CHAPTER III.

ORGANIC STABILITY.

Incipient Structure.—Filial relation.—Stable Forms.—Subordinate positions of Stability.—Model.—Stability of Sports.—Infertility of mixed Types.—Evolution not by minute steps only.

Incipient Structure.—The total heritage of each man must include a greater variety of material than was utilised in forming his personal structure. The existence in some latent form of an unused portion is proved by his power, already alluded to, of transmitting ancestral characters that he did not personally exhibit. Therefore the organised structure of each individual should be viewed as the fulfilment of only one out of an indefinite number of mutually exclusive possibilities. His structure is the coherent and more or less stable development of what is no more than an imperfect sample of a large variety of elements.

The precise conditions under which each several element or particle (whatever may be its nature) finds its way into the sample are, it is needless to repeat, unknown, but we may provisionally classify them under one or other of the following three categories, as they

apparently exhaust all reasonable possibilities: first, that in which each element selects its most suitable immediate neighbourhood, in accordance with the guiding idea in Darwin's theory of Pangenesis; secondly, that of more or less general co-ordination of the influences exerted on each element, not only by its immediate neighbours, but by many or most of the others as well; finally, that of accident or chance, under which name a group of agencies are to be comprehended, diverse in character and alike only in the fact that their influence on the settlement of each particle was not immediately directed towards that end. In philosophical language we say that such agencies are not purposive, or that they are not teleological; in popular language they are called accidents or chances.

Filial Relation.—A conviction that inheritance is mainly particulate and much influenced by chance, greatly affects our idea of kinship and makes us consider the parental and filial relation to be curiously circuitous. It appears that there is no direct hereditary relation between the personal parents and the personal child, except perhaps through little-known channels of secondary importance, but that the main line of hereditary connection unites the sets of elements out of which the personal parents had been evolved with the set out of which the personal child was evolved. The main line may be rudely likened to the chain of a necklace, and the personalities to pendants attached to its links. We are unable to see the particles and

watch their grouping, and we know nothing directly about them, but we may gain some idea of the various possible results by noting the differences between the brothers in any large fraternity (as will be done further on with much minuteness), whose total heritages must have been much alike, but whose personal structures are often very dissimilar. This is why it is so important in hereditary inquiry to deal with fraternities rather than with individuals, and with large fraternities rather than small ones. We ought, for example, to compare the group containing both parents and all the uncles and aunts, with that containing all the children. The relative weight to be assigned to the uncles and aunts is a question of detail to be discussed in its proper place further on (see Chap. XI.)

Stable Forms.—The changes in the substance of the newly-fertilised ova of all animals, of which more is annually becoming known,[1] indicate segregations as well as aggregations, and it is reasonable to suppose that repulsions concur with affinities in producing them. We know nothing as yet of the nature of these affinities and repulsions, but we may expect them to act in great numbers and on all sides in a space of three dimensions, just as the personal likings and dis-

[1] A valuable memoir on the state of our knowledge of these matters up to the end of 1887 is published in Vol. XIX. of the *Proceedings of the Philosophical Society of Glasgow*, and reprinted under the title of *The Modern Cell Theory, and Theories as to the Physiological Basis of Heredity*, by Prof. John Gray McKendrick, M.D., F.R.S., &c. (R. Anderson, Glasgow, 1888.)

likings of each individual insect in a flying swarm may be supposed to determine the position that he occupies in it. Every particle must have many immediate neighbours. Even a sphere surrounded by other spheres of equal sizes, like a cannon-ball in the middle of a heap, when they are piled in the most compact form, is in actual contact with no less than twelve others. We may therefore feel assured that the particles which are still unfixed must be affected by very numerous influences acting from all sides and varying with slight changes of place, and that they may occupy many positions of temporary and unsteady equilibrium, and be subject to repeated unsettlement, before they finally assume the positions in which they severally remain at rest.

The whimsical effects of chance in producing stable results are common enough. Tangled strings variously twitched, soon get themselves into tight knots. Rubbish thrown down a sink is pretty sure in time to choke the pipe; no one bit may be so large as its bore, but several bits in their numerous chance encounters will at length so come into collision as to wedge themselves into a sort of arch across the tube, and effectually plug it. Many years ago there was a fall of large stones from the ruinous walls of Kenilworth Castle. Three of them, if I recollect rightly, or possibly four, fell into a very peculiar arrangement, and bridged the interval between the jambs of an old window. There they stuck fast, showing clearly against the sky. The oddity of the structure attracted continual attention, and its stability was much commented on. These hanging stones, as

they were called, remained quite firm for many years; at length a storm shook them down.

