CHAPTER VIII.

LINEAR SERIES—*continued.* MAMMÆ.

SOME of the phenomena of Meristic Variation are well seen in the case of mammæ[1], and especially in the modes by which increase in the number of these organs takes place.

The facts regarding these variations in Man have so often been collected that it is scarcely necessary to detail them again. For our present purposes it will be sufficient to give a recapitulation of the chief observations in so far as they illustrate the phenomena of Variation.

The most important collections of the evidence on this subject are those of PUECH[2], LEICHTENSTERN[3], and WILLIAMS[4], from whose papers references to all cases recorded up to 1890 may be obtained. Besides these, BRUCE[5] has given a valuable account of a considerable number of new cases together with measurements and statistical particulars. These accounts contain almost all that is known on the subject but additional reference will be made to original authorities in a few special cases.

In Man supernumerary mammæ or nipples nearly always occur on the front of the trunk, being usually placed at points on two imaginary lines drawn from the normal nipples, converging in the direction of the pubes. These lines may thus be spoken of as the "*Mammary lines.*" It is with reference to supernumerary mammæ occurring on these lines that the subject of mammary variations is chiefly important to the study of Meristic Variation. In addition to these, however, there are a few well authenticated examples of mammæ placed in parts of the body other than the mammary lines and of these some mention must be made hereafter.

[1] It will be understood that facts as to variations consisting in absence of mammæ or nipples and other such changes do not come within the scope of this volume, but belong rather to the province of Substantive Variation.

[2] PUECH, *Les Mamelles et leurs anomalies*, Paris, 1876.

[3] LEICHTENSTERN, *Virch. Arch. f. path. Anat. u. Phys.*, 1878, LXXIII. p. 222. This collection was apparently made independently from that of PUECH.

[4] WILLIAMS, W. ROGER, *Jour. Anat. Phys.*, 1891, XXV. p. 225.

[5] BRUCE, J. MITCHELL, *Jour. Anat. Phys.*, 1879, XIII. p. 425.

In the great majority of cases (over 90 per cent., LEICHTENSTERN[1]) of mammæ placed on the mammary lines, the supernumerary structures are *below* the normal ones, being then as a rule *internal* to them, while those found *above* the normal mammæ are less common and are external to the normal mammæ. The distance separating the normal from the supernumerary mammæ differs greatly in different cases, and most conditions have been seen intermediate between a stage in which the nipple is bifid, and that in which completely separate supernumerary mammæ are presented. It is of consequence to observe that there appears to be no case in which a supernumerary mamma is so large as the normal mamma of the same individual.

The degree to which supernumerary structures of this nature are developed is very various. They may be fully formed mammæ with nipples, in the female capable of function; while in other cases, on the contrary, they may either consist of nipples only, having no distinguished glandular tissue of mammary character in connexion with them, or they may be tumours of mammary character without nipples or even definite ducts. Between these several conditions there is no sharp distinction. It appears therefore that there are *two* rudimentary or imperfect conditions possible: either supernumerary nipples without recognizable mammary glands, shading off into small warty elevations of uncertain character, and on the other hand redundant portions of mammary gland without nipples. The latter may be partially connected with the normal mammæ or quite separate from them. All these states of imperfection are much more common than the complete supernumerary mammæ.

Fully formed supernumerary mammæ have been found above the normal mammæ and also below them, the latter being the more frequent position. For those found on the mammary lines the axilla is the highest position and the upper part of the abdominal wall the lowest. Of the rudimentary forms, the mammary tumours without nipples occur usually if not always above and external to the normal mammæ, being generally in or near the axilla. The supernumerary nipples however are in the great majority of cases below and internal to the normal ones.

Small supernumerary nipples are quite common in Man, but the statistics of different observers give various results. Bruce found in 2311 females 14 cases (·605 per cent.), and in 1645 males 47 cases (2·857 per cent.). These persons were patients at the Brompton Hospital for Consumption and were not specially examined with a view to this inquiry. Among 315 such persons examined for the purposes of these statistics, 24 cases were seen (7·6 per cent.), 19 being male and 5 female. In 8 cases two extra nipples were present, and one doubtful case of three extra nipples

[1] Not including mammary tumours without nipples in the axillæ.

was seen. Bruce regards 7·6 as for various reasons rather too high a proportion. In a recent paper BARDELEBEN however states that among 2736 recruits examined with regard to supernumerary nipples, 637 cases (23·3 per cent.) were seen, 219 being on right side, 248 on left side, and 170 on both sides. The discrepancy between these statistics no doubt arises through want of agreement as to the inclusion of cases in which the extra nipples are very rudimentary.

