THE

JOURNAL OF TRAVEL

AND

NATURAL HISTORY

EDITED BY ANDREW MURRAY, F.L.S.
AUTHOR OF THE "GEOGRAPHICAL DISTRIBUTION OF MAMMALS," "PINES AND FIRS OF JAPAN," "COLEOPTERA OF OLD CALABAR," ETC.

VOL. I.

LONDON
WILLIAMS & NORGATE; AND EDWARD STANFORD
EDINBURGH: EDWARD RAVENSCROFT

CONTENTS.

ORIGINAL PAPERS.

REVIEWS.

CORRESPONDENCE.

MISCELLANEA.

ILLUSTRATIONS.

JOURNAL OF TRAVEL

AND

NATURAL HISTORY.

THE GEOLOGICAL ORIGIN OF THE PRESENT SCENERY OF SCOTLAND.

By Archibald Geikie, F.R.S.

IT is a common belief that geology as a science deals wholly, or almost wholly, with a time earlier than the advent of man upon the earth, and that its proper subject of research ends where human history begins. As Sanscrit, though indispensable in the philosophical study of living tongues, is itself a dead language, so geology, though it may be admitted to give the key to much that would otherwise be hard to understand in the present economy of things, is, nevertheless, frequently looked upon as essentially the investigation of an extinct past. But this estimate, true so far as it goes, is a signally defective one. Its prevalence, by fostering the love of the marvellous, has probably increased the general interest in geological questions; yet there can be little doubt that, at the same time, it has tended to hinder the progress of sound geology. The great truth cannot be too often or too strongly reiterated, that geology is still, to continue the figure, a living language. Not only does it record the history of the earth and its inhabitants during bygone periods, but it chronicles the life and motions of the world around us now. It is, if one may so speak, the physiology of the earth. The physiologist inquires into the structure and functions of the body: the geologist, in like manner, studies the nature and functions of the different forces that affect the surface or the interior of the crust of the earth. He watches their modes of working, and notes especially the results which they achieve. Winds, rains, rivers, springs, frosts, ice, waves, tides, currents, earthquakes, volcanoes —every agency, in short, which in any way can be recognised as modifying the outside or the inside of our globe, comes within the scope of his research. And in proportion to the thoroughness with which he comprehends these operations of living nature largely depends the measure of his success in realizing the changes which have formerly passed over the earth.

No line can be drawn between the social or political history of the present day and that of former times. We are living and acting history now as truly as men did in the days of Miltiades or Julius Cæsar. Nor can any boundary be traced between the operations of nature in our own age and those in what are called the geological periods. The world is working out geological history now as surely as it did in the times of the trilobite or the pterodactyle. It may be that all the forces which have at different times affected the earth's crust are not acting now, or may possibly have lost some of their first vigour. But the great leading principle of change, so far as we yet know, remain the same in kind, if not absolutely the same in degree.

To the wide prevalence of the feeling that geological research must deal rather with the past than with the present aspect of nature, we may with probability attribute the indifference which has long existed as to the study of the existing form of the surface of the country. If one considers the matter, it cannot but seem strange that so much should be known, and so much more conjectured, as to the outline of lands and seas in former geological times, and yet that so little concern should have been shewn to ascertain how the present contour of our lands came into existence. That contour has usually been quietly overlooked, or but vaguely accounted for. Though the broad outlines of the subject were long ago traced by Hutton and Playfair, it is only within the last few years that geologists have begun generally to acknowledge that the surface of the country has a history of its own, independent of any geological formation, and that its methodical study may throw new light on many parts of these formations.

Referring for further details to the writings of Ramsay, Jukes, and others who have recently treated of the subject, I do not propose in the present paper to bring forward new facts or conclusions, but rather to shew how the study may be prosecuted; and to select for that end the scenery of Scotland, as an illustration at once familiar and easily accessible. But the reader will bear in mind

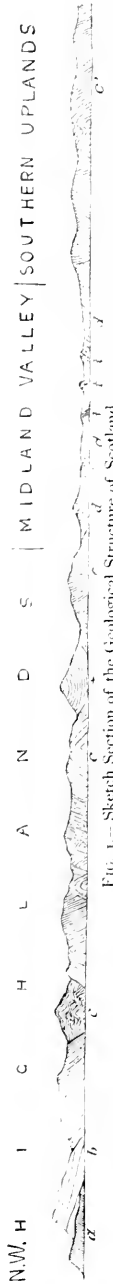


FIG. 1.—Sketch Section of the Geological Structure of Scotland.
a, Laurentian gneiss; *b*, Cambrian sandstones; *c*, Lower Silurian quartz-rocks, limestones, and very thick upper series of gneissose and schistose rocks; *c'*, Lower Silurian grits, greywackes, and shales of southern uplands; *d*, Old red sandstone and carboniferous formations, with associated trap-rocks *t*. × Structure of Ben Lawers.

that the principles applicable to the history of the shaping of the Scottish hills and valleys are of wider significance, and that what is true of Scotland is, with the necessary local modifications, true also of other countries.

First of all, let us lay aside the vague popular belief that all mountains are directly due to great upheavals, and all valleys to depressions or rents of the earth's surface. Without lingering at present to enquire whether or how far this belief is founded on reality, let us proceed to note the simpler elements of the geological structure of the country. For it is evident that we must know something of the varying nature and arrangement of the rocks before we can place ourselves in a position to understand how the hills and valleys have been formed out of them.

The accompanying section represents in a generalized form the main geological features of the country. It shews the existence of three great divisions, each characterized by a distinct group of rocks, and, consequently, as we shall afterwards see, by a distinct type of scenery. These divisions are, 1*st*, the Highlands, ranging from the extreme north-west to the lowland border that stretches from the Clyde to the coast of Kincardine; 2*d*, the Southern Uplands, extending from sea to sea, between a line drawn from St Abb's Head to Girvan, and another more sinuous line from the Solway to near Berwick-on-Tweed; and 3*d*, the Midland Valley—a low, broad, undulating, and often hilly tract, lying between the other two districts, and embracing the Firths of Tay, Forth, and Clyde.

Beginning at the north-west end of the section, we find rising from the Atlantic sea-board, a group of hard, gnarled, crystalline rocks (*a*), to which the name of Laurentian is now applied. They are overlaid with a thick mass of dull red sandstone (*b*), called Cambrian, which rises into those wonderfully picturesque mountains stretching from

Applecross, by Lochs Torridon, Maree, and Broom, through Assynt to Cape Wrath. These sandstones pass underneath a series of quartz-rocks and limestones, and these again dip under a vast mass of overlying crystalline gneissose rocks (*c*). It is this upper series which, as Sir Roderick Murchison first pointed out, spreads out over all the rest of the Highlands to the east and south. Its component strata, as roughly indicated in the diagram, are crumpled and contorted, and come to the surface again and again, being folded back upon each other, or undulated into waves, so to speak, which rise and fall south-eastward to the Highland border. The reader will remember, however, that it is the convolutions in the strata themselves, which are referred to, not the contour of the rocks upon the surface. Here and there the place of the contorted masses is taken by granite, porphyry, or other unstratified rock, but these interruptions may, for our present purpose, be passed over.

Along the southern edge of the Highland border, these hard crystalline contorted strata sink under the softer rocks (*d*) of the midland valley, on the further side of which there rises up into the southern uplands another series (*e*) of hard contorted strata. These are shewn by their fossils to belong to the same great geological period as those of the Highlands (*c*). Indeed they seem to be a prolongation of the same rocks, coming up again from under the later formations of the Lowlands; but in a less crystalline or metamorphised form. They consist of bands of various hard grits and shales which are thrown into endless plications, the direction of the folds being, as in the Highlands, from south-west to north-east. Occasional masses of granite, porphyry, felstone, &c., occur among this group of rocks, and its continuity is further interrupted by portions of the less antient strata that creep up from the lower grounds on either side. But the great bulk of these southern uplands consists of hard convoluted lower Silurian rocks.

The midland valley is more complex in geological structure, but our present object will be gained, if we bear in mind that between the Highlands and the uplands of the south, the wide intervening valley lies for the most part on comparatively soft sandtones, marls, shales, and other strata (*d*), belonging to the old red sandstone and carboniferous formations, through which are distributed masses of hard trap-rocks (*t*) that rise into more or less conspicuous hills.

Such, in baldest outline, is the general grouping of the rocks of the country. From their original horizontal or gently inclined position, the strata have been bent, broken, hardened, and for thousands of square miles together, corrugated and contorted. They have been cracked and displaced so generally, that probably not a single square mile is free from some such "fault" or displacement. And, lastly, they have, in many places, been traversed by masses of melted rock, which either reached the antient surface and flowed out as lava, or cooled and solidified under ground.

But if we admit that the rocks have been so twisted and fractured, it may seem, perhaps, that there ought to be no great difficulty in assigning a cause to the present external contour of the country. That contour, it may be asserted, must be due to the inequalities produced by the subterranean movements which folded and dislocated the rocks. This is, doubtless, a natural inference, and it is at this moment still the current belief upon the subject. But what seems the shortest and easiest explanation, is not always the true one. And that this is the case in the present instance, it is my object now to try to shew.

In order as far as may be to gain clearness, I shall arrange my argument under four propositions.

I.—The hills and high grounds consist for the most part of hard rocks; the broad valleys lie for the most part on soft rocks.

The simplicity of this proposition is apt to conceal its full significance. Yet, if well weighed, it will be found to deal a heavy blow to the interpretation which ascribes our present scenery to the direct influence of subterranean movements. As illustrations of its truth, reference may be made to the characteristic hardness and toughness of the rocks of the Highlands, considered as a whole, and to the uniformity of texture that runs through the hard compact strata of the southern uplands. But nowhere is it more strikingly exemplified than throughout the wide midland valley. The prevailing rocks of that district are sandstones, and other comparatively unresisting stratified deposits. But among these there occur masses of very hard trap-rocks. Now, it is a familiar fact, that while the low grounds lie upon the soft stratified rocks, the crags and hills, almost without exception, are chiefly or wholly formed of the hard trap. So invariably is this the case, that a geologist who ascends some prominent hill, can, if he chooses, roughly map in from its summit, the general disposition of the sedimentary and the trappean masses of the district around him.

The tourist who enters Scotland by the eastern route, finds on every side of him conspicuous illustrations of this feature. First, come the Bass Rock and North Berwick Law, (see fig. 2) that guard the entrance to the Forth. Journeying westwards, he passes the group of the Garlton Hills, and after crossing the low grounds of the Midlothian coalfield, finds himself among the basaltic crags

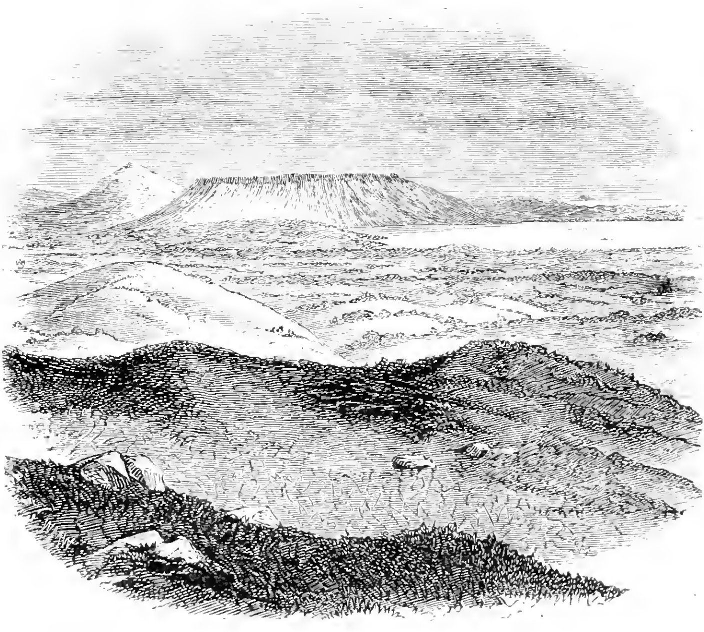


FIG. 2.—View of Loch Leven and the Lomonds of Fife, with North-Berwick Law and Bass Rock in the distance. To illustrate the part played by Trap-rocks in the landscapes of the Midland Valley. The upper part of Lomond Hill consists of sheets of hard Trap-rocks, lying upon soft Sandstone and Shale.

and hills of Edinburgh. Northwards lie the broken heights of Fife; and as he continues his way westwards, he skirts the chain of the Pentlands, and the endless crags and knolls of Linlithgowshire. The detached and prominent hills around Stirling arrest his notice, and beyond them, the terraced "fells" of Campsie to the west, with the green chain of the Ochils in front. He proceeds northward by Perth, and there still he finds rough masses of rock, rising into bold crags, or sweeping in far vistas eastward along the edge of the Carse of Gowrie. In all these examples, he is looking upon hard trappean rocks, which project boldly from the softer sedimentary strata among which they lie.

Thus, over the whole country, no matter what may be the variations in geological structure, wheresoever the observer notes some more conspicuous mass of rock, he may, with tolerable certainty, assume its greater prominence to be an accompaniment of superior hardness. But how can this fact be explained by the common hypothesis? If the present inequalities of surface have been produced by subterranean agencies, how is it that, as a rule, the upheaved masses should have been hard, and the depressed portions soft? Surely the varying texture of the rocks now at the surface could have had no influence on the antient underground movements. Is it not, on the contrary, evident that, whatever may have been the original influence of these movements, the existing outlines of the country must be in great measure dependent upon some cause where the relative hardness or softness of the rocks comes into play?

II.—*The mountains and hills are not mere crumplings or foldings of the earth's crust, nor are they due to the form assumed by melted rock when forced from beneath to the surface.*

This statement requires for its full comprehension a little more geological knowledge than the last, but, with the aid of the foregoing section, the reader will have no difficulty in following the line of reasoning. On reference to fig. 1. he will notice that several of the mountains there sketched are formed of strata which dip inwards both from the north-west and south-east. Many Highland mountains exhibit this structure, one of the most striking examples being Ben Lawers (× in fig. 1). That huge hill consists of gnarled schists, which are grouped in the form of a basin. They dip under the hill from Glen Lyon, and rise up again on the other side above Loch Tay. Now, it is plain that, if the broad foldings of the strata had given rise to the outlines of the country, Ben Lawers, instead of being a mountain, ought to have been a valley. Again, along the depression of Loch Tay the strata arch over, as shewn in the section to the right of the asterisk. Consequently, the fold at Loch Tay, instead of a valley, ought to have given rise to a mountain. No structure is of more frequent occurrence in nature than this. What in a geological sense is an upward fold or arch, instead of rising as such above the surface, and forming a hill or ridge, is very often a valley; while, on the other hand, a downward fold or basin of the rocks, which it might have been conjectured would have produced a valley, rises even into a bulky mountain. The examples where a hill has its form determined by a dome-shaped fold of the strata, or where a valley has been formed by a trough-shaped depression of the strata, are of much less common occurrence, and when they do occur, there is usually some other circumstance which has come in to aid the guiding influence of geological structure, such, for instance, as the greater hardness of the rocks that form the dome, or the greater softness of those that have been bent into the trough. And thus the seeming paradox remains true, that what should be, by geological structure, mountains, have been turned into valleys, while what ought to have been valleys, rise up into mountains. The attempt, therefore, to explain the present outlines of the ground by reference mainly to former crumplings of the rocky crust of the earth must be abandoned.

Nor can we more successfully appeal to the many masses of igneous rock which traverse the stratified formations, as causes of our existing hills. These rocks have, indeed, been forced upwards from a heated region within the earth's crust. But it can be shewn that many of them never reached the surface at all at the time of their ejection, that those which did flow out as melted rock at the surface were subsequently deeply buried under later formations, and that the actual appearance of igneous rocks above ground is due, as will be pointed out a little further on, to the removal of these later formations, and the consequent exposure of the trappean masses that lay beneath. Take, as illustrations, the hills which rise from the north side of the Firth of Tay and stretch north-eastwards through the chain of the Sidlaws; and also the hills on the opposite side of the Firth, which range through Fife and the line of the Ochils to Stirling. These heights consist mainly of different beds of trap-rock—old lavas which were poured over the surface from a succession of volcanic vents. They are interstratified with beds of sandstone and other sedimentary deposits by which they are shewn to have been erupted at intervals, and more or less horizontally during the time of the lower old red sandstone. From the subjoined section it will be seen that their former level position has been thrown into an inclined one. The

Firth, in fact, runs along an axis of upheaval, from each side of which the rocks dip away in opposite directions, like the two sides of a roof. Now, the old volcanic rocks, as the reader will per-

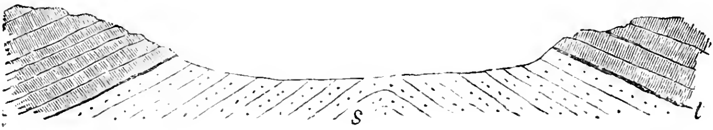


FIG. 3.—Section across the valley of the Firth of Tay.
s. Lower old red sandstone ; *t.* Trap-rocks.

ceive, have been bent over just as the sandstones and conglomerates have been. They do not come bursting up irregularly and give rise to hills in consequence. On the contrary, they have suffered from all the subterranean and superficial movements which have affected the stratified rocks among which they occur. They have been wholly removed from the valley of the Firth; for it is plain that the beds of trap on the one side are only the continuation of those on the other. Their truncated edges look across at each other, and rise into those groups of terraces so well marked along both sides of the Firth of Tay. Nor must we fail to observe that here again there is a valley where there ought, according to geological structure, to have been a wide hill. If the lower edge of the trap beds is prolonged upward at the same angle as the sandstones below, it will rise into a high dome. And had the shaping of our hills and valleys depended chiefly upon the way in which the rocks had been folded by subterranean operations, what is now the Firth of Tay must have been a long swelling ridge, much higher than the existing hills on either side of it.

III.—The valleys are in the great majority of cases independent of any faults or fractures of the crust of the earth.

We have already seen that the whole of this country is more or less cracked by faults; and as it is everywhere crossed by valleys, the case could hardly have been otherwise than that the valleys should sometimes correspond with the line of the faults. But no geologist can carefully map a large area of this country without becoming convinced, even it may be in spite of a previous belief to the contrary, that such examples of coincidence are quite exceptional. Those who have not the leisure or the faculty for such a kind of investigation will find the results of it in such detailed maps as those of the Geological Survey. They will there observe that the valleys much oftener cross faults than run along them; and that while some lines of valley seem to have had their trend determined by the direction of a powerful dislocation, many of the largest faults are not marked at the surface by any line of depression, while most of the valleys cross and re-cross faults in all directions, and with such complete indifference, as to shew that their courses have not been prescribed for them by lines of fissure in the solid framework of the country.

Between those valleys which have been determined by lines of fault and those where this guiding influence has been wanting, there are some strong points of difference. The former are, as a rule, narrow in proportion to their length, deep, with a marked monotony of breadth, and, instead of winding about, pursue a straight line. The latter, on the other hand, wind along in wide curves or short loops, now narrow with steep sides, now expanding into a broad plain, and receiving sinuous tributaries like themselves. The second class will at once be recognised as the prevailing type of valley in this country.

But, apart from geological evidence altogether, the thoughtful contemplation of a good map of the country seems to me enough to suggest that the grouping of the valleys can hardly be due to any cause acting from below. The endless branchings and windings of the valleys, their herring-bone arrangement, or, in other words, the way in which the runnels are directed downwards into the streamlet, the streamlets into the brook, the brooks into the river-course, the river-courses into the wider valley that carries the water finally to the sea; and then the wonderful harmony between the trend of the valleys and their great function of carrying off the drainage of the land are surely inexplicable on the supposition that these features have been determined by systems of fractures in the crust of the earth. The valleys have been specially adjusted for carrying off the surplus water to the sea, and this accurate and special adjustment could only have been the work of some force acting on the surface, and necessitating the formation of the valley systems in accordance with the drainage of the country. But the only force which could do this is the flow of the drainage itself, with all its attendant phenomena of waste and removal.

In short, the valleys must be the work of the rains and streams which flow in them. "If, indeed," says the profound and elegant Playfair, "a river consisted of a single stream without branches running in a straight valley, it might be supposed that some great concussion or some powerful torrent had opened at once the channel by which its waters are conducted to the ocean; but, when the usual form of a river is considered, the trunk divided into many branches, which rise at a great distance from one another, and these again subdivided into an infinity of smaller ramifications, it becomes strongly impressed upon the mind, that all these channels have been cut by the waters themselves; that they have been slowly dug out by the washing and erosion of the land; and that it is by the repeated touches of the same instrument that this curious assemblage of lines has been engraved so deeply on the surface of the globe."

But it may be objected, that surely the deep ravines and gorges of the country are proofs of great yawning gaps having been opened by rendings of the solid ground. Such defiles, for instance, as those of the Clyde below the Falls, or of the Ayr at Barskimming, it may be contended, must plainly be due to subterranean movements. Now, paradoxical again as the statement may seem, it is precisely in such narrow gorges that the reality and potency of the action of water in scooping out hard rock is most strikingly seen. How much soever these narrow, dark, chasm-like ravines may recall the effects of earthquake shocks, they can be easily shewn to have been excavated entirely by the streams which flow in them. A mere tyro in geology who has learned to trace out the line of a single stratum, can follow the beds of rock from side to side of a ravine, and across the bottom, and satisfy himself that no fault or yawning earthquake-rent had anything to do with the formation of the ravine, but that the process has been entirely one of excavation. I am tempted here to make one other quotation from Playfair, who, in reference to the gorges of large rivers in mountainous regions, remarks:—"There is no man, however little addicted to geological speculation, who does not immediately acknowledge that the mountain was once continued quite across the space in which the river now flows; and if he ventures to reason concerning the cause of so wonderful a change, he ascribes it to some great convulsion of nature which has torn the mountain asunder, and opened a passage for the waters. It is only the philosopher who has deeply meditated on the effects which action long continued is able to produce, and on the simplicity of the means which nature employs in all her operations, who sees in this nothing but the gradual working of a stream that once flowed as high as the top of the ridge which it now so deeply intersects, and has cut its course through the rock, in the same way, and almost with the same instrument, by which the lapidary divides a block of marble or granite."

IV. From the surface of the whole country there has been removed a vast amount of solid rock, under which the present hills and valleys were once deeply buried.

In this proposition lies the key to the whole question; but some little attention is required before its full significance is understood. It will, therefore, be of advantage first to bring forward a few forcible illustrations of its truth, and then to pass on to the inferences which necessarily flow from it.

If the reader will turn back to the long section (fig. 1) giving a generalised sketch of the geological structure of Scotland, he will not fail to notice that the curves of the strata there represented are cut off by the surface of the ground. The strata, once approximately horizontal, have been thrown into folds, and a great portion of the upper ends of these folds has been removed. In the case of such a valley as that of Loch Tay, for instance, the dome of arched rock has been worn down into a long and deep hollow, but the upward-pointing edges of the strata on each side of the valley shew how the rocks once extended upward, and how, in imagination, we must prolong them into the air in order to realize the size of the mass that has disappeared. This removal of rock from the surface, and the consequent exposure of portions which once lay buried under overlying masses, is called by geologists the process of *denudation*. Now, the whole surface of the country has largely suffered in this way; over the whole Highlands the highly inclined or vertical edges of the strata come up along the sides of the glens and mountains. Every such exposed edge is the remnant of a bed which once rose hundreds or thousands of feet above the point to which it has now been worn down: and hence it follows, that from the surface of the Highlands a thickness of hundreds, or rather thousands, of feet of solid rock has been worn away.

Nor is this lesson of vast waste less impressively taught us by the southern uplands of the country. There, too, a series of convoluted and highly inclined strata has been planed down into a long table-land. The arches have been so smoothly cut away as to give no indication of their existence by any rise in the outline of the ground. We walk over the edges of the rocks for miles, and, so far as the surface of the ground indicates, we might suppose ourselves to be upon a series of horizontal or gently inclined strata. It is along some of the striking coast sections that these features are most convincingly brought before the observer. The range of precipice to the north-west of St Abb's Head, for example, shews a series of highly-tilted strata, often indeed placed on end. (Fig. 4.) There, in a distance of five or six miles, sixteen or eighteen distinct arches and troughs of the strata can be counted. Now, it is plain that but for denudation there would have been along this coast some eight or nine huge conical or dome-shaped mountains, separated from each other by V-shaped depressions of corresponding magnitude. But what do we find instead? The rocks are planed off along the top of the cliff, and all traces of arches or troughs is effaced from the contour of the surface.

Again, throughout the midland valley, on every side we meet with monuments of denudation. Every hill of trap in that wide region, is a memorial of the destruction of softer rocks that once surrounded and overlaid it. The trap stands out in relief, because it is harder, and has thus been more able to resist the force of abrasion which has wrought such havoc among the less obdurate stratified masses. It can be demonstrated, that these trap-hills were once buried under several thousand feet of sandstone, shale, limestone, coal, and other strata, and this deep overlying mass has been, as it were, peeled off from districts of many hundreds of square miles in extent (see view of Lomonds, &c., page 6).

So much for the general denudation of the country. Let me, however, point for a moment to one or two examples of the process, as developed in the history of a single hill or mountain.

Along the north-western sea-board of the Highlands, there rises a chain of lofty and more or less isolated mountains of singularly pyramidal form, and a somewhat sombre red tint, barred along their sides with nearly horizontal lines and ledges, which look like huge courses of masonry, and scarred with deep clefts and rifts, where often the winter snow lingers far into the summer. These striking eminences are formed of that red Cambrian sandstone already referred to (*b*, in fig. 1), and their horizontal bars mark the edges of the flat strata. They are, in fact, built up of horizontal beds of red sandstone, as a pyramid is built up of level tiers of hewn-work. The strata of one mountain can be carried with the eye through the intervening air, across deep and wide valleys, till they join the corresponding strata along the side of the mountain beyond. Nor does it require more than a cursory inspection, to be convinced that the strata which may thus be connected by the eye, were of old in reality prolonged so as to form one mass. In short, these great hills are but fragments of a

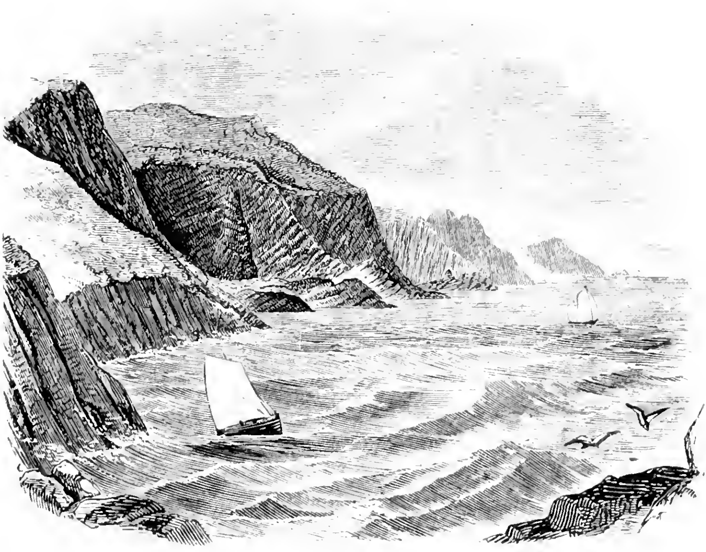


FIG. 4. View of the cliffs of curved Silurian strata to the north-west of St Abb's Head. See p. 13.

covering of red sandstone, at least 7000 feet thick, which once spread over the north-west Highlands, but which has been worn away till it exists only in scattered hills, though these, by their grandeur, remain as suggestive memorials at once of the magnitude of the old Cambrian formation in that region, and of the potency of those agencies of destruction by which so enormous an amount of solid rock has been removed from the surface.

