lime, and secured its closure; but, just as in the case of the pill, both it and the jam are likely to be forcibly ejected, amid rage and tears, to the no small mortification of the benevolent donor; so on July 8 I had the painful fact to record—"The marginal hairs look very red, the leaf was quite open at 6 A.M. The fly did not seem at all digested, but the small grains of lime which were near the sensitive hairs looked somewhat as if they had been wet, and had dried again;" and as the *denoûment*, in the case of the patient, is that the jam alone is given to be supped, and the pill is thrown into the fire, so in the end of my note I find "the lime was now taken out, and the leaf irritated and made to close on the fly, which it did with lashes at right angles."

I mentioned also the case with the iron nail; here I was more successful with my wiles. On July 7 a dead fly was added to the iron, and though on the 8th the leaf was again open, a little coaxing got it to close. It remained so till July 20, when from the blackness of the leaf I discovered that the dose had proved fatal, and that my success in this case had been more disastrous to me than my defeat in the last one.

In some cases, however, the leaf may close and continue so, as when a fatal shock has been given to the leaf by the administration of some poisons, or by cutting across the petiole; in this latter case the leaf generally closes very slowly.

Besides chloroform, some of the substances tried which proved poisonous, probably in some cases from the quantity used being too large, and were attended with closure of leaf, were chloride of ammonia, carbonate of soda, sulphite of soda, sulphate of soda, biborate of soda, sulphate of copper.

Where chloride of strontian was used, and also sulphate of iron, the leaves remained open though they died.*

At this time I had unfortunately no posological table to guide me as to the amount to be given in a medicinal point of view, and hence the plants succumbed to the toxic effect of the amount administered.

As there was only one experiment with each substance named, no weight can be attached to the fact of closure or otherwise, but as they are facts I record them.

The full contraction is not completed at once, and hence Dr. Curtis informs us that he "has liberated flies and spiders, which have sped away as fast as fear or joy could hasten them." I have done so also; but his observation as to the rate of their speed being determined solely by joy or fear requires to be qualified by the expression "remaining ability," to be in accordance with what I have seen. On July 24, at 3.30 P.M., a large spider was enclosed in a fine large leaf of Dionæa; and on July 25, at 3 P.M., on opening the leaf the spider was found alive but languid, being wet with the acid fluid. So with a fly, alive after two days' confinement: it was enclosed in a Dionæa leaf on September 29, and on opening the leaf on October 1 the fly was alive and damp, but with no great amount of secretion around it; on being taken out it moved about wonderfully, and in the evening seemed well, but did not attempt to fly.

The process of contraction is this: At first the sides of the leaf approach at the upper edge, leaving a concavity inside, in which the enclosed insect is comparatively free from pressure; but some time afterwards a distinct compression of the two sides may be noticed at about an eighth of an inch below the upper edge, and ultimately one of the sides may become quite convex internally, fitting into the concavity of the opposite blade. Hence, ultimately, the creatures, if of a soft nature—such as caterpillars, centipedes, and spiders—are squeezed flat, but those with a hard external covering, *e.g.*, beetles, resist the pressure, so that the skeleton may be found retaining its natural form and size.

But the contraction of the leaf is not single but double; it is not limited to the movements of the blades of the leaf, but is also manifested by the ciliary or marginal spines, which, when complete contraction of the blades is effected, may be found interlocked and at right angles to the blades. After remaining thus for some time (occasionally not longer than half an hour) the marginal spines gradually rise so as to form an obtuse angle with the inner side of the blade. In some cases the hairs never reach the right angle but remain at the obtuse angle, more especially if the blades close languidly.

In some cases the insect would certainly escape if it were not for the bending of the ciliary spines, which stops its progress outwards. Sometimes, however, the whole process is so slow, both in the case of blades and spines, that these latter have not crossed before the insect reaches them, and it escapes in such cases.

(*To be continued.*)

VENUS' FLY-TRAP.

Y THOS. A. G. BALFOUR, M.D., F.R.S.E., F.R.C.P.E.

(*Continued from* p. 67.)

July 1, 1874.—A bluebottle fly was made to walk owly over the leaf of a fresh specimen of Dionæa ithout any contraction occurring; the leaf was again ritated by the fly and now began to contract at a very ow rate, so much so indeed that part of the body of ie fly was above the margin of the blades when the liary hairs or spines pressed on its body; from hich pressure, however, the fly soon freed itself. 'hen the contraction of the leaf, about an eighth ' an inch below the margin, begins, the ciliary spines adually separate from each other and bend backards, in consequence of the eversion or retroversion ' the margins of the leaf.

How long does the contraction continue? This is ry much influenced by the amount to be digested. ıus in two instances, where a fly was entrapped, e contraction was only for eleven days; where a ·ge bluebottle fly was caught it was twenty-four ıys before the leaf opened: where a caterpillar was closed it was twenty-one days. In another case ıere a fly was caught it was sixteen days. In one stance with beef about the size of a fly it was fifteen ys, while in another similar case it was not opened the seventeenth day. Where a plant was gorged th meat more than twenty-four days were required. ıe average time of contraction seems to be between 'o and three weeks.

Do we know anything of the nature and cause of is contraction? My excellent friend, Dr. Burdon ınderson, showed two years ago that the peculiar ectrical effect, called a negative variation, which :curs when a muscle contracts, is also exhibited here contraction of the leaf of the Dionæa occurs. his observation is one of great interest, as pointing some special analogy between the animal and getable worlds.

As regards the question, "How does the irrita- ity lead to the contraction?" we must confess our ıorance. Is the impression conveyed to some ntral organ from which a centrifugal force is trans- tted, and can any interruption to the transmission this influence interfere with the closure of the leaf? poke of co-ordinating power in the closing of the o blades; now does this reside in the hypothetical ıtral organ, and may we, under any circumstances, re this action interfered with? Mr. Darwin has ted that he can produce this condition (a kind of lsy, if I may so style it) by pricking with sharp lancet a particular part of the plant. This servation of Mr. Darwin is still more interesting an Dr. Sanderson's, for it points to the possibility even a higher analogy than his. I do not know ıether the paralysed leaf was on the same side which s pricked, or whether there was a crossing of the luence which produced it. Given on the authority such an able and careful experimenter, we need : hesitate to accept it, though it is only right to te that I have not as yet been able to discover the nt referred to. I have made punctures in different ıts, but have never seen the operation followed by ı-closure of one blade.

On July 4 I pricked a Dionæa leaf near the central r, and it closed naturally.

uly 6.—Leaf open, and responded to stimulus by h blades closing.

Only the other day I pricked with a point of a fe a portion of the midrib, almost where the petiole ıs it, but no paralysis ensued.

On July 4 I also tried if I could cut off the direct ısmission of the impression made on the sensitive r, and for that purpose I performed two experi- nts, one on the above date and one on July 22. I t cut one leaf of Dionæa below the sensitive hair rest the midrib, but on July 6 the leaf was open, l responded to stimulus by again closing.

uly 13.—Leaf that had been incised from the front ; now cut from the back, and immediately closed; incision was made with a probe-pointed bistoury ıt through the one blade and extended the same gth as the sensitive hairs did, so as, if possible, to ·rpose between them and the hinge on the left side ·king from centre of plant).

uly 14.—The leaf is closed, but not very firmly. : cut was extended to-day, and care was taken that knife went quite through the left blade without ıring the right one.

uly 15.—Leaf closed; healthy look.

uly 16.—Leaf partially opened towards petiole of leaf.

July 17.—Leaf decidedly more open at the petiole end, at the part beyond that at which the cut terminates.

July 20.—Part still open, but has been closed by irritation.

July 23.—Open at end again.

The blades in this case acted in harmony, and though the leaf did not open much, this seemed owing to the shock given to the plant.

On July 22, to test whether the influence might not be transmitted from the root, I cut the midrib of the petiole quite through at about one-third of its length from the leaf; the wings of the petiole were left entire. The leaf remained open after this operation, but was closed on irritation.

July 23.—Leaf open to only half the lashes to-day.

July 24.—At 3 P.M. leaf half open, closed on irritation.

It continued to do so on July 27 and August 1.

Dutrochet in reference to the Sensitive Plant believes that there are two kinds of cells, the one exhibiting the power of contraction and the other the power of distension, and that these are situated, though in a reverse order, at the swelling of the leaflets and the pulvinar of the petiole, the contractive cells being above in the one case and below in the other, and consquently the place of irritation is in the one case above and in the pulvinar below; and as the over distension of the other kind of cells is, in his view, the immediate cause of the movement, the leaflets are forced to take an upward direction, while the petiole falls down; and he thinks that his view is confirmed by the effects of cutting the lower part of the pulvinar, which would interrupt the process on which his theory is founded.