In every congregation of mutually reacting elements, some characteristic groupings are usually recognised that have become familiar through their frequent recurrence and partial persistence. Being less evanescent than other combinations, they may be regarded as temporarily Stable Forms. No demonstration is needed to show that their number must be greatly smaller than that of all the possible combinations of the same elements. I will briefly give as great a diversity of instances as I can think of, taken from Governments, Crowds, Landscapes, and even from Cookery, and shall afterwards draw some illustrations from Mechanical Inventions, to illustrate what is meant by characteristic and stable groupings. From some of them it will also be gathered that secondary and other orders of stability exist besides the primary ones.

In Governments, the primary varieties of stable forms are very few in number, being such as autocracies, constitutional monarchies, oligarchies, or republics. The secondary forms are far more numerous; still it is hard to meet with an instance of one that cannot be pretty closely paralleled by another. A curious evidence of the small variety of possible governments is to be found in the constitutions of the governing bodies of the Scientific Societies of London and the Provinces, which are numerous and independent. Their development seems to follow a single course that has many stages,

and invariably tends to establish the following staff of officers: President, vice-Presidents, a Council, Honorary Secretaries, a paid Secretary, Trustees, and a Treasurer. As Britons are not unfrequently servile to rank, some seek a purely ornamental Patron as well.

Every variety of Crowd has its own characteristic features. At a national pageant, an evening party, a race-course, a marriage, or a funeral, the groupings in each case recur so habitually that it sometimes appears to me as if time had no existence, and that the ceremony in which I am taking part is identical with others at which I had been present one year, ten years, twenty years, or any other time ago.

The frequent combination of the same features in Landscape Scenery, justifies the use of such expressions as "true to nature," when applied to a pictorial composition or to the descriptions of a novel writer. The experiences of travel in one part of the world may curiously resemble those in another. Thus the military expedition by boats up the Nile was planned from experiences gained on the Red River of North America, and was carried out with the aid of Canadian *voyageurs*. The snow mountains all over the world present the same peculiar difficulties to the climber, so that Swiss experiences and in many cases Swiss guides have been used for the exploration of the Himalayas, the Caucasus, the lofty mountains of New Zealand, the Andes, and Greenland. Whenever the general conditions of a new country resemble our own, we recognise characteristic and familiar features at every turn, whether we

are walking by the brookside, along the seashore, in the woods, or on the hills.

Even in Cookery it seems difficult to invent a new and good dish, though the current recipes are few, and the proportions of the flour, sugar, butter, eggs, &c., used in making them might be indefinitely varied and be still eatable. I consulted cookery books to learn the facts authoritatively, and found the following passage: "I have constantly kept in view the leading principles of this work, namely, to give in these domestic recipes *the most exact quantities.* . . . I maintain that one cannot be too careful; it is the only way to put an end to those approximations and doubts which will beset the steps of the inexperienced, and which account for so many people eating indifferent meals at home."[1]

It is the triteness of these experiences that makes the most varied life monotonous after a time, and many old men as well as Solomon have frequent occasion to lament that there is nothing new under the sun.

The object of these diverse illustrations is to impress the meaning I wish to convey, by the phrase of stable forms or groupings, which, however uncertain it may be in outline, is perfectly distinct in substance.

Every one of the meanings that have been attached by writers to the vague but convenient word "type" has for its central idea the existence of a limited number

[1] *The Royal Cookery Book.* By Jules Gouffé, Chef de Cuisine of the Paris Jockey Club; translated by Alphonse Gouffé, Head Pastry Cook to H.M. the Queen. Sampson Low. 1869. Introduction, p. 9.

of frequently recurrent forms. The word etymologically compares these forms to the identical medals that may be struck by one or other of a set of dies. The central idea on which the phrase "stable forms" is based is of the same kind, while the phrase further accounts for their origin, vaguely it may be, but still significantly, by showing that though we know little or nothing of details, the result of organic groupings is analogous to much that we notice elsewhere on every side.

Subordinate positions of Stability.—Of course there are different degrees of stability. If the same structural form recurs in successively descending generations, its stability must be great, otherwise it could not have withstood the effects of the admixture of equal doses of alien elements in successive generations. Such a form well deserves to be called typical. A breeder would always be able to establish it. It tends of itself to become a new and stable variety; therefore all the breeder has to attend to is to give fair play to its tendency, by weeding out from among its offspring such reversions to other forms as may crop up from time to time, and by preserving the breed from rival admixtures until it has become confirmed, and adapted in every minute particular to its surroundings.

Personal Forms may be compared to Human Inventions, as these also may be divided into types, sub-types, and deviations from them. Every important invention is a new type, and of such a definite kind as to admit of clear verbal description, and so of becoming

the subject of patent rights; at the same time it need not be so minutely defined as to exclude the possibility of small improvements or of deviations from the main design, any of which may be freely adopted by the inventor without losing the protection of his patent. But the range of protection is by no means sharply distinct, as most inventors know to their cost. Some other man, who may or may not be a plagiarist, applies for a separate patent for himself, on the ground that he has introduced modifications of a fundamental character; in other words, that he has created a fresh type. His application is opposed, and the question whether his plea be valid or not, becomes a subject for legal decision.