Another illustration of the same great truths is furnished to us by that singular rock, the Scuir of Eigg, which rises into such a conspicuous landmark among the western islands. I have elsewhere described the geological history of this hill, but it furnishes so apt an instance of the meaning and results of the process of denudation, that I have taken the subjoined drawing out of my note-book and will briefly describe it. The Scuir of Eigg rises to a height of nearly 1300 feet above the sea, and consists of two distinct portions. Of these, the lower is a mere swelling or ridge of the general surface of the island, and, like the rest of that surface, is composed of nearly horizontal sheets of dolerite, basalt, and other varieties of the trap-rocks. Each of these sheets was originally a

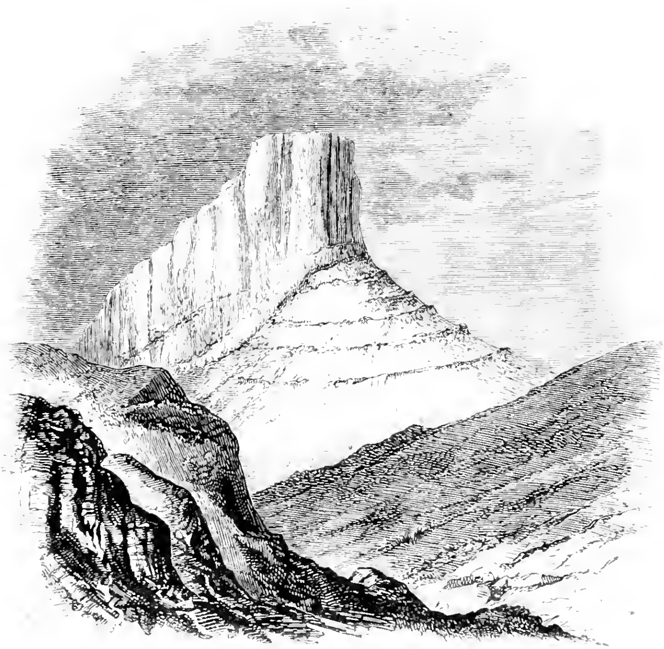


FIG. 5.—View of the Scuir of Eigg, from the east.—The lower part of the hill shews an older series of gently inclined lava-beds, which had been hollowed out into a valley, wherein the currents of pitchstone flowed that now form the vertical upper part of the hill.

flow of lava, poured one over the other during a long course of volcanic eruptions. At last this state of things ceased, and the lava-flows began to be acted upon by the different forces concerned in the process of denudation. The rock was gradually worn away, layer after layer was laid bare, until at last a valley several hundred feet deep was cut out of these old lava-streams. Its bottom was occupied by a river which brought down rubbish from distant mountains of red Cambrian sandstone as well as from the surrounding slopes of volcanic rock. Not only so, but large pieces of coniferous trees were likewise swept down and buried in the gravel of the river-course. At last, however, the volcanic forces, which seem to have been quiescent at this locality for a long period, broke out anew. Successive streams of a black glassy lava, called pitchstone-porphyry, were erupted. These found their way into the river-bed and flowed along it, solidifying, of course, as they went, until the old river-channel was filled up and buried under at least three or four hundred feet of solid rock. Then the work of denudation went on as before. The sides of the old valley, formed of the earlier series of volcanic rocks, continued to be worn away, but the very compact flinty pitchstone, though it too had to yield to the attacks of time, did so at a much slower rate. Hence, by degrees, the former hills and valleys crumbled away, while the pitchstone that had solidified, like so much cast iron, in the bed of the antient river, retained its place. But it no longer winds along a valley. The higher grounds and slopes that once bounded it have disappeared, and it now runs as a huge wall of rock along the crest of the highest ridge of the island. And, at the foot of the precipice, you may dig out from underneath this great mass of once melted rock the gravel and drift-wood which had gathered in the old water-course before it was sealed up under the river of lava. Here again we see how by denudation hills have been worn down into slopes and valleys, while valleys have been changed into hills.

Not less marvellous are the transformations which the same process of erosion has effected among the other volcanic islands of the inner Hebrides. In Mull, for example, the nearly horizontal sheets of dolerite, basalt, and other hard crystalline varieties of old lavas, rise above each other, terrace over terrace, to a height of sometimes more than 3000 feet above the sea. Yet these extremely tough and compact masses have been scooped out into wide, long, and deep valleys, now occupied in part by the sea as sea-lochs or fjords (fig. 6). The edges of the horizontal beds on one side of a valley can readily be connected by the eye with their continuation on the other side, and the observer sees before him a proof that these valleys, though sometimes several miles broad, and measured from the crest of the ridges on either side, 1500 or 2000 feet deep, can have been produced by no mere convulsion or fracture, but must have been dug out by the powers of denudation acting on the surface. And he learns, moreover, that the mass of rock which now rises above the sea-level is only a small fragment of what it originally was, and that more of the rock has been worn away than has been left behind, for the valleys are longer, wider, and deeper than the mountains.

It would be tedious to multiply illustrations of the great fact, so manifest on all sides, that from every part of the surface of the country, a mass of solid rock has been removed by denudation. If now we put together the different propositions discussed in the

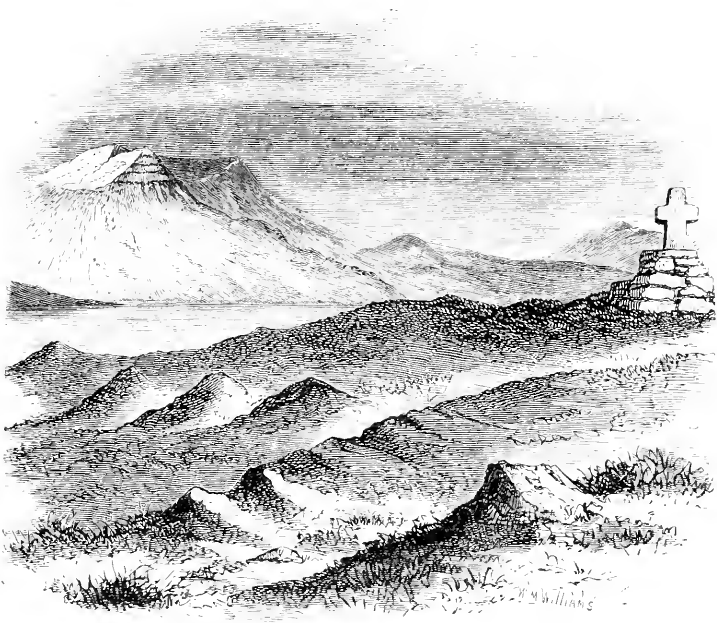


FIG. 6.—View of Ben More, Mull, from the south.
A pyramidal mountain of horizontal trapbeds, nearly 3200 feet high.

previous pages, we are led to see that the reason why hard rocks form hills, is that they are better able to resist those processes of decay which out of the softer rocks form valleys; that the mountains and hills are not due to mere upheavings, nor the valleys to mere depressions of the strata below; that the ravines and river-gorges are not simply open fissures or rents; that in every case hill, valley, and ravine bear witness to the removal of solid materials from their site; that the whole surface of the country has been denuded; and that in fine it is to the variations in the nature and progress of this work of denudation that the present contour of the country is mainly to be traced. The process of excavation must doubtless have been often and materially modified by underground movements, the land sometimes rising or sinking and altering the flow of water, one portion being removed under the protection of the sea, and another part projected to be attacked by the waves and weather. Moreover, earthquakes must have opened fissures, and these may sometimes have altered the form of valleys, or determined the course of new ones. And even when the levelling action of the waves and currents of the sea had smoothed off the asperities due to such fractures of the solid crust, there may still have been left inequality of surface sufficient to guide the flow of water and the progress of atmospheric waste along the line of the fracture underneath. We may readily grant all this, yet, after all, the influence of such underground movements, as it seems to me, sinks out of sight when we come face to face with the great facts of denudation. We are shut up to the conclusion first propounded by the immortal Hutton: "the mountains have been formed by the hollowing out of the valleys, and the valleys have been hollowed out by the attrition of hard materials coming from the mountains."

I have merely alluded to the forces of denudation. It would be beyond the scope of the present brief sketch to do more. Rain, springs, streams, rivers, frost, ice, waves, marine currents—these are the agents ceaselessly at work in altering the face of the country, and it is by their agency at different times and in different degrees that, as I believe, the existing outlines of the country have been mainly produced. By the action of the sea, a part of the earth's crust which is upraised into land, is planed down, as the Highlands and southern uplands must have been. As the land thus levelled rises above the reach of the waves, it comes within the sphere of the atmospheric agencies of waste. Rain falls upon it and flows off along the inequalities of the sea-worn surface. In thus moving seawards, the rivulets necessarily deepen their channels, and when these are fixed they continue to be chiselled out deeper and wider. The merest accidents, and the slightest impediments, may determine at first the direction of the water-courses; but once determined they remain. As the land by upheaval gains in elevation and extent, the channels of its rivers lengthen. Rain, springs, frosts, aid the action of the streams to enlarge the hollows, and thus the runnels widen out by degrees into valleys. By and bye, perhaps, sheets of snow and ice, such as once covered this country, lend their help to wear down the surface, especially in valleys and hollows where, as Professor Ramsay has pointed out, the erosive action of glacier-ice tends to scoop out cavities, which afterwards become the basins of lakes. And thus, by a system of slow excavation, the outlines of the country are gradually carved out.

In this prolonged process of denudation, many incidental features conspire to modify the final results. I have alluded to the influence of underground movements; but more universal, and perhaps even more important than these, are the effects of the varying texture and geological arrangement of the rocks. It is to this latter cause that we owe those local modifications in the scenery of the country, which form, indeed, its distinctive features. Each well-marked variety of rock has usually a peculiar mode of yielding to the forces of denudation, and this peculiarity, gives rise to a special variety of outline in the landscape. This is one of the most tempting parts of the subject; but I must merely refer to it, and urge the reader who wishes a new pleasure added to his autumn tour, to take a geological map with him, and mark as he goes along, how the character of the scenery varies with the changes in the nature of the rocks underneath. The regions of granite, gneiss, sandstone, limestone, trap-rocks, will each be found to present certain specialities of outline; and by watching this relationship between the external form and the internal texture and structure of the rocks, he will become more and more convinced, that it is mainly denudation which has brought about the present relief of the country.

In arguing against the common belief that the inequalities of surface are chiefly the result of irregular upheavals and depressions, or of fractures and open rents, I have tried to shew that these inequalities are of such a kind, that no mere subterranean movement could account for them, that they have been produced in the main by the removal of solid material, and that this removal, so far as known, could only have been the work of those denuding agents which are still engaged in the task. It does not affect the argument, whether we hold that the different powers of renovation and decay were more vigorous in former times, or have always been the same, on the whole, as they are now. The idea that underground commotions, even of the most catclysmal kind, could have opened our valleys and glens, seems to me excluded by the facts of denudation. But though we are shut up, I believe, to the conclusion, that these hollows have been eroded by forces acting on the surface, it by no means necessarily follows, that the forces so engaged have always been working at the same rate as now. We know of no other agencies in nature capable of performing the task, yet they may have done the work sometimes more slowly, sometimes more rapidly, than they do it at the present time. The action may have been the same in kind, without necessarily being always the same in degree. If, indeed, our

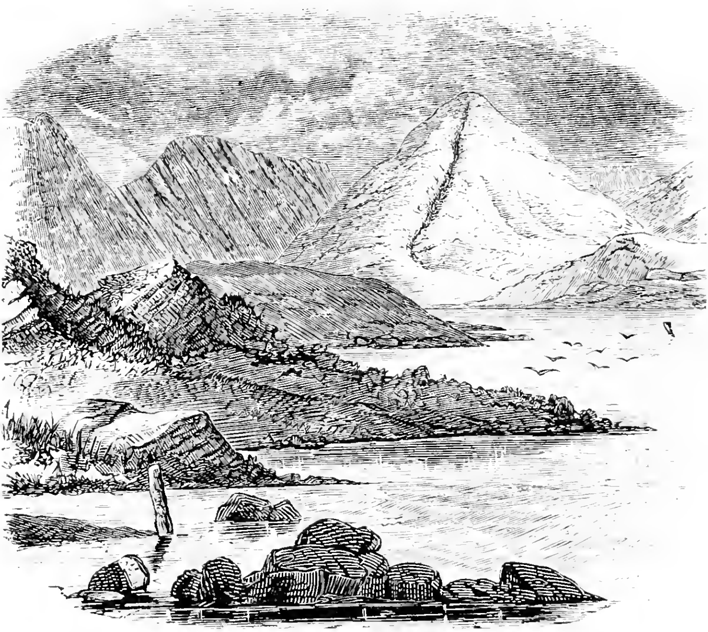


Fig. 7.—View of Ben Chro, Loch Slapin, Skye.

To shew the conical outline which is apt to be taken by a mass of homogeneous decomposing rock, such as the syenite of Ben Chro.

planet, and the solar system of which it is a part, have been slowly parting with heat, and if heat be the ultimate source from which the energy of all natural forces is derived, the present vigour of these forces is perhaps much less than it used to be. In especial, the rate of denudation may have varied, and might have been formerly more rapid than it has now become. This is a question which may be decided either way, without affecting the argument of those who, like myself, believe that, whether more quickly or not, it was by the same superficial agencies of waste as are still wearing down the surface of the earth, that this country had its valley-systems determined. We see certain results which could only be achieved by the denudation or erosion of the country, and it is of no consequence to the reasoning, what the rate of this erosion may have been. It must have been performed by some agencies working on the surface, and the only agencies of which we have any knowledge or conception, are the rains, frosts, streams, waves, and other forces, that are playing the same part still.

In fine, when for the vague popular notion that primeval earthquakes tossed up our hills, and rent open our valleys, we adopt the Huttonian explanation, which I have tried to lay before the reader in the foregoing pages, we are led to perceive that the shaping of the land has been accomplished by no random method, but after that calm orderly pattern so characteristic of nature's operations. Mountain and glen become eloquent not of terrestrial convulsion, but of the slow silent progress of the same powers of waste, by which from year to year their outlines are still changed. And if in this long and stately march of events our finite faculties can descry "no sign of a beginning, no prospect of an end," it is because man has taken his place upon a scene, wherein cycle after cycle, decay and renovation succeed each other—not less markedly upon the solid framework of the land than among the tribes of plants and animals by which the land is inhabited.

THE PEDRAS NEGRAS OF PUNGO ANDONGO IN ANGOLA.

By Dr Friederich Welwitsch.

THE "Black Rocks of Pungo Andongo," designated in most of the antient writings as "the Presidium of the *Pedras negras*," are situated in the interior of Angola, about 180 geographical miles eastward from the Atlantic coast. They are mentioned in the books of missionaries and other travellers, upwards of two centuries ago, as a great wonder of nature, and have claimed the attention of all travellers who have since visited them. Of these observers none, not even the sagacious Livingstone, has paid any attention to the surprising change of colour to which the above named rock-mountains are subject every year, and which led to the denomination of the place, and even of the whole district. A prolonged residence in Pungo Andongo, where I passed several months, commissioned by the Portuguese Government to study the vegetation and capabilities of the soil for future agricultural purposes, gave me a favourable opportunity of observing the entire progress of their coloration, convincing me that the intense blackness of the rocks, conspicuously seen at certain periods of the year, is not produced, as supposed, by their disintegration nor by the refraction of light, but by the growth and wonderfully quick propagation of a small cryptogamous plant during the annual rainy season, which at first marks with dark stripes the rocks in various places, then gradually entirely overgrows them, and gives them the appearance of being covered by a black mantle.

As every phenomenon in nature is more easily understood if compared with similar, or, at least, analagous, appearances already known elsewhere, I shall ask the reader to allow me to draw his attention for a few minutes away from the interior of Africa to other parts of the world, where we shall find that the variegated colouring of larger tracts of land and water frequently arises from the wide spread growth of excessively small cryptogamic plants, often only to be observed with the aid of a microscope.

This is not a rare occurrence in nature. Even in the streets of our European towns we see, during rainy springs, the more shaded bare walls of our houses marked by broad stripes or spots of a yellowish or dark green colour. These are due to the presence of oscillatoraæ, or other microscopic algæ.* In many stagnant waters and slow-running streamlets, even in the reservoirs of the ornamental waters of our gardens, we see appear, in the course of a few days, a velvet-like covering of greyish green, or yellow colour, which, on minute examination, is found to consist of an accumulation of algæ, so small that one drop of water not seldom contains several thousand individuals.†

In still more conspicuous and varied phases does this phenomenon force itself on the attention of the wanderer in the damp ravines of Highland valleys and the Alps, where huge rock walls are coloured sometimes sulphur-yellow by the mysterious Leprariæ, or again are tinted in blood-red circles by the Hæmatococcus; and it is seen in its grandest scale in the so-called red and green snow, which, particularly in polar countries, and in the regions of the Alps, occasionally cover miles with a rose-red or emerald-green hue, an appearance due, as is well known, to the multiplication of a few species of Protococcus.‡

Not only the mainland and its fresh water shew us such phenomena, produced by algoid vegetation, but also salt waters, nay, even the wide ocean itself becomes often their birthplace; and in such instances we see with amazement the otherwise dark blue waves glistening with a purple hue, or tinted as with a crimson dye. It is generally understood that the Red Sea owes its name partially to the occasional appearance of immense quantities of a species of Trichodesmium, a microscopic alga which in the early state of its existence is of a deep red colour. §

---

* In some of the quieter, less-populated streets of London, we observe even larger filamentous algæ like Lyngbya and others, covering the basements of walls with a delicate green.

† Among the number of species of algæ which produce such phenomena, it will be sufficient to mention Anabœna flos-aquæ, Kütz; A. chalybea, Kütz; Limnochlide flos-aquæ, Kütz; Sphœrozyga floccos Agaand Sph. insignis, Kütz; and various species of Desmidiacæ which cover stagnant waters with a green scum.

‡ Protococcus nivalis, Ag. (Conf. Saussure Voyages dans les Alpes, tome ii., p. 44; Wrangel Acta Holm. 1823; Schuttleworth, in Biblioth. Univer. de Genève, Feb. 1840.

§ Conf. Trichodesmium erythrinum Ehrenberg, in Poggendorf's Annal. 1830, p. 506; and Montagne Memoire sur le Phénomène de la Coloris. de la Mer Rouge, Comptes Rend. Acad. Sc., 15 Juillet 1844; also in Ann. des Sc., 3, ii., p. 332, tab. 10.

I was not a little surprised in May 1852, whilst crossing the salt waters of the Tagus, from Lisbon to Lavradio, to observe, in approaching the opposite shore, that the ordinarily bluish-green waters of that majestic river, had suddenly become of a violet purple colour. A closer examination, however, of the colouring substance soon taught me that this unusual hue had been caused by the presence of a species of Protococcus, which is generated in vast quantities in the extensive neighbouring Salinas.

Several years previously, Messrs Turrel and Freycinet, whilst sailing round Cabo d'Espichel, on the Portuguese coast, observed the Atlantic ocean glittering with a blood-red colour to the extent of many miles; and the subsequent investigation of this coloured sea water by Montagne, proved that myriads and myriads of a red Protococcus * had imparted this tint to the ocean.

It would be an easy task to cite many more examples of this great phenomenon in temperate regions; but I have said enough to prepare the reader for its occurrence on the African continent, in equally rich variety. I saw it immediately on first setting foot on the west coast of Africa, in September 1853. I landed at Freetown, Sierra Leone, and I there found the walls of the houses facing the north painted like maps, with black, bronze, green, and violet spots, reaching from the basement up the gable. On closer investigation, these proved to consist of a felt-like accumulation of several small species of algæ, which could be taken off the walls almost like paper-hangings. Even in Loanda, the stately capital of Angola, I observed that, although surrounded on its land side by burning sand deserts, the damper places, especially the yards of the houses, were covered during April 1854, within a few days, with a gray-green velvety coating, spread like a crust almost uninterruptedly over the level portions of the soil. I looked upon this at first as a vegetation arising from the neighbouring sea-shore, until a subsequent microscopic examination proved, to my great astonishment, that the entire green covering was composed of an immense accumulation of Botrydium,† one of the prettiest little terrestrial algæ, which occurs

* Protococcus atlanticus, Montagne (Note sur un nouveau fait de colorisation des eaux de la mer. Comptes Rend. de l'Academie Sc., 16 Nov. 1846.

† This species, occurring in Loanda, resembles very much in its habitus the Botr. argillaceum, Wall., from which it is distinguished by its brighter colour and closer juxtaposition of the separate vesiculæ, which are also much smaller than those of the European species.

also often in Europe under similar cirumstances. However, all these hues observed on land and in water, though the product of true algoid vegetation, are mostly of short existence, and not limited to definite periods; they rarely, sometimes never, reappear on the same spot, and, therefore, they must be looked upon as ephemeral appearances, which thus escape general observation, and disappear without trace.

Quite different is it with the colouring of the mountain rocks of Pungo Andongo, because there this phenomenon has not only been observed for centuries, recurring annually with a certain regularity, but also with such intensity, extending on a large scale over so wide a district, that it gives a definite character to the physiognomy of the landscape, in which the fantastically shaped huge mountain rocks, which project high above the level of the green forest and fields, appear sometimes in their natural grey-reddish, or greyish-white aspect, at other times clothed in deep black, rising towards the blue sky like the gigantic ruins of a bygone Cyclopean town.

At first glance it is evident that such colouring of rocks caused by the smallest plants, and extendiug in a short time over an immense district, cannot be the result of climatic influences alone, but must also be dependent on the co-effect of other, especially of topographical circumstances; hence a short sketch of the situation, the environs and the climate of Pungo Andongo, with a few remarks on its vegetation, may here not be out of place.

Pungo Andongo, the chief place in the district of the same name, includes a large portion of the upper river country of the great River Cuanza, is situated in 90° 42′ 14″ south lat., at a distance of about 180 geographical miles from the Atlantic coast, and rises, inclusive of the height of the surrounding mountains, to about 3800 feet above the level of the sea, picturesquely overtowering the fertile pastures in the valley of the Cuanza* which limits the district on the south, and which is 5 miles distant. Opposite, on the left bank of the Cuanza, rise the mountain chains of Libollo Alto, further east those of Hako and of other negro countries, converging or diverging more or less with the river-bed.

Pungo Andongo, as well as the subordinate district belonging to

* I write *Cuanza* not Quanza, the former being more in accordance with the pronunciation and genius of the Bunda language, also because this mode of writing has been adopted by the better Bunda grammarians.—Conf. Cannecatim. Observ. grammat. sobre a lingua Bunda, p. 9.

it, formerly formed part of the wide-spread and powerful negro empire of Ginga (pronounced Shinga) of which at present a few tribes still exist as free negro states, north-east of the capital. Pungo Andongo by its commanding situation, and still more by the rapacious habits of the Gingas, opposed for a length of time an annoying *non plus ultra* to the gradual progress of the Portuguese into the interior. Constant strifes arose until the rock castle, one of the fortified seats of the Ginga kings, after several hard struggles, was taken by storm by the Portuguese, under their valiant leader Lopez de Sequeira; and, shortly after, the place was incorporated with the Portuguese possessions, under the name of Presidio das Pedras Negras, and was raised into a tenable fortified outpost for the protection of Portuguese trading caravans, and serves, at the same time, as an entrepot for the reception of goods coming from the interior of the continent along the eastern boundary-line of Angola, and for a trading post for the dissemination of Portuguese or other European goods in the interior.

The Presidium proper, the town of Pungo Andongo counts at present with its adjoining farms nearly 1300 inhabitants,* and lies in a hollow, in the midst of mighty gneiss rocks, which extend over an area of more than 10 miles in circumference, and of which some rise like gigantic pillars, and others like successive mountain masses, forming all around, chiefly on the west and south-west, precipices of from 300 to 600 feet in height. Three steep ravines allow a tolerably easy entrance to the Presidium, besides a few others more difficult of access.

Evergreen forests, chiefly of leguminous trees, abound on all sides of these picturesque rock groups, except on the west and south-west, where the mountain's ridge falls off almost perpendicularly, displaying at its foot the charming Cuanza valley, commencing with shrubs and pasture lands, followed up by smaller groups of trees, or in marshy soil adorned by the Cyperus Papyrus, until we observe on the immediate banks of the Cuanza river itself, luxuriant meadows with clusters of trees closer and closer grouped together, their dark green masses over-topped by the stately feather crown of the thorny Date palm.

* In the last official statistical report, published at Loanda in 1862, the population of the entire district of Pungo Andongo is given at 26,815 inhabitants, most of whom are stock-breeders, farmers, and merchants, chiefly trading in wax and ivory. In the census of the population, mostly negroes and mulattoes, are included 55 white colonists, nearly all Portuguese.

At a certain distance the rocks of Pungo Andongo appear poor in vegetation, only a few of the higher mountain peaks shewing small clusters of trees or shrubs, here and there mingled with a few single tall trees.

However, the nearer we approach the rocky mountains the richer and more varied becomes the vegetation, the more luxuriant and greener the forests, the more flowery the open fields, the more numerous the crystal brooks. These, surrounded by succulent meadows, pour forth from zig-zag ravines or cross valleys, or fall in cascades from the walls of the higher rocks, down to the feet of the traveller, spreading freshness through the stifling atmosphere all around. The winding way, edged in on both sides by grotesque-looking rocks, leads us on a gradually steeper incline at last through one of the narrow clefts into the charming oblong valley, where the Presidium itself is situated. The little town itself consists of modest, neat dwellings grouped around the little church, and the more stately residence of the governor, and other buildings abutting against the elevated rocks. Many houses of a newer style, several stories high, in the midst of orchards and kitchen gardens, are scattered about in the adjoining valley inlets, adding materially to the idyllic charm of this beautiful secluded Eldorado. In the centre of the place stands a splendid Adansonia, marking the spot where the Portuguese concluded their peace, in far past ages, with the Amazon queen of the Gingas. Single groups of trees hide the huts of the poorer black or mulatto population. A dense dark-green primeval forest, the so-called Mata do Pungo, occupies the side valley on the N.W., and forms a marked contrast with the neighbouring, partly denuded, rock walls. Wells and brooks, with the freshest water, in every direction; luxuriant bushes overshadowing all ravines; exposed rock-blocks clothed with elegant creepers, or fiery-flowered aloes and sweet-scented orchids; the mountain slopes, with their succulent meadows, enlivened by pasturing herds; and still higher the gigantic gray or dark black massive rocks, projecting high into the air, and crowned with the fascinating azure of the tropical sky—this is the justly praised, romantic Presidium of the Pedras Negras.

If Pungo Andongo commands the full attention of every traveller by its picturesque situation and its exceptionally healthy climate in a tropical region, it deserves in a still higher degree the interest of naturalists, and especially that of botanists. Excepting the high table-lands of Huilla, further south, there is hardly another place in tropical South Africa, where, in so small a circuit, we find the vegetation so varied, peculiar, and at the same time, so nearly related to that of countries far distant from it and far distant from each other; nay, I should call Pungo Andongo a botanical garden, in form of an extensive grand park, in which are found the most interesting treasures of vegetation, from the various districts of tropical and sub-tropical Africa, judiciously grouped together, with a considerable number of forms of vegetation quite peculiar to itself.

It would by far surpass the space allowed me to give here a detailed account of the highly interesting flora of the rock-district, I shall, therefore, only point out a few of those genera which, in a prominent degree, characterise the vegetation of Pungo Andongo. Amongst these the numerous succulent plants take the foremost rank, mostly of the order of Aloes, Orchids, Euphorbias, Asclepiads, and even of Labiates, associated with Rhipsalis Cassytha, Gärt., the only cactaceous plant hitherto found really wild out of the American continent. These overgrow the rock walls in every direction, often up to their summits, in the most variegated form, and generally associated with Cissoideæ and fragrant Verbenaceæ. The prettiest ferns, some with gold-coloured fronds, grow abundantly over the crevices, whilst the gorgeous Musa ensete, and the beautiful tree-fern, Cynthia Angolensis, Welw.,* embellish the margins of the numerous streamlets. The meadows on the mountain slopes make a richly variegated display, with the blue and red flowers of different Commelynaceæ and Indigoferas, profusely interspersed with many white or orange blooming Cyperaceæ,† whilst the cliffs are adorned with various species of Gladiolus, curious Hæmodoraceæ, resembling Vellosias, and the superb Gloriosa Abyssinica, with its profuse and gorgeous blossoms. In the wide woody ravines, the entrances of which are decorated with climbing Hugoniæ grow the peculiar Monodora Angolensis, the mimosa-leaved Parkia, in company with other strange tree forms of Violaceae, Sterculiaceæ, and Apocynaceæ. In narrow ravines, the botanist is surprised by pretty Begonias, strangely shaped Dorstenias, and several elegant pygmy Piperaceæ. But the greatest variety is offered by the shrubs of the underwood in which Leguminous, Acanthaceous, Verbenaceous, and immense

* Hooker, Synopsis Filicum, p. 22.