Dr. Carpenter adopts these views, and applies them to the explanation of the closing of the Dionæa leaf. But whatever we may think as to the Sensitive Plant,* it certainly seems to fail in the Dionæa; for I have in two instances cut off a considerable slice from the lower portion of the midrib and yet the leaf has closed, so that some other explanation than that of contractile and distensible cells is here necessary. Again, if we take the case of the Droseras, which are congeners of the Dionæa we find that in D. longifolia, Whitakerii, rotundifolia, &c., the mode of contraction is just a reversal of the circinate venation which they exhibited while being developed. Now if this process depends on these kinds of cells, are we to believe that they can perform directly opposite functions? Or do the two sets of cells change places? Or, thirdly, are no such cells necessary to effect the evolution of the plant? Then, I ask, why should they be necessary in the other case, *i.e.*, in its contraction? Besides, in the case of Dionæa how can the distensible cells at the lower portion of the midrib effect the closure of the marginal bristles, which are an essential part of this wonderful contrivance for entrapping insects?

No attempted explanation, of which I am aware, is satisfactory. If I might be allowed to throw out a suggestion, I should be inclined to look for the explanation of the closing rather to the spiral vessels, which are very abundant both in Dionæa and Drosera, and which from their distribution and arrangement seem to play an important part. I shall only instance the peculiar expansion of the spiral as it enters the glandular head of the hair of Drosera dichotoma or binata. We know that elasticity is an inherent property of the spiral, and that consequently it may either contract or expand according to the forces applied to it; and in the case of Drosera binata any shortening of the spiral would certainly cause the secreting head to bend. Of course I do not mean to say that spirals will explain all the phenomena, but they may hold a very important place. I have spoken of the abundant spirals in Dionæa and Drosera, and I take this opportunity of expressing my appreciation of the kindness of Mr. Sadler, who has given me invaluable aid in investigating the microscopic structure of these plants; and any one who knows his remarkable skill and ability in preparing objects for the microscope will understand the peculiar satisfaction which I feel in having him associated with me in my researches into the minute structure of these plants.

But to return from this digression, from the midrib of the Dionæa we have at short distances spirals passing off at right angles across the blades and entering the interior of the spines or marginal bristles. They proceed to the very end of the spines, but we have not yet made out how they terminate there. But even this relation might help us to understand how the double closure of blades and spines might be effected.

But while we contemplate the marvellous but secret connection between the irritability and contraction, and mark the matchless wisdom displayed in the whole contrivance, we have the unspeakable satisfaction of knowing, and of reverently exclaiming, that "This also cometh forth from the Lord of Hosts, who is wonderful in counsel and excellent in working."

3. *Secretion.*—Ellis believed that the viscous fluid secreted was a kind of nectar, to allure the insect to the sensitive part of the leaf; but this view is entirely negatived by the fact that it is not poured out till after the capture of the insect, and it sometimes does not occur till about thirty-six or forty-eight hours after that event, though it appears to me to be generally found at the end of twenty-four hours, if not sooner. Professor Dewar, who very kindly examined some of the secretion for me, informed me that it contained no sugar. Mr. Darwin showed that the secretion was acid, and Professor Dewar writes me that the acid which he discovered was "formic acid, and that the secretion also contained chlorides; that it was of a viscid nature, and on keeping did not decompose to any great extent."* I feel deeply indebted to him for the very kind way in which he undertook to examine the secretion for me; and when I inform you that the produce of some twenty-four or twenty-five leaves amounted to only about 1 or 1¼ drachms, you will at once see the trouble and difficulty of making an analysis in such a case, and I can only add that I feel most grateful to him for having done so.

The presence of formic acid in the secretion of Dionæa is peculiarly interesting. Of course most of you know that this acid derives its name from having been first found in ants, specially in the species Formica rufa; and Will has shown that the poisonous principle in certain caterpillars, especially in Bombyx processionea, consists of this acid, and that it occurs in a concentrated state in all the parts of this creature. It is also regarded as highly probable that the irritation caused by the stings of various insects is due to the same acid. In man it has been found in the blood and in the juices of muscles and of the spleen, also in the thymus gland. It is the principal volatile constituent of the sweat, and has been found in the urine, and, what is specially interesting to us, in vomited matters.

But it has also been found in plants, for it occurs in Stinging Nettles, and in some species, *e.g.*, Urtica urentissima, the effects produced by the sting are, as the name implies, peculiarly severe. In the plants in which it is found it is generally regarded as the result of decomposition, and this seems confirmed in the case of Pinus Abies, by the fact that it is found in larger amount in the needles which have fallen off than in those which are dried while fresh. As might have been expected from this circumstance the acid is also found in oil of turpentine; and when this has been kept in leaden vessels crystals of formate of lead are sometimes found.

When the fruit of Sapindus Saponaria and that of Tamarindus indica are distilled with water and sulphuric acid, formic acid is obtained as one of the products. Gorup Besanez thinks that it may be formed by oxidation of tartaric acid originally present in the fruit; and Döbereiner has actually obtained formic acid by distilling ten parts of tartaric acid with fourteen parts of binoxide of manganese and from thirty to forty-five parts of water.

Formic acid can easily be obtained from vegetable products; thus, starch and sugar when oxidised by manganese and sulphuric acid yield it. It is also got by the action of oil of vitriol on ligneous tissue, also by distilling oxalic acid with sand and glycerine, and also from carbonic acid in water, by passing through it a current of electricity. But though it might easily be formed in plants, it has not as yet been often found, and hence one of the sources of interest in this case.

Mr. Andrew Murray, in an article in the *Gardeners' Chronicle* for September last year, takes Dr. Hooker to task for his views regarding the carnivorous habits of the Dionæa, and he thinks that he (Dr. Hooker) has attached too great weight to the statements of Ellis. As a solution of the difficulty, he suggests two questions which seem to me very reasonable: the first is, "Is the secretion never present until after an insect has been captured?" In answer I may say that I do not remember of having seen it under other circumstances, and, as I said above, it is always some little time after the insect has been caught before it appears. His second question is, "Whether it is always present after an insect has been secured?" My experience is that if the plant be healthy it is always so. I am speaking of living insects. Is this fluid a real secretion or is it merely the exudation of the juices of the plant which are distinctly acid? There can be no doubt that it is truly a secretion. Its viscid nature would itself prove that the juices must have undergone some change. But I have better evidence, for I tried whether mere pressure would cause this fluid to appear.

(*To be continued.*)

* I have tried some experiments on the upper and lower parts of the attachment of the petiole, and I must own that though they have been far from being quite confirmatory of Dutrochet's view, there was one instance which seemed to support it: a portion of the upper part of the petiole was cut away and some days afterwards on touching the pulvinar the petiole did not descend to the same length as the others did, though from the weakening of the base of the petiole we should have expected it to have gone down further than any of them.

* The name of Professor Dewar is the best guarantee for the accuracy of this analysis.