It seems to be clearly shewn that the abnormality is commoner in men than in women, and there is some evidence that it is more frequent on the left side than on the right (BRUCE, LEICHTENSTERN and BARDELEBEN). It is also well established that supernumerary nipples are much more commonly present as single than as paired structures, and that when paired they are by no means always at the same level on the two sides. Cases of the presence of supernumerary mammæ as paired structures symmetrically placed are nevertheless sufficiently numerous. Organs of this nature may also occur simultaneously on the same side of the body at different levels. For example in one of LEICHTENSTERN'S cases, a small secreting supernumerary mamma with a nipple was present in the left axilla, while there was also another supernumerary nipple on the lower border of the left breast. The greatest number of supernumerary nipples occurred in a case described by NEUGEBAUER[1], represented in Fig. 29. In this patient there were on each side three supernumerary nipples above the normal ones, and

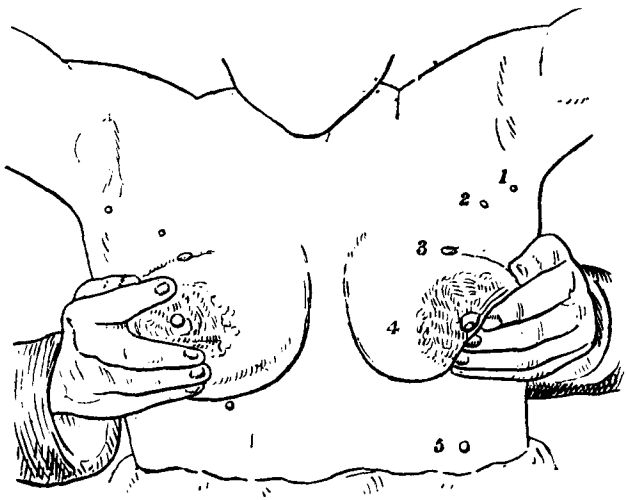

FIG. 29. Diagram of a case of four pairs of supernumerary nipples in human female. The normal breasts raised to shew the lowest pair. (After NEUGEBAUER.)

[1] NEUGEBAUER, F. L., *Centralb. f. Gynäk.*, 1886, p. 729.

one on each side below them. The latter were concealed by the pendent breasts. When the child was being suckled milk oozed from each of the uppermost or axillary nipples, but from the remaining six supernumerary nipples milk could only be extracted by pressure. The flowing of milk from supernumerary nipples when the child is at the normal breasts, has often been observed.

A few references to cases exhibiting the several features above mentioned may be of use.

149. Bifid nipple, the same on each breast [plane of division not specified]. DUVAL, *Du Mamelon et de son auréole*, Paris 1861, p. 90.

150. Two nipples on the same areola, bilaterally symmetrical. The two nipples stood in the mammary line defined above. TIEDEMANN, *Ztsch. f. Physiol.*, v., 1833, p. 110, Taf. I. fig. 3.

151. Cases are given by CHARCOT and LE GENDRE, *Gaz. méd. de Paris*, 1859, p. 773, in which an extra nipple was placed *external* to the normal one on the same breast. In one of these the extra nipple had no areola. Leichtenstern (p. 253) in quoting these cases, speaks of them as instances of supernumerary nipples on the same level as the normal ones, but this is not expressly stated in the original account, which does not, as I think, exclude the possibility that the supernumerary nipples were *above* and external to the normal ones. Two functional nipples with separate areolæ on the left breast, which nevertheless was not larger than that of the right side, *ibid.* The same authors mention another case in which such a second nipple had no areola; the mother of patient stated to have been the same. See also SINÉTY, *Gaz. méd. de Paris*, 1887, p. 317 (full description and measurements). In this case the supernumerary nipple was placed below the normal one.