† There are four or five species of Asclepias, all having more or less the appearance of white or yellow-headed composite flowers.

numbers of Rubiaceous plants, with the very pretty Ancylanthus ferrugineus, are often half smothered by climbing Asclepiadæ. An incredible number of slender soft grasses, thrive luxuriantly in the meadows in the side valleys, which is the immediate inducement to cattle-breeding in this part of the country, excelling therein all other districts of Angola. Along with these occur several larger Gramineæ, near the brooks in the neighbouring forests, where a species of bamboo occurs 30 to 40 feet high, with such thick stalks, that the natives manufacture out of them drinking vessels and snuff boxes Among a great number of interesting Cryptogamic plants, I shall only mention a gigantic Agaric which I found growing in the neighbouring Panda woods, distinguished by the immense size of its head, which sometimes measures more than 3 feet in circumference, as well as by the delicate flavour of its flesh. Even the beds of the brooks glitter with a dark green turfy cover, formed by a few species of Podostemaceæ, those interesting Phanerogams which some liverworts so closely resemble.

After this rapid glance over the indigenous vegetation of this rock-encircled botanical Paradise, we must add, that the different groups of cultivated plants are not less remarkable for their variety and number. In and near Pungo Andongo, most of the tropical cultivated plants are found, together with vegetables of southern Europe, the latter thriving, without exception, so well, that one would hardly expect to see them so developed in the interior of equinoctial Africa, especially after making allowance for the inferior abilities of the agriculturists.

Immediately on entering the Presidium, the traveller's eye is attracted by luxuriant bushes of fennel and parsley, reminding him of his European home, but growing here like weeds in the streets ; most of the European vegetables, too, are seen in thriving condition in the gardens surrounding the habitations, often hedged in by a kind of Dracæna, or by the Curcas purgans. In a still higher decree the wanderer's amazement is excited by cultivated orchards, wherein ananas and bananas grow together with the European peach and apple trees, Spanish fig trees, with guava and Indian mango trees, the West Indian caju, associated with the coffee tree and the South European orange and lemon trees. High above their dark-green foliage rise here and there single oil-palm trees with their stately feathered crowns, which, however, in this more elevated country bring forth less developed fruits than in the neighbouring lower districts. This slight disadvantage is amply repaid in the vine, which finds in Pungo Andongo a most propitious climate. It has been cultivated by some Portuguese colonists for a long time with such success, that annually a quantity of wine is produced, which, to my own mind, is not inferior to the Constantia wines. In more favourable spots the sugar-cane and the palmy Papaya are planted, whilst the Jambos tree, the cherry-yielding Eugenia pedunculata and very fine varieties of the Spondias tree thrive in the more stony soil.

An equally varied productiveness is to be seen in the tillage grounds. Fields of wheat, ground nuts (Arachis hypogæa), maize, Sesamum indicum (the Gingilie oil-plants), Voandzeia (Voandzeia subterranea), another kind of ground nut, potatoes and mandioca or Cassava adjoin, according as the soil suits them, fields of rice and Sorghum, beans aud sweet potatoes, whilst the Cafoto* and Ginsonge,† two pretty leguminous shrubs, are planted as hedges between them.

Here and there are plantations of Luco‡ (Eleusine coracana var.), and Muxiri,§ the former serving, like the barley in Europe, for making beer and also yielding mealy corn, and furnishing groats and flour, the latter supplying sweet roots of which the negroes brew their beer. Water-cresses overgrow the brooks, sometimes lined with clumps of Canna indica, or with thick bushes of Mirabilis Jalapa. Both these plants and the Coix lacryma were introduced in olden times by Catholic missionaries, their fruits or seeds furnishing a suitable and cheap material for the manufacture of the indispensable rosary. The soil is everywhere favourable to the growth of tobacco; the various Cucurbitaceous fruits thrive excellently, and the leaves of a wild Sinapis give a palatable vegetable, whilst its seed embodies all the ingredients for mustard.

The nutritious Hibiscus esculentus, the oily Ricinus, several species of Capsicum, the cotton plant, growing in equal luxuriance

* Cafoto is a shrub 4 to 6 feet high, a species of Tephrosia, a very ornamental plant, related to the Tephrosia Vogelii of the Niger flora. Its leaves and tender branches, when fresh gathered, squashed and thrown into rivers, stupify the fishes, by which means the latter are caught.

† Ginsonge is the Cajanus indicus, the beans of which are very palatable and nutritious, either cooked entire or ground into meal.

‡ Luco is a grass of the beautiful genus Eleusine, largely cultivated for its mealy corn by the Caffers, and in Abyssinia, and likewise in tropical India.

§ Muxiri, a leguminous shrub, with trifoliate leaves and blue flowers, and long cylindrical roots, often as thick as a man's finger, nearly approaching in taste the Spanish liquorice.

with the (in tropical Africa) ubiquitous tomato, appear like weeds in the cultivated plantations. Neither must we overlook the Zingiber and Bixa Orellana, cultivated for their dye, used by the negroes for colouring the straw of an Eleusine,* out of which they manufacture their celebrated artistic and tasteful basket work known under the name of "Balaios de Pungo Andongo," and which are so much in demand even in Portugal, that they give rise to distinct branches of industry in this district.

Pungo Andongo is also justly praised for its good hunting, excelling, in numbers of large and small game, every other district of Angola. Without speaking of the numerous kinds of antelopes or the abundance of fowl, I cannot leave unnoticed the Hyrax (perhaps an undescribed species), not unlike a rabbit in appearance and habits, which peoples the rock crevices in great numbers, and furnishes meat of excellent taste. Unfortunately, the surrounding often inaccessible cliffs are also the abode of a kind of dog-like monkey (a species of Cynocephalus), which surpass by far in boldness and cunning all other animals. They make nightly rapacious inroads even into the fields near the habitations; and it often happens that they destroy in a single night entire plantations of maize or mandioca. These equally cunning and voracious animals make their invasions in immense troups. For their security and the success of their enterprise some of the older individuals are posted as guards round about on projecting rocks. These, on the approach of danger, give the alarm by loud barking, when the whole troup takes to instantaneous flight. With the velocity of lightning, carrying their prey under the fore-arms, they run to the first rock-wall, however perpendicular or apparently inaccessible, and scale it with amazing ease and rapidity. On reaching the top, they immediately form a regimental line on the extreme edge of the precipice, scoffing at the powerless pursuer below by a loud, hideous barking, or, if attacked with gun-shots, throwing or pushing down stones.

Before leaving the animal kingdom I must remark that all kinds of birds, reptiles, fresh-water and land shells, fishes, and insects, are represented in as great abundance as the various forms of vegetation. Future naturalists visiting this country can reckon

---

* Most probably this Eleusine is a distinct species, or, at least, a prominent variety of the E. indica, It is characterised by its straight erect tender culms, 1 to 2 feet high; when ripe, of a golden yellow colour, and might be fitly designated as Eleusine textilis.

with certainty on a rich harvest of new species, or important varieties in any of the above-named classes.

Having already stated that the climate of Pungo Andongo, considering its situation in equinoctial Africa, is healthy and congenial to Europeans, it is right that I should point out to the newly-arrived that the frequent and severe atmospheric changes, occurring often in the space of a few hours, require particular precaution. Owing to its elevated position, the rock circle, and also the Presidium itself, are covered with fog from dawn till 9 or 10 o'clock A.M.; consequently during these hours it is damp and cold (in the spring 62° to 63°,* in the summer, 66° to 69° Fahrenheit). As soon as the foggy clouds disappear, the temperature rises quickly, reaching its maximum height about 2 o'clock P.M. (in the spring, 1857, 73° to 75°; in the summer, 75° to 79°). From thence it gradually falls again until it reaches its minimum, about two hours before sunrise. This course in the temperature is subject to exceptions and irregularities, because on calm days, or when the horizon is cloudless early in the morning, the perpendicular sunbeams falling then sooner into the rock hollow, thereby altering and considerably increasing the day's atmospheric temperature within a very short time. This, however, occurs exceptionally, for I observed, on a few rare occasions, the thermometer shewing in Pungo Andongo, that is, in the Presidium itself, more than 80° Fahrenheit.

The countries surrounding the rock circle, more especially the Cuanza valley, extending on the west and south-west, have, as may be supposed, a much higher temperature. One of the highest temperatures which I observed during my residence in Angola, occurred on the banks of the Cuanza River, 5 miles distant from the Presidium. There, in March 1857, the sand-slates, close to the river, were glowing with heat, at noon, so intensely, that they scalded the feet of my negro attendants, and penetrated even the strong soles of my boots in a most sensible manner.

The reader having been made acquainted in the foregoing sketch with the topograpical and general botanical relations of the

* All my observations in temperature were made with one Parisian and two English thermometers, which, previous to my journey, had been carefully tested and compared with standard instruments, I have, therefore, reason to believe that the results, and my data of temperature, as well as my hypsometrical measurements with the same instruments, are entitled to confidence.

Pedras Negras, I shall now proceed to the description of the phenomenon which causes their black appearance at certain times of the year. On my arrival at Pungo Andongo at the end of October (the spring season in the southern hemisphere), the colossal rocks, projecting high above their girth of vegetation had a pretty equal aspect of grey or greyish yellow colour, shaded darker in a few places near the top. From this I was inclined to concur in the opinion that the black colouring, so much spoken of, probably resulted from an optical delusion. This idea became more confirmed after I had ascended the higher mountains several times. On the flat part of their summits I noticed pools overgrown with Nympheæ and Aponogeton; but neither in the ponds (stagnant deep waters of small extent) nor on their borders could I trace any kind of vegetation which might possibly account for the colouring of the rocks. However, very soon afterwards, I was convinced to the contrary. During the following month, several successive thunder storms brought down heavy rains. In the following December I observed in several places on the cliffs facing the Presidium perfect black stripes pointing downwards, their dark colour in conspicuous contrast with the general aspect of the other stone masses. These stripes increased considerably in breadth and length in the course of a few days, and other new ones appeared on rocks previously of grey yellow colour. Now was the time to investigate the extraordinary phenomenon; and with the view of tracing its origin, I ascended on the next bright morning the Pedra Songue (pronounced Songhe) known under this name among the natives as one of the highest mountains in the Presidium. Arrived on its plateau, I found that the continuous rain-fall had swelled all the ponds to excess, and filled every hollow with water. On the brink of these waters, mostly covered with sterile mosses, my attention was immediately attracted by a shiny black substance which extended in all directions, with few interruptions, towards the descending edge of the cliffs. There I saw its further course along the streamlets made by the overflowing of the ponds. Examining this black substance with the aid of a strong pocket-lens, I saw at once that it was a filamentous Alga; and from that moment the riddle of the Pedras Negras was solved. On the following day I subjected specimens of the Alga to a minute careful microscopical examination, and its characteristics proved it to be probably a non-described species of the prolific genus

Scytonema, which in that situation during the rainy season generates and multiplies so rapidly, that the upper portions of the mountains are covered with it in a very short time.* The rains falling in the early part of the year, especially those in March and April, are accompanied by heavy thunderstorms and frequently also by thick fogs. The latter envelope the rock summits from dawn till noon, creating a surrounding damp warm atmosphere, which naturally favours the rapid growth and propagation of this Alga, which, besides, is otherwise known to be of a prolific kind. Hence arises the phenomenon that in very wet

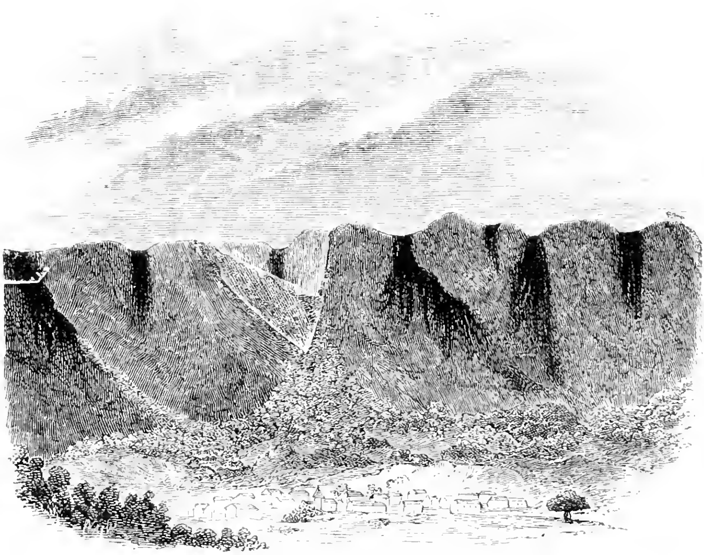


FIG. 1.—Pedras Negras before the rainy season.

years, most of the upper rock portions are covered with the black Scytonema towards the end of April; whilst in years with scanty rainfall, only single rock-clefts and a few of the cliffs appear more or less with the algoid covering (see figs. 1 and 2). Soon after the hot season has set in, at the end

* Supported by this observation, made in 1857, I stated already, in 1858, in my printed Report to the Portuguese Government, that the black colouring of the rocks in the Presidium, must be attributed to the massive growth of a species of Scytonema.

of May, when the horizon above the Presidium is generally clear and bright, the black plantlets begin to discolour with the intense heat. They gradually become dry and brittle until they peel off altogether by and bye, after which the rocks lose their sombre black aspect, and reappear in their natural grey, or grey-brownish colour before the succeeding spring.

In conclusion, I have to observe that the wonderful growth of Scytonemas in such immense quantities, is not confined to the mountain ridge of the Presidium. It also extends eastwards, with more or less interruption, effecting a most important and bene-

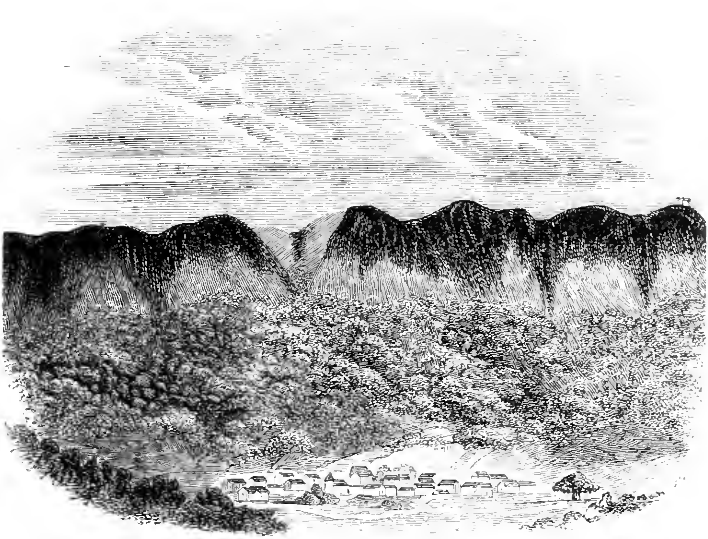


FIG. 2.—Pedras Negras after the rainy season

ficial influence on the maintenance and existence of many other small herbs. In proof of this fact, I may refer to the damp sandy upper valley of the Cuanza River, where a species of Scytonema is abundant, frequently extending across the wide meadows, closely spread, like a net over the soil, intergrown with other herbs and smaller shrubs. Through its hygroscopic nature, it eagerly absorbs the atmospheric moisture during the dewy nights, affording by this means a refreshing protection to the roots of many other and larger plants, during the glowing heat of the following day. (The growth and thriving of numerous small Phanerogamous plants, from the orders of Eriocauloneæ, Cyperaceæ, Campanulaceæ, Scrophularinæ, and Droseraceæ, nay, even the existence of a few Isoeteæ, in these places, is conditional on the co-presence of the prolific Scytonema. If they were to lose the important hygroscopic protection of the latter, they might be unable to thrive under the scourge of the tropical sun.) But these species, although all belonging to the genus Scytonema, are specifically quite distinct from those growing on the mountains of Pungo Andongo; they are of brighter colour, and are spread like velvet, in a horizontal layer, over the soil. An exquisite species, bright red, I encountered abundantly, eastward of Pungo Andongo, between Condo and Quisonde, where it covered tracts of 20 to 30 paces, like a carpet, harbouring numerous small phanerogamic plants. Also on my later journeys to the Highlands of Benguella, and principally on the high plateau of Huilla, I often met with other species of Scytonema growing over the sandy soil of the pastures and open forests; but nowhere did I observe these small cryptogamic plants in such abundance, nor their effect on the physiognomy of the country so striking, as at the Pedras Negras of Pungo Andongo.

Fig. 3.—Shews the Scytonema of its natural size.

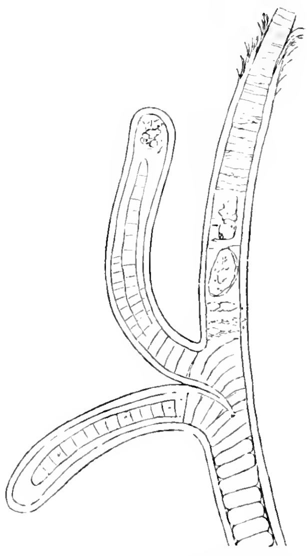


Fig. 4.—A branchlet magnified. It will be described under the name of Scytonema chorographicum.

PROFESSOR AGASSIZ IN BRAZIL.

BEFORE this meets the eye of the reader, Messrs Ticknor and Field, of Boston, will have published a "Journey in Brazil," by Professor and Mrs Louis Agassiz—an illustrated book of over 500 8vo pages. We have been favoured with advance sheets, from which we are enabled to give the following preliminary notice.

The narrative is interwoven with some of the more general results of Professor Agassiz' scientific observations, especially his inquiries into the distribution of the fishes in the greatest hydrographic basin in the world, and the proof of the former existence of glaciers throughout its extent. The vegetation of the tropics, seen by Professor Agassiz from a palæontological point of view, is drawn in charming pictures by Mrs Agassiz' pen.

The first chapter embraces the journey from New York to Rio. Mr Agassiz' instructions to his corps of assistants, given in a series of lectures on shipboard, exhibit the systematic plan upon which the scientific survey was conducted.

Subsequent chapters follow the course of the party along the coast to the Amazons, in the ascent of the river to Tabatinga on the Peruvian frontier, including short residences at Manaos, Mauhes, and Teffé. At Teffé, frequent mention was made of Mr Bates, "Senhor Henrico," whose narrative Mrs Agassiz often recalls with interest. Nearly six months were spent on the Amazons.

Besides a special chapter on the physical history of the Amazons, several appendices on scientific subjects are added by Mr Agassiz. Comparisons are drawn between the Indian and Negro—a subject which is occasionally discussed in the text. Mr Agassiz expresses his conviction that the relation of human races to each other is the same in kind as that which species bear to each other, and that hybrids of the human races are always a mixture of two primitive types, and never, as among domesticated animals, the simple reproduction of the characters of one progenitor alone.

The itinerary of the assistants is also traced in an appendix. These gentlemen explored most of the country between Rio and Bahia, from the coast range of mountains to the sea; the whole course of the rivers San Francisco, Paranahyba, and Tocantins, besides making shorter excursions up the affluents of the Amazons.

The principal scientific topics discussed in the book, relate to the distribution of the Amazonian fishes, the discovery of immense deposits, believed to be drift, and the physical history of the Great River.

Mr Agassiz believes that several well-characterized ichthyological faunæ can be distinguished in the Amazons. "The species," he says, "inhabiting the river of Para, from the border of the sea to the mouth of the Tocantins, differ from those which are met in the network of anastomosis which unite the river of Para with the Amazons proper. The species of the Amazons below the Xingu differ from those which occur higher up; those of the lower course of the Xingu differ from those of the lower course of the Tapajos. Those of the numerous igarapés and lakes of Manhaés differ as much from those of the principal course of the Great River and of its great affluents." Even shores, which, from a geographical point of view, must be considered as opposite banks of the same stream, were found to be the abodes each of an essentially different ichthyological population. A few fish, such as the Pirarucu, were found throughout the whole extent of the river, although their migrations were evidently limited to movements from shallow to deeper waters, and back again to shoals.

Even bearing in mind the large number of distinct faunæ, we are astounded to hear of the multitude of species inhabiting the river: at the close of his explorations, Professor Agassiz writes to the Emperor of Brazil, "it is very difficult for me to familiarise myself with the idea that the Amazons nourishes nearly twice as many species as the Mediterranean, and a more considerable number than the Atlantic, taken from one pole to the other." And again, "All the rivers of Europe united, from the Tagus to the Volga, do not furnish one hundred and fifty species of fresh-water fishes; and yet, in a little lake near Manaos, called Lago Hyanuary, the surface of which covers hardly four or five hundred square yards, we have discovered more than two hundred distinct species, the greater part of which have not been observed elsewhere." He estimates the total number as not less than eighteen hundred or two thousand species. His artist made eight hundred drawings of fish.

Professor Agassiz' attention was early arrested by a very peculiar formation near Rio, which he at once suspected to be drift;

it was not long before he found, at Tijuca, "a drift-hill with innumerable erratic boulders, as characteristic as any he had seen in New England." The sandy clay of the vicinity which rested immediately upon the partially stratified metamorphic rock frequently contained these boulders. The extensive decomposition of the rock, which often made it very difficult to determine the line of demarcation between the rocks and the drift, had, of course, obliterated every trace of rock-polishing or grooving which might once have been present ; yet, even where the disintegration was extensive, it had not destroyed the undulating lines of the *roches moutonnès* upon which the drift rested. Aided by frequent examinations of the geology in the vicinity of Rio, Mr Agassiz and his assistants were able to trace the same formation throughout every part of Brazil which they explored. Whatever the nature of the underlying rock, they always found at the surface the same homogeneous clayey reddish paste containing quartz pebbles. In the Amazons valley, however, the relations of this sandy clay to the underlying deposits were of a different nature, and have furnished the basis of a remarkable hypothesis presented pretty fully in this work. Throughout the valley, three distinct deposits occur :

1*st.* Finely laminated clays, resting upon a well-stratified sandstone, and overtopped by a crust almost resembling a ferruginous quartzite.

2*d.* A cross-stratified, highly ferruginous sandstone, with occasional quartz pebbles.

3*d.* The ochraceous, unstratified sandy clay already mentioned, spreading over the undulating surface of the sandstone, and filling all its depressions and cracks.

We are not told the extent of the first series of beds ; the second sometimes attains a thickness of more than 800 feet, and the third ordinarily varies from 20 to 50 feet.

Notwithstanding the thickness of these deposits, their compact structure, and the fact that the first and second are conformable to each other, while the third lies uncomformably above them, Mr Agassiz believes that they *all* belong to the glacial epoch. He attributes their position and variable character to the conditions under which they were deposited, and the hardness and compactness of many in the series, to the heat of a tropical sun. This conviction is founded on the correspondence of their materials to those accumulated in glacier bottoms ; on the resemblance of the uppermost layer to the Rio drift (the glacial origin of the latter he believes to be unquestionable) and on his views of the physical history of the valley in general. These require the explanation of two phenomena: the filling of the basin of the Amazons with clays and sandstone to the height of more than 800 feet above the sea, with no seaward barrier of rock; and the subsequent denudation of the country to its present level. Mr Agassiz thought the valley of the Amazons was an immense cretaceous basin filled with recent deposits, and that the history of its formation was briefly this:

1*st*. The filling of the whole valley with a glacier, which extended from the high lands of Guiana to those of central Brazil. 2*d*. The formation of a vast terminal moraine, which, upon the retreat of the glacier, shut out the sea and eventually left an immense fresh-water lake. 3*d*. The partial melting of the glacier, during which time the lower stratified layers were deposited, the coarse materials falling to the bottom. 4*th*. The disintegration of the whole body of ice, at which period more or less regular beds of sand were deposited to the depth of 800 feet. 5*th*. The breaking through of the morainal barrier and the extensive denudation of the whole country; which was followed by, 6*th*, a period of quiet accumulation of ochraceous sandy clay with boulders brought by floating ice at the close of the ice period. 7*th*. A second drainage, caused by the total destruction of the seaward barrier and a reduction of the waters to their present level. 8*th*. The gradual encroachment of the sea upon the river-bed, destroying all traces of a delta, and causing the former affluents near its mouth to flow into the sea.

This volume, from portions of which we have given this brief preliminary notice, consists almost entirely of Mrs Agassiz' diary, written from day to day, in the hope that, "some use might be made of the thread of the narrative in knitting together the scientific reports of the journey." The work is appropriately inscribed to Mr Nathaniel Thayer, who, with unusual munificence, bore the entire expense of six regular assistants.

Mr Vogeli, Professor in the Military Institute at Rio, and sent to Boston by the Emperor of Brazil, is translating the work into Portuguese and French. It will appear at an early day in Rio and Paris.

S. Scudder, Boston.

*DUFTON'S ABYSSINIA.**

IN the last century, Bruce, who will always be recognised as one of the most accomplished of modern travellers, was subjected to much illiberality, and bore with calm endurance the unprovoked taunts and coarse ridicule of the shallow critics of the day, who more than questioned the veracity of his account respecting some of the manners and customs of Abyssinia. Since his death, however, his reputation has been cleared from the aspersions of his detractors, for many subsequent travellers through the same region have borne testimony to the general truthfulness of his statements.

But this desirable termination can scarcely be expected by *all* the writers of the present day; for whilst some declare the attempt to invade the country an impossibility, and paint the most alarming pictures of arid plains, mountain torrents, malaria-laden valleys, and frightful precipices; whilst they almost threaten the expeditionary force with all that is loathsome and dangerous in natural history, from guinea-worms and poisonous flies to gliding reptiles and men-devouring lions—the obverse side glows with vivid descriptions of the salubrity of the climate and beauty of the country, with its undulations of hill and dale, and either ignore the bugbears of the pessimists, or leave them in doubtful obscurity.

The work before us can scarcely be dignified into a book of travel. Exploration, for its own sake, was not the cause of the journey; and although the author affords a few brief glimpses of the country, and touches slightly on the most prominent customs, it will, we think, be desirable to give a brief *resumé* of the little we know of these equatorial highlands, more especially as the author candidly admits that, in the compilation of his narrative, he has drawn largely on his memory.

In many modern maps, Abyssinia is depicted as extending to the coast of the Red Sea, whereas, in fact, it is a mountainous inland country, whose actual boundaries nowhere reach the coast, and which, indeed, it would be difficult to define at all, for the warlike races of the various provinces bordering on Abyssinia

---

* Narrative of a Journey through Abyssinia in 1862-3; with an Appendix on the Abyssinian Captive Question, by Henry Dufton. London: Chapman & Hall. 1867.

proper are engaged in almost constant conflict, either to preserve or regain their own independence, against the grasping ambition of King Theodorus.

Until lately the whole sea coast on both sides of the Red Sea was under the actual dominion of Turkey, and the kaimakans, or governors, were appointed from Constantinople; but now, though the Turkish flag is retained as a symbol of power, the sovereignty of the Sultan is only nominal, for the whole of the western or African side of the Red Sea, from Suez to Massowah, has recently been ceded to the Egyptian Government, and the Viceroy's jurisdiction remains unquestioned, whilst his troops garrison the various towns bordering on the sea.

Between the sea coast and the mountainous region of Abyssinia is an extensive tract of low-lying and waterless country, ranging in breadth from 30 to 300 miles; and, although discrepancies exist respecting the nature of the level, there seems little doubt that the scrubby wilderness will cause considerable difficulty to any large body of troops, whose camp equipage and commissariat are dependent on such primitive means of conveyance as camels and mules.