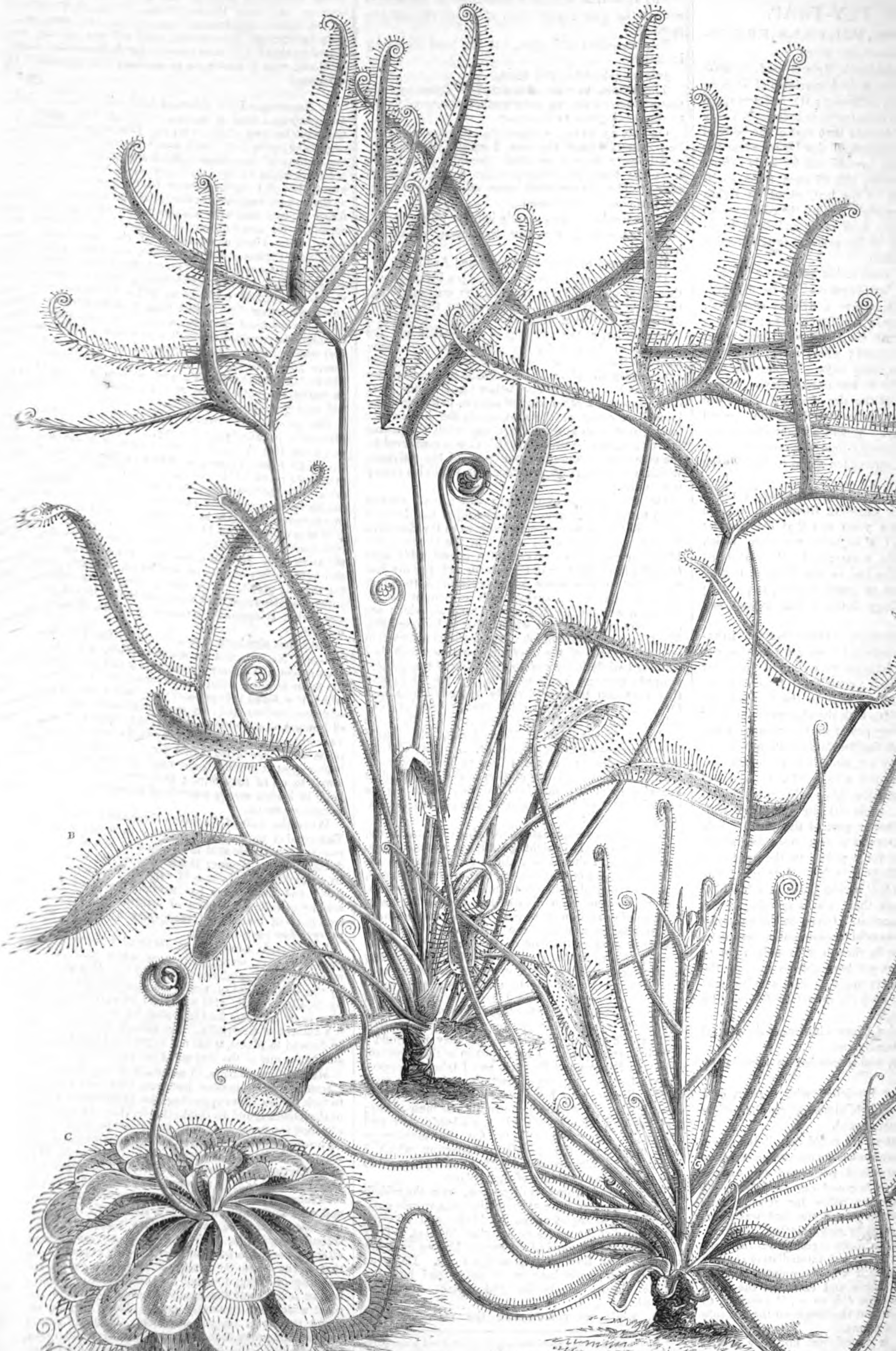

FIG. 20.—GROUP OF DROSERAS AT MESSRS. VEITCH'S.
A, Drosera dichotoma. B, Drosera capensis. C, Drosera spathulata. D, Drosophyllum lusitanicum.

Owing to the kindness of Dr. Hogg, we have recently had a good opportunity of examining this Peach-leaf fungus when in the best possible condition, and we here give a figure of it as seen under the microscope (fig. 29). To make the parasitic fungus at once clear to the mind, we have engraved a single blistered leaf natural size (A), with the fungus at B, which is almost invisible to the unaided eye, and can only be seen with a strong lens as a fine white pulverulent stratum.

Now to get a really good view of this damaging fungus it is necessary to cut an almost inconceivably thin transverse slice out of the lamina of the leaf. It is not every one who can perform this feat to perfection, but practice and perseverance at length overcome all difficulties. At C C is shown one of these extremely

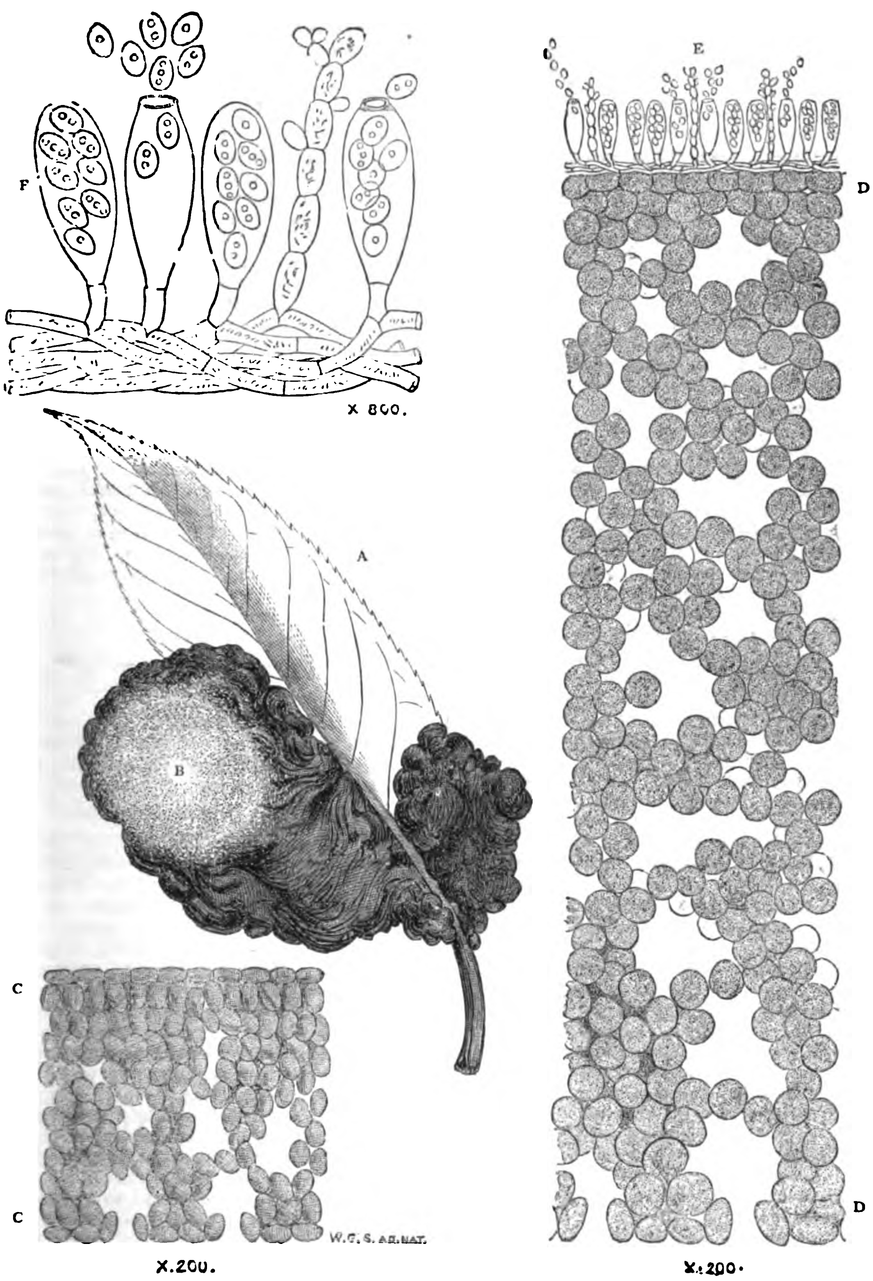

FIG. 29.—PEACH BLISTER AND ITS ACCOMPANYING FUNGUS, ASCOMYCES DEFORMANS, BERK.

thin transverse slices from a part of the leaf where there is no disease, and D D shows a similar section, but cut out of the thick, leathery blister, with the fungus *in situ* on the top. C C and D D show respectively the thickness of the diseased and healthy portions of leaf, and this shows how very small the fungus is in comparison with the thickness of the leaf. The section from the uncontaminated quarter of the leaf needs no comment, but it will be seen at a glance that the whole of the cells in the diseased portion are morbidly enlarged in size and materially increased in number. If our figure had been coloured the cells would all be green in the healthy slice, and corroded to crimson in the diseased one. The fungus is clearly capable of exciting a morbid growth, both in the number and size of the component parts of the leaf.

