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INHERITANCE

THE tendency in any new character or modification to reappear in the offspring at the same age at which it first appeared in the parents or in one of the parents, is of so much importance in reference to the diversified characters proper to the larvæ of many animals at successive ages, that almost any fresh instance is worth putting on record. I have given many such instances under the term of "inheritance at corresponding ages." No doubt the fact of variations being sometimes inherited at an earlier age than that at which they first appeared—a form of inheritance which has been called by some naturalists "accelerated inheritance"—is almost equally important, for, as was shown in the first edition of the "Origin of Species," all the leading facts of embryology can be explained by these two forms of inheritance, combined with the fact of many variations arising at a somewhat late stage of life. A good instance of inheritance at a corresponding age has lately been communicated to me by Mr. J. P. Bishop of Perry, Wyoming, N.Y., United States:—The hair of a gentleman of American birth (whose name I suppress) began to turn grey when he was twenty years old, and in the course of four or five years became perfectly white. He is now seventy-five years old, and retains plenty of hair on his head. His wife had dark hair, which, at the age of seventy, was only sprinkled with grey. They had four children, all daughters, now grown to womanhood. The eldest daughter began to turn grey at about twenty, and her hair at thirty was perfectly white. A second daughter began to be grey at the same age, and her hair is now almost white. The two remaining daughters have not inherited the peculiarity. Two of the maternal aunts of the father of these children "began to turn grey at an early age, so that by middle life their hair was white." Hence the gentleman in question spoke of the change of colour of his own hair as "a family peculiarity."

Mr. Bishop has also given me a case of inheritance of another kind, namely, of a peculiarity which arose, as it appears, from an injury, accompanied by a diseased state of the part. This latter fact seems to be an important element in all such cases, as I have elsewhere endeavoured to show. A gentleman, when a boy, had the skin of both thumbs badly cracked from exposure to cold, combined with some skin disease. His thumbs swelled greatly, and remained in this state for a long time. When they healed they were misshapen, and the nails ever afterwards were singularly narrow, short, and thick. This gentleman had four children, of whom the eldest, Sarah, had both her thumbs and nails like her father's; the third child, also a daughter, had one thumb similarly deformed. The two other children, a boy and girl, were normal. The daughter, Sarah, had four children, of whom the eldest and the third, both daughters, had their two thumbs deformed; the other two children, a boy and girl, were normal. The great-grandchildren of this gentleman were all normal. Mr. Bishop believes that the old gentleman was correct in attributing the state of his thumbs to cold aided by skin disease, as he positively asserted that his

thumbs were not originally misshapen, and there was no record of any previous inherited tendency of the kind in his family. He had six brothers and sisters, who lived to have families, some of them very large families, and in none was there any trace of deformity in their thumbs.

Several more or less closely analogous cases have been recorded; but until within a recent period every one naturally felt much doubt whether the effects of a mutilation or injury were ever really inherited, as accidental coincidences would almost certainly occasionally occur. The subject, however, now wears a totally different aspect, since Dr. Brown-Séquard's famous experiments proving that guinea-pigs of the next generation were affected by operations on certain nerves. Mr. Eugène Dupuy of San Francisco, California, has likewise found, as he informs me, that with these animals "lesions of nerve-trunks are almost invariably transmitted." For instance, "the effects of sections of the cervical sympathetic on the eyes are reproduced in the young, also epilepsy (as described by my eminent friend and master, Dr. Brown-Séquard) when induced by lesions of the sciatic nerve." Mr. Dupuy has communicated to me a still more remarkable case of the transmitted effects on the brain from an injury to a nerve; but I do not feel at liberty to give this case, as Mr. Dupuy intends to pursue his researches, and will, as I hope, publish the results.

July 13

CHARLES DARWIN

VOLCANOES

Volcanoes: what they are, and what they Teach. By John W. Judd, F.R.S., Professor of Geology in the Royal School of Mines. (London: C. Kegan Paul and Co., 1881.)