The spurs of the uplands or mountain ranges approach Massowah much nearer than any other parts of the coast, for Dr Beke, writing in 1842, states that he descended from Kiaquor to Massowah—about 30 miles—by a gradual and easy road, well watered, and occupying only two days and a-half of very gentle travelling: whilst, according to the same authority, Halai, on the eastern spur of the table-land, 8400 feet, or upwards of a mile and a-half in height, is yet nearer the coast, being only about 20 miles from Anesley Bay. Dr Beke, however, strongly recommended the route through the Haddas Valley as the best approach to the highlands, and pointed to Senafé as the most eligible position to select as the base of inland operations; and the valuable advice of the experienced traveller appears to have been strictly followed by Colonel Merewether. From the other two well-known points of communication, viz., Amphilla Bay and the Gulf of Tajurrah, the distance across the arid plain varies from 200 to 300 miles; there is, therefore, little doubt that a wise selection has been made in fixing on Massowah, or Anesley Bay, in its immediate neighbourhood, as the sea base of operations for the expeditionary force about to invade the dominions of the self-styled descendant of the Queen of Sheba.

Massowah is, moreover, the chief place of shipment for the exports from Abyssinia, and Theodorous is well known to entertain the hope that it will eventually become the seaport of his empire. It lies about 300 miles from the Straits of Bab el Mandeb (Gate of Tears), at the entrance of the Red Sea; and about 400 miles from Aden, our Eastern Gibraltar, at the southern extremity of Arabia.

The small island on which Massowah stands is nearly covered with buildings, the only respectable house in size or build being the official residence of the Kaimakan; the remainder are miserable hovels, not excepting those occupied by the English and French Consuls. In 1866 the garrison numbered about 1000 Egyptian troops, and the artillery defences consisted of twelve guns; but, in consequence of the contemplated invasion of Abyssinia, the force has lately been increased to 10,000 men.

The climate of Massowah, between March and November, is said to be pleasant enough, but the remaining months of the year are very trying to European constitutions, for the harbour being landlocked is beyond the influence of the prevailing breezes outside, and a damp, dead stagnation of atmosphere often takes place, with not a breath of air to remove the oppressive feeling.

The Christianity of the country is rather of a mixed character. It enforces the observances of fasts and other ceremonials, the adoration of the Virgin, the invocation of saints, the doctrine of the real presence, and in many other respects bears a strong resemblance to the Romish Church; whilst, on the other hand, it retains many of the rites of Mosaic dispensation, such as circumcision, the observance of the Jewish Sabbath, the veiling off a holy place in their churches, and all the restrictions respecting clean and unclean animals.

The object of primary importance to be attained by the expeditionary force, was to select a suitable base of operations on the sea coast, and thence by as short and easy a route as the nature of the country permits, to establish a second inland base on the edge of the upland plateau facing the sea. The road or route connecting the two stations must necessarily be kept open, and, if possible, communication should be effected by means of telegraph, for which arrangements have been made. As we have before inferred, Senafé has now been reached by our advanced brigade, who must be rejoiced to find a temperature resembling that of an English autumn. The troops appear to be in the best possible spirits, the people are friendly, and the advance into the interior is looked forward to with eagerness. Mr Dufton is opposed to the opinions of those who, knowing the country well, are not disposed to imagine that anything in the shape of a flank movement would be attempted by the enemy, who, even if desirous of undertaking such a hazardous proceeding, would probably have to pass through hostile territories.

The foregoing sketch will serve as a brief introduction to Mr Dufton's narrative, the latest original-work, so far as we are aware, on a country with which our troops have by this time begun to make a practical acquaintance. It is unnecessary to dwell in detail on the cause of the author's traversing the country, and we therefore content ourselves by observing that his object in visiting Equatorial Africa, as stated in his preface, was of a philanthropic character, with a view to the future extension of Christianity and colonization, a sufficiently wide field, it must be confessed, for any one man to undertake.

Like Bruce, our author entered the "Switzerland of Africa" from the banks of the Nile, and starting from Khartoum, at the confluence of the White and Blue rivers, he proceeded along the banks of the latter to Meselemich and Wad Medineh, and thence by way of Matammah to Debra Tabor, in the heart of Abyssinia, where he became personally acquainted with Theodorus, and had an opportunity of forming his own estimate of the character of the chieftain who now enjoys rather a questionable sort of celebrity.

Mr Dufton appears to have been troubled with only a small amount of *impedimenta* in the shape of baggage, but was much embarrassed in having for his only companion on leaving Khartoum, "a donkey wot would'nt go." Frequent reference is made to the intractable spirit of this animal, which, being probably of a philosophic turn, was evidently not so enthusiastic on the subject of exploration as his owner. At the village of Tyibeh Mr Dufton experienced much kindness from the natives, which culminated in their offering, for his acceptance, a damsel of seventeen. "I declined," he observes "with thanks, alleging as my reason that Christians did not allow what Mahommedans permitted. They (the would-be donors) marvelled at the reply, and the maid likewise."

In November 1862, Mr Dufton, then accompanied by Mr Lejean, the French Consul, left Matammah, a place of considerable importance, in consequence of its close proximity to the Abyssinian frontier, which is described as being indefinitely marked. On entering the territory of Theodorus, "the road was very uneven, now ascending a steep mountain side, now descending into a deep valley. The country was magnificent, far surpassing anything I had previously seen. The high mountains of the Scotch Highlands, covered with the fertility of the Rhine land would best represent it; but the vegetation was of a nature quite different from that of the Rhine, characterized as it was by the luxuriance of the tropics. Once the road skirted the side of a mountain, the summit of which, raised 1000 feet above our heads, looked down into a deep valley another 1000 below our feet."

The foregoing description will serve to remind those of our readers who have travelled from Colombo to Kandy, in Ceylon, of the Kadaganava Pass. "On the opposite side of the valley, the land rose to a similar steep eminence, which, in one part, was connected with that on which we stood by a low chain of undulating ground, so that a pretty little stream at the bottom, like a silver thread in the dark shadow of the mountains, wound about, searching for a channel. Fruitful fields hung over it, thick at every curve. The hills, of secondary formation, were broken here and there into rocky chasms, through which eaped innumerable falls of water, in their downward course to join the stream; and here I saw for the first time, the beautiful Euphorbia, called the Kolquol, whose dark candelabra-shaped branches, tipped with bright yellow flowers, stood out in deep relief from the lighter green around. Bright flowers, of every variety, most of which were unknown to me, but amongst others, the familiar wild-rose, the honeysuckle, and jessamine, lent their beauty and fragrance to the scene. The whole was a perfect gem of nature."

From the summit of the Wekhni Mountain, the travellers were rejoiced by having a prospective view of no less than 30 miles, which is thus described,: "This part of the country consists of vast table-lands of transition rock, intercepted by deep valleys of undulating ground, partly covered with wood. The flat summits of the higher lands are entirely bare. We saw here, for the first time, the grain called *teff*, consisting of what at first would be aken for long grass run to seed. It stands about a foot high, and yields a small round grain, not larger than a pin's head. It makes good sweet bread, however, which is much preferred by the natives to that of the *mashila* (doura, or maize), or even to wheaten bread.

During the author's visit to Tchelga, a market was held, the principal articles for sale being, "raw cotton and coarse cloth, tanned hides, honey, grain, milk, butter, red pepper, coffee, *tchat* (a sort of tea), *kosso*, and sweet potatoes."

The Maria Theresa dollar is the only coin used, and necessarily limited to large purchases; smaller transactions are made with pieces of salt, called *tsho*, cut into small blocks, which form the principal circulating medium throughout the greater part of Abyssinia.

On the margins of several streams traversing the undulating plains of Tchelga, the presence of iron was evidenced, by the effect produced on a compass of delicate construction, whose needle, when placed on the ground, was deflected as much as 90°; and a further proof, was the yellow deposits of oxide left by mountain rivulets. Beds of inferior coal were also found in the plain of Tchelga, and Mr Dufton expatiates on the advantages possessed by the country, but which would require an enlightened government to develope.

Here, also, on the summit of a hill, traces of the remains of a stone building—supposed to be those of a Portuguese Church—were discovered. "As usual in buildings of such a description, this is situated in the midst of a beautiful grove of trees, amongst which the Kolquol, by its beauty, claims an undisputed preference. It here attains a height of 40 feet, and the cactus-like branches, springing from the parent stem, about 10 feet from the ground, are some six inches in thickness, and yield on contusion a bitter milky fluid, which is said to be poisonous. The wild aloe, about two feet high, adorned with a beautiful red flower, is also very common in this neighbourhood."

On his way to Debra Tabor, Mr Dufton skirted the northern shores of Lake Tsana, about 70 miles long, by 40 broad, and 6000 feet above the sea level. Several islands, covered with rich tropical foliage, appear to float on the surface of its smooth waters; yet, notwithstanding all its attractions, the Abyssinians have never had on it a boat worthy of the name. Here, in addition to teff, doura, wheat, barley, and other cereals, its shores produce cotton, the grape vine, and a few fruit trees, whilst to the south-west the coffee plant is said to flourish.

In the comparison between the Christians of Abyssinia and the Mahommedans and Jews, the contrast is unfavourable to the former, whom he characterizes as being not only proud and inhospitable, but deceitful, lying, and insincere, a character which unfortunately, seems only too well deserved.

At Debra Tabor, Mr Dufton had an opportunity of forming a personal opinion of the appearance and character of Theodorus, King of the Kings of Ethiopia; and his description would tend to imply that his sable Majesty is not so black as he is painted. For the following portrait the author is responsible: "His appearance was that of a man of about forty-five, of middling stature, and possessed of a well-knit but not over-powerful frame, conveying more the idea of being tough and wiry than of strong physical development. His complexion is dark, approaching to black, but he has nothing of the negro about him. His features are altogether those of a European. His head is well formed, and his hair is arranged in large plaits, extending back from the forehead. The forehead is high, and tends to be prominent. His eye is black, full of fire, quick, and piercing. His nose has a little of the Roman about it, being slightly arched and pointed. His mouth is perfect, and the smile which, during the conversation, continually played upon it was exceedingly agreeable, I may say fascinating. He has very little moustache or beard. His manner was peculiarly pleasant, gracious, and even polite, and his general expression, even when his features were at rest, was one of intelligence and benevolence. On the whole, the physiognomist would find no trace of fierce passion, save in the lightning-glance of his eyes. I watched for the keen shot of light coming from them at times, and reflected on what he could be capable of, but they did not strike me as treacherous eyes."

If the above description be not overdrawn, it tends to confirm the truth of the old adage respecting appearances, for it would almost appear as if Mr Dufton had drawn his pen at a venture, and produced a characteristic sketch of a Howard, a Wilberforce, or a Peabody. The fact is—at least, we strongly suspect—that the author was not a little thankful to have escaped the delicate attention of the amiable despot, and unintentionally (for throughout the whole book there is a manifest impress of sincerity) he had drawn too largely on a grateful memory in depicting the cold-blooded tyrant who was capable of avenging the death of his favourite, the Englishman Bell, on the field of battle, by the mutilation of 1700 prisoners, whose hands and feet were chopped off, and their bodies laid in a heap for wild beasts to devour. On another occasion, we are told, after the suppression of a revolt in the Province of Tigre, the rebel leader, Agow Negusie, and his brother had their right hands and left feet cut off, and were exposed in the market-place of Adowa, with strict injunctions from Theodorus that not even a cup of water should be given them. Breaking on the wheel, or being torn asunder by horses, are merciful deaths compared with such diabolical atrocities.

After obtaining his *congè* from the gentle Prince of Ethiopia, Mr Dufton started for Massowah, via Adowa, the capital town of the Province of Tigre, and second city in the empire. Though in a valley, it is yet 4000 feet above the sea, and excites interest on account of its being the centre of a chronic state of rebellion, and the many eventful scenes enacted there. In Adowa, M. Schimper, the German botanist, whom Mr Dufton describes as the best informed of all Europeans who have visited the country, has resided for a period of twenty-six years; and we echo the regret expressed in the work before us that he has not yet published anything on the subject, although he is stated to have constructed a map of the mountains of Adowa, with all their heights estimated, not from thermometric observations of boiling point, but according to the known habitat of various plants.

The celebrated Taranta Pass is described as being almost perpendicular for 8000 feet, and the descent, hemmed in as the traveller was on all sides by mountains, as "going down into the very bowels of the earth." Here, at a place called Tubbo, a native Albino was encountered, "with white hair and pink flesh, looking just like a boiled European," possibly a correct description, but one, which we suspect, few of our readers will be able to verify.

The foregoing extracts, convey only a small idea of the interesting matter the book contains. The Appendix, of no less than 94 pages, consists of a *resumé* of the main incidents of the Abyssinian question, but sufficiently voluminous to put the reader in possession of all that is necessary to understand the cause of our present complications with Theodorus. But, whatever may have been the cause, or whatever may be the result of our forcible interference, one thing is certain, that by it we possess an unrivalled opportunity of adding to our scientific knowledge of equatorial Africa; and we are glad to perceive, that the Government, in making several late appointments, not only share in this feeling, but have taken prompt action in carrying out the desirable object. Geography will be represented by Mr Clements Markham, senior secretary of the Royal Geographical Society; Zoology by Lieutenant R. C.

Beaven of the Bengal Staff Corps, who has already distinguished himself by his collections of natural history in various parts of India and Burmah; Geology by Mr W. Blandford, the deputy-superintendent of the Geological Survey of India; and Botany, it is expected, by Dr Birdwood, curator of the Victoria Museum, Bombay. Other nations are availing themselves of the same opportunity. The King of Prussia has despatched the African traveller Gerard Rohlfs, to join the expedition as a scientific observer; and the King of Italy has sent two staff officers of eminence to profit by observation of the military operations.

D. M'G.

*BENTHAM AND HOOKER'S GENERA PLANTARUM.**

Note by Editor.—When the last part of this work appeared we immediately saw the difficulty of getting it satisfactorily reviewed in Britain; for however eminent the critic might be who should undertake the task, it was not to be expected that the public would put much faith in his qualifications to sit in judgment upon Mr Bentham and Dr Hooker. We felt that we must look beyond our own island for some one whose qualifications and position would be sufficient weight to allow his verdict to be accepted as a guide, and we naturally turned to the first botanist on the other side of the channel as best qualified to give an opinion upon the scientific work of the first botanists on this side. Professor De Candolle has kindly complied with our request, as the reader will see from the following note and accompanying review:—

"*Genève, 16th Decembre* 1867.

"Monsieur,—Vous m'avez témoigné le desir de recevoir pour votre *Revue* un article sur le *Genera Plantarum* de MM. Bentham et Hooker. Un ouvrage de cette importance, dont le mèrite est pour beaucoup dans les détails, a besoin d'etre consulté pendant plusieurs années pour etre bièn apprécié. Cependant il y a quelques reflexions gèneralés qu'on peut énoncer des á present, et je m'empresse de vous envoyer les miennes. Elles sont écrites en francais et vous paraître dans la *Bibliotheque Universelle de Genève*, cahier de Decembre 1867, mais puisque vous etes le cause de ce travail, je vous en envoie une épreuve que vous pouvez traduire en anglais, si cela vous convient, et publier dans votre journal. Agréez, monsieur l'assurance de ma consideration distingué.

ALPH. DE CANDOLLE."

NOT a year passes without the publication of a multitude of floras, monographs, and memoirs of all sorts, but the appearance of a Genera Plantarum has always been a rare event in science. The work of Messrs. Bentham and Hooker, of which we propose to speak, is, in truth, only the sixth of that nature since the regular establishment of genera at the commencement of last century. In fact, if we put aside the enumerations of new genera, and of genera of particular countries, a small number of incomplete or insignifi-

* Genera Plantarum ad Exemplaria imprimis in Herbariis Kewensibus servata definata; Auctoribus—G. Bentham et J. D. Hooker. Vol. I. sistens Dicotyledonum Polypetalarum Ordines lxxxiii. (Ranunculaceæ—Cornaceæ). Londini: Lovell Reeve. 1862-67, pp. 1040.

cant compilations, and the tables of Adanson specially relating to families, we must regard the "Institutiones" of Tournefort, published in 1709, as the oldest work upon genera. It is there that botanical genera are for the first time clearly distinguished, defined by character, and even represented by analytical figures. The species are there merely enumerated, and are also strangely mixed up with varieties or monstrosities, so that the merit of the work lies essentially in the definition of the genera. The Genera of Linnæus appeared in 1737. The classical work of Antoine Laurent de Jussieu is of 1789. Almost simultaneously (1790), de Necker brought out under the title of "Elementa" an enumeration, much less remarkable, of the genera then known, with an indication of their characters. A considerable time then elapses, and in 1836 two learned botanists, Endlicher and Meissner, separately and simultaneously set about publishing Genera Plantarum. Finally in 1862 Messrs Bentham and Hooker undertake anew that always great and difficult task.

Was this, then, a work imperatively demanded by the state of the science? or, in reality, have not the zealous English botanists chiefly consulted their powers, their classical knowledge of classification, and the extraordinary riches of the materials at their disposal? We rather incline to believe the latter alternative. The Prodromus with its slow but regular step was passing gradually over the large class of Dicotyledons, creating or destroying many genera; and putting them, one after another, to the proof by a complete revision of species.

The Genera of Endlicher, a work of remarkable perfection, and of a convenient size, was still in all hands. The division of Cryptogams is undergoing profound transformations, which it will be difficult for many years to condense into truly stable genera, or sub-genera, analogous to those of the Phanarogams. Besides, the history of botany shews that more than a quarter of a century has commonly elapsed between the publications of "Genera." On the other hand, few botanists are so well situated as Messrs Bentham and Hooker, for undertaking a work of this nature. Each of them has already published floras of different countries, and monographs, two kinds of works which develope the tact and the judgment in matters of natural classification. They have the necessary coup d'œil and experience. The disposition of their minds is not to absorb themselves in details. They delight to group facts, and as they have at their hand immense herbaria, with a rich library, it is easy to understand the seductions which the work of a "Genera" has for them. It happens often enough to naturalists, and to all learned men, to allow themselves to be led by their individual aptitudes, or by private circumstances, more than by considerations of the general state of science. When De Candolle commenced the Systema and the Prodromus, the time was badly chosen. Travellers were every year bringing back between one and two thousand new species. It was like a submergence of genera: and families in proportion as the revision operated; and, nevertheless, is it not better that the work has been courageously ventured on and continued? In future, the authors of new "Genera" will have to traverse in the series of families entire regions, in which they will find little or nothing to correct or modify. Nevertheless, since that enterprise has smiled upon them, let us not blame them. One only does that well which they like; and a serious employment of the time of capable botanists always produces good results. The first volume of the new "Genera," which is just finished, is a proof of it. The next in which the immense family of Composites will be comprised, will probably be of still greater importance, on account of the numerous retouches and additions made by divers authors since the Prodromus.

At the first glance, the work has not that regular, we would say even magisterial disposition which one admires in Endlicher's book. The great divisions of the kingdom are not there exposed from the beginning and co-ordinated with the rest. They are expressly reserved. That is a consequence of a profound difference in the manner of proceeding. Endlicher had constructed his Genera chiefly from books. Our authors draw up theirs chiefly from plants. Endlicher, in spite of all his capacity, could never have executed his work in four years, if he had attempted to verify all the characters, and to innovate, by referring back to the direct examination of species. Without doubt he had examined many plants, or rather he had seen, and he has profited by his notes to amend here and there; but he has not indicated what he had himself verified, and, in general, one has the feeling in consulting him that he has verified little, and that he shines chiefly by an exposition as complete as lucid of the labours of his predecessors. Messrs Bentham and Hooker, on the contrary, work upon the plants themselves. Their title bears:—"Genera Plantarum ad exemplaria imprimis in Herbariis Kewensibus servata definita." It is clear and it is true. We know, thanks to the friendly relations by which we are united to the two authors, that they analyse for their work millions of specimens. In consulting their work, one can start from the basis that they have verified the characters, except in the rare cases, where they tell us that they have been unable to do so. This is a capital point. Since Jussieu, no "Genera" has been drawn up so completely after nature.

Hence some slowness is the necessary result. The publication of the first volume of the two writers has required five years, as much as the entire work of Endlicher. Another consequence has been to drive off to the end, after a complete review of the families, the consideration of the great divisions and great classes. For the present, our authors limit themselves to indicating a first category of Dicotyledons, the Polypetala, which are subdivided into Thalamifloræ, Discifloræ, and Calycifloræ. These latter comprehend cohorts and families assuredly more evident than the new group of Discifloræ. One does not yet see what will be done with the Gymnosperms, nor how certain families of Monochlamydeæ, perhaps Apetala, which touch on several Polypetala, will be finally arranged. For the rest, Messrs Bentham and Hooker have adopted in the series of families, the order of the Prodromus, without doubt, not that they regard it as perfect—there is no perfect linear order, nor can any linear order be perfect—but because it is a well-known and convenient order. It is that of a quantity of floras and many herbaria. It is also a logical order, under the point of view that it makes the enumeration commence by families which are easy of comprehension, in which no difficult question of organography comes to stop us. Thus in the Ranunculaceæ all the organs of the flower repose upon one extremity of the axis, and shew their intimate analogy with the leaf. The ovaries are superior. Their soldering present steps which facilitate the understanding of the phenomenon. The ovules take their rise clearly from the side of each carpellary leaf (Delphinium.) To place the Ranunculaceæ at the head of the vegetable kingdom, certainly does not respond to the idea of selecting a perfect form in the sense of very complicated; but it does respond to the need our minds require of proceeding from the known to the unknown. Many other arrangements in the series of the Prodromus are less easy to justify; only it must be admitted, that the other dispositions proposed by Lindley, Endlicher, Brongniart, Agardh the son, &c., are also open to objections; and it is an established rule, that in cases of doubt we should give the preference to the most considerable work, to the only "Species" of the current epoch. That spares readers trouble in turning over works, and searching continually in tables. The true and very complicated relations of groups, the one with the other, are, we have said reserved; and the conclusion of the work may place them better in evidence, than transpositions made by degrees in the series of families.

As regards the manner in which the Genera are grouped in tribes and families, we prefer the new Genera to that of Endlicher. The exposition is clearer and more convenient in certain respects. For example, Messrs Bentham and Hooker do not admit groups annexed in a vague way to families. with a tribal termination without being tribes. When one hesitates as to the place or nature of a group, the simplest mode of indicating it is to mark it with a point of interrogation. Neither embarassment nor equivocation result from that; while, for instance, the Coriariæ of Endlicher, annexed to the Malpighiaceæ, without number of family or tribe; the Grubbiaceæ, Nyssaceæ, Antholobeæ, &c., annexed in the same manner to the Santalaceæ, and many others, are not easy to comprehend and cite. Some authors mention them as families of Endlicher, others as tribes. The synonymy becomes complicated by these middle terms; and one no longer recognises in this case the usually clear treatment of the learned German.

The synoptic tables of Messrs Bentham and Hooker are numerous and ably done. One finds them at each step of the classification, for the divisions of classes, cohorts, and families. They take up little space, and, moreover, appear in perfect conformity with the text, which is not the case in all books. These *resumés* will be found very convenient. The rather original innovation by our authors of indicating, separately and distinctly, the exceptions and anomalies which present themselves in the Genera, whether in the families or cohorts, will be appreciated. The botanist who seeks to determine a plant, and who, perhaps, holds in his hand an exceptional form, is put on his guard; at the same time, the characters of the groups are abridged. They are less encumbered with these *vel* which commonly lengthen and confuse them. It is practical; only the reader must not forget that the exceptions fall within the group, and that in reality a character is composed of the rule with the exceptions; whence it results that one ought not, for example, to transcribe the character without the exceptions, in the same way as he must not transcribe a specific phrase of the Prodromus without keeping count of the words placed outside of it and in evidence to constitute the association of species.

As one might expect in a "Genera," the characters of the genera and families are the parts of the work most cared for. The synonymy, that of the families especially, is rather abridged. We may, perhaps, be permitted to regret the absence of the usual citaiion of the author who has first given each name of a family or tribe, and the indication of what was a family in the most important antient works. One likes to be advertised by the name of an author that a group is not new as family or tribe; neither is it any more a matter of indifference to know, without seeking elsewhere, that such a tribe was regarded as a family, or such a family regarded as a tribe, by such or such a botanist of a certain merit. Nevertheless, we believe that Messrs Bentham and Hooker have done well not to repeat all the synonyms of families, tribes, genera, sub-genera, and sections, which exist already in the Prodromus, in Endlicher, Meissner, &c. They do not mention those synonyms already proved, unless they have something to say about them; and, so far as regards sub-genera or sections, they scarcely speak of any but those on which they have a remark to make, or a new observation to publish. That abbreviation is almost a necessity, for the number of synonyms has augmented enormously. I possess a manuscript dictionary in which, for sixty-eight years past, my father and I have introduced all the names of classes, families, genera, and sections,—in one word, all the general names superior to species. It is a repository more complete than the tables of any work, and by so much the more precious that it gives for each name the indication of its date of publication, of the author who proposed it, of the place which he gave it in the classification, and of that which has been given to it in the Prodromus, when that work has spoken of it. Whenever a book, a pamphlet, or a journal is entered in our library, it is analyzed, to excerpt from it those indications on the new names. Consequently, our dictionary now contains from 43 to 44,000 names. It would, obviously, be absurd to intercalate all these names in a "Genera." That would be to double its size without real advantage. It would be better for science that our manuscript were published, such as it is, under the same form as dictionaries of languages. Every author would consult it before proposing a new name, which would prevent double employment of the same name. It would be consulted, also, for questions of priority. In short, I do not doubt that the work would be very useful (and I can speak from experience), but its place cannot be supplied by a "Genera." Its extent justifies Messrs Bentham and Hooker for the greater part of the retrenchments which they have imposed upon themselves in the citation of their synonyms.

They rectify in passing many citations badly made, which lead into error. No one would believe, for instance, how much the opinions of De Candolle, given out in the Systema and the Prodromus, are erroneously represented by many subsequent botanists. M. Schnizlein (Iconogr. Famil. Nat.) mentions the Gompheaceæ, D.C., Andromadaceæ, D.C., and other names which do not exist in the works of De Candolle at least under that form, and as names of families. Ecklon and Zeyher (Enum. Plant. Afr. Austr., p. 8) attribute to my father genera named Carponema, Leptormus, Ormiscus, which he has not made, and which he did not want to make, for he had proposed these groups as sections of the genus Heliophila (Syst. ii., p. 679). Messrs Bentham and Hooker, who of new consider them as sections, re-establish the truth in citing these names as the names of sections of De Candolle, and of genera of Ecklon and Zeyher. Carried on over the whole extent of the vegetable kingdom, such rectifications are not without importance.

Messrs Bentham and Hooker do not take up everything ab ovo. They suppose botanists to be provided with the most important works which have preceded them. They refer back to several of these works, and even to monographs of families. What they give is a resumé, or a complement, of previous labours. The newest part of their work is disclosed by the use that is made of it. It consists in an infinity of information upon genera badly known or badly described, of which the Herbaria of Kew contain authentic specimens, or on which our authors have been able to obtain information which was not to be found elsewhere. These details are extremely scattered, but each is put in its place, and the tables refer to them.

Messrs Bentham and Hooker propose few new genera. They destroy many old ones. That last tendency is made a matter of reproach to them, but it appears to us to flow naturally from the present state of things, and from the quantity of publications lightly made since the time of Linnæus, and even within the last few years. How many genera have there not been proposed on insignificant characters, or on characters common to a whole family, or on some species slightly exceptional, without paying regard to the fact, that if we separate their species, we must make not one, but four, five, perhaps fifty analogous genera. In the works of floras, of gardens, of descriptions of plants, of travellers, one does not see certain transactions nor certain similarities. Monographers are afterwards obliged to make a hecatomb of new genera as of new species. Without doubt, there are great botanists endowed with much tact, who divine the genera at the sight of a species, of a character, of a particular habit; but these are exceptions. The rule is, that it is necessary to have seen all the units, and to have studied them well, in order to be able to group them suitably, and the merit of the "Genera" of Messrs Bentham and Hooker, is that they rest themselves on a review of species, not, it is true, so deep as those of monographs, but nevertheless on a review, accompanied by analysis and the comparison of numerous specimens. Let us ask from them only that the reductions of genera be always well explained, and the grounds fully exposed, so as to permit every one to make the necessary verifications for himself.