The fungus Ascomyces belongs to the same order with the large and delicious Morel and the various species of Peziza, some members of the order being amongst the largest of known fungi, whilst Ascomyces is amongst the smallest, and, says Mr. Berkeley, "the lowest form to which the Ascomycetes can be reduced." The white pulverulent stratum, when enlarged to 200 diameters, is seen as shown at E, and consists of a basement of threads from which arise numerous sacs (asci) intermixed with necklace-like organisms, which latter, when broken up, doubtless form a second form of fruit. The true sporidia are contained in the asci, eight in a sac, and this latter membranous receptacle at a certain moment of excitement opens a sort of mouth at the top, and discharges the sporidia into the air, as is shown in the engraving. The sporidia (= spores, or analogues of seeds) are seen to better advantage at F, where they are still further enlarged to 800 diameters, to better show the one, two, or three nuclei with which they are furnished, and which remind the botanist of a similar structure in the sporidia of the genus Propolis. There are various other species of Ascomyces met with in this country on the leaves of the Pear, Walnut, &c., and one on the Continent, with which we are acquainted, which grows upon the leaves and fruit of the Plum. The latter we have not at present seen recorded from this country. *W. G. Smith.*

VENUS' FLY-TRAP.

By THOS. A. G. BALFOUR, M.D., F.R.S.E., F.R.C.P.E.

(*Continued from p.* 103.)

SEPTEMBER 26.—At 3.50 P.M. a portion of litmus was placed on the internal surface of a leaf of Dionæa, on which a piece of flattened wood had been previously firmly pressed, and no change in colour followed. The litmus was then moistened with water and applied as before, but without any change. The moistened litmus was then placed between the two portions of leaf, and these were firmly and strongly compressed by the fingers, and yet the litmus was unchanged in colour.

What secretes it? Ellis long ago stated that the surface of the leaf was studded over with red glands, which secreted what he regarded as sweet fluid, but which we know to be of an acid nature. These glands are among the most beautiful objects in Nature, their graceful symmetry, since the regularity of their cells, and their lovely colour render them most attractive microscopic objects. In some leaves, however, their colour is green and not red. If beauty of form and brilliancy of colour can be appreciated by flies, then we have a sufficient object of attraction for these insects, without having recourse to Ellis' nectar. They are very numerous, being studded over the upper surface of the leaf (excepting a small strip at the base of the marginal spines), and being most abundant and in lines in the immediate neighbourhood of the sensitive hairs. They are somewhat elevated above the surface, and have a dome shape; the larger cells, which have a crenate margin, contain in their interior numerous red rounded cells, which seem to contain the secretion.

That Ellis was right in supposing these to be secreting glands can scarcely be doubted, if we consider their structure and the position which they occupy on the leaf relatively to the fluid which is poured out. But there is an argument from analogy which seems quite legitimate and conclusive, and it is this: in other genera of the same natural order, as, for example, the Droseras, we find that the secretion in their case is effected by glands of a similar colour, and there can be little doubt that these sparkling vegetable rubies have a similar ultimate design, viz., to attract the insects within the reach of the secretion, which is accomplished at once in the case of the Drosera, but only after a time in that of the Dionæa.

This secretion is not poured out needlessly.

The following experiments will afford the best answer to Mr. Murray's first question:—

July 4.—A piece of wood on leaf of Dionæa, a piece of lime on another leaf of same plant, and a piece of iron on yet another.

July 6.—Exactly forty-eight hours afterwards no fluid was secreted in any of these cases.

Even when a fly is shrivelled up, if the secretion be poured out in any quantity whatever it is long delayed, thus—

July 7.—Piece of Fuchsia on Dionæa leaf.

July 8.—Leaf open, and a fly now added.

July 10.—Do., no secretion, closes readily.

July 13.—Fuchsia leaf with white fungus on it; this leaf and the bottom of the leaf of Dionæa are moist; fluid faintly acid.

The mere moisture, the faintly acid character, and the long delay in this particular case, establish the fact of there being no needless waste of the secretion.

But this peculiarity is also manifested in another way, so far as I have seen in one or two instances. The acid secretion after being poured out either changes so as to be much less acid, or the subsequent fluid poured out has only a faint acidity, while that in contact with the insect is intensely so.

Examples.—A Dionæa leaf containing a fly was open on the seventh day, and a great deal of fluid was found, specially at the distal end of the leaf, where the fly was; this was very acid, but fluid at petiolar end only feebly reddened litmus.

What amount of secretion is poured out? This seems to vary according to the creature or substance introduced. If it is a *bonne bouche*, such as a fat spider, or a smooth caterpillar, or a fresh fly, or a piece of raw meat, the secretion seems abundant, but if a shrivelled fly be inclosed there is, as we have already seen, little or no secretion.

We know the old saying about "making our teeth water," which refers to the increased secretion of saliva which is poured out when a choice morsel is before us, or placed in our mouths, or, as French has shown, even when it is introduced into the stomach by a fistulous aperture, without ever being in the mouth. No doubt this also bears a relation to the amount to be digested, for a good spider is not only a tasty article of diet, but contains a large amount of material available for nutrition.

July 24.—At 3.30 P.M., a living spider of large size was inclosed in a large healthy Dionæa leaf.

July 27.—The spider was dead, and was surrounded with fluid, which forms almost a little well near the apex of the leaf. Six tubes* of secretion were withdrawn, and the remaining fluid, which was small in amount, was carefully mopped up. The first two tubes had clear fluid, but the other four had a whitish opalescent appearance (all more or less gummy to the touch), and the fluid was acid in all. The leaf was allowed to close.

July 28.—At 3.30 P.M., spider again surrounded with fluid, and five tubes of secretion were removed, which was somewhat viscid and quite acid, and only slightly opalescent. One of the blades was unfortu-

* The tubes which were used were the medium-sized capillary ones used in vaccination.

nately torn a little in opening it up; the leaf was treated as on the former day.

July 29.—Small amount of fluid to-day, only about a half-tubeful, quite acid, and somewhat viscid.

July 30.—No secretion to-day, either on the spider, which is quite dry, or on the blades of the leaf.

Aug. 1.—There is a damp appearance on spider and leaf to-day, but no accumulation of fluid.

Another experiment was tried on July 25. A living spider of smaller size was put on the leaf of another plant. On July 27, at 4 P.M., it was surrounded with fluid, which was all wiped away, as a whitish semi-fluid substance was found coming from the hinder part of the spider (a similar substance may have caused the opalescence in the former case also). The leaf was allowed to close.

July 28.—One tube of clear fluid was taken away to-day; it was acid. The rest was wiped up.

July 29.—Little fluid to-day; only enough to half fill a tube. It was neutral.

Aug. 1.—There was simply a dampness on spider and on sides of leaf.

Yet another experiment was made with a spider, which in this instance was a very fat one, and apparently in an interesting condition! It was entrapped on July 27, 1874, and on the 28th it was found surrounded with fluid: two tubefuls of this were removed, and the remainder was wiped off.

July 29.—The interior of the spider seems squeezed out, the fluid about it is abundant and quite acid; two and a half tubefuls were taken, which had a reddish colour from contents of spider.

July 30.—The fat spider is much broken down, and a great deal of fluid of a reddish colour (from mixing with contents of spider) was removed. Four tubefuls were taken.

Aug. 1.—Two and a half tubefuls of reddish fluid withdrawn, and the spider was left damp. This experiment, like many others, was abruptly terminated at this date, as the Scottish Alpine Club can brook no delay.

There was one circumstance which I noted on more than one occasion. It was this: that if the meat was not put well down, so as to be near the sensitive hairs, there was little or no secretion. I shall give one example. On July 1, 1874, at 3 P.M., a piece of raw beef, about the size of a bluebottle fly, was brought into contact with the hairs of a leaf of Dionæa; in this case the contraction was rather rapid, and the meat, having been slightly moved, was fixed at the part of the leaf a little below the marginal bristles or spines, and there it was found on July 3, looking dark, dry, and somewhat shrivelled. On that date, however, I pushed it down to the hinge, and in twenty-three hours after it had been pushed down, on separating the blades, the intermediate space was found very full of fluid, and the meat was pale, like veal, and partly digested.

Now, if these observations be proved to hold generally good, it would point to a beautiful relation existing between all the properties already mentioned, viz., irritability, contraction, and secretion, for we must remember that a piece of meat placed near the marginal spines is not in accordance with the natural process, which renders it necessary that the insect should be down in the neighbourhood of the hairs when it is caught, so that no insect would naturally be found in such a position as the beef was, unless the plant were very sickly and closed so slowly that the creature would have time to creep up to that position, but this would indicate in the plant a feeble or unhealthy condition, and, under such circumstances, absence from animal food is usually enjoined.