152. A case in which three nipples were placed on each breast is given by PAULLINUS, *Miscell. Curios.*, &c., 1687, Decur. ii. Ann. v. *Append.* p. 40. The case is given on the authority of PRACKEL and the three nipples are said to have been arranged in an equilateral triangle, the normal being above at the apex, and the two others at the same level below. The description and the figure accompanying it do not however justify complete confidence in this observation, and indeed the contributions of Paullinus to the *Miscellanea Curiosa* contain so much of the marvellous that they should not be accepted without hesitation. The same may be said of the case of *five* nipples each having an areola quoted by PERCY and LAURENT, *Dict. Sci. méd.*, XXXIV. p. 517, *s. v.* "*Multimamme.*" The authority for this case is a letter of Hannæus to Borrichius, dated 1675. I have not found any observation of this class of abnormality later than the seventeenth century, but it is of course quite possible that cases may occur in which the nipples are distributed on the breast otherwise than along the mammary lines.

153. Supernumerary mamma with nipple in axilla, LEICHTENSTERN, p. 245, and others.

154. Supernumerary mamma above and external to the normal ones. Numerous cases; see especially case of two bilaterally symmetrical mammæ in this position, SHANNON, *Dubl. Med. Jour.*, 1848, v. p. 266, *fig.* [figure repeated by AHLFELD, WILLIAMS &c.]; also similar case, QUINQUAUD, *Rev. photogr. des hôp.*, 1870, p. 19.

155. Supernumerary mammæ below and internal to normal ones: numerous cases, see LEICHTENSTERN, &c. In nearly all these the

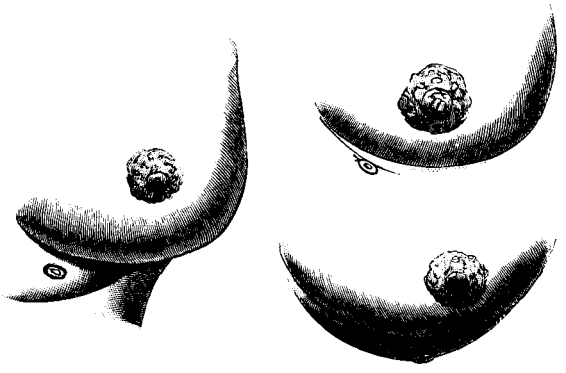

FIG. 30. Supernumerary nipples and mammæ of different sizes in human female. (After BRUCE.)

supernumerary organs are close to the normal mammæ. A few examples of such structures on the upper part of the abdominal wall are known, *e.g.*, TARNIER in his edition of CAZEAUX, *Traité de l'art des Accouchements*, 1870, ed. 8, p. 86. In the male several such cases are recorded, *e.g.*, BRUCE, *J. Anat. Phys.*, XIII. 1879, p. 446, *Pl.* Examples of this kind in the female are shewn in Fig. 30 (after Bruce) and in the male in Fig. 31 (after Leichtenstern).

156. Mammary tumours in the axilla are described by CHAMPNEYS, *Med. Chir. Trans.*, 1886, LXIX. p. 419, as of common occurrence in lying-in women. These structures are of various sizes and without any nipple, pore, or duct. The secretion was obtained by squeezing the lump and oozed through the skin at the situations of the sebaceous follicles. In this manner both colostrum and milk were obtained, following each other as in the normal mammæ. Similar observations in single cases have been made by many writers.

157. Redundant mammary tissue of this kind connected with, and thus forming an axillary extension of the normal mammæ, CAMERON, *Jour. Anat. Phys.*, 1879, XIII. p. 149; also NOTTA, *Arch. de Tocologie*, 1882, p. 108.

*158. *Two pairs* of supernumerary mammæ below the normal ones, DE MORTILLET, *Bull. Soc. d'Anthrop.*, 1883, Sér. 3, VI. p. 458. An

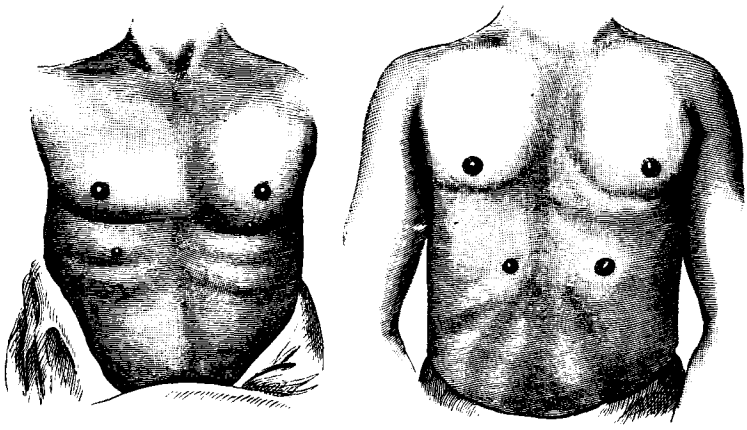

FIG. 31. Supernumerary mammæ in the male, symmetrical and asymmetrical. (After LEICHTENSTERN.)