ONE of the fathers of vulcanology in this country was the late Mr. Poulett Scrope, in whose well-known treatise on Volcanoes, the subject of their cause and effect was for the first time discussed from a thoroughly philosophical standpoint. A great traveller and investigator himself, he strove to imbue younger geologists with his spirit, and when he became too old and infirm to undertake travel and research in distant countries, he directed some chosen disciples to prosecute his favourite lines of thought. Prof. Judd was one of these, and upon him has assuredly fallen the mantle, and a portion of the spirit of his master. His able papers on the study of volcanoes, contributed to the *Geological Magazine*, are well known to every vulcanologist. He has travelled much; he makes good use of both pen and pencil, and he is an accurate observer. We are glad that he has condensed his reading and research into a work, which becomes so widely distributed, both at home and abroad, as the volumes of the International Scientific Series invariably do.

Before entering more minutely into a discussion of the work, we would venture to say that among its few defects, that which strikes us most prominently is an insufficiency of logical sequence and method. The facts are multitudinous; carefully selected, but not carefully arranged. They require to be grouped; to be classified, and each set of facts to be set in apposition to the generalisation which they tend to prove. It is indeed a useful mental discipline for the reader to do this for himself, but unless he starts with some knowledge of the subject, and as the

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possessor of a thoroughly methodical habit of mind, he can scarcely hope to arrange all the facts as they should be.

After an introductory chapter on the general nature of the inquiry instituted in the succeeding chapters, the author discusses "the nature of volcanic action." To illustrate this he takes the case of the ever-active volcano Stromboli, first examined scientifically by Spallanzani in 1788, and by Mr. Judd in 1874. It is a conical mountain rising 3090 feet above the sea, but the shore slopes to a depth of nearly 600 fathoms, hence the real height of the mountain from the bottom of the ocean exceeds 6000 feet. On the upper side of the crater a spot exists from which it is possible to look down upon the floor of the crater, and here may be seen apertures in which three classes of action take place. From some high-pressure steam is emitted in loud puffs; from others masses of molten lava well out; and in the third kind, a semi-liquid substance may be seen heaving up and down. Sometimes it rises as a kind of scum, swollen by the steam beneath it, and at last a gigantic bubble of molten lava filled with steam appears, and bursts; the imprisoned steam then escapes, carrying with it masses of the bubble high into the air. The author considers that all volcanic phenomena depend on these same conditions: (a) cracks or apertures forming communication between the surface and the interior of the earth; (b) highly heated matter beneath the surface; and (c) imprisoned water.

Animadverting on the common delusion that a volcano is a burning mountain, and that sulphur is the combustible, it is shown that sulphur is the result and not the cause of volcanic action. Common constituents of volcanic action are sulphurous acid and sulphuretted hydrogen, and when these come into contact, according to the author, "water and sulphuric acid are formed and a certain quantity of sulphur is set free." It should be understood however that if the gases are at all dry, as they sometimes are in the Solfataras of Krisuvik and elsewhere, water and sulphur are the sole products of the decomposition, while if moist, sulphur, water, and pentathionic acid are the first result.

If we examine the history of Vesuvius and other volcanic centres which have been known from a remote antiquity, we are led to the following conclusions, as regards the frequency of outbursts:—(1) A long period of quiescence is generally followed by an eruption which is either of long duration, or of great violence. (2) A long-continued, or very violent eruption is usually followed by a prolonged period of repose. (3) Feeble and short eruptions usually succeed one another at brief intervals. (4) As a general rule, the violence of a great eruption is inversely proportional to its duration."

In the third chapter the author describes the products of volcanic action. In the account of Vulcano he has omitted to mention the very remarkable substance lately analysed by Prof. Cossa of Turin, which contains no fewer than seven non-metals and eight metals, combined in the following forms:—Arsenious sulphide, selenium sulphide, boric acid, ammonium chloride, lithium sulphate, thallium alum, caesium alum, rubidium alum, and potassium alum. Bunsen's important division of all lavas into "acid lavas" and "basic lavas" is accepted, and the author admits an intermediate lava which contains from

55 to 66 per cent. of silica. He divides lavas further into five great groups: the Rhyolites, Trachytes, Andesites, Phonolites, and Basalts; the first being *acid*, the last *basic*, and the three others intermediate. An interesting account (illustrated by the frontispiece) is given of the microscopic examination of thin sections of rock, and the practicability of tracing by this means the passage from a glassy to a crystalline lava. It is shown that volcanic rocks having precisely the same chemical composition differ considerably in texture according as they are cooled slowly or rapidly. Thus gabbro, basalt, and trachyte are respectively the crystalline, lava, and glassy forms of the same substance. Some interesting details are given of the liquid cavities found in certain crystals, and of their contents.