I come now to speak of the fourth head, which is

4. *Digestion*, or the action of the contraction and secretion in favouring the solution of the animal matter, and preparing a pulp suitable for absorption. If this effect is produced then there can be no question that true digestion has occurred, whether it be in the stomach of a man, or of a beast, or in the leaf of a plant, or in the interior of a glass vessel. No doubt it may be a more complicated process in the one case than in the other, but the essential parts of the process are alike in all, and I cannot see why Mr. Murray should so strenuously oppose the use of the term digestion in the case of Dionæa. Dr. Hooker, I am certain, knew as much about the structure and functions of the human stomach when, by way of illustration, he beautifully compared the action of the Dionæa leaf to it. Mr. Murray cannot suffer this statement to pass; and he asserts that even in this Dr. Hooker "will scarcely deny that, put it any way he likes, the analogy is of the feeblest." And Mr. M. goes on to say, "Would it not be an anomaly in the economy of Nature if a complicated apparatus should be provided to do something which is of no advantage to the plant, and which it seems to be able to do quite well without? Of course there are no flies for the Pinguicula to feed on in winter, and yet it grows as well then as in summer. For three weeks of the time I observed it we had a great deal of rain and the leaves were washed free from all remains of flies, yet the plants seemed to thrive better and better. Drosera was in the same predicament, and I presume Dionæa must be so too." Now in these sentences there are two or three assumptions which it might be well to notice; the first is that "the process is of no use to the plant." He is referring to Pinguicula, but from his concluding sentence, he seems to include Dionæa also. On what grounds does he rest this opinion? Mr. Lindsay, a very intelligent person and a careful observer, informed me that when they used to grow young plants of Dionæa under bell-jars they found that they never throve so well as those which were left free. As regards his remarks about the rain washing off the remains of flies, he seems to forget that where there were "remains" the substance must have gone to feed the plant; and if not entirely gone the rains which swept them away must have favoured their decay and brought them in contact with the roots of the plants, and thus have contributed to the nourishment, for no one, so far as I know, ever asserted that the leaf was the only medium through which the Dionæa was supplied. Surely Mr. Murray must know that though there is such admirable provision in the human mouth, stomach, &c., for receiving food for the nourishment of the body, yet the skin may absorb nutriment, as in the case of baths of milk, but who would assert that the fact of the one doing so precludes the action of the other?

Again, Mr. Murray says, "The entrapped insects do melt away under the influence of the secretion, but no more, I apprehend, than they would do under the influence of any other feeble acid. Now the secretion is slightly acid; not quite so much as the juices of the plant itself, but still slightly so. The juices of most plants are acid." . . . . . "It is not an unnatural assumption that the secretion exuded will participate more or less (less rather than more) in its acidity; and so it does." He then, in reference to the acid juices of plants, exclaims, "Here is a means of dissolution which is applied universally to assist decay; but something more is needed to make digestion. If you apply the litmus paper to the moist or half rotten leaves of Sphagnum or Polytrichum you will find them much more acid than the Pinguicula; but no one will consequently propose to endow them with digestive powers." And, after other remarks, he concludes thus, "I do not believe that had this question not been complicated by the curious machinery of Dionæa, for which it is so difficult to find a purpose, that we should ever have heard of carnivorous plants or digesting vegetables." This argument, if carried out, would apply equally to the acid secretion of the stomachs of men and of the lower animals; for, stated in the broad and general way in which he has put it, we might explain that, as acid is the general agent of decay throughout all Nature, we cannot believe that we should ever have heard of carnivorous beasts or digesting animals if it had not been for the curious machinery found in their bodies. And had we only lived before the structure and functions of the stomach had been so thoroughly investigated we might have boldly asserted that no true digestion did take place in that organ, but only a process similar to that we see around us, whether in the kitchen or in the mill, or throughout all Nature; and we might have fortified our position by an appeal to most eminent authorities, for Hippocrates held that digestion was merely a cooking process; while Borelli, Bœrhaave, and others regarded it as a mere mechanical trituration; while Plistonicus held that it was simply a putrefaction.

But surely, after all, there is a decided difference between the juice of a plant and its secretion. In the Dionæa I grant that the acid character is of about equal intensity in both. In the Drosera dichotoma, however, it is far otherwise, for while the juice is quite acid, the drops of secretion are scarcely, if at all, so. But in both Dionæa and Drosera we find that while the juice is thin and watery, the secretions are gummy and tenacious, which certainly indicates that a great change has been effected by the secreting cells.

Another circumstance indicating digestion is this, that putrefaction does not occur during the whole period, even when we find that the secretion has become only faintly acid. This certainly is not what we should find under ordinary circumstances. Even the Sphagnum is no exception. Mr. Murray is right in saying that it is acid, but he makes a great mistake when he asserts that the disappearance of insects in the Dionæa and Drosera is simply by a process of decay caused by the acid fluid, just as in the case of the Sphagnum. On June 8, 1875, I placed a piece of raw beef in the centre of a considerable amount of Sphagnum, partly green and partly decayed, and again I placed another piece more loosely amongst the leaves of this plant, while, on the other hand, I put a similar piece of raw beef on the leaf of a Dionæa. On June 10, at 6 P.M., the first two pieces were putrid, while the piece in Dionæa had no bad smell whatever.

I could give many illustrations of this, as almost all the ordinary experiments attested it. In order, however, to prove that the mere exclusion of much air and the coolness of the leaf had nothing to do with the absence of decay, I took a piece of meat, and having selected a leaf of Stadmannia australis (which was in the same house with the Dionæa), on July 4, 1874, I got Mr. Lindsay to tie the meat up in the leaf, which was then folded several times. On July 6 the meat had a darkish look and a putrid smell, and on wetting it with water only a very faint red was given to litmus, which indicated that ammonia, one of the earliest products of decomposition of animal matter, had been developed to such an extent as nearly to neutralise the natural acid of the beef. On July 11 the meat was very putrid and quite decayed.

But a more striking instance, inasmuch as it illustrated both processes, was this. Mr. Lindsay had gorged some leaves with raw beef—so great was the quantity given that the meat projected beyond the marginal spines or bristles. This was done on July 4, 1874.

On July 6, on opening one of the leaves, it was found that while the portion of meat beyond the marginal hairs was dark and dry, and had a faintly putrid odour, the portion contained within the leaf was white and had the appearance of having been macerated, and had no apparent putridity, but seemed quite fresh. The meat was now taken from the leaf, and the tainted portion having been cut off from the fresh portion, this latter was put under a wooden box (to keep away flies) to see if the partial digestion which it had undergone would retard decay. This was done on July 6.

July 7.—The tainted meat cut away is much more putrid, while the partially digested meat has no smell.

Another interesting fact is that when meat is partially decayed, if it be put amongst the secretion it will lose its smell.

On July 6 one of the gorged leaves, on which the part projecting gave a very putrid smell, had this portion pushed within the leaf, and on July 8 no putrid smell could be discovered. On opening the leaf there was much acid juice, and the meat was much whiter, but no smell was discoverable.

How is the process carried on, and what is the result? —In answer to these questions I would say, slowly but steadily; and if we select raw beef for observing the changes, we find that it soon loses its red colour, as in the instances just cited, and is gradually disintegrated more and more till ultimately the state of pulp is produced. In one instance, viz., that of a piece of raw beef, about the size of a bluebottle fly, which was introduced on July 1, it was found on July 23 reduced to the state of pulp, quite free from smell.

Ex uno disce omnes.

(*To be continued.*)

Apiary.

Work for August.—Those of our readers who are well up in the management of their stocks, will not need to be told to seek amongst the cottagers in their neighbourhood for condemned stocks. For our own part, and speaking from past experience, we have been most successful in the apiaries which are the pride of many of our farmer's wives. They, in nearly every instance, manage their stocks on the old-fashioned method in small straw skeps, and if not seen in time they invariably destroy them over the brimstone pit. They are, however, very thankful to any one who will save them the trouble and annoyance of this method by driving the bees instead of destroying them by wholesale. The author of the *Manual of Bee-keeping* states—"Driven out bees may often be bought in rural districts at about 1*s.* per lb., and are well worth the money to the advanced apiarian." We have hitherto, by a little courtesy and tact, had no difficulty in securing more condemned stocks than we have been able to find room for, just for the trouble of driving them. We think it would be an insult, or considered as such, if we offered to pay for them in the North of England; they are only too thankful to be saved all trouble, as above stated, and think this abundant recompense for the bees. Nay, in many instances, we have been asked how much they must pay for our labour in coming to take them? We reckon amongst the most happy and enjoyable days we have ever known, our bee-driving expeditions in the autumn, in company with two or three valued friends—one of whom is far from being a total abstainer; in fact, he always returns home singing, and as jolly as possible with the good wine brought out by daughters of our noble yeomen, whom, to say the truth, it is hard to resist. We take with us empty skeps, &c., on an old perambulator, which will hold, maybe, eight or ten stocks when tied on, and return home just in the cool of the evening.