Whenever a patent is granted subsidiary to another, and lawful to be used only by those who have acquired rights to work the primary invention, then we should rank the new patent as a secondary and not as a primary type. Thus we see that mechanical inventions offer good examples of types, sub-types, and mere deviations.

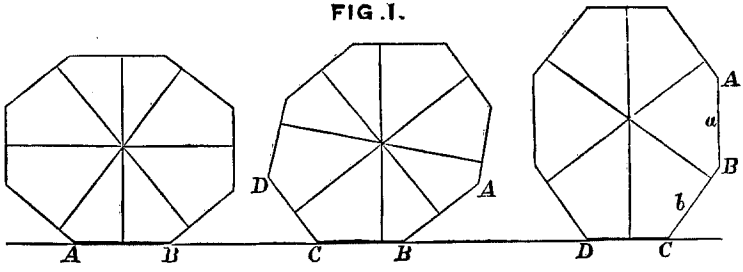
The three kinds of public carriages that characterise the streets of London; namely, omnibuses, hansoms, and four-wheelers, are specific and excellent illustrations of what I wish to express by mechanical types, as distinguished from sub-types. Attempted improvements in each of them are yearly seen, but none have as yet superseded the old familiar patterns, which cannot, as it thus far appears, be changed with advantage, taking the circumstances of London as they are. Yet there have been numerous subsidiary and patented contriv-

ances, each a distinct step in the improvement of one or other of the three primary types, and there are or may be in each of the three an indefinite number of varieties in details, too unimportant to be subjects of patent rights.

The broad classes, of primary or subordinate types, and of mere deviations from them, are separated by no well-defined frontiers. Still the distinction is very serviceable, so much so that the whole of the laws of patent and copyright depend upon it, and it forms the only foundation for the title to a vast amount of valuable property. Corresponding forms of classification must be equally appropriate to the organic structure of all living things.

Model.—The distinction between primary and subordinate positions of stability will be made clearer by the

FIG. I.



help of Fig 1, which is drawn from a model I made. The model has more sides, but Fig. 1 suffices for illustration. It is a polygonal slab that can be made to stand on any one of its edges when set upon a level table, and is

intended to illustrate the meaning of primary and subordinate stability in organic structures, although the conditions of these must be far more complex than anything we have wits to imagine. The model and the organic structure have the cardinal fact in common, that if either is disturbed without transgressing the range of its stability, it will tend to re-establish itself, but if the range is overpassed it will topple over into a new position; also that both of them are more likely to topple over towards the position of primary stability, than away from it.

The ultimate point to be illustrated is this. Though a long established race habitually breeds true to its kind, subject to small unstable deviations, yet every now and then the offspring of these deviations do not tend to revert, but possess some small stability of their own. They therefore have the character of sub-types, always, however, with a reserved tendency under strained conditions, to revert to the earlier type. The model further illustrates the fact that sometimes a sport may occur of such marked peculiarity and stability as to rank as a new type, capable of becoming the origin of a new race with very little assistance on the part of natural selection. Also, that a new type may be reached without any large single stride, but through a fortunate and rapid succession of many small ones.

The model is a polygonal slab, the polygon being one that might have been described within an oval, and it is so shaped as to stand on any one of its edges. When the slab rests as in Fig. 1, on the edge A B, corresponding to

the shorter diameter of the oval, it stands in its most stable position, and in one from which it is equally difficult to dislodge it by a tilt either forwards or backwards. So long as it is merely tilted it will fall back on being left alone, and its position when merely tilted corresponds to a simple deviation. But when it is pushed with sufficient force, it will tumble on to the next edge, B C, into a new position of stability. It will rest there, but less securely than in its first position; moreover its range of stability will no longer be disposed symmetrically. A comparatively slight push from the front will suffice to make it tumble back, a comparatively heavy push from behind is needed to make it tumble forward. If it be tumbled over into a third position (not shown in the Fig.), the process just described may recur with exaggerated effect, and similarly for many subsequent ones. If, however, the slab is at length brought to rest on the edge C D, most nearly corresponding to its longest diameter, the next onward push, which may be very slight, will suffice to topple it over into an entirely new system of stability; in other words, a "sport" comes suddenly into existence. Or the figure might have been drawn with its longest diameter passing into a projecting spur, so that a push of extreme strength would be required to topple it entirely over.