important case of a man having two pairs of supernumerary mammæ on the mammary lines. There was a gradual diminution in size from the highest to the lowest, the latter being a little above the level of the umbilicus. Each pair was at the same level.

*159. *Four pairs* of supernumerary nipples (ten in all) are recorded only in NEUGEBAUER'S patient, already mentioned. Three of the supernumerary pairs were above the normal ones, and the other pair below them. As seen in Fig. 29 the nipples of each pair did not stand in the case of each pair at precisely the same levels, and between those of the lowest pair there was a considerable difference of level, that on the left side being at some distance below the normal breast, while that on the right side was on its lower border.

In a few cases the supernumerary nipple is described as having been perpendicularly below the normal one, and it is likely that such cases must be looked on as exceptions to the general rule that the mammary lines converge posteriorly; but it is not impossible that even in some of them the supernumerary nipple might have been found to be rather nearer the middle line if this point had been specially inquired into.

The foregoing examples are given as selected illustrations of the several facts, and for full lists of cases the reader is referred to the works already mentioned.

160. Of supernumerary mammæ placed in parts of the body other than the mammary line some mention must be made, though those of them

that are authentic have no close bearing on the subject of Meristic Variation. There are firstly two often quoted cases[1] in the *Miscellanea Curiosa* in which mammæ are said to have been present on the back, but as has already been remarked, many of the stories told in this collection are clearly fabulous, and this is especially true of the contributions of Paullinus. Both these records are given at second hand and the first case (Paullinus) is said to have been seen in 1564, more than a hundred years before the date of the account. Helbig's accounts of things seen by himself are generally trustworthy, but in this case he is only repeating what was told to him by a Polish noble about a woman seen in Celebes. There are no modern cases on record. There is however indisputable evidence of the presence of a mammary gland on the thigh (especially ROBERT's case; for references to several accounts of this see Leichtenstern, p. 255); on the cheek, BARTH, *Arch. f. path. Anat. u. Phys.*, 188, p. 569; on the acromion, KLOB, *Ztsch. f. K. K. Ges. d. Aerzte in Wien*, 1858, p. 815; in the labium majus, HARTUNG, *Ueb. einen Fall von Mamma Accessoria*, Inaug. Diss., Erlangen, 1875. In the two last cases the mammary nature of the gland was proved by microscopic examination. In Barth's case of a mamma on the cheek the microscopical investigation did not give a certain result (*q. v.*).

As Leichtenstern shewed, the case of *inguinal* mamma, mentioned by Darwin and others, really related to Robert's case of a femoral mamma. In 1885, however, BLANCHARD (*Bull. Soc. d'Anthrop.*, 1885, p. 230) stated that TESTUT had lately seen such a case and was about to publish an account of it, but this has not yet appeared (1892).

Most writers on the subject have accepted cases of supernumerary mamma placed *anteriorly in the middle line*. These are given by PERCY and LAURENT, *Dict. Sci. méd.*, XXXIV., 1819, on the authority of several different persons. One case was seen by themselves (p. 526), and in it the third mamma stood below and between the other, forming a triangle with them. In another case given on the authority of GORRÉ there are said to have been a pair of extra mammæ below the normal ones, and a fifth between the supernumeraries. In view of the fact that many paired organs may by Variation occur compounded in the middle line, there is nothing incredible in these accounts, nevertheless there is, so far as I know, no recent observation of such an occurrence in the case of mammæ, and with the one exception (which is very briefly described), the accounts given are at second hand[2]. It is moreover not clear that the words used "*au-dessous et au milieu des deux autres*" do not mean simply below and *between* the other two. The case contributed by Gorré is nevertheless given in great detail and cannot lightly be set aside.