We urgently advise every bee-keeper whose stocks are weak to strengthen them with driven stocks, and then to feed them up liberally before the winter sets in. Every second swarm or cast should be inspected, for these are often worthless as separate colonies, except they are increased with condemned stocks. Looked at even in this light driven bees are exceedingly valuable. Many apiarians believe it is impossible to place condemned stocks in empty hives to make them into good colonies. We say, once for all, try it; nothing can be done without trying. It is sor, Sibthorp, who had been exploring the botany Greece, and collecting the materials published so ıgnificently after his death as the *Flora Græca*. By n the new plant was brought to England, and on pril 1, 1797, it was figured in the *Botanical agazine*. One of Sibthorp's intimate friends was the lebrated Dr. (afterwards Sir J. E.) Smith, founder the Linnæan Society; and what more likely to go him as a present than this delightful and fragrant rub, from the land of the once glorious Incas? In at case, possibly enough, one of the first individuals at grew in England would be cherished by a lady ll living, Lady Smith herself, a "perpetual Rose" in- ed, who on May 12, 1875, attained her 102d year. hat a plant so exquisitely fragrant should inherit the nowned name of Verbena, by a kind of mere botan- ıl accident, is certainly a most curious and interest- g coincidence. The mystic and sacred energy of e old *hiera botanē* seems to react upon itself. If in e ancient times Verbena covered the altars of the ods, to-day it is the cherished inmate of the conser- atory and the boudoir. And not only does it live 'er again in the sweet Peruvian shrub. "Verbena" on a thousand toilette-tables, stored in little scent- ottles. The perfumers' Verbena appears, however, be an oil prepared from one of the fragrant East ıdian Lemon-grasses, probably the Andropogon tratus.

The brilliant scarlet and purple Verbenas, now so rgely employed in the "bedding-out" style of gar- ning (suggested, it always appears to me, by the ıinted visage of the clown in the pantomine), belong the same genus as the two species above-mentioned. npossessed of any of the qualities of the *hiera tanē*, they do good service, nevertheless, in confer- ng upon the old name whatever recommendations may crue from colour. Destiny seems to insist that all theritors of the title shall, in one way or another, ender themselves worthy of it. The first and most howy of the modern Verbenas, the V. chamædri- olia or Melindres, was introduced from Buenos Ayres n 1827, and great was the sensation produced by its plendid scarlet. Within a very few years there fol- owed venosa, incisa, and Tweedieana, and now we ave numbers of hybrids in addition. The grand ppearance of the scarlet Verbenas upon the plains f their native countries is said to be unimaginable. There they are "bedded-out" by Nature, or after ıe same artless and unsophisticated way in which in ld England she displays the Bluebell and the wood nemone. The spectacle no doubt is delightful to ne's ideas of taste, in which is always involved the uality of repose, as contrasted with what startles, ut it is a very different thing to have flowers disposed fter patterns that Nature never dreamed of, and vould abolish in a twelvemonth were she emancipated. None of these extra-European Verbenas, of course, ıave any claim to the name of "Vervain;" that belongs exclusively to the realms of fable, and to the little wayside herb which in the mediæval times became accredited so widely with a reputation it never deserved. Though insignificant, it is not to be despised, for it serves at all events to link the present to the past, and make "former times shake hands with latter," always a very pleasing form of useful- ness. Those who may happen to be unacquainted with the V. officinalis may learn its complexion from a capital life-size coloured drawing in Curtis' *Flora Londinensis*, vol. i., pl. 41. *Leo Grindon, Man- chester.*

VENUS' FLY-TRAP.

By Thos. A. G. Balfour, M.D., F.R.S.E., F.R.C.P.E.

(Concluded from p. 138.)

I have been speaking of healthy plants, in which all the functions were normally discharged; but we have pathological as well as physiological conditions to consider, and unfortunately many of these conditions are induced by imperfect digestion, owing to artificial feeding, and hence dyspepsia in different forms is not uncommon. Some articles of diet are peculiarly diffi- cult of digestion, and ought never to be indulged in by a Dionæa: such is cheese; hard boiled albumen they can digest pretty well, but this coagulated and com- pressed casein they cannot manage. Mr. Canby lost one of his patients among the Dionæas by ordering it a diet of cheese, and my own experience is equally painful.

On July 8, 1874, I had eleven patients under my care at one time, and to one of these a diet of cheese was prescribed. After Mr. Canby's experience I felt anxious about him, and watched him carefully.

On July 9 the entry in my note-book is "Leaf healthy and quite closed except at farthest point, where it is open about one-eighth of an inch, and lets out a clear acid fluid smelling of cheese." This vomiting evidently indicated considerable irritation, and the smell of cheese which attended the ejected fluid showed clearly that that substance had not yet been digested. However, as he had a healthy look and a firm grasp, I was not so alarmed.

My next note is a short one, on July 10, 12 noon:—"Leaf closed, not injured." The vomiting had apparently ceased, which, with the general appear- ance, was re-assuring.

July 11, 3 P.M.—Much the same as yesterday.

At 4 P.M., on July 13, he was still quite healthy and firmly closed.

July 14.—Much as previously.

On July 15 I had so little time that I scarcely saw my patient.

July 16 contains notes of the other patients, but his case is omitted, probably from being much *in statu quo*.

On July 18, 4.15 P.M., the short notice is, "Cheese closed," which means that he had still considerable muscular power remaining.

July 20, 3.30 P.M.—Same note.

But on July 21 my alarm was excited, for though the muscular power was good, yet biliary disturbance was indicated, for the note is to the following effect: "Still closed, but yellowish on blades, and two lashes of a dark colour." These symptoms were unmistakably serious, and, as I suppose I had formed the worst prognosis of the case, I had prudently withdrawn. I find no further attendance marked. This was on the thirteenth day.

Nothing is more injurious than overloading the stomach, and hence the common advice is "Not to cram like John Bull." I had generally been very particular in the amount which I had prescribed, but on one occasion after I had left, Mr. Lindsay had, in defiance of all proper dietetic rules, gorged four fine healthy Dionæa leaves to such an extent that on the following day, July 6, I was horrified at finding some of the beef still sticking out of the mouths of three of them. In the case of one of these I promptly applied a remedy by pulling the meat out of its throat by my fingers, and thus saving it from threatened suffocation—the mouth immediately closed, and all danger was at an end, as I find on July 13 the note—"Leaf still closed by the lashes crossing, but the blades are slightly separated."

On that date, however, a nasty jaundiced appear- ance manifested itself in the other three patients, who had been left to retain the excessive amount of beef. Digestion in their cases was very seriously impaired, as offensive eructations testified.

I shall give the notes. July 13.—The three surfeited ones are quite closed (this is now the ninth day after the gorging), but have a dingy yellow and unhealthy look, which applies also to the upper part of the petiole. On opening one of them the meat is about one-eighth of an inch from the edges, and fluid abounds which has now only a faint acid re-action; but there is a slightly tainted smell about the meat, which seems to be considerably digested."

On opening another leaf, the meat seemed less digested, but it was lower down, and there was scarcely any perceptible smell. Fluid here was also faintly acid. On the blades of these two leaves there are slight darkish brown discolorations on the out- sides.

On opening the third leaf a part of the meat was dark and projecting between the margins. Here there was a more putrid smell. The fluid was faintly acid. This leaf has a shrivelled look outside, and also a slight discoloration here and there on the blade.

I have continuous notes to July 28, which I need not give *in extenso*; suffice it to say that one of them was in a pitiable condition and was executed on the 24th. One of the remaining two had by that date recovered wonderfully, the whole meat having been dissolved, and his breath being quite sweet; while the other had only partially recovered, there being still a faint smell like that of old meat perceptible in his breath.

July 28 has the note "As before."

The capacity of their stomachs is not large, two flies being apparently sufficient to satisfy them, if given in succession; but a surfeit is extremely danger- ous, for, though they may sometimes escape a fatal issue, they may suffer long and severely from stomach complaint.