In this respect, Messrs Bentham and Hooker have taken pains. Nevertheless, they might do still more, and in future inspire still greater confidence. Let them not fear, with that object, to add a few words from time to time. Let us cite an example: the generic division of the Begoniaceæ is almost the same as that which we have admitted in the Prodromus. The fifty and odd groups distinguished by Klotzsch on the old genus Begonia, and of which he had made genera, are brought back with the title of sections under the common name of Begonia, as we have ourselves done. But Messrs Bentham and Hooker go a little further. They abandon the genus Casparya, of Klotzsch, which we have characterized principally by a dehiscence of the capsule by means of a longitudinal fissure of the angles or wings. Messrs Bentham and Hooker say, in speaking of the whole family, "Capsulæ dehiscentiam in una eademque specie invenimus, nunc secus angulos loculorum ut in Casparya, nunc secus faciem ut in Begonia." If they had mentioned the species which presented that double dehiscence, we might perhaps have been able to verify it, and on a view of the facts, have ranked ourselves as of the opinion of our friends. In doubt on the point, we have run over the whole genus Begonia in our herbarium, without discovering a single example of dehiscence anywhere but on the sides, to right and left of the wings; and it even appears to us impossible to have two dehiscences more different than those of Begonia and Casparya, since the wings of the Begonias have no disposition to divide themselves, while, in the true Casparyas, the wing or angle of each loculus divides itself. There are, according to the "Genera," species of Casparya non-dehiscent; but then either a genus should be made of them, or rather we should regard them as forming a section, for between a dehiscent fruit and an indehiscent fruit, there is sometimes less difference than between a loculicide capsule and a septicide capsule, the absence of dehiscence being perhaps due to something else than a difference of nervation, or the position of the loculi. One may see by this example, that the citation of the names of species in the "Genera" is sometimes desirable. This would make it a little longer; but to inspire more confidence is an object worth the additional length. Besides, when one goes through the labour of analyzing so many species, it is a matter of regret that the public should not profit more by it.

The tendency of Messrs. Bentham and Hooker to unite, whether it be species, or genera, or families—a tendency habitual with them, and which to some appears exaggerated—appears to us to flow almost per force from the successive discoveries which are taking place. The more the cases are filled, the more intermediate forms multiply. Varieties formerly neglected or unknown come to unite species; new species make the transition between genera; new genera between families. One is obliged to multiply the steps of classification and to round in each of them. To thoroughly understand that march, and at the same time several of the questions relating to the natural method, it is well to employ a mode of representation very graphic and sufficiently simple.

Let us suppose a botanist, very exact, a very good observer, and very judicious in the appreciation of relations. If he has devoted a sufficient time to the study of a family, if he has seen all its forms, from the smallest variations of species up to genera, tribes, and even neighbouring families, he would represent to himself the beings which compose that region of the vegetable kingdom as a vast archipelago. The distribution of forms on a plane surface will be, I admit, often insufficient; he would require to employ the three dimensions; and still the supposed botanist would have difficulty in exhibiting the extreme complication of facts by the means of such material procedure. Nevertheless, there are cases where the affinities may be represented by means of a sort of geographical map; and to simplify the argument we shall suppose one of these cases. Our learned and profound botanist has then grouped the varieties and the races in species, and he has succeeded in placing the species upon a map dispersed according to their degrees of resemblance and dissimilarity, On designing them by the first letter of their names they are found to be placed thus:—

n k			*g m*	
l	*d z x*		*i j p y e*	
c		*a*	*y p*	*w*
			u t v	
o				
c s				

There are here evidently six groups: *n k l c; o c s; d z x; a; g* down to *v;* and *w*. The most numerous in species is subdivided naturally into two, for *y* and *w* are more or less distinct from the rest.

The value of the characters common to species of each group will decide whether we must make of these groups six distinct genera or six sections of a large genus; or again, perhaps, three genera, that of the left divided into three sections; *a* a monotypic genus; and a genus on the right divided into two sub-genera, of which *w* is monotypic, and the remainder of the sub-genus into two sections. The sound judgment of the supposed botanist will direct him in the appreciation of the characters. He will desire to be consistent with himself in the same family and in the group of families in question. He will name the genera from associations of an importance analogous to that of the genera admitted by means of authors, and of very apparent genera consecrated by the language of all people. If he hesitates to make of a group a genus or a sub-genus, he will prefer this latter course, which dispenses with a new generic name and relieves the memory; the large genera being after all sufficiently convenient. But whatever course he resolves on, it is clear that the discovery of a species between *c* and *o*, between *x* and *a*, between *a* and *y*, between *w* and the nearest species, will change his combinations completely. A better knowledge of species would have the same effect if our supposed botanist was not a veritable monographer; but we have supposed him such. It is plain that the march of science ought to bring about fusions, and rather fusions than divisions. In former times in entering on the flora of very distant countries, species were discovered which have appeared very distinct, and which afterwards have been united by others from these or neighbouring countries.

Draw by lot a thousand species of all islands and all continents, study them thoroughly: they will appear to you to constitute 500 genera of which several are monotypes. Add 20,000 species of all countries: immediately several intermediate species will appear, the proportion of monotypical genera will diminish, and that of species per genus will augment. In fact, science has not progressed in any other way.

The same graphic construction, and the same reasonings, may be applied to all the steps of natural classification. Thus a species thoroughly studied in all the extent of its habits, and all its forms, compared afterwards with neighbouring species, may equally give place to figures where letters would represent varieties. The question would then be, to know if the groups of neighbouring letters deserve to be called sub-species (races), or species with the chance that on a new form being discovered (or one of the old ones actually disappearing from the world, which is possible) one may have to modify their ideas. Letters disposed in a certain way, would equally represent genera, and groups of genera forming tribes or families. The same for letters which should represent families. Only the probability that the combinations might be destroyed, by the discovery of new units, diminishes the higher groups we deal with. It is impossible to believe in the discovery of a higher class in the vegetable kingdom. One does not discover, so to speak, any more families. In that category, there can scarcely be any more changes, except by a better appreciation of the distance which separates the tribes belonging to families formerly admitted. I have shewn elsewhere* by figures, that the definite constitution of new genera, truly admissible, becomes rarer and rarer, and that by the end of the century it will probably have ceased; while, for a long time to come, the question of species, races, and varieties will be agitated.

According to these facts, based alike on the history of the science and on the principles of the Natural method, it is more and more hazardous to propose a new genus. The probability that such or such a genus is bad increases, we shall not absolutely say each year, but certainly each decennial period. Except in the case of a form completely original, found in some distant little explored region, or of a complete work on a family, it is very rash, now-a-

* Laws of Botanical Nomenclature, &c. Lovell Reeve. London, 1868. See Introduction.

days, to propose a new genus. On the other hand, as there are, and always will be, plenty of rash botanists, it belongs to monographers and the authors of "Genera," to revise their pretended discoveries. Thus, the tomb has just closed upon a Russian botanist, assuredly most estimable and zealous, who knew the plants of his own country well, but who made the mistake of establishing a genus every time he could not determine clearly a plant from South America and the Philippine Islands. Many of these genera of M. Turczaninow are based upon a single species, in groups of which he did not see the whole. One nearly always destroys them at the first regular examination; and it is fortunate in such cases that Messrs Bentham and Hooker have set themselves to make a "Genera." Isolated monographs are rare; those of the Prodromus march slowly, and do not return upon what is past. It is for our two botanists, who pass in review all families, to proceed more completely and more rapidly. Special works explore to the bottom a small space in the field of science. The "Genera" run over the whole and clear, in some sort, the whole extent of the ground. The service which they render is by so much the more real, that it does not require us to wait. After a volume of the Prodromus, or a monograph of a family, the genera proposed on light grounds may remain for ten or twenty years in the books, if there were not some rapid revision elsewhere. This is one advantage of the "Genera" of Messrs Bentham and Hooker, and we ought to keep it in mind, even when we are not of their opinion on the union of some old genera up to this time regarded as valid.

On the subject of that fusion of antient genera, we are very little disposed to cite examples, and to weigh them. That would be a perfect bore to the reader, and, at the same time, contrary to our principles. If we have criticised the suppression of a genus of Begoniaceæ, it is that we have made that family a special object of study. Let others in similar circumstances, but then only, examine and discuss them. Probably many botanists will do as we do. They will judge it right to consult the work, to profit by the numerous renseignments that are to be found in it, and they will suspend their opinion on many points. The new "Genera" will advance. It will have its defects, like all works; but definitely, it has already cleared up many things, and it will continue to render positive service to all those who are working in the field of descriptive botany.

ALPH. DE CANDOLLE.

Correspondence.

THE STRAITS OF MAGELLAN.

THANKS to the kindness of Captain Richards, Hydrographer to the Admiralty, and Dr Hooker of Kew, both of whom, with their well-known zeal for the diffusion of science, have readily acceded to our request for information regarding the Government Scientific Expeditions now in progress, we are enabled to lay before the reader, extracts from the correspondence of Captain Mayne, the Commanding Officer, and of Dr Cunningham, the Naturalist of the Surveying Expedition, now employed on the survey of the Straits of Magellan.

The eastern part of the Straits has now been nearly completed, and by last accounts, Captain Mayne, after passing the winter (our summer) at Monte Video, had returned to the Straits to resume his work, and the western entrance about Cape Pillar, will probably be the point to which his attention will first be directed.

The following are a few extracts from some of Captain Mayne's earlier letters to Captain Richards, and one of Dr Cunningham's later letters to Dr Hooker:

Captain Mayne, R.N., to Captain Richards, Hydrographer to the Admiralty.

H.M.S. "NASSAU," SANDY POINT,*
December 23, 1866.

"This place is greatly improved since we were here in the 'Plumper;' the present governor has only been here about two months, and was appointed, it appears from what he says, on our account, as he speaks both English and French, and has travelled a great deal in Europe. He seems very willing to assist us, informing me the moment he came on board, that not only the orders of his government, but also his own wish, made him desirous to help us. Since that, he has promised to send out all his men to cut firewood for us to-morrow, and has also engaged to get us 30 good poles for stations, as I see we cannot get any wood eastward of Cape Negro. He has also promised us an interpreter, to take back with us. He has here about 1000 head of cattle, and is endeavouring to rear stock of all kinds: he has some 100 or more wild geese, from Elizabeth Island, 4 guanacoes, 2 ostriches (Rheas), and is getting his garden into nice order. He is also building a pier. He will not *sell* the cattle, but has told me I may have a bullock whenever I please, if I will return it in kind from the Falkland Islands or Monte Video. The officers are delighted with the place, what with fish, abundance of wild fowl, deer, and an occasional guanaco. Cunningham finds Scotland reproduced, he says, and has done nothing but 'pot' animals since we came in: between the dredge, towing net and shore, he has been pretty well engaged, but he seems perfectly ready and willing. Campbell assists; he shot four parrots yesterday. Last, but I think by no means least, I should add, that our friendly 'commandant' has promised to build us a large beacon, on the high summit some few miles back from this, and I think this will be of great use to us whenever we triangulate this part.

* Sandy Point is a place on the north coast of the Straits of Magellan, about 50 miles farther north than Port Famine, where, it appears, the Monte Videan Government have established a post, with a governor.

Coal has been found nine miles from this: I am going to the mine on Christmas day, and we are to have a sack or two sent off to try. I brought a specimen off, and the engineer says it will do very well mixed with other coal.

"The governor says, they never experience the least trouble with the natives here.

"It is, perhaps, premature to say much of the surveying staff, until we send you home some charts, but I may say, so far as I have yet seen, I am very much pleased with them.

"The weather is still beautiful—the sun at this moment shining as brightly as on an English summer's day."

"JASON, WEST CAY,—in 67° east, 56 miles.—*February* 18, 1867.—So far, all the work of the survey has gone very well, and the only bad news I have to give, is of Mr Connor having been wounded by some Fuegians, who attacked a party that was detached under the command of Mr Gray. On the 29th December, we left Sandy Point, and reached an old anchorage under Direction Hill that evening. On Monday (31st) I steamed over to Cape Orange, and left Messrs Gray and Connor, first whaler and cutter, to look for a base on Orange Bank, while I took the ship into Possession Bay, and went with the galley and steam cutter to look for one there. We were very fortunate in each getting a good base, and I got three set of circums, and a three day rate,—while Mr Hoskyn, in the steam cutter, sounded the narrow bank. I saw Mr Gray's boats go on board on the 3rd, but merely assumed they had finished their work, and was, therefore, much surprised to hear, when I went on board on the 5th, of the attack on their party. I enclose you the letter I have written about it, which contains all I know; at that time, I could not get an interpreter, although I have since done so. I fear, however, we shall never be able to trust the Fuegians. We had an interview with the Patagonians the other day, and they sold us some guanaco and ostrich meat, and promised not to meddle with our marks. Mr Connor has since quite recovered from his wound.

"To return to our work,—I measured a base of 7705 feet, and Mr Gray one of 5204 feet. Mine being from the base of Direction Hill towards the Narrows, and his along the Orange Bank,—and fixing Orange Peak independently, our two bearings agreed exactly, so that we started with Orange to Direction—nearly nine miles—as our base east and west. We had a week of beautiful weather, and worked out to Cape Virgin and Cape Espiritu Santo, with calculated triangles the whole way, fixing Mount Dinero from each base, and then from the long base. I had marked out the triangulation on the passage out, and have carried out the scheme then drawn, though I confess, when I drew it, I thought it very improbable I should carry it out. We have been most fortunate in our sights. Fitzroy says, it is 'fruitless waste of time' to attempt rating the chronometers by equal altitudes, in other months than May, June, and July, but we got excellent sights at Sandy Point on our arrival there, and also on quitting it the other day; besides which, we have rated at our Direction Hill base, got circums two days running at Dunganness Spit, and any number of true bearings at Cape Virgin, Direction Hill, and Cape Gregory. On the whole, therefore, I think our astronomical observations very satisfactory, much more so than I thought they would be.

"Messrs Hoskyn and Connor, I have left behind at Elizabeth Island, with the steam cutter and one whaler, a month's provisions and coals; I dropped them on the way to Sandy Point last time, and then called there on my way up to see if they were all right, and to leave them eight days' fresh beef. They were all volunteers. I hope they will be able to finish Royal Roads, and connect with Cape Gregory before our return. All the staff are going on very well, and I still consider myself very fortunate in them.

"*February* 21.—Just before leaving Sandy Point, Cunningham and I visited the coal seam near it, but it is not at all fit for working, and Cunningham thinks would not be so without considerable boring.

"I wish to call your attention to our Rio longitude, and that of Mouchez. No doubt you have seen his address to the Academie, in which he says,—that after much trouble, &c., &c., he considers Rio in 3h. 01m. 57s.00 west of Greenwich,—while our mean distance, which we have taken as our most correct, is 3h. 01m. 57s.50. The agreement is curious at least."

"Between GREGORY BAY and VALLE POINT,—*April* 13, 1867.—The ebb tide rushes out of Lee Bay at such a rate, that it was as much as we could do to stem it at full speed the other day. The cutter got swept out into the narrow stream, and I weighed and steamed after her; by the time she was up, we were making stem way at half speed ahead, and as I said, only just stemmed it at full speed. . . . The governor at Sandy Point gave our steam cutter some of the coal from the mine near, to try, and the engineer reported very favourably on it. . . .

"Also I went to see the Chonos Archipelago; it seems to me, that if there is no passage through by the Gulf of St Estevan—and I suppose Fitzroy made certain of this, there is no reason why a vessel should not go out at the Gulf of Penas, and again enter the inner waters by Wickham Inlet, or Darwin Channel, and so pass up inside Chiloe Island. This would give 260 or 270 miles more of smooth water for a steamer. Inside Chiloe Island, the Spanish Admiral Nunez Mundez took three ironclads, and he told me it was quite safe; and in *Harper's Magazine* for April 1865, there is an account of the 'Waterer,' an American man-of-war steamer that went through part of the channel inside the Chonos Islands. The account is not very precise, but they seem to have tried the entrance marked on the chart as the Triangular Channel, and found it closed up, and that they then entered by a passage south of it, probably southward of Bartholomew Island; after which they met with no difficulties.

"I propose to commence next year, by finding a harbour onthe south shore, if possible a little west of Cape Froward, perhaps Hidden Harbour, or one thereabouts, and them some western one, perhaps Port Tamar; after that setting to work at the Smyth's Channels."

"SANDY POINT, *May* 15, 1867.—With my Rio letter, I send all our magnetic observations for the voyage out, a specimen of the bottom obtained on the Jaseur Bank, a tracing, and a report of Dr Cunningham's on said bottom.

"The Chief of the Patagonians is a great friend of mine, and I am arranging with him to meet us at the Gallegos next month; indeed I am not quite sure that a party will not go up with him and bring the fossils* down on horseback.

RICH. C. MAYNE."

Letter from Dr Cunningham, Naturalist on Board H.M.S. "Nassau" (Captain Mayne, Commander), to Dr Hooker, Kew.

H.M.S. "NASSAU," GREGORY BAY,
April 12, 1867.

"As we shall have an opportunity of despatching a mail in the course of two or three weeks by the 'Spiteful,' which meets us with coals and provisions, I write to you again to inform you of our proceedings since my last, which was penned in St Iago Bay, nearly two months ago, and sent off from the Falkland Islands shortly thereafter. We left the Straits late on the afternoon of the 16th of February, passed the Jason Islands on the evening of the 18th, and reached Stanley Harbour about 6 P.M. on the 19th. It was a wretched cold, rainy afternoon, and I thought Stanley one of the most miserable-looking places I had ever seen, with its houses irregularly scattered up and down the side of a bare, bleak hill. I cannot say that a further acquaintance with Stanley and its neighbourhood prepossessed me in its favour, although I saw much that interested me in the course of various walks that we took while we were there. Owing to the season being far advanced, the greater number of the plants were out of flower, but I got specimens of several that were new to me, though well known to the scientific world. The day after we arrived, I had a walk up one of the low hills in the environs of Stanley, and saw, for the first time, specimens of the famous 'Balsam Bog' plant, as well as the beautiful little Callixene marginata, which the colonists call the almond flower, from its sweet smell. I was told that the Tussock grass is in a fair way of being extir-

*Some large fossil bones alluded to in a former letter, but which have not yet arrived.

pated, it having been destroyed in most parts of the island by the cattle, which eat it and trample it down in order to get at the sweet succulent base of the stem ; and that it is now limited almost entirely to small islands and low rocky points close to the sea. The Veronica elliptica, which was cultivated in abundance in the gardens at Stanley, was, I was told, not uncommon in the neighbourhood, but I did not obtain any wild specimens of it. Round about the settlement, a variety of naturalized plants were to be met with, *e. g.*, Veronica serpylifolia, Senecio vulgaris, Stellaria media. Among the few plants that were still in flower were the Senecio Falklandicus, abundantly, and the Myrtus nummularia and Oxalis enneaphylla, sparingly. I was not very fortunate, either, as regards marine zoology or botany. I did not meet with almost any Algæ that we had not previously obtained in the Straits, and there was a great similarity in the marine animals to those of the Straits. Thus I picked up specimens of Trophon Magellanicus and Mytilus Magellanicus, two of the most characteristic Strait shells. The dredge yielded nothing, so I was limited to what I could procure on the beach. I found two or three sponges, and a variety of animals in the roots of the kelp, such as a hermit crab I had not seen before, some small Echini, a curious little papillose Ascidian, &c. One day I saw great numbers of a small Medusa, of one of which I have a sketch. I was much struck by the extraordinary tameness of the cormorants and steamer ducks in the harbour, some of the latter positively landing apparently for the purpose of scrutinizing one's appearance. I was very sorry I had no opportunity of visiting any of the penguin rookeries. The weather was very broken, with much rain and wind, and there were not facilities for taking long excursions on land that I had hoped for. I saw one of the well-known streams of stones : it certainly constituted a most remarkable phenomenon, and one which does not admit of easy explanation. From the governor, Mr Robinson, I received specimens of a carbonaceous mineral procured from various parts of the island. As I have not the materials on board requisite for a careful analysis of it, I shall not venture to pronounce a decided opinion as to its nature, which, however, appears to me to partake more of that of anthracite than of coal proper. We left the island on the evening of the 2d of March. On the forenoon of the 3d, Mr Sullivan, the officer on watch, directed my attention to some brilliant scarlet-coloured patches floating past the ship. These, on examination, proved to be composed of multitudes of macrourous decapodous Crustacea, bearing a great general resemblance to Galathea. The body of the animals (a few of which I kept alive in sea-water for some days) was about three-quarters of an inch long when the tail, which in the ordinary state is curved under the cephalo-thorax, is stretched out, while the claw-bearing limbs were nearly an inch long. The general colour of the body was scarlet ; the eyes, a large patch on the cephalo-thorax, and a line following the course of the alimentary canal, bluish black. The animals swam rapidly backwards, by repeated flexions and extensions of the tail. On the 6th we re-entered the Straits, and anchored off Cape Possession, where I obtained a splendid haul of Terebratulæ, as well as some fine Calyptreæ, Polyzoa, &c. We proceeded on to Sandy Point next day, in company with the flag-ship, 'Zealous' which arrived at the Falklands while we were there, and which we again met off Cape Possession.

On the 8th, on the return of Captain Mayne from taking sights, he brought on board some specimens of gold and copper ore, which the governor of Sandy Point had given him, with the information that they had been procured not far from the settlement. I examined them, and feel no doubt as to the genuineness of the gold, which is associated with quartz. The copper ore is a very rich one, consisting of the sulphuret, together with a certain proportion of the blue carbonate of copper. In the afternoon I went on shore, spending some time. There I got several Fungi that I had not before seen ; a most beautifully-coloured Polyporus on the deciduous beech ; Cyttaria Hookeri, also on the deciduous beech (this Cyttaria I obtained growing on the same tree with Cyttaria Darwinii, on a subsequent excursion to Sandy Point) ; an Exidia, &c.

The day after, in accordance with the wish of Admiral Hastings that the 'Nassau' should pilot him through the Straits to the western entrance, we left

Sandy Point and went on to Port Famine, where we anchored early in the afternoon. A good many of us landed, and spent some time on shore. The day was very stormy, and made us realize that we were entering the damp region of the Strait. The woods were so thick that we only penetrated a short distance into them, but I got some fine lichens on the trunks of the trees. On the bare ground, Festuca Fuegiana was very plentiful, and a few lingering specimens of Sisyrinchium filifolium were still in flower. On the beach, a sand-inhabiting bivalve, allied to Mactra, was abundant, and I picked up a portion of a decapodous crustacean, apparently a Muneda. A small party of Fuegians made their appearance on the opposite side of the river, at Port Famine, from where we were—miserable-looking objects, whose only covering was a short guanaco-skin cloak. They attempted to hold communication with us in their language. A seining party was despatched from the ship, and a considerable number of fish belonging to two species was obtained. A beautiful little excessively spiny Lithodes was got in the seine, and brought to me. We weighed on the morning of the 10th, and proceeded to Port Gallant, outside of which we anchored in the afternoon, and next day several of us spent a considerable time on shore. We landed on a small, thickly-wooded island at the entrance of the Port, which is united to the mainland at low water; and here I saw the Fuchsia coccinea for the first time, and I think I have seldom seen a more beautiful sight than was presented by the plants, which were from 8 to 12 feet high, and thick with flowers. It was interesting to observe that they did not occur in any considerable number, save on the islet. I picked up one or two large dead Fissurellæ on the beach, and the dredge yielded quantities of beautiful branching Nullipores, as well as a few minute Terebratulæ, Ophiocomæ, Annelidæ, &c. I spent some hours most pleasantly wandering about in the woods round the harbour. I was greatly delighted by finding the exquisite Philesia buxifolia in profusion almost everywhere, in some situations forming a low under shrub, and in others climbing up the stems of the trees to a height of 8 or 9 feet, and letting its clusters of bright, rosy flowers hang down in the air. The Empetrum occurred abundantly, both with bright red and purplish-black berries, which I thought an interesting circumstance, as you remark in the 'Flora Antarctica,' that the only marked distinction between the Empetrum rubrum and the European Empetrum nigrum exists in the colour of the berries. Pernettya mucronata attained a much larger size than I had before witnessed, and every hollow in the ground (and the whole surface of the ground was a succession of hollows, moss-covered tree-stumps, and prostrate tree-trunks) was lined in the most beautiful manner with mosses, Jungermanniæ, and ferns. Two species of Hymenophyllum were very plentiful, as were also the Gleichenia acutifolia, and another fern that I have not as yet identified. I also obtained specimens of Asplenium Magellanicum, as well as some fine lichens. The Berberis ilicifolia, which was rather common in the woods, had its branches frequently covered by a moss that I did not see occurring in any other situation. Altogether, it appeared to be a very fine field for cryptogamic botany, to the working of which, in a future season, it was very satisfactory to look forward.

"Thuja tetragona occurred rather sparingly, forming trees from 15 to 18 feet high, and I noticed the Winter Bark in flower. On a grass, growing close to the water, a form of ergot occurred abundantly. A fine kingfisher was shot; I have not materials with me for the determination of the species; but neither King, Fitzroy, or Darwin mention a Strait kingfisher in their volumes. A large dragon-fly was captured, and we saw several specimens of a fine large humble-bee. The scenery around Port Gallant is remarkably fine. The mountains appear to be composed chiefly of metamorphic rocks, which almost always give a bold character to the landscape; and on gazing gradually up the sides of the hills, the eye first meets with thickly-wooded slopes of the verdant and ever-green beeches, with an admixture of Winter Bark, then with an infinite succession of grey precipices, then fields of snow, and finally sharp black-jagged peaks, which pierce the clouds. I felt that short stay at Port Gallant *per se* an abundant reward for coming all the way to the Strait of Magellan.

"On the 18th, we pursued our westerly course. The day, though showery, was not a bad one, and we had a constant succession of views of the most magnificent description, which entirely surpassed my expectations of the grandeur of this portion of the Strait. Sometimes the nearer heights would be bathed in bright sunlight, while the more distant snowy ones lay in shadow; and at others the sun shone brightly on the snowy slopes and summits. Every now and then there were splendid irises on the hills, in some instances nearly the whole rugged side being rainbow tinted. We saw some very fine glaciers, several of which were most extensively crevassed, both longitudinally and transversely. I look forward with much satisfaction to their exploration next year, or the year after. We anchored in the afternoon in a beautiful little cove in Praya Parda. I had no opportunity of landing, but two or three of the officers were on shore for a short time, and, as usual, brought me off any specimens that they could lay their hands on. By this means I got specimens of Desfontainesia spinosa, and the largest-berried specimen of Pernettya mucronata that I have ever seen. The Desfontainesia was new to me, and I felt considerably puzzled at first as to its nature, owing to the combination of character which it presents. We parted from the 'Zealous' next morning and retraced our course. We were, as before, struck with the savage grandeur of much of the scenery, and I was rather amused to hear Mr Darwin's remark that "the distant channels between the mountains appeared, from their gloominess, to lead beyond the confines of this world," echoed by one of our men. We saw several Fuegians' canoes, and lay to for a short time to allow one of them to come alongside. There were three men in her who kept shouting and screaming while they were coming towards us, reminding us of sea-birds in the nature of their vociferations. On coming alongside they shouted "rope, rope, yaummer schooner!" then kept up a perpetual demand for "tā-bācā," accompanied by a variety of gesticulations. As usual they were miserable-looking objects, very slightly clothed with short guanaco-skin cloaks, which left their long lanky legs bare, and only partially covered their bodies. Their canoe, which was formed of five pieces of wood or bark sewn together with narrow stripes of bark, had a fire in it made of damp boughs of evergreen beech. They exchanged some arrows, a bow, and a quiver, for tobacco, and, after having been presented with some ship-biscuit, shoved off apparently much amazed at the revolutions of the screw as we went on our way. We anchored in Port Gallant early in the afternoon so that I had another opportunity of landing there. I found the woods extremely wet, and progression excessively fatiguing from the uneven nature of the ground. There was a death-like stillness, only broken occasionally by the chirping of a little bluish-black wren. I obtained a few additional lichens, and Jungermanniae; and two specimens of the humble-bee, which I have mentioned, were procured. A seining party was despatched from the ship and got a very successful haul. Among those obtained there was a fine specimen of, I believe, a Uranoscopus, which I have preserved. It had a row of parasitic Lernæans along each side, and so symmetrically were they arranged, that, on a cursory view, I took them for integumentary appendages.