Before speaking of the bearing of these facts on morphological conceptions it is necessary to refer to some of the phenomena of

[1] PAULLINUS, *Miscell. Curios.*, &c., Dec. ii., Ann. IV. 1686, p. 203, *Appendix*, giving a case said to have been seen in 1564; also OTTO HELBIG, *ibid.*, Dec. i., Ann. IX. and X., pubd. 1693, p. 456.

[2] Williams (p. 235) quotes BARTELS, *Arch. f. Anat.*, 1872, p. 306, as alluding to such a case, but I do not think that the passage is meant to convey this meaning.

mammary Variation in other mammals. In connexion with the case of Man it may be mentioned that supernumerary mamma below and internal to the normal ones has been seen in *Macacus* and in *Cercopithecus patas*, SUTTON. J. B., *Intern. Jour. of Med. Sci.*, 1889, XCVII. pp. 252 and 253; in the Orang-utan, OWEN, *Comp. Anat.*, iii. p. 780. In many mammals the number of the mammæ is very inconstant even within the limits of species and from the facts seen in such cases deductions may be drawn which are at once instructive as to the nature of mammary Variation and have an application to the morphology of Meristic Series in general. Of these I shall give examples taken from three species.

*161. The first is that of the cow's udder. Normally the cow has four teats of about equal size. Not unfrequently there are six teats, of which four are large and may be said in the usual parlance to be the "normal" ones, and two are small and placed posteriorly to the others. A case of this kind is shewn in Fig. 32, II. Commonly these extra teats give no milk, but in many cases they have been known to do so. Their size and position vary greatly; sometimes they are placed near the other teats as shewn in the figure, but I have seen them very high up, almost in the fold between the udder and the thighs.

Very frequently, however, there is only one extra teat making five in all, such an extra teat being so far as I know, always on

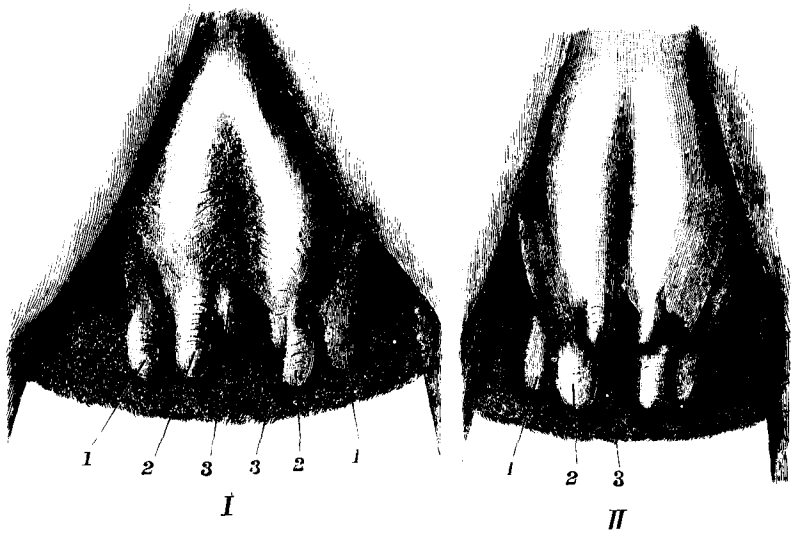

FIG. 32. Supernumerary teats in two heifers. I. The third teat is completely separate on the left side, but on the right side is united with the second. (The cleft between the two is incorrectly represented as a sharp line; there was no such sharp line of demarcation; the skin being very slightly depressed in this place.) II. Teats of the third pair both completely separate.

*162. one side of the udder. The sketch given in Fig. 32, I. was taken from a heifer having an arrangement intermediate between the condition with four teats and that with six. As the figure shews, on the left side there were three complete teats but on the right side the third teat was incompletely separated from the second. This third teat was joined to the second for its whole length but had a separate pore. The animal which belonged to the St John's College Dairy Farm was unfortunately sold before the first calf was born, so I had no opportunity of seeing whether milk was given by both these teats. The significance of such a case will afterwards appear.