All their diseases, however, are not owing to im- proper diet, but when the general health is impaired the secretion is not poured out in sufficient amount to digest the food, as the following example will show:—A yellowish looking leaf, which, if we had been living in the days when the doctrine of signatures was prevalent, would certainly have been prescribed as an infallible cure to any one suffering from hepatic de- rangement; this leaf, I say, was selected, and a small beetle enclosed within it. On opening it afterwards the leaf was found dry, and so was the beetle, but on pressing the beetle slightly a good deal of fluid was forced out of it, indicating that in consequence of the ill-health of the leaf there had been no power of secreting fluid, and hence the contents of the be[illegible] had not been removed.

Amount capable of being digested.—As I have already said, two good flies or two spiders seem to be all that the Dionæa leaf can digest with comfort, to itself at least, for some time. Now, if we multiply these by the number of the leaves, we shall find the amount of food which, by its foliar stomach at least, a plant of Dionæa can digest. The leaves are, on an average, about six to each plant, so that if all the leaves were equally successful in their capture we should have a dozen of flies as the amount of food devoured by the leaves.

I shall give an example of how much one leaf digested. On June 30, 1874, a Dionæa with four or five leaves, within one of which, at least, a fly had previously been enclosed, was chosen, and on a fresh leaf a spider of good size was made to crawl and was immediately entrapped. On July 13 the remains of the spider were removed, and seemed to be a mere shell. On placing these under the microscope the legs seemed nearly transparent; there was one portion opaque and dark, but on pressing it firmly nothing came out. On this, the thirteenth day, another spider was placed on the same leaf, and was somewhat languidly entrapped. On August 1 the leaf was almost open (*i.e.*, on the nineteenth day), and the remains of this spider, which were of small amount, were removed, and now it was found that the leaf would not close on irritation by another spider, or by the blade of a knife, or by touching it with the finger.

5. *Absorption, including Assimilation.*—Duchartre objected to this idea of absorption on the ground that it was not in accordance with our knowledge of the functions of leaves, and to the whole course of the nutrition of vegetables, and therefore was not to be seriously entertained. This argument reminds one of the miserably fallacious arguments against miracles by Hume. It is in both cases a mere *petitio principii*. All plants are not constituted like the Dionæa, and if it has such a peculiarity in structure why should it not have a similar one in function?

Other objectors may say, True, the insect is digested and reduced to a semi-fluid pulp, but this is simply for the purpose of allowing it to run down the chan- nelled petiole, and so of reaching the absorbent roots of the plant. Mr. Canby at one time thought that such was the case, but he afterwards discovered his mistake.

Two answers may be given to the above objection.

1. In a healthy Dionæa, where the natural food of the plant has been taken and in the normal amount, no fluid does run down the petiole. Three flies were placed on three leaves of Dionæa, and pieces of lit- mus were attached to the petioles on Sept. 26, and on Sept. 28, at 4 P.M., the litmus was not in the least degree reddened. On Sept. 29 the same, and so on Oct. 1 and Oct. 3, and yet on this latter date one of the leaves was opened and a considerable quantity of fluid of an acid nature was found. This was on the seventh day.

The second is that the leaf is found quite dry on the surface, with only the slightest indication, if even that, of remains, and if we open the leaf from time to time we can see the process of change going on, and the gradual diminution of the amount.

Example, piece of raw meat on leaf of Dionæa on July 1. On July 18 there seemed very little difference on the external appearance from what had been noticed on the 4th, when it was pale, like veal, and partially digested; but on the 23d the beef was found in a soft thin pulp and in small bulk. On the 24th almost all gone, and on the 25th small thin dry flakes are all that remain.

In this case the whole process of digestion and absorption took twenty-four days, but the absorption seemed to go on at a much more rapid rate towards the end.

The first answer proves that there was no escape from the leaf, and the second declares that after a certain time nothing, or next to nothing, was found in the leaf; and if these considerations do not shut us up to the conclusion that absorption had taken place, I fear we must have an equally great difficulty in establishing the fact of absorption by the roots of plants, or by the lacteals and lymphatics of animals.

I understand that some one has asserted that the disappearance of the food is not owing to absorption, but to its being devoured by Bacteria and Vibrios. Well, if these be, as Professor Lister supposes, vege- table and not animal bodies, we may as well believe in the digestion and absorption by the larger plants as by the smaller ones; but we must remember that these minute bodies are now generally regarded as the cause of decomposition, with its attendant noxious gases, but, as we have seen in a normal case of diges- tion in the Dionæa, we have none of these present.

How is absorption effected? I cannot as yet say. I tried the following experiment to discover it, but I failed, in consequence of the vital elective power of the absorbent cells or vessels. On July 16, 1874, I put insects and beef, which I had stained red or blue by steeping them in a solution of cochineal or in one of sulphate of indigo, and I hoped that by the colours in the cells I might be able to trace the course of the absorbed material; but these colours were pressed out from between the leaves, and entirely disappointed my expectations. On examining the surface of the leaf of a Dionæa you find two sets of stomata, the one set presenting the usual appearance, with two or four cells surrounding the opening. These are found on both sides of the leaf, though, as is usually the case, much more abundantly on the lower side than on the upper. The other set are of a brownish colour, and are peculiar, inasmuch as, in addition to the central cells, there are from five to eight peristomatic cells, which are of such delicate structure that they fold upon themselves with the utmost ease. These seem confined to the lower side of the leaf. Bearing in mind, then, these two kinds of stomata, let us next direct our attention again to the beautiful red glands to which we referred in speaking of secretion, and if we examine them very carefully by the microscope we occasionally see in the centre of the cells, and apparently connected with them, bodies presenting an appearance not unlike stomata, and it has struck me that probably these are the mouths of absorbent ducts. When we consider the double supply of stomata which this plant possesses we can hardly doubt that all the ordinary functions of such organs are well discharged by them, and is it not reasonable to suppose that these other bodies placed in the immediate vicinity of the pulp, formed by the contents of the secreting cells, are intended for absorbing that substance and so rendering it available for the nutrition of the plant?

BERKFIELD LODGE, SUFFOLK,

The Residence of E. Packard, Esq.

This place is situate about a mile and a half south of the important town of Ipswich, at an elevation of some 300 feet above the level of the beautiful River Orwell. The house is built with the famous Woolpit brick, and is a very neat and elegant structure. The front has a light open verandah that adds much to the beauty and comfort of the building, and from which a magnificent view, extending some 10 miles down the Orwell, is obtained. This view embraces the whole of the highly picturesque banks of this beautiful river, including portions of the well-wooded parks forming part of the estates of Wherstead, Woolverstone, and Nacton. The grounds surrounding the house are very park-like and well-wooded, shutting out from view the near-lying town of Ipswich.

The conservatory is a neat, light iron structure adjoining the house, from which it is entered by passing through the billiard-room. Tacsonias, Cobæas, and other creepers are trained loosely over the roof, from which they are allowed to festoon in a natural way. The centre of the house is formed into a single bed, edged with stone, round which a pathway is carried. A neat staging is carried round the other side of the walk, over the pipes, on which Caladiums, Dracænas, Achimenes, and such-like plants are arranged, and where they show to great advantage. The main group in the middle of the house is tastefully arranged by placing three thriving young Tree Ferns equidistant down the centre of the bed, and the remaining space is filled in with handsome specimens of Allamandas, Bougainvillea glabra, Crotons, Ericas, Dracophyllums, Caladiums, and other choice plants that have graced the exhibition tents of several of the local shows. Among the above, fine specimens of greenhouse and hardy Ferns are interspersed, together with a few Palms, giving the whole an imposing and pleasing effect.