In the fourth chapter the distribution of materials ejected from volcanic vents is discussed. In the account of "Pele's Hair"—the long threads of lava blown out by high-pressure steam in Hawaii—the reader may be misled. The author speaks of it as "filamentous volcanic glass," and in the passage preceding it (p. 71) he is evidently discussing "glassy lavas" and "pumice," which have been ranged among the acid lavas. But on p. 94 the same lava of Kilauea is spoken of as a "basic lava," although before described as a "molten glass," and presumably acid in character, that is, containing from 66 to 80 per cent. of silica. But basalt is a basic lava, and by rapid cooling it may become a perfect glass, hence we can understand how Pele's Hair may be described as "filamentous glass," without belonging to the class of acid lavas.

In the following chapter an extremely interesting account of the dissection of volcanoes by denudation is given, and the subject is illustrated by some striking examples, among which we may specially mention the plan of the volcano of Mull in the Inner Hebrides. In a past geological period this volcano was probably as large as Etna. The Island of Skye is the basal wreck of another volcano of Tertiary times. In the account of the formation of mineral veins the author has not alluded to Bunsen's surmise that the metallic copper found in the palagonite tuff of the Faroe Islands was reduced by volcanic hydrogen from the chloride.

The sixth chapter treats of the parasitic cones which appear upon the flanks of great volcanoes, and herein we notice one or two errors. Thus on p. 162 we read, "Among the hundreds of parasitic cones which stud the flanks of Etna, there are some which are nearly 800 feet in height." There are however less than a hundred cones worthy of the name, the rest are mere monticules, and of these we believe there are over six hundred. Among the larger cones Monte Minardo is the largest, and it is 750 feet in height, but has undoubtedly been much higher. In Fig. 63, p. 163, the outline of Etna, *as seen from the Val del Bove*, is wrongly described. The picture represents Etna as seen from Bronte, the opposite side of the mountain to the Val del Bove. It is taken from von Waltershausen's "Atlas des *Ætna*," and appears in Mr. Scrope's book on Volcanoes, in which it is also wrongly described. Occasionally we meet with hasty writing, particularly when the author is firmly convinced of his statement. Such small defects are easily remedied in the second edition. The following is an example of what we mean:

"That volcanoes are thus built up along lines of fissure in the earth's crust, we have the most convincing proofs. Not only have such fissures been seen in actual course of formation at Vesuvius, Etna, and other active volcanoes, but a study of the volcanoes dissected by denudation affords the most convincing evidence of the same fact. The remarkable linear arrangement of volcanoes, which is conspicuous to the most superficial observer, is a very striking evidence of the same fact." A slight looseness of expression is also apparent when the author speaks of carbonic acid as a *poisonous gas*, the fact being that the gas produces suffocation by spasmodically closing the glottis and without entering the lungs at all. On the other hand, carbonic oxide, which has a direct and baneful action on the organism, may truly be described as a poisonous gas.

In the account of Geysers the author, after stating that many attempts have been made to explain the mechanism by which the intermittent action of geysers is produced, remarks that probably no "such explanation will cover all the varied phenomena exhibited by them." Herein he does not even allude to Bunsen's classical experiments on the action of geysers, which are generally accepted as furnishing conclusive proofs of the mechanics of these intermittent springs.

A highly-instructive chapter discusses the number and distribution of volcanoes. In the second edition the map inserted at the beginning of Mr. Scrope's book might with advantage be introduced.