In many mammals, such as the pig, rabbits, cats and dogs, the mammæ are distributed in two mammary lines along the ventral surface. The number of the mammæ in such cases is notoriously variable, and in some respects this variation is interesting and has a bearing on questions of the nature of Meristic Repetition. If a number of such animals be examined it will be found that as a rule there are the same number of glands on the two sides, and that they are arranged in pairs, those of each pair standing at the same level or nearly so. Nevertheless departures from this arrangement are very frequent. Individuals are in the first place commonly found with a different number of mammæ on the two sides, and in such cases it is interesting to observe that together with the difference in the number of mammæ on the two sides

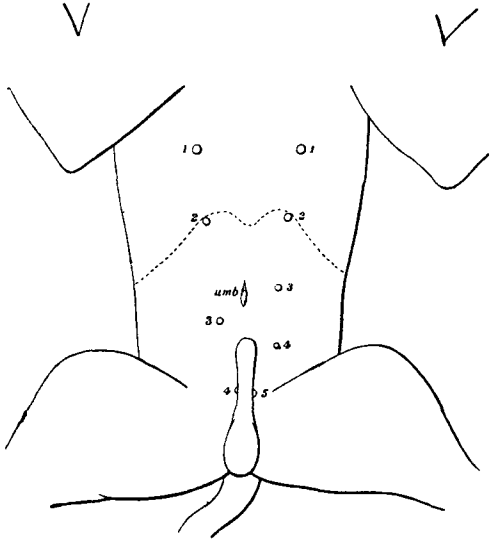

FIG. 33. Diagram of nipples in a male Bull-dog. On right side, four; on left, five; the two anterior and two posterior being almost at the same levels. *umb.* umbilicus. The dotted line shews the outline of the thorax.

there is generally if not always a disturbance in the paired arrange-
*163. ment. A simple case of this kind occurring in the dog is represented in Fig. 33. The animal is a male bulldog lately in my possession. On the right side there are four nipples, while on the left there are five. The most anterior on each side stand almost at the same level on the thorax. The second on each side are almost at the same distance below them, that on the left side being $\frac{1}{4}$ in. higher. Similarly the most posterior nipples stand on each side at almost exactly the same level on the sheath of the penis, the total length from the first to the last nipple on each side being practically the same. On the left however there are *two* nipples placed between the second and the last, but on the right there is only one. This one nipple stands at a level not far from the middle between the 3rd and 4th of the other side, making as it were a complement to or balance with them.

*164. Thirty-five young pigs examined with regard to these questions gave the following results. They belonged to five litters (30 pure-bred Tamworths; 5 cross-bred, out of Berkshire sow, sire unknown). These pigs were all quite young, about a fortnight old, and consequently there was no displacement due to functional development of the glands.

MAMMÆ.

	Right.	Left.		Pigs.
A.	6	6	regularly arranged in pairs	3
B.	7	7	ditto	10
C.	7	7	ditto 5th rudimentary	1
D.	8	8	ditto 4th rudimentary	3
E.	7	8	all paired exc. l. 4th rudimentary	2
F.	7	8	l. 4th rudimentary, l. 3rd and 5th displaced	1
G.	7	8	rt. 2nd balances l. 2nd and 3rd	1
H.	8	7	l. 2nd balances rt. 2nd and 3rd	1
I.	8	7	l. 3rd balances rt. 3rd and 4th	1
K.	6	7	rt. 1st balances l. 1st and 2nd	1
L.	6	7	l. 2nd rudimentary l. 1st and 3rd displaced	1
M.	6	7	all paired exc. l. 4th rudimentary	1
N.	7	7	altogether irregular	4
O.	6	6	ditto	2
P.	7	6	ditto	1
Q.	7	8	ditto	1
R.	8	7	ditto	1
			Total	35

The animals in groups D and E, except one of the latter, belonged to the same litter. In them a small rudimentary nipple stood between the 3rd and 5th, but the latter were not spaced out for it, being no further apart than any of the others. The measure-

ments of the distances between the nipples on one side in one of these cases were, in inches, $1\frac{1}{16}$, 1, $\frac{7}{16}$, $\frac{7}{16}$, $\frac{14}{16}$, $\frac{13}{16}$, $\frac{15}{16}$, the rudimentary nipple standing $\frac{7}{16}$ in. from either of its neighbours. In the D

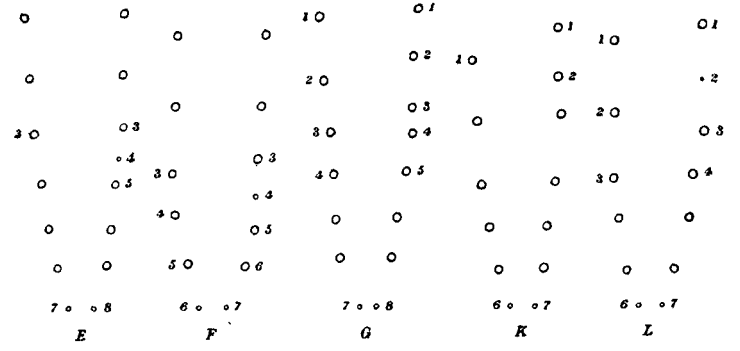

FIG. 34. Diagrams of nipples in very young pigs. Letters refer to groups in No. 164.

group this was found on both sides, but in the E group on one side only, as in the figure (Fig. 34).

