XXVIII. *Observations upon the natural Laws which govern the Production of Double Flowers, arising out of a remarkable Case of Præternatural Formation in the Flowers of an* Amaryllis. *By Mr.* John Lindley, *F.L.S., &c. &c. Assistant Secretary for the Garden.*

Read December 6, 1825.

In September last, some dried roots of a plant called the Double Barbadoes Lily were, with several other things, sent to the Horticultural Society by Mr. John Herbert, Superintendent of the Botanic Garden St. Vincent's, by the desire of His Excellency Sir Charles Brisbane, the Governor of that Island. Upon blossoming last month in the stove, the Lily proved to be a variety of *Amaryllis crocata*, in which so considerable an alteration of the parts of fructification had taken place, as to produce a very handsome double flower. It is not however for the purpose of bringing into notice this particular variety, which has not now been introduced for the first time, that I submit the following observations, but for the sake of recording one of the most singular instances of præternatural formation with which I am acquainted in the vegetable kingdom, and which appears to me to confirm an opinion I have for some time entertained, respecting the laws which regulate the production of double flowers.

It is well known that the cause of that kind of monstrosity which is commonly called a double flower, is either the mul-

tiplication or the transformation of the various organs which envelope the ovarium, or even of the ovarium itself; but I am not aware that it has been shewn that actual changes of structure are subject to the influence of certain fixed laws, from which it rarely happens that any considerable deviation takes place. It has indeed been stated by Sir JAMES EDWARD SMITH,* that the change of form in the various parts of a flower takes place backwards, but the question has been so cursorily treated in the work referred to, that I am induced to make some additional remarks upon the subject.

It is well understood that the universal principle upon which perfect vegetables are formed, is by the continual addition of parts one above the other, round a common axis which is produced by their accretion. This law is not confined to the production of foliage or branches only, but must be considered to extend to the ultimate point of vegetable developement in the ovarium; and seems to indicate that the progress of nature is continually onwards. Unless, therefore, it could be shewn that the order of alteration in the structure of organs so produced is in monstrous formations reversed, it would be a reasonable inference that nature follows her usual course in transformation, as well as in original production, and that the changes which particular portions of a flower may undergo, always have the character of that series which is placed next them in the inside, and not of that on the outside. The consequence of the prevalence of such a law would therefore be this with respect to the formation of double flowers, that bracteæ, if present, would change into

* Introduction to Botany, Edit. 5, page 220.

calyx, calyx into petals, petals into stamens, and stamens into ovaries; and that the reverse of that order could not take place. Alterations indeed of another kind may happen, such as changes in the appearance of stamens, occasioned by abortion; but such metamorphoses are to be considered imperfect attempts on the part of particular organs to revert to their primitive forms, and are analogous to the alterations of the ovarium, which I shall have presently occasion to notice, but they do not affect the present question, which concerns only the law of transformation of one organ into another organ.

I am not ignorant that the common belief upon this subject may be against the opinion I venture to entertain; I am aware that the usual explanation of the cause of the monstrous multiplication of the parts of a flower is the conversion of stamens into petals, and that, as I have already stated, a Botanist of high consideration has recently expressed his opinion, that such changes take-place backwards, or in an inverse order to that of first developement. But, if the common explanation were admitted with respect to these alterations, it would not be easy to shew the cause of the greater beauty of double than of single flowers, because the inevitable consequence of a reversed order of transformation would be, that the rich or delicate colour of the petals, upon which all flowers depend for their beauty, would be converted into the uniform green of the calyx. Such a change, therefore, instead of producing a flower more beautiful than its original, would tend to destroy its beauty.

But if the true order of alteration be such as I have described, if it takes place upwards, or, speaking more plainly,

from the circumference to the centre, and if the different organs of fructification are only susceptible of being converted into those which are next between them and the axis of inflorescence, and if no retrograde action takes place, the reason of the superior beauty of double flowers will be obvious. In the latter case, the calyx may indeed throw off its dull green colour, and assume the vivid hues of the petals, as in the Pæony and Primrose, and the petals may dilate themselves, and in attempting to perform the functions of stamens may multiply and transform themselves in the transition into an hundred curious and grotesque appearances; but no diminution of beauty, or loss of brilliant colours will take place. It would also, I think, be reasonable to conclude, in the absence of more satisfactory evidence, that a given organ would in its transformation bear a more perceptible resemblance to that from which it was changed, than to that towards which its form was altering. Now it is obvious to every observer, that in double flowers the metamorphosis which takes place between the petals and stamens bears a far greater resemblance to the former than to the latter.