If the first position, A B, is taken to represent a type, the other portions will represent sub-types. All the stable positions on the same side of the longer diameter are subordinate to the first position. On whichever of

of them the polygon may stand, its principal tendency on being seriously disturbed will be to fall back towards the first position; yet each position is stable within certain limits.

Consequently the model illustrates how the following conditions may co-exist: (1) Variability within narrow limits without prejudice to the purity of the breed. (2) Partly stable sub-types. (3) Tendency, when much disturbed, to revert from a sub-type to an earlier form. (4) Occasional sports which may give rise to new types.

Stability of Sports.—Experience does not show that those wide varieties which are called "sports" are unstable. On the contrary, they are often transmitted to successive generations with curious persistence. Neither is there any reason for expecting otherwise. While we can well understand that a strained modification of a type would not be so stable as one that approximates more nearly to the typical centre, the variety may be so wide that it falls into different conditions of stability, and ceases to be a strained modification of the original type.

The hansom cab was originally a marvellous novelty. In the language of breeders it was a sudden and remarkable "sport," yet the suddenness of its appearance has been no bar to its unchanging hold on popular favour. It is not a monstrous anomaly of incongruous parts, and therefore unstable, but quite the contrary. Many other instances of very novel and yet stable inventions could be quoted. One of the earliest

electrical batteries was that which is still known as a Grove battery, being the invention of Sir William Grove. Its principle was quite new at the time, and it continues in use without alteration.

The persistence in inheritance of trifling characteristics, such as a mole, a white tuft of hair, or multiple fingers, has often been remarked. The reason of it is, I presume, that such characteristics have inconsiderable influence upon the general organic stability; they are mere excrescences, that may be associated with very different types, and are therefore inheritable without let or hindrance.

It seems to me that stability of type, about which we as yet know very little, must be an important factor in the general theory of heredity, when the theory is applied to cases of high breeding. It will be shown later on, at what point a separate allowance requires to be made for it. But in the earlier and principal part of the inquiry, which deals with the inheritance of qualities that are only exceptional in a small degree, a separate allowance does not appear to be required.

Infertility of Mixed Types.—It is not difficult to see in a general way why very different types should refuse to coalesce, and it is scarcely possible to explain the reason why, more clearly than by an illustration. Thus a useful blend between a four-wheeler and a hansom would be impossible; it would have to run on three wheels and the half-way position for the driver would be upon its roof. A blend would be equally impossible

between an omnibus and a hansom, and it would be difficult between an omnibus and a four-wheeler.

Evolution not by Minute Steps Only.—The theory of Natural Selection might dispense with a restriction, for which it is difficult to see either the need or the justification, namely, that the course of evolution always proceeds by steps that are severally minute, and that become effective only through accumulation. That the steps *may* be small and that they *must* be small are very different views; it is only to the latter that I object, and only when the indefinite word "small" is used in the sense of "barely discernible," or as small compared with such large sports as are known to have been the origins of new races. An apparent ground for the common belief is founded on the fact that whenever search is made for intermediate forms between widely divergent varieties, whether they be of plants or of animals, of weapons or utensils, of customs, religion or language, or of any other product of evolution, a long and orderly series can usually be made out, each member of which differs in an almost imperceptible degree from the adjacent specimens. But it does not at all follow because these intermediate forms have been found to exist, that they are the very stages that were passed through in the course of evolution. Counter evidence exists in abundance, not only of the appearance of considerable sports, but of their remarkable stability in hereditary transmission. Many of the specimens of intermediate forms may have been unstable varieties,

whose descendants had reverted; they might be looked upon as tentative and faltering steps taken along parallel courses of evolution, and afterwards retraced. Affiliation from each generation to the next requires to be proved before any apparent line of descent can be accepted as the true one. The history of inventions fully illustrates this view. It is a most common experience that what an inventor knew to be original, and believed to be new, had been invented independently by others many times before, but had never become established. Even when it has new features, the inventor usually finds, on consulting lists of patents, that other inventions closely border on his own. Yet we know that inventors often proceed by strides, their ideas originating in some sudden happy thought suggested by a chance occurrence, though their crude ideas may have to be laboriously worked out afterwards. If, however, all the varieties of any machine that had ever been invented, were collected and arranged in a Museum in the apparent order of their Evolution, each would differ so little from its neighbour as to suggest the fallacious inference that the successive inventors of that machine had progressed by means of a very large number of hardly discernible steps.

The object of this and of the preceding chapter has been first to dwell on the fact of inheritance being "particulate," secondly to show how this fact is compatible with the existence of various types, some of which are subordinate to others, and thirdly to argue

that Evolution need not proceed by small steps only. I have largely used metaphor and illustration to explain the facts, wishing to avoid entanglements with theory as far as possible, inasmuch as no complete theory of inheritance has yet been propounded that meets with general acceptation.