"Next day we returned to Sandy Point, where we remained for a day or two. I must not forget to mention that the two officers (Mr Heskyun, and Mr Connor) who were left at Elizabeth Island during our absence at the Falkland Islands, and western portion of the Straits, procured some plants of which I had not previously got specimens, such as Embothrium coccineum, Aspidium metrioides, both of which were obtained in Laredo Bay. On the 20th we left Sandy Point, and proceeded to Peckett Harbour, where we spent some little time. I was on shore on two occasions with Captain Mayne, when he was engaged in triangulating, and got a few specimens. I found Bolax glebaria abundantly round about the harbour, as well as a low shrubby plant with fleshy leaves. On the 27th we left Peckett Harbour. While the anchor was being got in, some Siphunculi and a sea cucumber came up on the cable.

"We proceeded to Oazy Harbour, where we anchored early in the afternoon. Shortly after our arrival, two of the officers who had preceded us, came on board, bringing with them specimens of a small brown tern and a beautiful brown-breasted goose. There seems to be at least three species of geese in the Straits, *i.e.*, the kelp or rock-goose (Anser antarcticus), the upland goose (Anser Magellanicus), and this brown-breasted one, which is much smaller than the other two. I spent the greater part of the 29th on shore. In a little stream running into the harbour, I obtained specimens of a small Lymnæa, about the size of our British L. peregra, and I found Hippuris vulgaris growing abundantly. I observe you only give Port Famine as an attractive locality for this familiar friend, so that the discovery of it in Oazy Harbour is interesting, inasmuch as it proves its occurrence in the bare as well as in the woody country. In a flat space of ground close to the beach, I procured examples of an obscure flowered composite plant, with a very pungent smell, and on some high ground the foliage of Oxalis enneaphylla occurred plentifully, the flower being over. I also observed some lingering specimens of Armeria maritima in flower, and the Lycoperdon, which I saw first at Sandy Point, was very abundant in every stage of growth and decay; geese, ducks, and steamers were seen in considerable numbers, as well as several barranchas (Polyborus Braziliensis).

"On the 1st of April I again landed, and walked about on the high ground outside the harbour. The Magellanic Ribes was common, and I got three specimens of Botrychium lunaria. I was interested to find, on reference to the 'Flora Antarctica,' that the only locality you give for this little fern is Good Success Bay, in the extreme south of Fuegia, between two and three hundred miles from Oazy Harbour. We left Oazy on the morning of the 2d, and spent a day or two in the neighbourhood of Laredo Bay. On the 5th, we anchored off Cape St Vincent, Fuegia, and I had an opportunity of paying a visit to Quartermaster Island, at the entrance of Gente Grande Bay, with one of the officers. On landing on this island, which is in some places bounded by high clay cliffs, and in others slopes gradually down towards the sea, it was curious to observe what great numbers of shells (principally Fissurellæ) had been carried up to the high ground by cormorants and other birds. At one place, at the top of some high cliffs, there was the most extraordinary assemblage of cormorants that I have ever seen. On a very moderate computation, they must have numbered considerably upwards of a thousand. It was most amusing to notice the difficulty which they experienced in taking wing on our approach, so closely were they packed together. Rank after rank hustled forward, and, breaking up, flew over the cliffs out to sea.

"In walking over the island, I got two geraniums not procured previously, as well as a Thlaspi (I suppose the T. Magellanicum), which was very abundant in certain spots. We spent the 8th lying in Gregory Bay, and a number of us spent the afternoon on shore. I was fortunate enough to find a good Patagonian skull in a sand-bank. It was very perfect when first procured, all the teeth being present, and ground down to a uniform level. I am sorry to say, however, that one zygoma, and the turbinated bones, crumbled away, and one incisor was lost. On the 10th, I spent a day and night in Fuegia, in the neighbourhood of Isidro Point, at the eastern entrance of the second Narrows. I obtained three live specimens of a species of Lithodes on the beach. On land, I found some specimens of Calceolaria nana, still in flower, one or two lichens growing on the ground, &c. Our common mushroom appears to be widely distributed over the Straits: thus we have procured it at Sandy Point, Elizabeth Island, Oazy Harbour, and Gregory Bay on the Patagonian; and on the coast of Lee Bay, and at Isidro Point on the Fuegian side. Small lizards were rather common. I believe they all belonged to one species, though the colouring varies considerably. Mr Darwin does not appear to have met with reptiles of any description south of Santa Cruz. This lizard, however, seems to be not uncommon in the eastern part of the Straits, for I have specimens from Sandy Point (wooded country), as well as from St Iago Bay on the Patagonian side, and from Lomas Bay and Point Isidro in Fuegia. I saw considerable numbers of a large yellowish-brown moth, and a single specimen of an apterous grasshopper was taken.

ROBT. O. CUNNINGHAM."

Miscellany.

Maps of Abyssinia.—As the public will, to all appearance, have occasion to refer to the Map of Abyssinia pretty frequently for some time to come, we have made it our business to examine the different maps recently published, with the view of giving our readers such information regarding them as will assist them in selecting the map best suited to their requirements. (1.) For a general coup d'œil of Abyssinia, the eastern and western limits of its mountainous plateau, its chief political divisions, principal places, most important tribes in the interior and on the frontiers, its great rivers, and their relations to the Nile on the west, and the Red Sea on the east;—we recommend the Sketch Map prepared at Stanford's Geographical Establishment, and contained in Dr Beke's instructive book on "The British Captives in Abyssinia." 8vo. Longmans. (2.) The most complete general map o the country is, doubtless, the Map of Nubia and Abyssinia, which forms a part of Keith Johnston's Royal Atlas; but is sold separately for 3s. in a sheet, and 5s. in a case. It embraces the entire field of operations, from Aden and the Red Sea on the east, to the plains on the west which are in possession of the Egyptians, and recommended as the base of operations by Sir Samuel Baker. The scale is 45 miles to an inch. (3.) There is a smaller map by Johnston, price 1s. 6d. (4.) The Route Map of Abyssinia, compiled by E. G. Ravenstein, and lithographed at the Topographical Department of the War Office, under the superintendence of Lieut.-Colonel A. C. Cooke, C.B., R.E., is on the scale of 10 miles to an inch, and about 40 by 27 inches in size. It includes the north-eastern part of Abyssinia, having Massowah on the north, Magdala (where the principal Europeans are confined), on the south, and Gonda on the west. As far as it extends, it has the advantage of greater detail than Johnston's map, in consequence of its superior scale. It has been prepared for the use of H.M. Government, and is not at present issued to the public. It is, however, proposed to issue it as a Blue Book. (5.) Dr Petermann has prepared two excellent maps for a supplement to his well-known German periodical the "Geographische Mittheilungen." One is limited to the country which forms the ascent to the Abyssinian Highlands on the west of Adulis Bay, and includes Massowah on the north and Halar on the south. It is the best map of this district, and its scale is 5 miles to an inch. But it is probable that the principal track of the army will be through the passes south of Halar; and the limited knowledge which exists in that direction is contained in the other of Petermann's maps. This map includes the north-east of Abyssinia, from the Bagos country on the north (the scene of Consul Cameron's unfortunate visit), to the remains of the antient city of Axum and the present town of Adowa on the south. Adowa is one of the largest towns in the country, although nothing more than a village in a European point of view. This map is about 16 miles to an inch. It has a very small general map of Abyssinia in one corner. The maps are accompanied by a "Study of Abyssinia," by Werner Munzingers, and forms a 4to pamphlet, price 3s.

Rhinoceros Shedding their Horns.—At a recent meeting of the Zoological Society, Mr Blyth stated that he had been informed that a rhinoceros in the menagerie at Moscow had shed its horn. We know that the horn of the rhinoceros is nothing more than an agglutinated mass of hairs; and there is nothing more extraordinary in an old rhinoceros shedding its horn than an old man becoming bald. Mr. Blyth mentioned that in Tenasserim he had seen old rhinoceroses with very small horns; and it occurred to him as not impossible that those might have shed their old horns, and that the horns they bore were young ones just grown.

Greenland.—Edward Whymper and Robert Brown have returned from their expedition to that country, made during the summer of 1867, although, from causes "beyond their own control" (such as the death of the dogs, sickness of the natives, and lateness of the season—vide *Athenæum* Dec. 7th) they have not made such geographical discoveries as would otherwise have ensued, yet they have added considerably to our knowledge of Greenland; and the scientific member of the party (Mr Brown) has made not a few observations in all departments of science, and considerable collections of plants and animals. The plants comprise some 5000 specimens of flowering plants, ferns, and fern allies, musci, jungermannæ, hepaticæ, lichens, fungi, algæ (fresh water and marine), diatomaceæ, desmidieæ, &c., containing a number of interesting and new species. The zoological collections consist chiefly of a number of skeletons and skulls of cetacea and seals of different species, birds, fishes (a few) crustacea, annelidæ, echinodermata; insects (consisting of a number of lepidoptera, hymenoptera, coleoptera, arachnidæ, neuroptera, diptera, and suctona) mollusca, zoophytes, &c. In addition to these, both gentlemen have brought home a good collection of the tertiary fossil plants of the Wargatz, of which region Mr Brown has made a geological survey, and many astronomical observations for positions, flint implements, &c., all of which we shall hear more about in good time; and, as both travellers propose giving an account of their labours in an extended form, we shall reserve any further remarks. In Greenland there are some officers of the Royal Greenland Company (a monopoly of the government) who are interested in natural history; and we may mention, as residents at present in the country, Dr Rink (the eminent geologist), and the inspector of South Greenland, Herr Districtlœge Pfaff, Jakobshavn, Dr Rudolph, Upernavik, and Messrs Anderson, Bolbroe, Hansen, and Neilsen (colonibestyners or governors of the districts of Ritenbenk, Egedesmende, Godhavn, and Sakkertoppen, respectively) as collectors of zoological specimens. Chevalier C. S. M. Olrik, Director of the Royal Company at Copenhagen (and so well known to the expeditions in search of Sir John Franklin, as being for many years Royal Inspector of North Greenland), through whom all communications ought to be addressed, is also an enthusiastic naturalist.

New Vermifuge.—It is well known that amongst the diseases to which the natives of Abyssinia are especially subject, is that caused by the troublesome Tænia sotium. For the cure of this scourge the flowers of a plant known as Kousso, the (Brayera Anthelmintica, Kth.) are in great request. These flowers have long been acknowledged, even by European practitioners, as a most effectual remedy; but another has lately come to our notice, specimens of which have been received at the Kew Museum, from Mr Calvert the Consul at Alexandria. This remedy has been used, it is said successfully, in

Abyssinia as a tænifuge for some time, though perhaps but sparingly. We are not aware, however, that it has ever been used by European practitioners, or that any others but one or two continental writers on tænifuges have ever noticed it. We speak of the bark of Albizzia Anthelmintica, Broug. Known to the natives as Beseuna, Bessana or Moussina, &c., and for which plant Richard, before having seen the flowers or fruit, constituted a new genus, under the name of Besenna; it has, however, since been proved to be the species of Albizzia we have mentioned. It is a small tree with bipinnate leaves, composed of one or two pinnæ, upon each of which are four pairs of obovate leaflets. The bark is from the eighth of an inch to a quarter of an inch thick, and is composed of thin plates or layers on the inner side, which are easily separated, leaving a mass on the outside, of full half the entire thickness, of cellular tissue, in which is thickly dispersed masses af yellow resin—the whole bark itself being of a lightish yellow colour. It has no smell, and when first put into the mouth has scarcely any taste; but after being chewed for some little time it has a disagreeable rankness which clings to the palate, and is slightly astringent. It is used, when powdered and mixed with honey or oil, in doses of from two to four ounces of the powder as a specific against tænia, and is by some considered more efficacious even than the flowers of Brayera Anthelmintica.—*J. R. Jackson, Kew.*

French Expedition to the North Pole.—Subscriptions in furtherance of the proposed French Expedition to the North Pole, have now been collected for some time; and we are sorry to see, from Petermann's "Geographische Mittheilungen," that they have only reached the sum of 52,000 francs. As 50,000 francs of this have been subscribed by the French Emperor, the total which had, at the time Mr Petermann wrote, been subscribed by the French people, appears to have been 2000 francs, or about £80; which for an undertaking which is estimated to cost 60c,000 francs, cannot be regarded as very encouraging.

The "American Naturalist."—This is a new North American illustrated magazine of Natural History, cheap in price, good in quality, at the same time popular and scientific, supported and contributed to by many of the best American Naturalists. It has already reached a circulation of 2000 in its native country, and is now desirous of extending its roots into this country. We gladly welcome it, and wish it all success.

Pink Topazes.—These are usually supposed to be manufactured by subjecting yellow or brown topazes to heat. Whether this is the universal practice or not, we do not know; one thing is certain, that the yellow topaz does become pink under heat—*experto crede.* We have tried it ourselves; but recent discoveries in Australia have shewn that pink topazes have been found in the mines of Victoria, and cut at Melbourne, while neither a yellow nor a brown one has been yet discovered, those reported being all cairngorms.—*Transactions of the Royal Society of Victoria*, 1865-66, p. 79.

New Dinosaur—Laelaps aquilunguis.—Professor Cope exhibited the remains of a gigantic Dinosaur from the cretaceous green sand of New Jersey. The bones were portions of the under jaw with teeth, portions of the scapular arch, including supposed clavicles, two humeri, left femur, and right tibia and fibula, with numerous phalanges, lumbar, sacral, and caudal vertebræ, and numerous other elements in a fragmentary condition. The animal was found by the workmen, under directions of J. C. Voorhees, about two miles south of Barnesbro, Gloucester Co., New Jersey. The bones were taken from twenty feet below the surface, in the top of the "chocolate" bed, which immediately underlies the green stratum, which is of such value as a manure. The discovery of this animal filled a hiatus in the cretaceous Fauna, revealing the carnivorous enemy of the great herbivorous Hadrosaurus, as the Dinodon was related to the Trachodon of the Nebraska beds, and the Megalosaurus to the Iguanodon of the European Wealden and Oolite. In size this creature equalled the Megalosaurus Bucklandii, and with it and the Dinodon constituted the most formidable types of rapacious terrestrial Vertebrata of which we have any knowledge. In its dentition and huge prehensile claws it resembled closely the Megalosaurus, but the femur, resembling in its proximal regions more nearly the Iguanodon, indicated the probable existence of other equally important differences, and its pertinence to another genus. For this and the species the name of Laelaps aquilunguis was proposed. The disproportion between the fore and hind limbs of the Iguanodon, together with the compressed form of the tail, suggested to Professor Owen an aquatic habit, a relation of proportions of limbs to habit seen in the tailless Batrachia. The discovery of the massive short-toed foot of the Iguanodon subsequently has lent little countenance to the supposition of its entire adaptation to aquatic life. Dr Leidy has regarded this disproportion in the case of the Hadrosaurus as an index of a habit like that of the kangaroos (Macropus, &c.), and that that monster rested in an oblique position on the hind limbs and tail, and reached upwards with its muzzle and short fore-limbs to the foliage on which it fed. That such a habit characterized the Laelaps is very probable; the tail was nearly cylindric, and from the extent of the condyles of the femur the hind limb must have been considerably flexed. The small size of the fore-limbs must have rendered them far less efficient as weapons than the hind feet in an attack on such a creature as the Hadrosaurus; hence, perhaps, the latter were preferred in inflicting fatal wounds. The exceedingly eagle-like character of the digits and claws and ornithic type of sacrum, elucidated by Professor Owen, suggest a resemblance in the use of the limb. The bulk of the species, as compared with that of Hadrosaurus, illustrates again the law observed in the relation between Felis and Bos, Thylacoleo, and the herbivorous unplacentals of its time, and the other raptorial and herbivorous Dinosauria, which might probably be reduced to exact terms. The remains indicate an animal of near 18 feet in length, which could probably raise itself to a height of 6 feet at the rump. The genus (Laelaps) belongs to the family Dinodontidæ, which is characterized by its contractile raptorial claws and slender digits and compressed sabre-shaped teeth. It differs from Megalosaurus in its femur, and from Dinodon in that the teeth of the latter have two posterior serrate edges separated by a posterior plane. From supposed Dinosaurian genera of doubtful affinity it differs, *e.g.*, from Regnosaurus (Mant.) in the totally different humerus, and from Pelorosaurus and Streptospondylus in the vertebræ. Cetiosaurus and Cimoliasaurus were perhaps mutilate like the Cetaceans, according to Owen and Leidy.—*Proceedings of the Academy of Natural Sciences of Philadelphia*, 1866, p. 279.

A THEORY OF BIRDS' NESTS:

SHEWING THE RELATION OF CERTAIN SEXUAL DIFFERENCES OF COLOUR IN BIRDS TO THEIR MODE OF NIDIFICATION.

BY ALFRED R. WALLACE, F.Z.S., &c.

ONE of the most remarkable and interesting characteristics of birds, is the habit which the great majority of them possess of forming a more or less elaborate structure for the reception of their eggs and young. In other classes of vertebrate animals, such structures are few and exceptional, and never attain to the same degree of completeness and beauty. Birds' nests have, accordingly, attracted much attention, and have furnished one of the stock arguments to prove the existence of a blind but unerring instinct in the lower animals. The very general belief that every bird is enabled to build its nest, not by the ordinary faculties of observation, memory, and imitation, but by means of some innate and mysterious impulse, has had the bad effect of withdrawing attention from the very evident relation that exists between the structure, habits, and intelligence of birds, and the kind of nest they construct. It will be necessary to point out a few of these primary relations, since they have an important bearing on the subject we are about to discuss.

A considerable number of birds form no nest whatever, but lay their eggs and hatch their young upon the bare ground. Such are a large portion of the wading and swimming birds, many of the Gallinaceæ, and, among perching birds, almost all the Caprimulgidæ. These may be considered to form one extremity of the scale, while such birds as the Icteridæ, the weaver birds, and the wren, which build elaborately woven, domed, or pensile nests, are at the other. Now, the general structure and mode of life of the birds in question, almost of itself explains this difference. The large head and excessively small broad bill of the Caprimulgidæ, and their small weak feet, with scarcely any power of grasping, render them physically unable to weave together grass, or moss, or fibres, or wool, into a strong and well-constructed nest. The feet of terns or of sandpipers are equally ill adapted to this purpose; and while engaged in seeking their food, they chiefly frequent places where no materials for making a nest are to be found. Those birds, on the other hand, which form the most elaborate and perfect nests, are the most highly organised of the class, having powerful and yet delicate grasping feet, a well formed pointed bill, and extreme rapidity of motion. The places where they seek their daily food are those where all the materials used in their nests are abundant; and their intelligence is shewn by their not unfrequently modifying the position, the form, or the materials of their nests, to suit the changed conditions with which the presence of man surrounds them.

If we descend more into detail, we find the same principles manifested; and we are often able to understand the reason of the particular position and material of a nest, by a consideration of the mode of life of the bird that has made it. The kingfisher, seeking his food in rivers and streams, makes his nest in their banks. His strong and sharp-pointed bill, is a weapon which readily pecks away sand or earth; and the disgorged bones of the fishes he has devoured, form a rude nest at the bottom of the hole. The woodpecker, who is daily engaged in boring holes in trees to seek his food, enlarges one of these holes, and makes a cavity within which he can bring up his young in safety. The toucan, whose huge weak bill, imperfect feet, and clumsy motions incapacitate it from building a nest, makes use of the holes formed by woodpeckers, squirrels, or other animals, which it finds in the trees among which it seeks its daily food. The rook lines its nest with roots and fibres, the crow with wool or rabbits' fur. It is no blind instinct that leads birds so much alike to use such different materials, but simple convenience. The rook hunts for grubs in ploughed fields and pastures, and has continual experience of roots and fibres. The crow frequenting moorlands and warrens, and feeding on dead lambs and rabbits, finds wool and fur continually, and uses them in its nest. The wren constructs its beautiful nest almost entirely of moss, because while hunting about in hedgerows for small insects and molluscs, moss is continually before its eyes.*

We see, then, that a consideration of the structure, the food, and other specialities of a bird's existence, gives us a clue, and sometimes a very complete one, to the reason why it builds its nest of certain materials, in a definite situation, and in a more or less elaborate manner. There are, however, two other factors in the problem, whose effect in any particular case we can only

* For other examples, see "The Philosophy of Birds' Nests;" *Intellectual Observer*, July, 1867.

vaguely guess at, but which must have had an important influence in determining the existing details of nidification. These are—changed conditions of existence, whether internal or external, and the influence of hereditary habit; the first inducing alterations in accordance with changes of organic structure, of climate, or of the surrounding fauna and flora; the other preserving the peculiarities so produced, even when changed conditions render them no longer necessary. There are many facts which shew that birds do adapt their nests to the situations in which they place them. That of the Orchard Oriole of the United States (Icterus spurius), when built among the strong branches of a fruit tree, is a very shallow cup, but when suspended from the slender boughs of a weeping willow, it is much deeper, to prevent the young birds from being thrown out during violent winds. The common house sparrow builds a far less careful nest when it is placed in a hole, than when built in a tree; and the adoption of eaves, chimneys, and boxes, by swallows, wrens, and many other birds, shews that they are always ready to take advantage of changed conditions. It is probable, therefore, that a permanent change of climate would cause many birds to modify the form or materials of their abodes. The introduction of new enemies to eggs or young birds, might induce many alterations tending to their better concealment. A change in the vegetation of a country, would often necessitate the use of new materials. So, also, we may be sure, that as a species slowly became modified in structure, it would necessarily change in some degree its mode of building. Its work would be more or less delicate, and the materials used more or less fine, according to the modifications its external organs underwent.

During all these changes however, certain specialities of nest-structure would continue for a shorter or a longer time after the causes which had necessitated them had passed away. Such records of a vanished past meet us everywhere, even in man's works, notwithstanding his boasted reason. All the main features of Greek architecture, for example, are but reproductions in stone of what were originally parts of a wooden building. Our copyists of Gothic architecture often build solid buttresses, capped with weighty pinnacles, to support a wooden roof which has no outward thrust to render them necessary; and even think they ornament their buildings by adding sham spouts of carved stone, while modern water-pipes, stuck on without any attempt at harmony, do the real duty. So, when railways superseded coaches, it was thought necessary to build the first-class carriages so as to imitate a number of coach-bodies joined together; and the arm-loops for each passenger to hold on by, which were useful when bad roads made every journey a succession of jolts and lurches, were continued on our smooth macadamised mail-routes, and, still more absurdly, remain to this day in our railway carriages, the relic of a kind of locomotion we can now hardly realize. With these and a hundred similar facts everywhere around us, we may fairly impute much of what we cannot understand in the details of Bird-Architecture to an analogous cause. If we do not do so, we must assume either that birds are guided in every action by pure reason to a far greater extent than men are, or that an infallible instinct leads them to the same result by a different road. So many and such well-known facts are opposed to both these views, that I do not think it necessary here formally to refute them.

The preceding observations are intended to shew that the exact mode of nidification of each species of bird is probably the result of a variety of causes, which have been continually inducing modification in accordance with changed organic or physical conditions. The most important of these causes seem to be, in the first place, the structure of the species, and, in the second, its environment. If, therefore, we find less important and more easily modified characters than these correlated with peculiarities of nidification, we shall be justified in concluding that the former are dependent on the latter, and not *vice versa*. Such a correlation I am now about to point out.

Considering the main purpose of bird's nests to be the protection of the eggs and the security and comfort of the young birds, we may group them under two primary divisions, according as they more or less completely fulfil this important function. In the first, we place all those in which the eggs and young are hidden from sight, no matter whether this is effected by an elaborate covered structure, or by depositing the eggs in some hollow tree or burrow underground. In the second, we group all in which the eggs and young and sitting bird are exposed to view, no matter whether there is the most beautifully formed nest, or none at all. Kingfishers, which build almost invariably in holes in banks; woodpeckers and parrots, which build in hollow trees; the Icteridæ of America, which all make beautiful covered and suspended nests, and our own wren, which builds a domed nest, are examples of the former; while our thrushes, warblers, and finches, as well as the crow-shrikes, chatterers, and tanagers of the tropics, together with all raptorial birds and pigeons, and a vast number ot others, in every part of the world, all adopt the latter mode of building.

It will be seen that this division of birds according to their nidification, bears little relation to the character of the nest itself. It is a functional not a structural classification. The most rude and the most perfect specimens of bird-architecture are to be found in both sections. It has, however, a certain relation to natural affinities, for large groups of birds undoubtedly allied, fall into one or the other division exclusively. The species of a genus or of a family are rarely divided between the two primary classes, although they are frequently divided between the two very distinct modes of nidification that exist in the first of them.

All the Scansorial, and most of the Fissirostral birds, for example, build concealed nests; and, in the latter group, the two families which build open nests, the swifts and the goat-suckers, are undoubtedly very widely separated from the other families with which they are associated in our classifications. The tits, also, vary much in their mode of nesting: some making open nests concealed in a hole, while others build domed or even pendulous covered nests, so that they all come under the same class. Starlings vary in a similar way. The Mynahs, like our own starlings, build in holes, the glossy starlings of the East (of the genus Calornis) form a hanging covered nest, while the genus Sturnopastor builds in a hollow tree. One of the most striking cases, in which one family of birds is divided between the two classes, is that of the finches; for, while most of the European species build exposed nests, many of the Australian finches make them dome-shaped.

Turning now from the nests to the creatures who make them, let us consider birds themselves from a somewhat unusual point of view, and form them into separate groups, according as both sexes, or the males only, are adorned with conspicuous colours.

The sexual differences of colour and plumage in birds are very remarkable and have attracted much attention; and in the case of polygamous birds have been well explained by Mr Darwin's principle of sexual selection. We can, to some extent, understand how male pheasants and grouse have acquired their more brilliant plumage and greater size, by the continual rivalry of the males, both in strength and beauty; but this theory does not throw any light on the causes which have made the female toucan, bee-eater, parroquet, macaw and tit, in almost every case as gay and brilliant as the male, while the gorgeous chatterers, manakins, tanagers, and birds of Paradise, as well as our own blackbird, have mates so dull and inconspicuous that they can hardly be recognised as the same species.

This anomaly can, however, now be explained by the influence of the mode of nidification, since I find that, with but very few exceptions, it is the rule—*that when both sexes are of strikingly gay and conspicuous colours, the nest is of the second class, or such as to conceal the sitting bird; while, whenever there is a striking contrast of colours, the male being gay and conspicuous, the female dull and obscure, the nest is open and the sitting bird exposed to view.* I will now proceed to indicate the chief facts that support this statement, and will afterwards explain the manner in which I conceive the relation has been brought about.

We will first consider those groups of birds in which the female is gaily or at least conspicuously coloured, and is in most cases exactly like the male.

I. Kingfishers (Alcedinidæ). In some of the most brilliant species of this family the female exactly resembles the male; in others there is a sexual difference, but it rarely tends to make the female less conspicuous. In some the female has a band across the breast, which is wanting in the male, as in Halcyon diops. In others the band is rufous in the female, as in several of the American species; while in Dacelo gaudichaudii, the tail of the female is rufous instead of blue. In most kingfishers the nest is in a deep hole in the ground; in Tanysiptera it is said to be in a hole in the nests of termites, or sometimes in crevices under overhanging rocks.

II. Motmots (Momotidæ). In these showy birds the sexes are exactly alike, and the nest in a hole under ground.

III. Puff-birds (Bucconidæ). These birds are often gaily coloured; some have coral-red bills; the sexes are exactly alike, and the nest is in a hole in sloping ground.

IV. Trogons (Trogonidæ). In these magnificent birds the females are generally less brightly coloured than the males, but are yet often gay and conspicuous. The nest is in a hole of a tree.

V. Hoopoes (Upupidæ). The barred plumage and long crests of these birds render them conspicuous. The sexes are exactly alike, and the nest is in a hollow tree.