The plant-houses, vineries, &c., form a compact range along one side of the kitchen garden, and have been recently erected, together with the conservatory, by Mr. Dennis of Chelmsford. Like many of the more modern houses for plant and fruit growing these appear to have too much glass and too little framework, thereby letting in an excessive flood of light and sunshine, that soon sends up the heat of the houses to a very high pitch unless shading is used to counteract it. It becomes a serious question therefore whether hothouse builders are not carrying this sort of thing too far, and whether it would not be better either to use heavier framework with sash-bars closer together, or, in case of metallic roofs, only such glass as Hartley's rough plate, or some other answering the same purposes. The centre house of this range is raised considerably above the others, and is used for plant growing for exhibition purposes, and to supply the conservatory. This house contains a lot of choice useful things, which under the care of Mr. Rose are fast making valuable plants. The selection appears to have been made with much care, and contains among others such things as Cocos Weddelliana —a perfect gem among Palms, Hyophorbe Verschaffeltii, Areca sapida, Latania rubra, Euterpe edulis, Dracæna Shepherdi and Guilfoylei, two very beautiful varieties that contrast well with their red-leaved congeners. Among Caladiums Prince Albert Edward was most conspicuous. This is one of the handsomest of Caladiums, having richly marked leaves in the way of Meyerbeer or Belleymei, but with leaf-stalks stout and stiff, more resembling an Alocasia. All who grow Caladiums should have a plant of Prince Albert Edward. Young plants of the beautiful Davallia Mooreana were also in thriving condition. This, too, when of large size, is a grand thing for exhibition purposes. Some well-grown plants of Croton interruptum, pictum, and angustifolium having richly-coloured leaves were very effective. Plenty of light, without actual sunshine, on both these and Dracænas appears what is most requisite to bring out their lovely rich leaf-markings to perfection. The vineries are arranged on each side of the centre or plant-house, and the Cucumber and Melon houses are at the extreme end of these. The Vines are making good strong rods, although the foliage shows signs of suffering somewhat from excess of light and heat. Zonal Pelargoniums and sappy plants of that class are just at home in such structures, as those here abundantly testify, the whole of them looking remarkably healthy, and exceedingly floriferous. The Cucumber-house was filled with Telegraph and Douglas' "Tender and True," the latter evidently an improved variety of the former.

Suffolk is noted for its Cucumbers, many of the old standard varieties having originated in the county, but out of about thirty odd brace at the Ipswich show "Tender and True," grown by Mr. Rose in this house, carried off the prize. Those who wish to grow handsome Cucumbers of good quality should not lose sight of the above. The back wall of this Cucumber-house is being covered with plants of Echites splendens and Stephanotis floribunda, that will soon afford a good supply of bloom for cutting.

Melons are covering an immense surface of trellis, and with such ample foliage and full exposure cannot fail to produce fruit of superior quality.

Behind this range is a nice useful house, having a north aspect, for standing plants when in bloom or for retarding the same; and houses so situate are perhaps the most useful of all a gardener can have.

Mr. Packard, the spirited proprietor, appears to take great interest in gardening, and it is encouraging to those connected with horticulture to find that as old exhibitors drop off others step in and take their places; and thus may it always be to the end. *J. S.*

FRUITS OF ALGERIA.

(*Concluded from* p. 136.)

The limits of the Tell and Sahara are determined by their produce. There are, however, transitional regions, where the Date and the ear of Wheat equally ripen; there are others which produce neither, and these being unenclosed and unfit for culture, belong to the Sahara. The natives distinguish the zones in their characteristic manner: the country where corn is the rule they call the Tell, the country where corn is the exception the Sahara. Upon the limits of the Sahara there are doubtful districts where the valleys produce in their lower parts Dates, Capsicums, Chilies, and grains, and places where pasture is intermixed, or others where there are immense ungrateful steppes. The vegetation in the northern part is nearly the same as in the south of Spain, Provence, and Italy, and most of the fruits common in Europe are to be found in Algeria. The Apple, Plum, Apricot, and Cherry stock the orchards and gardens as they do in England. The Vine is cultivated to advantage, the stems are very large, and the bunches of Grapes enormous; these ripen at the end of July, and are eaten fresh and dry by the natives, who seldom make wine, although this process will most likely be attempted with success by such admirable Vine growers as the French.

The Fig, which forms a considerable part of the food of the Arab, possesses an historic interest. The finest in the North of Africa come from Scherschell, whence they are sent to Algiers, Constantine, Tunis, &c. In the province of Oran there is one part of the Atlas Mountains famous for the quantity and delicacy of its Figs, resembling those that the elder Cato praised when he threw them down in the Senate, saying, "The country where this fine fruit grows is only three days' voyage from Rome," and then he uttered the doom of Carthage in that well-known phrase, "Mihi quoque videtur Carthaginem delendam esse." On the northern slopes of the Atlas, at an elevation of 2000 feet, Oranges grow mixed with the Aloe and Cactus. Both the Citron and Orange trees are remarkably fine, and their fruit is considered as good as those of Portugal, Malta, and Candia. Near Blidah there were some beautiful groves which have been cut down and burnt since the arrival of the French, to strike terror into the natives, and thus to insure the new reign of order.

The wild Pomegranates grow in such profusion that their fruit, when perfectly ripe, is sold at six for a halfpenny, and all descriptions of fruit are cheap, although prices have doubled since the foreign occupation. Gardens, fields, and houses near the metropolis are fenced in with hedges of Cactus and Agaves. The Cactus produces the Barbary Fig, which is eaten by the Arabs during six months in the year. The stems, stript of their numerous thorns, and cut into pieces, are eaten by the poor when vegetables are scarce. The shoots, when planted, will sometimes take root. Of the leaf of the Agave they make a kind of paper, and the fibres are used as a thread for weaving into cords. The Palma christi, which yields castor-oil, the sugar-cane, Cotton-tree, Cactus without thorns, Madder, Flax and Alhenna grow wild. The latter is a beautiful odoriferous plant, 10 or 12 feet high, bears small flower with a pleasant smell like camphor. The leaves of this plant, dried and powdered, are used by all African women as a cosmetic, being preferable to the bullock's dung with which the Gallas smear and adorn themselves in Abyssinia. The Palma-christi reaches its full height of 16 or 20 feet in one year.

The inhabitants are found to differ in character with the varying features of the country—there are the sun-burnt plains where the Palm tree flourishes, and the traveller makes his way painfully ankle-deep in the sands, under the scorching sun, or again amongst the airy heights of the Atlas, where the vultures and eagles soar and scream around him by hundreds. The Saharian is strong, active, and clever, a believer in labour, whilst the Tellian is lazy and awkward. The knowledge of the solar months, though necessary in agriculture, is less spread in the Tell than in the Sahara. In the Tell the Marabouts give the signal for tilling and harvest. In the Sahara, where the labour is more individual, each proprietor regulates himself the order of his work. The Sahara contains a great many towns and villages, whose construction does not imply any great skill, but much more than a tent, the usual dwelling of the Tellians, excepting the mountaineers of Kabylia who live in houses. The Tellian only knows his neighbour, the Saharian is a great traveller. The Kabyles inhabit a wild kind of Switzerland, and carry on a deadly feud with the Arabs, who have been their conquerors, and against whom they have a hereditary hatred. The Arab is hospitable, but with ostentation; whilst amongst the Kabyles the stranger is always well-treated, whatever may be his origin. They have a generous custom, that when the fruits, such as Figs, Grapes, &c., begin to ripen, the chiefs publish a decree that no one, during fourteen or fifteen days, under pain of a penalty, shall touch any of the fruit on the trees. At the expiration of the time fixed the proprietors assemble in the mosque, and swear on the holy books that the command has not been violated. He who cannot take the oath pays the fine. The poor of the tribe are then consulted; they make out a list, and each proprietor by turn feeds them till the fruit season is passed. The same thing takes place during the Bean season, this plant being much cultivated by the Kabyles. At these periods every stranger may enter the gardens and eat as much as will satisfy him; but he must not take away anything with him, for a theft is doubly culpable on these occasions, and might cost him his life.

The markets, where fruits and produce are disposed of, have been described by Marshal Castellane in a manner that furnishes us with an insight into Arab life. In Africa markets are not only places of sale but bazaars of news, and the whole population, Arab and Kabyle, frequent them. On market days, breaking their repose and silence, multitudes of Kabyles and Arabs were seen trooping in from all sides to the little magazine-port of Khamis, built like many other such belonging to the French in Algeria. They came from the mountains and the valleys, from every path, some driving sheep, others horned cattle, many carrying loads of corn, Beans, fruits, wool, or manufactured stuffs, but all armed, and many with their muskets only, or that knotty stick, one blow of which can break the hardest heads. Jews, with dirty turbans, drive in their half-starved mules, displaying their goods at the spot pointed out by the Caid and police, and erecting a little tent of bad cotton to guard them from pillage. The first hours were usually devoted to business. The butchers skinned the sheep they had killed, uttering *bis-millahs*, and suspended the flesh to little Fir trees, whose branches served as skewers; cattle dealers were standing near their beasts, awaiting purchasers; the corn and Bean merchants were shouting and quarrelling about a halfpenny; but the noisiest of all was the Jew. The first hours and business over, the hum of men increases. The groups thicken, the state of affairs is canvassed—sometimes general politics, at others disputes between tribes. Envoys of the Emir gliding in among these groups used to fan the flame of rebellion at the market of Khamis, and the religious fraternities of the *zaouias* exchanged the messages confided to their fanaticism. *E. T. B.*