Concluding chapters discuss the information furnished by volcanoes concerning the interior of the earth, and the attempts made to explain the causes of volcanic action. In regard to this latter matter we are left as much in the dark as ever, and authors usually content themselves with stating the various hypotheses which have been proposed, leaving the reader to select that which he considers the most rational.

Prof. Judd's work is very instructive, and it will excite intense interest in the minds of many readers. Laid down upon the lines of Mr. Scrope's book, it is less methodical, less philosophical, and to most people more readable. A few things seem to us to be wanting, but probably the author has good reasons for their omission. Particularly we notice the absence of references to the labours of such men as Bunsen, von Waltershausen, Johnstrup, von Lasaulx, Steenstrup, Elie de Beaumont, and Tacchini. Iceland, the most marvellous country in the world from the volcanic point of view, is scarcely alluded to. And, as we said above, it seems to us that we require some *vous* to arrange and put in order the countless *δημοσιόμειραι* that are scattered throughout the pages. But even without this we cannot read the book attentively without feeling that we have acquired a great mass of information concerning phenomena which have occupied the attention of wise men from the earliest times.

G. F. RODWELL

THE FIGURE OF THE EARTH

The Figure of the Earth: an Introduction to Geodesy.
By Mansfield Merriman. (New York, 1881.)

THE author of this volume has already made his name known to us as the writer of an excellent treatise on the Method of Least Squares. The book

before us presents to the reader, who is supposed to have some little knowledge of Algebra and Geometry, an explanatory and historical sketch of the labours of geodesists from the earliest days. We read in Chapter I. that Anaximander—a speculator in Geometry, Astronomy, and other sciences—concluded, from some reasons best known to himself, that the earth was a cylinder whose height is three times its diameter. There must have been some good reason for this idea, for we are told that Anaxagoras held the same. And it is scarcely to be wondered at that Plato originated some views of his own in the matter.

Passing to comparatively modern times we have a detailed account of the measurement of a degree (in 1766-68) by Mason and Dixon along the boundary line between the states of Maryland and Delaware. This measure gave 3947 miles as the radius of our supposed sphere.

Then the Franco-Peruvian expedition—*circa* 1736—of the Academicians M.M. Bouguer and Lacondamine is briefly referred to (and here there is a misprint in the length of the base-line at Cotchesqui, which was 6274 toises in length), their labours giving 3936 miles as the radius. Henceforth the earth, abandoning its claims to sphericity, and not escaping a temporary imputation of being egg-shaped, settles down into an oblate spheroid—the figure generated by the revolution of an ellipse round its lesser axis.

Chapter II. treats of the method of determining the excentricity of this spheroid. As one measured arc will determine the radius of the spherical earth, so two measured arcs determine the radii of the spheroidal earth, that is, if the two arcs differ considerably in latitude. The actual excentricity is then calculated from the arc measured in Peru and that measured in Lapland. Then, further, taking the arc measured in France and combining these three in pairs, three quite different values of the excentricity are obtained. Here enters a discord not yet resolved; and in fact all modern measurements show that the earth is not a true spheroid, for, combining the arcs in pairs, all kinds of values of the excentricity present themselves. Then we fall back on the method of least squares, and grouping all the measurements into a unique calculation, we get a unique value of the excentricity, which may, with some show of reason, be called the most probable value. A specimen of this mode of calculation applied to pendulum observations is given at page 52; and it may be noted in passing that the calculation would have been made both neater and simpler by writing $S + 39$ instead of S . By inadvertence it is stated at page 54 that pendulum observations give 1-288.5 as the earth's ellipticity, and again at page 64, 1-289 is given as the result of the same observations. But these are the ellipticities that were obtained previous to the very extensive pendulum work recently completed by General Walker in India. When these modern observations are taken into account the 1-289 is changed to 1-292 or 1-293.

The earth then being no true spheroid, an attempt, described in Chapter III., is made to ascertain whether it is an ellipsoid with three unequal axes. Here but little better success is met with, and failing to establish for itself any fair name, the earth, like other pretenders, takes shelter under hard words, and in the concluding chapter of the book calls itself a geoid. Here we are safe and