VI. Hornbills (Bucerotidæ). These large birds have enormous coloured bills, which are generally quite as well coloured and conspicuous in the females. Their nests are always in hollow trees, where the female is entirely concealed.

VII. Barbets (Capitonidæ). These birds are all very gaily coloured, and, what is remarkable, the most brilliant patches of colour are disposed about the head and neck, and are very conspicuous. The sexes are exactly alike, and the nest is in a hole of a tree.

VIII. Toucans (Rhamphastidæ). These fine birds are coloured in the most conspicuous parts of their body, especially on the large bill, and on the upper and lower tail coverts, which are crimson white or yellow. The sexes are exactly alike, and they build always in a hollow tree.

IX. Plantain-eaters (Musophagidæ). Here again the head and bill are most brilliantly coloured in both sexes, and the nest is in a hole of a tree.

X. Ground cuckoos (Centropus). These birds are often of conspicuous colours, and are alike in both sexes. They build a domed nest.

XI. Woodpeckers (Picidæ). In this family the females often differ from the males, in having a yellow or white, instead of a crimson crest, but are almost as conspicuous. They all nest in holes in trees.

XII. Parrots (Psittaci). In this great family, adorned with the most brilliant and varied colours, the rule is, that the sexes are precisely alike, and this is the case in the most gorgeous families, the lories, the cockatoos, and the macaws; but in some there is a sexual difference of colour to a slight extent. All build in holes, mostly in trees, but sometimes in the ground, or in white ants' nests. In the single case in which the nest is exposed, that of Pezoporus formosus, the bird has lost the gay colouring of its allies, and is clothed in sombre and completely protective tints of dusky green and black.

XIII. Gapers (Eurylæmidæ). In these beautiful Eastern birds, somewhat allied to the American chatterers, the sexes are exactly alike, and are adorned with the most gay and conspicuous markings. The nest is a woven structure, *covered over*, and suspended from the extremities of branches over water.

XIV. Pardalotus (Ampelidæ). In these Australian birds the females are often very conspicuous, having brightly-spotted heads. Their nests are sometimes dome-shaped, sometimes in holes of trees.

XV. Tits (Paridæ). These little birds are always pretty, and many (especially among the Indian species) are very conspicuous. They always have the sexes alike, a circumstance very unusual among the smaller gaily-coloured birds of our own country. The nest is always covered over or concealed in a hole.

XVI. Nuthatches (Sitta). Often very pretty birds, the sexes alike, and the nest in a hole.

XVII. —— (Sittella). The female of these birds is often the most conspicuous, being white- and black-marked. The nest is, according to Gould, "completely concealed among upright twigs connected together."

XVIII. Creepers (Climacteris). In these the sexes are alike, or the female most conspicuous, and the nest is in a hole of a tree.

XIX. Estrelda, Amadina. In these genera of finches the females, although more or less different from the males, are still very conspicuous, having a red rump, or being white spotted. They differ from most others of the family in building domed nests.

XX. Certhiola. In these pretty little American creepers the sexes are alike, and they build a domed nest.

XXI. Mynahs (Eulabes, Sturnidæ). These showy birds have the sexes exactly alike. They build in holes of trees.

XXII. Calornis (Sturnidæ). These brilliant metallic starlings have no sexual differences. They build a pensile covered nest.

XXIII. Hangnests (Icteridæ). The red or yellow and black plumage of most of these birds is very conspicuous, and is exactly alike in both sexes. They are celebrated for their fine purse-shaped pensile nests.

It will be seen that this list comprehends six important families of Fissirostres, four of Scansores, the Psittaci, and several genera, with three entire families of Passeres.

The cases in which whenever the male is gaily coloured, the female is much less gay or quite inconspicuous, are exceedingly numerous, comprising, in fact, almost all the bright coloured Passeres, except those enumerated in the preceding class, and far exceeding them in number. The following are the most remarkable :—

I. Chatterers (Cotingidæ.) These comprise some of the most gorgeous birds in the world, vivid blues, rich purples, and bright reds, being the most characteristic colours. The females are always obscurely tinted, and are often of a greenish hue, not easily visible among the foliage.

II. Manakins (Pipridæ.) These elegant birds, whose caps or crests are of the most brilliant colours, are usually of a sombre green in the female sex.

III. Tanagers (Tanagridæ.) These rival the chatterers in the brilliancy of their colours, and are even more varied. The females are generally of plain and sombre hues, and always less conspicuous than the males.

In the extensive families of the warblers (Sylviadæ), thrushes (Turdidæ), flycatchers (Muscicapidæ), and shrikes (Laniadæ), a considerable proportion of the species is beautifully marked with gay and conspicuous tints ; but in every case the females are less gay, and are very often of the very plainest and least conspicuous hues. Now, throughout the whole of these families the nest is open, and I am not aware of a single instance in which any one of these birds builds a domed nest, or places it in a hole of a tree, or underground, or in any place where it is effectually concealed.

In considering the question we are now investigating, it is not necessary to take into account the larger and more powerful birds, because these seldom depend much on concealment to secure their safety. In the raptorial birds bright colours are as a rule absent ; and their structure and habits are such as not to require much protection. The larger waders are sometimes very brightly coloured in both sexes ; but they are probably little subject to the attacks of enemies since the scarlet ibis, the most conspicuous of birds, exists in immense quantities in South America. In game birds and water-fowl, however, the females are often very plainly coloured, when the males are adorned with brilliant hues ; and the abnormal family of the Megapodidæ offers us the interesting fact of an identity in the colours of the sexes (which in Megacephalon and Talegalla are somewhat conspicuous), in conjunction with the habit of not sitting on the eggs at all.

Taking the whole body of evidence here brought forward, embracing as it does almost every group of bright-coloured birds, it will, I think, be admitted that the relation between the two series of facts in the colouring and nidification of birds has been sufficiently established. There are, it is true, a few apparent and some real exceptions, which I shall consider presently; but they are too few and unimportant to weigh much against the mass of evidence on the other side, and may for the present be neglected. Let us then, consider what we are to do with this unexpected set of correspondences between groups of phenomena which, at first sight, appear so disconnected. Do they fall in with any other groups of natural phenomena? Do they teach us anything of the way in which nature works, and give us any insight into the causes which have brought about the marvellous variety, and beauty, and harmony of living things? I believe we can answer these questions in the affirmative; and I may mention, as a sufficient proof, that these are not isolated facts, that I was first led to see their relation to each other by the study of an analogous though distinct set of phenomena among insects, that of protective resemblance and "mimicry."

On considering this remarkable series of facts, the first thing we are taught by them seems to be, that there is no incapacity in the female sex among birds, to receive the same bright hues and strongly contrasted tints with which their partners are so often decorated, since whenever they are protected and concealed during the period of incubation they *are* similarly adorned. The fair inference is, that it is chiefly due to the absence of protection or concealment during this important epoch, that gay and conspicuous tints are withheld or left undeveloped. The mode in which this has been effected is very intelligible, if we admit the action of natural and sexual selection. It would appear from the numerous cases in which both sexes are adorned with equally brilliant colours (while both sexes are rarely armed with equally developed offensive and defensive weapons when not required for individual safety), that the normal action of "sexual selection" is to develop colour and beauty in both sexes, by the preservation and multiplication of all varieties of colour in either sex which are pleasing to the other. The female bird, however, while sitting on her eggs in an uncovered nest, is especially open to the attacks of enemies, and any modification of colour which rendered her more conspicuous would lead to her destruction and that of her offspring. All variations of colour in this direction in the female, would therefore sooner or later be exterminated, while such modifications as rendered her inconspicuous, by assimilating her to surrounding objects, as the earth or the foliage, would, on the whole, be preserved the longest; and thus lead to the attainment of those brown or green and inconspicuous tints, which form the colouring (of the upper surface at least,) of the vast majority of female birds which sit upon open nests.

At the commencement of this article I have endeavoured to prove that the characteristic differences and the essential features of birds' nests are dependent on the structure of the species, and upon the present and past conditions of their existence. Both these factors are more important and less variable than colour; and we must therefore conclude that in most cases the mode of nidification (dependent on structure and environment) has been the cause and not the effect of the similarity or differences of the sexes as regards colour. When the confirmed habit of a group of birds was to build their nests in holes of trees, like the toucans, or in holes in the ground, like the kingfishers, the protection the female thus obtained, during the important and dangerous time of incubation, placed the two sexes on an equality as regards exposure to attack, and allowed "sexual selection" to act unchecked in the development of gay colours and conspicuous markings in both sexes.

When, on the other hand, (as in the tanagers and flycatchers) the habit of the whole group was to build open cup-shaped nests, in more or less exposed situations, the production of colour and marking in the female was continually checked by its rendering her too conspicuous, while in the male it had free play, and developed in him the most gorgeous hues. In cases, however, where there was more than usual intelligence and capacity for change of habits, the danger the female was exposed to by a partial brightness of colour or marking, might lead to the construction of a concealed or covered nest, as in the case of the tits and hangnests; so that the acquisition of colour and the modification of the nest might in some cases act and react on each other, and attain their full development together.

There exist a few very curious and anomalous facts in the natural history of birds which fortunately serve as a crucial test of the truth of this mode of explaining the inequalities of sexual colouration. It has been long known that in some species the males either assisted in or wholly performed the act of incubation. It has also been often noticed that in certain birds the usual sexual differences were reversed, the male being the more plainly coloured, the female more gay and often larger. I am not, however, aware that these two anomalies had ever been supposed to stand to each other in the relation of cause and effect, till I adduced them in support of my views of the general theory of "Mimicry."* Yet it is undoubtedly the fact, that in the best known cases in which the female bird is more conspicuously coloured than the male, it is either positively ascertained that the latter performs the duties of incubation, or there are good reasons for believing such to be the case. The most satisfactory example is that of the gray phalarope (Phalaropus fulicarius, Linn.), the sexes of which are alike in winter, while in summer the female instead of the male takes on a gay and conspicuous nuptial plumage; but the male performs the duties of incubation, sitting upon the eggs, which are laid upon the bare ground.

In the dotterell (Eudromias morinellus) the female is larger and more brightly coloured than the male, and here, also, it is almost certain that the latter sits upon the eggs. The Turnices of India also have the female larger and often more brightly coloured; and Mr Jerdon states, in his "Birds of India," that the natives report that during the breeding season the females desert their eggs and associate in flocks, while the males are employed in hatching the eggs. In the few other cases in which the females are more brightly coloured the habits are not accurately known. The case of the ostriches and emeus will occur to many as a difficulty, for here the male incubates, but is not less conspicuous than the female; but there are two reasons why the case does not apply,—the birds are too large to derive any safety from concealment, and from enemies which would devour the eggs they can defend themselves by force, while to escape from their personal foes they trust to speed.

We find, therefore, that a very large mass of facts relating to the sexual colouration and the mode of nidification of birds, including some of the most extraordinary anomalies to be found in their natural history, can be shewn to have an interdependent relation to each other on the simple principle of the need of greater protection to that parent which performs the duties of incubation.†

* "Mimicry and other Protective Resemblances among Animals."—*Westminster Review*, July 1867.

† In his "Origin of Species," fourth edition, p. 241, Mr. Darwin recognises the necessity for protection as sometimes being a cause of the obscure colours of female birds; but he does not seem to consider it so very important an agent in

Considering the very imperfect knowledge we possess of the habits of most extra-European birds, the exceptions to the prevalent rule are few, and generally occur in isolated species or in small groups. The only marked exceptions I have been able to discover are the following:—

I. King crows (Dicrourus). These birds are of a glossy black colour with long forked tails. The sexes present no difference, and they build open nests. This apparent exception may probably be accounted for by the fact that these birds do not need the protection of a less conspicuous colour. They are very pugnacious, and often attack and drive away crows, hawks, and kites; and as they are semi-gregarious in their habits, the females are not likely to be attacked while incubating.

II. Orioles (Oriolidæ). The true orioles are very gay birds; the sexes are in many Eastern species either nearly or quite alike, and the nests are open. This is one of the most serious exceptions, but it is one that to some extent proves the rule; for in this case it has been noticed that the parent birds display excessive care and solicitude in concealing the nest among thick foliage, and in protecting their offspring by incessant and anxious watching. This indicates that the want of protection consequent on the bright colour of the female makes itself felt, and is obviated by an increased development of the mental faculties.

III. Ground thrushes (Pittidæ). These elegant and brilliantly-coloured birds are generally alike in both sexes, and build an open nest. It is curious, however, that this is only an apparent exception, for almost all the bright colours are on the under surface, the back being usually olive green or brown, and the head black, with brown or whitish stripes, all which colours would harmonise with the foliage, sticks, and roots about the nest, and thus serve as a protection to the female bird.

---

modifying colour as I am disposed to do. In the same paragraph (p. 240) he alludes to the fact of female birds and butterflies being sometimes very plain, sometimes as gay as the males, but apparently considers this mainly due to peculiar laws of inheritance, which sometimes continue acquired colour in the line of one sex only, sometimes in both. Without denying the action of such a law (which Mr. Darwin informs me he has facts to support), I impute the difference, in the great majority of cases, to the greater or less need of protection in the female sex in these groups of animals.

IV. Grallina Australis. This Australian bird is of strongly contrasted black and white colours. The sexes are exactly alike, and it builds an open clay nest in an exposed situation on a tree. This appears to be a most striking exception, but I am by no means sure that it is so. We require to know what tree it usually builds on, the colour of the bark or of the lichens that grow upon it, the tints of the ground, or of other surrounding objects, before we can say that the bird, when sitting on its nest, is really conspicuous. It has been remarked that small patches of white and black blend at a short distance to form grey, one of the commonest tints of natural objects.

V. Sunbirds (Nectarineidæ). In these beautiful little birds the males only are adorned with brilliant colours, the females being quite plain, yet they build covered nests in the few cases in which the nidification is known. This is a negative rather than a positive exception to the rule, since there may be other causes besides the need for protection which prevents the female acquiring the gay colours of her mate. In this case, too, the facts are very imperfectly known, and there is one curious circumstance which tends to elucidate it. The male of Leptocoma zeylanica is said to assist in incubation. It is possible, therefore, that the group may originally have used open nests (which, for all we know, may still be the case in many species), and some change of conditions, leading the male bird to sit, may have been followed by the adoption of a domed nest.

VI. Superb warblers (Maluridæ). The males of these little birds are adorned with the most gorgeous colours, while the females are very plain, yet they make domed nests. It is to be observed, however, that the male plumage is nuptial merely, and is retained for a very short time; the rest of the year both sexes are plain alike. It is probable, therefore, that the domed nest is for the protection of these delicate little birds against the rain, and that there is some unknown cause which has led to the development of colour in the males only.

I think I have now noticed all exceptions of any importance to the law of dependence of sexual colour on nidification. It will be seen that they are very few in number, compared with those which support the generalization; and in several cases there are circumstances in the habits or structure of the species that sufficiently explain them. If the views here advocated are correct as to the various influences that have determined the specialities of every bird's nest, and the general colouration of female birds, with their action and reaction on each other, we can hardly expect to find evidence more complete than that here set forth. Nature is such a tangled web of complex relations, that a series of correspondences running through hundreds of species, genera, and families in every part of the system, can hardly fail to indicate a true causal connexion; and when, of the two factors in the problem, one can be shewn to be dependent on the most deeply seated and the most stable facts of structure and conditions of life, while the other is a character universally admitted to be superficial and easily modified, there can be little doubt as to which is cause and which effect.

But the explanation of the phenomenon here attempted does not rest alone on the facts I have been able now to adduce. In the article on "Mimicry" already referred to, it is shewn how important a part the necessity for protection has played in determining the external form and colouration, and sometimes even the internal structure of animals.

As illustrating this latter point, I may refer to the remarkable hooked, branched, or star-like spiculæ in many sponges, which are believed to have the function chiefly of rendering them unpalatable to other creatures. The Holothuridæ or sea-cucumbers possess a similar protection, many of them having anchor-shaped spicules embedded in their skin, as the Synapta; while others (Cuviera squamata) are covered with a hard calcareous pavement. Many of these are of a bright red or purple colour, and are very conspicuous, while the allied Trepang, or Beche-de-mer (Holothuria edulis), which is not armed with any such defensive weapons, is of a dull sand- or mud-colour, so as hardly to be distinguished from the sea bed on which it reposes. Many of the smaller marine animals are protected by their almost invisible transparency, while those that are most brightly coloured will be often found to have some protection either in stinging tentacles like Physalia, or in a hard calcareous crust, as in the star fishes.

In the struggle for existence incessantly going on, protection or concealment is one of the most general and most effectual means of maintaining life, and it is by modifications of colour that this protection can be most readily obtained, since no other character is subject to such numerous and rapid variations. The case I have now endeavoured to illustrate is exactly analogous to what occurs among butterflies. As a general rule, the female butterfly is of dull and inconspicuous colours, even when the male is most gorgeously arrayed; but when the species is protected from attack by a disagreeable odour, as in the Heliconidæ, Danaidæ and Acrœidæ, both sexes display the same or equally brilliant hues. Any general theory of the phenomenon of colour in animals must deal with both these cases, as well as with the whole series of facts presented by every degree and kind of protective and imitative tinting.

To some persons it will perhaps appear that the causes to which I impute so much of the external aspect of nature are too simple, too insignificant, and too unimportant for such a mighty work. But I would ask them to consider that the great object of all the peculiarities of animal structure is to preserve the life of the individual, and maintain the existence of the species. Colour has hitherto been too often looked upon as something adventitious and superficial, something given to an animal not to be useful to itself, but solely to gratify man or even superior beings—to add to the beauty and ideal harmony of nature. If this were the case, then, it is evident that the colours of organized beings would be an exception to most other natural phenomena. They would not be the product of general laws, or determined by ever-changing external conditions; and we must give up all inquiry into their origin and causes, since (by the hypothesis) they are dependent on a Will whose motives must ever be unknown to us. But, strange to say, no sooner do we begin to examine and classify the colours of natural objects, than we find that they are intimately related to a variety of other phenomena, and are like them strictly subordinated to general laws. I have here attempted to elucidate some of these laws in the case of birds, and have shewn how the mode of nidification has affected the colouring of the female sex in this group. I have before shewn (in the article on "Mimicry" already alluded to) to how great an extent, and in how many ways, the need of protection has determined the colours of insects, and of some groups of reptiles and mammalia. Lastly, I would call particular attention to the fact that the gay tints of flowers, so long supposed to be a convincing proof that colour has been bestowed for other purposes than the good of its possessor, have been shewn by Mr Darwin to follow the same great law of utility. Flowers do not often need protection, but very often require the aid of insects to fertilize them, and maintain their reproductive powers in the greatest vigour. Their gay colours attract insects, as do also their sweet odours and honeyed secretions; and that this is the main function of colour in flowers is shewn by the striking fact, that those flowers which can be perfectly fertilized by the wind, and do not need the aid of insects, *rarely or never have gaily coloured flowers.*

This wide extension of the general principle of utility to the colours of such varied groups, both in the animal and vegetable kingdoms, compels us to acknowledge that the "reign of law" has been fairly traced into this stronghold of the advocates of special creation. And to those who oppose the explanation I have given of the facts adduced in this paper, I would again respectfully urge that they must grapple with the whole of the facts, not one or two of them only. It will be admitted that, on the theory of evolution, as worked out in detail by Mr Darwin, a wide range of facts with regard to colour in nature have been co-ordinated and explained. Until at least an equally wide range of facts can be shewn to be in harmony with any other theory, we can hardly be expected to abandon that which has already done such good service, and which has led us to the discovery of so many interesting and unexpected harmonies among the most common (but hitherto most neglected and least understood), of the phenomena presented by organised beings.

*THE NILE TRIBUTARIES OF ABYSSINIA, AND THE SWORD HUNTERS OF THE HAMRAN ARABS.**

THE "Nile Tributaries of Abyssinia," means the Abyssinian Tributaries of the Nile; and the "Sword Hunters† of the Hamran," means the sword-armed hunters of the Hamran. It is not swords that they hunt, but elephants, and other wild animals; and it is not the Nile that pays tribute to Abyssinia, but Abyssinia that sends, and has sent for thousands upon thousands of years, tribute to Egypt. The inverted title is a sacrifice to rhythm, which we may pass the more easily that it is the only piece of feather in the book.

In other respects the title is happy, and well expresses the contents of the book. It is divided into two well-marked streams, which, although they flow contiguously through the volume, never mix. The one is the exploration of the Abyssinian water sources of the Nile, the other the sporting adventures of the author, in which latter the so-called "sword-hunters" bore a share.

It is the complement of the author's previous work, "The Albert Nyanza Great Basin of the Nile." That work laid bare the sources which supplied the constant flow of the great river, but did not sufficiently explain the cause of the annual inundations. That is done in the present volume.

The Lake sources of Central Africa, as Sir Samuel says, and has proved, support the *life* of Egypt, by supplying a stream throughout all seasons, that has sufficient volume to bear the exhaustion of evaporation and absorption, for nearly 1200 miles, from the junction of the Atbara to the Mediterranean, although not one streamlet joins the mysterious river, nor one drop of rain ruffles its surface; but this stream, if unaided, could never over-

* The Nile Tributaries of Abyssinia, and the Sword Hunters of the Hamran Arabs. By Sir Samuel W. Baker, M.A., &c. 1 vol. London: M'Millan & Co. 1867.

† Sir Samuel may plead the word swordsmen, as an authority for the use of the word sword-hunter, but swordsmen is used in a figurative sense—men belonging to the sword—while the words "fox-hunter, hare-hunter, lion-hunter, elephant-hunter, sufficiently shew that the prefix properly relates to the thing hunted.

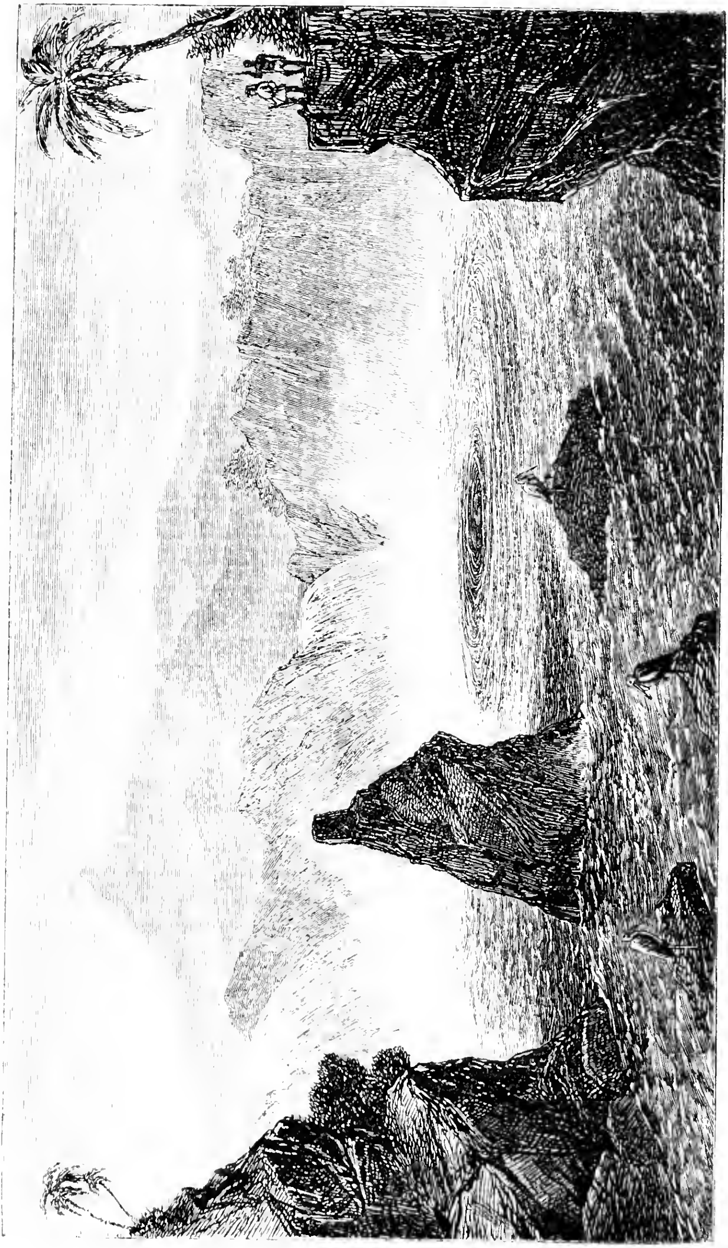
flow its banks; and Egypt thus deprived of the annual inundation, would simply exist, and cultivation would be confined to the close vicinity of the river.

The inundation which, by its annual deposit of mud, has actually created the Delta of lower Egypt, has its origin entirely separate from the lake sources of Central Africa; and the supply of water has been now proved by Baker to be derived exclusively from Abyssinia.

The two grand affluents of Abyssinia, are the Blue Nile and the Atbara, which join the main stream respectively, in north latitude 15° 30′ and 17° 37′. These rivers, although streams of extreme grandeur during the period of the Abyssinian rains, from the middle of June until September, are reduced during the dry months to utter insignificance: the Blue Nile becoming so shallow as to be unnavigable, and the Atbara perfectly dry, except a few isolated pools, like the water holes of the Australians, crowded with all the life of land, air, and water, gathered for scores of miles around; and some of the rivers, like the Gash, never reaching the Nile at all, but losing themselves in numberless ramifications in the thirsty sands, facts which in themselves are conclusive against the existence of glaciers or snowy mountains in any part of Abyssinia, which would otherwise have furnished a more permanent supply. In the dry months, the water supply of Abyssinia ceasing, Egypt depends solely upon the equatorial lakes, and the affluents of the White Nile, until the rainy season shall again have flooded the two great Abyssinian arteries. That flood occurs suddenly about the 20th June; and the great rush of water pouring down the Blue Nile and the Atbara into the parent channel, inundates Lower Egypt, and is the cause of its extreme fertility.

Sir Samuel was a witness, not only to the dried-up channels of these Abyssinian rivers during the dry season, but also to their flooding, having been encamped in the very bed of the Atbara, when, like a thief in the night, it burst upon them.

After a graphic description of the night's turmoil, and the change wrought by the flood in a few hours, he says:—"Although this was actually the beginning of my work, I felt that by the experience of this night, I had obtained a clue to one portion of the Nile mystery; and that, as 'coming events cast their shadows before them,' this sudden creation of a river was but the shadow of the great cause. The rains were pouring in Abyssinia! *these were sources of the Nile.*"



THE WHIRLPOOL AT THE ROYAN JUNCTION.

The scenery of these rivers, would appear to be often magnificent in the extreme. The junction of the Royan with the Settite, is described as a curious and frightful spot in the rainy season. The entire course of the Royan is extremely rapid, but at its lower extremity, it enters a rocky pass between two hills, and leaps, in a succession of grand falls, into a circular basin of about four hundred yards diameter. This peculiar basin is surrounded by high cliffs, covered with trees: to the left, is an island formed by a rock about sixty feet high; at the foot a deep and narrow gorge, through which the Settite River makes its exit from the circle. This large river enters the basin through a rocky gap, at right angles with the rush of water from the great falls of the Royan; and as both streams issue from gorges which accelerate their velocity to the highest degree, their junction forms a tremendous whirlpool, and in the rainy season is a most frightful scene of giddy waters. The accompanying plate, kindly lent us by Sir Samuel's publishers, will give the reader some idea of it.

Of course actual travelling, during such rains as those which supply these torrents, is impracticable. Baker encamped at a village favourably situated on the banks of the Atbara, and remained for three months, until the rainy season passed. Although violent storms were of daily occurrence, opportunities of hunting were not unfrequent, especially at the latter part of the rainy season. The game, however, was all on the other side of the rapid river, and the modes of crossing, by extemporised apparatus, might be instructive to our troops now entering Abyssinia.

When the dry season came, Baker resumed his journey, and as he journeyed from district to district, and from river to river, found full scope for his hunting fervour. At an early period, he heard of and came in contact with the Hamran hunters; and the most exciting adventures in his book, were performed in company with these swordsmen. The following is his account of them:

"Before my arrival at Sofi, I had heard of a particular tribe of Arabs that inhabited the Basé country; these were the Hamrans, who were described as the most extraordinary Nimrods, who hunted and killed all wild animals, from the antelope to the elephant, with no other weapon than the sword; the lion and the rhinoceros fell alike before the invincible sabres of these mighty hunters.