Comment on foregoing evidence.

On looking at a series of cases like those roughly illustrated in the diagrams, one is tempted to inquire as to the factors which determine the positions of these mammæ and nipples. Though such an inquiry must lead to small definite results it may not be unprofitable to point out some deductions which may be made from the facts. I take this opportunity as a good one for illustrating the position here adopted with respect to the theory of Reversion, and for discussing certain features of the phenomena of Division.

The mammary glands form an example of a class of Meristic organs which are distributed in series along a body already segmented, but whose positions have no obvious coincidence with the fundamental segmentation. In the case of the pig, for instance, it would doubtless be found that the mammæ bear more or less definite relations to particular vertebræ, but they are not limited to such positions as the ribs or spinal nerves must be. The segmentation of the mammæ is thus a segmentation, or serial arrangement, superadded upon that of the vertebræ. The question to be considered is, what determines the points at which mammæ are to be formed?

In the paper to which reference has been made, WILLIAMS has contended for the view that each somite bore originally a pair of mammæ; and we may remark that if this were so the problem of the segmentation of the mammæ would be the same as that of the

general segmentation of the trunk. The same author then argues that the appearance of supernumerary nipples or mammæ along the mammary lines is a reversion to an ancestral condition, and a figure is given, shewing the places at which mammæ are on this view believed to have been placed, definite ordinal numbers being assigned to each. Against this suggestion may be urged those objections to appeals to the hypothesis of reversion which were mentioned in the Introduction (Section XII.), but in addition to these there are a number of objections applying specially in the case of mammary Variation. The view that supernumerary mammæ are reversions rests on the frequency and definiteness with which they occupy certain positions. But though they do occur more often in some positions than in others they are in no sense limited to these positions, for they may stand anywhere, at least upon the mammary lines. To justify the view that the positions of supernumerary mammæ are definite it is necessary to exclude the cases of bifid nipple, of multiple nipples on the same breast, and of axillary extensions of the mammæ, all which phenomena would then be looked on as belonging to a class different from that of actual supernumerary mammæ. In the argument referred to, this course is actually adopted. The acceptance of such a view leads to great difficulty. For example, in Neugebauer's case (see Fig. 29), Williams considers that the posterior nipples of the two sides belong to different pairs, and have consequently different homologies, because they stand at different levels.

Such distinctions are, I believe, unreal. It is surely impossible to suppose that the Repetition seen in the udders of the two cows in Fig. 32 is a phenomenon different in the two cases. In the one there are two extra teats in symmetrical positions, equally spaced out from the second teats; in the other there is a third teat on one side and a double second or posterior teat on the other. Surely it is clear that the double condition of this teat represents an imperfect phase of a process perfected on the other side. If further proof were needed it may be found in the fact already mentioned, that the mammæ of the pig and other such animals, may be the same in number even on the two sides, but nevertheless stand quite irregularly and without any visible arrangement into pairs.

The existence of these cases in which no order of form or regularity can be traced may seem at first sight to be an insuperable objection to any attempt at the detection of principles in the arrangement of the mammæ. There is however the fact that many, and indeed in most forms the majority of individuals do shew an orderly and paired arrangement, and the further fact that of those cases which depart from this, a certain number present appearances which suggest that this departure has come about in a regular way. Though the irregular cases remain, something would be gained if we could comprehend any of the elements on which the regularity depends. The case of regularity and symmetry, in a

sense, includes the cases of irregularity. The difficulty is to understand the causes of regularity and of symmetry; but if we could be sure of these it would not be hard to conceive disturbances resulting in irregularity.