Independently however of these considerations, an attention to the nature of the alterations which take place in the centre of double flowers appears to me to prove that it is impossible that any retrograde action can influence the præternatural alteration of the parts of fructification. If we examine the various double flowers with which our gardens are enlivened, we shall find that the ovarium either continues to maintain its original form, notwithstanding any changes which may take place around it, or, that it is altogether

abortive, or, that it at once reverts to the state of a leaf, thus assuming the original simple form of which it would in its perfect state be a modification: as happens in what are termed proliferous flowers; but I am not aware that any example exists of the ovarium ever indicating the smallest disposition to become a stamen, or to retrograde; if altered, it either becomes abortive, or reverts to its primitive type; as in the double Cherry mentioned* by Sir JAMES EDWARD SMITH, in which the ovary had changed to a leaf of the ordinary appearance.

The contrary of this, namely the change of stamens into ovarium, in which the progressive action takes place, must be familiar to the recollection of many. The curious case of the Common Wall-flower (Cheiranthus Cheiri) in certain individuals of which the stamens constantly undergo this alteration, is one instance; that of the House-leek (Sempervivum tectorum) the anthers of which are frequently filled with ovula instead of pollen, affords another, and the double Barbadoes Lily, the subject of this communication, is a new instance.

Of this plant the petals were in the usual position and state, except that at their points of union at the base, was a slight tendency to distortion. Inside of them were nine other petals, quite similar to the exterior, and like them united at the base in an irregularly imbricated way. These I consider to be merely supernumerary petals, no tendency to an alteration of form being perceptible in them. Next these in the inside were nine other petal-like leaves, which were

* Introduction to Botany, Edit. 5, page 220.

much distorted and frequently halved down the middle, having a more or less perfect indication of an anther on either side. Here then the multiplication was bringing on transformation, and exhibiting in an obvious manner an attempt on the part of the multiplied petals to assume the functions of stamens by the formation of a polliniferous receptacle. Upon one of the most interior of the transformed petals above the unguis, I observed the presence of that glandular fringed process, which in the perfect flower is placed at the orifice of the tube of the corolla; where it forms a sort of annular excrescence. This fact alone might, even if unattended by any other evidence, be considered conclusive that the conversion, which was operating, was of the petals into stamens. Among the petaloid bodies were intermixed four unhealthy stamens, bearing anthers of the natural form, their filaments being neither petaloid, nor altered in any material degree from their usual appearance, except being shorter than common. The place of the ovarium was occupied by a deformed subulate process, much shorter than the petals, and cucullate at the lower end, where it enwrapped two other smaller appendages. In the usual situation no trace whatever could be perceived of ovula, but upon a more careful examination, I discovered three different places at the base of the innermost staminoid petals, where ovula were produced in sufficient abundance. In two cases the ovula proceeded from the edge of the body to which they were attached, and in the other case, two only appeared from a point which I did not discover to be marginal with respect to any organ. In the latter instance the ovula were collateral, in the others

they were imbricated vertically in a single row, as is represented in the accompanying magnified figure of a portion of the lower part of the flower.

From this description it appears that the male organs were converted partially into female, by the addition of ovula to their base, and that the ovaria themselves indicated no disposition to assume the functions of males, but were nearly obliterated.

This and other circumstances have therefore led me to conclude, as has been already stated, that the same laws which govern the production of the various organs of vegetation, exercise an undeviating influence upon their transformation also; that the latter consequently proceeds upwards in the order of developement, or from circumference to centre, and that the popular opinion held upon this subject is not

founded upon a just consideration of all the facts connected with metamorphosis.

That exceptions to this law may exist, although unknown to me, I am prepared to anticipate, for no attentive observer of nature can be ignorant of the singular caprice which it is her privilege to exercise, or of those frequent anomalies which shew how incomprehensible are her operations, and how little the human mind is capable of understanding her mysterious workings; but I think it may be affirmed that the principle above laid down is that by which she is guided in the great mass of her creations of this kind.

Before I conclude, I wish, in order to prevent misconception of my meaning, to observe, that the changes in the parts of a flower which take place either by mulplication, or transformation, or abortion of particular organs, are altogether of another nature from those which happen in Compositæ, where impletion is only apparent, and in which the metamorphoses depend upon laws of a different kind.