In the pigs are found, first, cases of six on both sides in pairs, and also of seven on both sides in pairs; besides these there were cases of 6—7 and of 7—8. Of these there were some in which two on one side stood in positions which geometrically balanced that of one of the other side, the others being arranged in pairs. In such cases the appearances suggest that there has been a division of one mamma to form two, and that the two have then separated or travelled apart. The division of organs into two is of course a common occurrence, and may naturally be supposed to be a phenomenon of the same nature as the division of single cells. The case of mammæ is perhaps instructive inasmuch as it bears witness to the fact that such division must take place at a remotely early period in development. For while in cases to be given hereafter of division, for example, between teeth, it may be supposed that the travelling apart of the two resulting teeth is mechanical, in the sense that the two growing teeth may simply push apart from each other just as two cartilage-cells, &c., may separate by the concentric deposition of material, the separation cannot be supposed to occur in the mammæ by these *late* changes, but the process of mechanical separation, though the same in kind as that in the case of teeth, must be conceived as beginning early in the history of segmentation.

At this point a circumstance, very often to be seen in other cases, should be mentioned. When an organ, single on one side, corresponds geometrically with two organs on the other side, each of the latter is frequently of the same size and developed to a like extent as the single one of the other side. This of course would be expected on the hypothesis that the division of organs is a phenomenon similar to the division of cells, that is to say, not merely a *division*, but a *reproduction*.

But the supposition of division of single members of the series is not sufficient to account for all the facts of Variation seen. We have to consider not only the case in which one organ of one side balances two of the other. We have to deal also with the cases of six on each side and seven on each side all corresponding in pairs. In these there is no indication that there has been a division of a single member on each side. The spacing is regular in each case and there is no obvious crowding at any part of the series. Even if therefore in the former case there is a suggestion that the germs of single mammæ have divided into two at a period of development after the series of mammæ was constituted as a series, there is no such suggestion in the present case. We must, I think, in the latter suppose that the existences of all the mammæ, whether

six or seven, are *determined together*. How or at what stage such determination is made, there is no direct evidence to shew.

The various arrangements seen suggest then that the relative positions occupied by the mammæ depend partly on the number that are present, and that the position of each mamma is to some extent dependent on the position of other mammæ, especially of its neighbours. In this connexion the cases F and L are interesting ones (Fig. 34). In L for example, the 1st on the left is at a higher level than the 1st on the right. It is succeeded by a rudimentary 2nd having none on the same level on the other side. The left 3rd is behind the right 2nd, but posterior to this point the nipples are approximately paired. These appearances suggest that the displacement of the 1st and 3rd on the left are in some way connected with the presence of the rudimentary left 2nd. Similarly in F the left 3rd and 5th are spaced out for the rudimentary 4th. From its position and small size it might fairly be supposed that this is a "supernumerary" organ, for at all events it is visibly different from the others: but in the case of seven on each side in pairs, no one mamma rather than another can be pointed out as obviously supernumerary when compared with a similar series of six. It seems therefore that of the factors determining the relative positions of the mammæ along the mammary lines, the number of the mammæ is one, and that the positions of the mammæ are in some way and to a limited extent correlated with each other. That there are other factors at work, also, is sufficiently shown by the existence of cases of apparently utter irregularity.

In seeking to go beyond this and inquire as to the way in which this correlation is brought about there is, in the present state of knowledge of the mechanics of Division, not much to be gained. Reference may be made to recent observations published in abstract by O. SCHULTZE[1]. According to him there is in young embryos of several mammals (Pig 1·5 cm. long; Rabbit 13—14 days, &c.) a ridge running along the *dorso-lateral* aspect on each side and at points upon this the mammæ and nipples are eventually formed. (The formation of the true nipples is preceded by the raising of the epidermis into small elevations, "primitive teats," which afterwards disappear.) The two mammary lines are by subsequent changes and growth of the body brought into the ventro-lateral position. The question of the position of the mammæ therefore resolves itself into this: what determines the positions at which mammary centres, to borrow the word used in the case of bone, are to be formed on the mammary lines? In a subsequent place I shall contend that the facts given are only intelligible on the view that the forces determining the points of growth of mammæ are compounded into one system of forces. But to the question what are these forces there is no answer.

[1] O. SCHULTZE, *Anat. Anz.*, 1892, VII. p. 265, since published in full (*Verh. d. phys.-med. Ges. zu Würzburg*, XXVI. 1893, p. 171, *Pls.*).