"In a long conversation with these men, I found a corroboration of all that I had previously heard of their exploits, and they described the various modes of killing the elephant with the sword. Those hunters who could not afford to purchase horses hunted on foot, in parties not exceeding two persons. Their method was to follow the tracks of an elephant so as to arrive at their game between the hours of 10 A.M., and noon, at which time the animal is either asleep or extremely listless and easy to approach. Should they discover the animal asleep, one of the hunters would creep stealthily towards the head, and, with one blow, sever the trunk which stretched upon the ground; in which case the elephant would start upon his feet, while the hunters escaped in the confusion of the moment. The trunk severed would cause a hæmorrhage sufficient to insure the death of the elephant within about an hour. On the other hand, should the animal be awake upon their arrival, it would be impossible to approach the trunk, and in such a case they would creep up from behind, and give a tremendous cut at the back sinew of the hind leg, about a foot above the heel. Such a blow would disable the elephant at once, and would render comparatively easy a second cut to the remaining leg: the arteries being divided the animal would quickly bleed to death."—(p. 172.)

These are the methods adopted by the poor hunters. When provided with horses their proceedings are modified acccordingly; they are changed from a stalk into a chase; but this hunt on horseback will be best appreciated by the account of a characteristic one given by Sir Samuel Baker, at which he was himself present. For want of space we must pass over the spirited account of the "find," and first "burst." The elephant had entered a stronghold, composed of rocky and uneven ground, in the clefts of which grew thinly a few leafless trees, the thickness of a man's leg. It then turned boldly and stood determinedly at bay:

"The elephant stood facing us like a statue; it did not move a muscle, beyond a quick and restless action of the eyes that were watching all sides. Taher Sherif and his youngest brother Ibrahim now separated, and each took opposite sides of the elephant, and then joined each other about twenty yards behind it; I accompanied them, until Taher advised me to keep about the same distance on the left flank. My tokrooris kept apart from the scene, as they were not required. In front of the elephant were two agageers, one of whom was the renowned Rodur Sherif, with the withered arm. All being ready for action, Rodur now rode slowly towards the head of the cunning old bull, who was quietly awaiting an opportunity to make certain of some one who might give him a good chance.

"Rodur Sherif rode a bay mare, that, having been thoroughly trained to these encounters, was perfect at her work. Slowly and coolly she advanced towards her wary antagonist, until within about eight or nine yards of the elephant's head. The creature never moved, and the *mise en scene* was beautiful. Not a word was spoken, and we kept our places amidst utter stillness, which was at length broken by a snort from the mare, who gazed intently at the elephant, as though watching for the moment of attack.

"One more pace forward, and Rodur sat coolly upon his mare with his eyes fixed upon those of the elephant. For an instant I saw the white of the eye nearest to me. 'Look out, Rodur, he's coming!" I exclaimed: with a shrill scream the elephant dashed upon him like an avalanche.

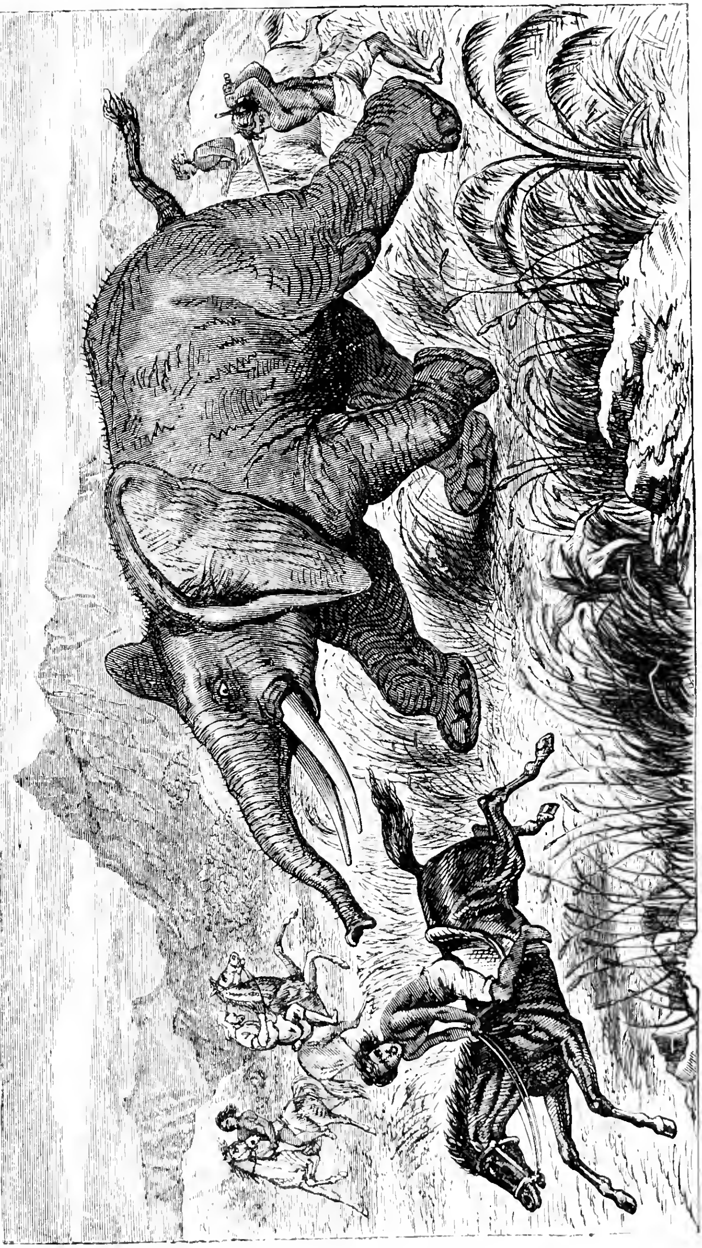
"Round about went the mare, as though upon a pivot, and away over rocks and stones, flying like a gazelle, with the monkey-like form of little Rodur Sherif leaning forward and looking over his left shoulder as the elephant rushed after him.

"For a moment I thought he must be caught. Had the mare stumbled, all were lost, but she gained in the race after a few quick, bounding strides, and Rodur still looking behind him kept his distance so close to the elephant that its outstretched trunk was within a few feet of the mare's tail.

"Taher Sherif and his brother Ibrahim swept down like falcons in the rear. In full speed they dexterously avoided the trees, until they arrived upon open ground, when they dashed up close to the hind quarters of the furious elephant, who, maddened with the excitement, heeded nothing but Rodur and his mare, that were almost within its grasp. When close to the tail of the elephant, Taher Sherif's sword flashed from its sheath, as, grasping his trusty blade, he leapt nimbly to the ground, while Ibrahim caught the reins of his horse. Two or three bounds on foot, with the sword clutched in both hands, and he was close behind the elephant. A bright glance shone like lightning as the sun struck upon the descending steel. This was followed by a dull crack, as the sword cut through skin and sinews, and settled deep in the bone, about 12 inches above the foot. At the next stride the elephant halted dead short in its tremendous charge. Taher had jumped quickly on one side, and had vaulted into the saddle with his naked sword in hand. At the same moment Rodur, who had led the chase, turned sharp round, and again faced the elephant as before. Stooping quickly from the saddle, he picked up from the ground a handful of dirt which he threw into the face of the vicious-looking animal, that once more attempted to rush upon him. It was impossible! the foot was dislocated, and turned up in front like an old shoe. In an instant Taher was once more on foot, and again the sharp sword slashed the remaining leg. The great bull elephant could not move! the first cut with the sword had utterly disabled it; the second was its death blow; the arteries of the leg were divided, and the blood spouted in jets from the wounds. I wished to terminate its misery by a bullet behind the ear, but Taher Sherif begged me not to fire, as the elephant would quickly bleed to death without pain, and an unnecessary shot might attract the Basé, who would steal the flesh and ivory during our absence."
—(p. 438.)

And so they left the poor beast! and really we were not sorry to learn that the Basé did steal the flesh and ivory before their return, the whereabouts of the quarry having been betrayed by the vultures before they got back with the necessary conveyance for carrying off the spoil.

Such an exploit beats bull fighting. There is only one trifling criticism which we would venture to make on the exciting narrative, and that is, that Taher Sherif must have been well up and abreast with the elephant when he jumped down to deliver the hamstringing blow, for he must have been parallel with it, and also standing still when he delivered it. It is plain that he could not have delivered a two-handed blow when running: let anyone try



ELEPHANT HUNTING—THE SWORD WINS THE DAY.

it and he will see it is impossible. He must have had a stable fulcrum for his swing. He is figured as standing still in Sir Samuel's own sketch of the occurrence (which we have borrowed to illustrate our quotation), and unless he had got a little in advance of the hind leg when he did poise himself for the blow, the animal would have been out of reach before it descended. The elephant may, indeed, before he jumped down, have been slackening his pace sufficiently to allow him to run forward along its side, as far as was necessary, to give him time to stand and deliver his blow in passing, as it were.

It is in passing that the blow is delivered by hunters in other parts of Africa, who adopt something of the same style of hunting as that of the Hamrans. In fact, that of the latter is only a bolder, more daring, and more hazardous exaggeration of a not unusual mode of attacking the elephant practised in some parts of Inner Africa. The elephant, as the reader knows, is an ease-loving animal; he belongs to what in Scotland would be called the "canna be fashed" order; consequently, when he has to pass through a thick-grown forest, he does not usually, or unless when excited, go crushing through the heart of it, regardless of obstacles; but if there are any paths through it (which there usually are, made by the elephants themselves), he habitually takes them. The natives know this, and take advantage of it. They select a place for an ambush close to one of these paths, and having one or two requisites: it must be well clothed with foliage, to conceal them from the eye of the elephant; there must be room for them to swing their weapon round, and it must be close to a Baobab (Adansonia digitata), or other large tree, on which he can take refuge after delivering his blow. (Sir Samuel alludes to the natives climbing the Baobab for honey, by pegs stuck in the soft bark.) They then lie in wait for the elephant. A herd comes sauntering slowly and meditatively along, the hunter waits until the last passes, and as soon as it does so, he strikes a hamstringing blow, as described by Sir Samuel; and the moment it is delivered, without waiting to see the result, he is up the tree like lightning, or flying at full speed into the thickest of the jungle. If the blow is successful, the animal is persecuted with spears and arrows to death.

The Hamran practice is a bolder and nobler step in the art of venery, but they are obviously both species of the same genus.

With or without these swordsmen, alone or in company with others of the natives, Sir Samuel waged for months an unrelenting war upon the wild animals of these countries. No doubt we now and then meet with an instance of occasional self-denial where he refrains from slaughter, on the ground that he had plenty of food in camp; but we do not observe that these qualms of conscience ever obtruded themselves when the temptation was great, as in the case of an elephant or a rhinoceros, but were usually confined to partridges or antelopes. Still, to find any qualms at all stopping the forefinger of such an enthusiast, is something.

It is hopeless to attempt to do justice to the narrative of his hair-breadth 'scapes in the short space that we can give for quotation. It requires the adjuncts and accessories leading up to, and accompanying them, to enable one fully to appreciate them. We must refer the reader to his book itself for them, and shall now turn and take a short look at its natural history.

Sir Samuel is not strong in natural history, in fact, he obviously has no scientific knowledge of it at all, and has viewed everything from the sporting stand-point; consequently, scarcely anything is noticed that was not big enough to be shot or eaten. Generally speaking, however, his descriptions of the animals he has met with are sufficiently precise to enable a naturalist, without much difficulty, to recognise the species he is speaking of. Of mammals, we find that he met with one species of monkey, which, from his description, was probably Cercopithecus griseo-viridis; also one species of baboon, but which of the four or five reported Abyssinian species, does not appear. It is probable that the present expedition may have the effect of reducing the number of species, as it certainly will the number of individuals. His observations confirm those already made as to the intelligence of these animals, one remarkable instance of which is their digging wells in the sand for water. Sir Samuel gives the credit of this to "the monkeys," but we have no doubt that he used the word in its largest sense, and that, specifically, it was the baboons he meant, because we find Mansfield Parkyns relating the same thing of them:

> "They shew also the same sagacity in searching for water, discovering at once the places where it is most readily found in the sand, and then digging for it with their hands, just as men would, relieving one another in the work if the quantity of sand to be removed be considerable." (Parkyns, p. 230.)

We would refer those who have not read Mansfield Parkyns's "Life in Abyssinia," to that work for some credible instances of the intelligence of these animals, which he vouches for as true, and for some incredible instances of their sagacity, which the Arabs vouch for as true. The fact of their placing sentinels, and those sentinels keeping their posts, and subduing their appetites, while all the rest of their fellows are plundering and gorging, is one of the most extraordinary approaches to human intellect that we know of.

Of carnivorous mammals, he met with the lion, which furnishes some of the most sensational incidents in the book; the leopard, which he found devouring a snake that it had killed; the hyæna crocuta, which was abundant and generally unmolested, for sanitary reasons.

Of herbivorous animals, he gives a long list of antelopes, which is not limited to Abyssinia, but includes all the species met with by him, and by Von Heuglin, or one or other of them, in any part of East Africa. This was supplied to him by Heuglin, and will more properly come under notice in our account of that gentleman's travels, which we must shortly pass under review, merely observing that there is amongst them a new Abyssinian species, the "Maarif," named after Sir Samuel by Heuglin.

Besides antelopes, he encountered the Cape buffalo and the Indian buffalo (naturally spoken of by Sir Samuel as a new species, as he, doubtless, never expected to see his Ceylon and Hindostanee acquaintance in the wilds of Abyssinia), the aboriginal wild ass, the hippopotamus, the rhinoceros bicornis, the elephant, and the giraffe. It would appear that many of these animals, although, perhaps, not in the proper sense migratory, are so practically, being compelled to shift their quarters regularly every year by flies, drought, &c. The Seroot fly, which we shall have presently to mention, is one of the chief agents in these migrations of the giraffe. Sir Samuel mentions a circumstance of which we were not aware, viz., that the long bones of the limbs of the giraffe are solid, not hollow, as in other ruminants:

> "It would be natural to suppose that the long legs of this animal would furnish the perfection of marrow-bones, but these are a disappointment, as the bones of the giraffe are solid, like those of the elephant or hippopotamus."

It is rather curious to find the practical man pointing out, from the experience of his desert dinner table, a fact like this, which has escaped the attention of comparative anatomists. Professor Owen, in his "Comparative Anatomy and Physiology of Vertebrates," published in 1866, says (vol. i, p. 24), without any qualification or reservation,—

> "In the active land quadrupeds the shaft of the long bones of the limbs is hollow. The strength and lightness of the limb bones are thus increased, after the well-known principle of the hollow column, which Galileo, by means of a straw picked up from his prison floor, exemplified as an evidence of design, in refutation of the charge of Atheism brought against him by the Inquisition."

But we see that, when the additional bulk requires it, the ordinary type is departed from, and the hollow bones become solid.

The notices of the birds are very meagre—the only ones which seem to have particularly struck him are the vultures and the francolin partridge, any notices of others being too brief for recognition. Apropos to the vultures, he discusses the vexed question whether these birds discover the carcases on which they prey by sight or smell. This is now well settled, but his observations are interesting, not only as regards it, but as pointing out that these birds probably occupy different heights in the air—strata of vultures, as it were—and that it is their distance which regulates the comparative priority of arrival of the different species. The order in which they come is—1, the black and white crow; 2, the common buzzard; 3, the red-faced small vulture; 4, the large bare-throated vulture; and, lastly, the Marabou stork and adjutant, which, although not vultures nominatim, are in reality the greatest vultures of them all.

Of reptiles, the crocodile and tortoise (Trionyx Ægyptiacus), which is so destructive to young crocodiles, are the only species he mentions. Snakes must be very scarce, or we should have heard of them. He gives some thrilling tales about the voracity and boldness of the crocodile, which we are sorry that we have not space to quote. His acquaintance with the Trionyx was made through the medium of the fishing-rod, he having caught, but not landed, a fellow 100 lb. in weight.

His angling with fish was more successful:

> "This afternoon, I took the rod, and having caught a beautiful silver-sided fish, of about a pound weight, I placed it upon a large single hook fastened under the back fin. In about an hour I had a run, but upon striking I pulled the bait out of the fish's mouth, as the point of the hook had not touched the jaw. I had wound up slowly for about thirty yards, hoping that the big fellow would follow his last prize, as I knew him to be a large fish by his attack upon a bait of a pound weight. I found my bait was killed, but having readjusted the hook I again cast it in the same direction, and slowly played it towards me. I had him! He took it immediately, and I determined to allow him to swallow it before I

should strike. Without a halt about a hundred yards of line were taken at the first rush towards the middle of the river; he then stopped, and I waited for about a minute and then fixed him with a jerk that bent my bamboo like a fly rod. This he repelled by a splendid challenge; in one jump he flew about 9 feet above the water, and shewed himself to be one of the most beautiful fish I had ever seen; not one of those nondescript antediluvian brutes that you expect to catch in these extraordinary rivers, but in colour he appeared like a clear run salmon. He gave tremendous play, several times leaping out of the water, and shaking his head furiously to free himself from the hook, then darting away with 80 or 100 yards of fresh line, until he at last was forced to yield to the strong and elastic bamboo, and his deep body stranded upon the fatal shallows."

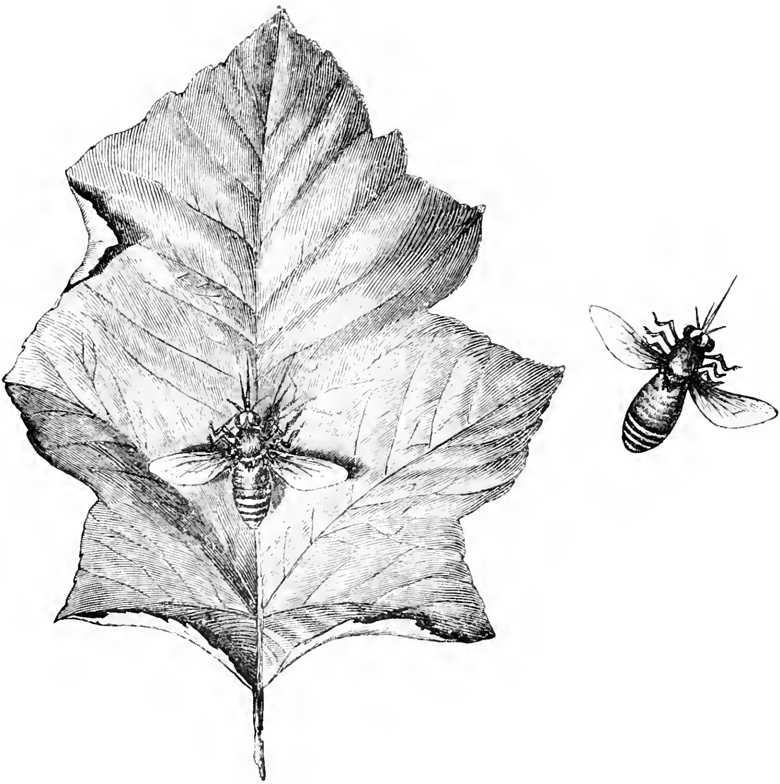
This he names the "Baggar," *i.e.*, the cow. From the figure he gives of it, it was undoubtedly the Lates Niloticus of Cuvier—the latos of the Greeks, after which the town called Latopolis is supposed to have been named—a perch, the largest and most esteemed fish of the Nile. Sir Samuel naturally thinks he had caught a stunner, a giant of the pools, a centenarian; but it was only a puny youngster after all. If he thinks so much of a 30 or 40 pounder, what would he have said to one of 10 feet in length, which is the size that St Hilaire mentions that they reach to. Fancy playing a fish like a salmon, 10 feet in length; that *would* have been a foeman worthy of Sir Samuel's bamboo.

Another fish, described by Sir Samuel under the Arab name of the Coor, is an ugly monster, of about 50lb weight, a species of Silurus; differing from the Silurus of Europe, by having a dorsal fin, like a fringe, that extends along the back to the tail. This fish had lungs resembling delicate branches of red coral, and if kept moist, it would exist upon the land for many hours, like an eel. It smells strongly of musk. This is, no doubt, the Heterobranchus bi-dorsalis of St Hilaire. He says it is as rare in Egypt as the other species of Heterobranchus is common. This species belongs essentially to the Upper Nile, and it is only, therefore, as it were, accidentally that they are met with in Egypt, where, for a reason easy enough to comprehend, only very large individuals arrive. These drawn from their true country by their extreme voracity, engage in the pursuit of troops of travelling fishes which descend the river, and come with them into the Egyptian Nile. He gives its length as 2 feet 4½ inches.

Another species, figured under the name of Bayard, is apparently the Bagrus bajad, Val.

All the species mentioned are already well known as inhabitants of the Nile.

Of invertebrate animals, the only one mentioned by Sir Samuel, besides the usual insect annoyances common to all hot countries, is the Seroot fly, a scourge which, although not so fatal in its re-



sults as the attacks of the Tsetse fly, is infinitely more annoying and distressing. It worries the wild animals almost to death, and, during its prevalence, drives them from the country. From Sir Samuel's account, it appears that this peculiar fly is about the size of a wasp, with an orange coloured body, with black and white wings; the proboscis is terrific; it is double, and appears to be disproportioned, being two thirds the length of the entire insect. When this insect attacks an animal or man, it pierces the skin instantaneously, like the prick of a red hot needle driven deep into the flesh; at the same time, the insect exerts every muscle of its body, by buzzing with its wings, as it buries the instrument to its greatest depth. The blood starts from the wound immediately, and continues to flow for a considerable time: this is an attraction to other flies, in great numbers, many of which lay their eggs upon the wound.

From the figure and description, it is unquestionably a Pangonia, a genus largely represented in South Africa, and is not very far from P. barbata, Wied., a Cape species. It is not in the British Museum, and Mr Frederick Smith seems to think it is probably new. It has nothing to do with the Tsetse (the Glossina morsitans), which belongs to a totally different section of flies, and does its mischief in a totally different fashion. The pain caused by the bite of the latter is trifling, not more than the slight itching irritation caused by the bite of a mosquito. That of the former puts every one to flight. Here is Baker's account of his personal experience:

"My giraffe was not quite dead, and the throat having been cut by the Arabs and Richard, we attempted to flay our game: this was simply impossible. The Seroot fly was in swarms about the carcase, thousands were buzzing about our ears, and biting like bull-dogs: the blood was streaming from our necks, and as I wore no sleeves, my naked arms suffered terribly. I never saw such an extraordinary sight; although we had killed our giraffe, we could not take possession; it is no wonder that camels and all domestic animals were killed by this horrible plague, the only wonder was the possibility of wild animals resisting the attack. The long tails of the giraffes, are admirable fly-whippers, but they would be of little service against such a determined and blood-thirsty enemy as the Seroot. They were now like a swarm of bees, and we immediately made war upon the scourge, by lighting several fires within a few feet to windward of the giraffe; when the sticks blazed briskly, we piled green grass upon the tops, and quickly produced a smoke that vanquished the enemy."—(p. 196.)

It appears that this peculiar fly, which tortures all domestic animals, invades the country shortly after the commencement of the rains, when the grass is about two feet high; and more particularly infests the flat and rich table-lands, where the quality of the grass is totally different to that produced upon the pebbly and denuded soil of the higher sandstone slopes. So long as moisture continues it prevails, but as soon as drought returns its reign is over. No sooner does the grass turn yellow than it disappears, and its presence may thus be dated from about 10th July to 10th October.

Of plants we do not learn anything that is new. The prospects of the introduction of valuable new fruits and vegetables from Abyssinia are not bright. Sir Samuel speaks of the hegleek

(Balanites Ægyptiaca) favourably, as a fruit. The account we have heard of it is, that it is only a little more unpalatable than an acorn; but Sir Samuel seems not to have disliked it; Lady Baker made preserves of it, with honey; and one of their servants sacrificed her life to her predilection for it—continuing to eat it, although warned against its noxious or indigestible properties. Sir Samuel also speaks of the valuable qualities of the cultivated onion as food, he having lived for days on nothing but rusks and them; of the uneatable properties of a wild onion (may we be pardoned for suggesting that the bulb was possibly a lily); of several varieties of wild spinach; and a plant called regly, that makes a good salad. He also tells of the Adansonia, its spongy wood being not much firmer in substance than cork, and as succulent as a carrot—the refreshing sub-acid flavour of its seeds, and its immense girth (the largest he measured being 51½ feet in circumference); of the poisonous and irritant Asclepias gigantea; the thorny mimosas; and, generally, the thorny vegetation usually confined to dry and desert districts; the quantities of gum-arabic to be had for the picking up, &c.; but, so far as the kitchen or dessert table is concerned, there does not appear to be much scope for the exertions of the Horticultural Society in the districts he visited. Mansfield Parkyns told us long ago that a man who cares a straw about what he eats should never attempt to travel in Africa: his life would be anything but one of pleasure. It would, indeed, be a matter of hardship; but then, he says, the semi-starvation to which one is now and then reduced, so far from being a hardship in travelling, as it is often represented by tourists, is, if not continued to extremity, one of the greatest possible blessings. Senna is another unpalatable blessing which this land possesses in abundance; curiously enough, the camels are very fond of it.

Of the geology and mineralogy of the country we learn little. Limestone, sandstone, with fossilized wood and basalt, are spoken of, also gold in small quantities; copper, in some places so abundant as to poison the water of the river-pools on whose bed it occurs; agates; cornelian; masses of exquisite bloodstone, the size of a man's head, &c.

Of the climate—healthy and delightful where high and dry, villanous in low and damp localities—we need not speak. Neither is there much to say of the natives. Not that we mean that the subject is a barren one, but that Sir Samuel has not looked at it from the point of view which would have most interest to our readers. Abyssinia is, undoubtedly, the bridge by which a certain interchange of Europeo-Asiatic with true African species of animals (*i.e.*, species belonging to Africa south of the Sahara) has taken place; and it would be interesting to know how far the facts indicative of this in other animals and in plants were confirmed or not by the present distribution of the peoples of that country. We glean little of this directly from Sir Samuel Baker's book, but have a good deal of amusing information about their habits and manners, which want of space compels us to pass over. We would only say that so far as these furnish any indication of affinity they rather seem to point to a considerable share of the Negro element in the natives of Abyssinia. Lastly, for the same reason, we must treat with a neglect in very unsatisfactory contrast to the attention bestowed upon it by Sir Samuel—the whole subject of his artillery, from his "dear little Fletcher 24," to the "Baby," a terrific blunderbuss that fired explosive shells of half-a-pound weight. It is most ungrateful on our part, for we have derived no little amusement and interest from the battery. Our excuse is that it is a fault unwilling.

EDITOR.

A GLANCE AT THE PRESENT POSITION AND PROSPECTS OF GEOGRAPHICAL SCIENCE.

THE progress of geographical science has of late years been very rapid; the increased facilities for travel, and the continued craving for knowledge, induce those fond of enterprise to go forth in quest of new discoveries, so that we may be said to be daily adding to them; while the ever recurring changes, not so much affecting the form as the territorial divisions of countries, necessitate continual attention to geography in all its bearings, which, being so inseparably connected with the subjects to be treated of in this *Journal*—Travel and Natural History—a review of these changes from time to time in its pages cannot be otherwise than appropriate.

The annexation of Savoy and Nice to France; the forcible exclusion of Naples from the list of independent kingdoms; the absorption of duchies in the new kingdom of Italy; and, more recently, Austria deprived of her Italian dominions to increase the same kingdom; the annihilation of the individuality of Hanover and Saxony as separate kingdoms, and the incorporation of Schleswig-Holstein and other states, now forming the confederated kingdom of Prussia, have so changed the map of Europe as to cause geographers and staticians no little trouble to keep pace with the changes.

Not only in Europe are these changes taking place, but in Asia also. Russia, after many years of persevering struggle, attended with great expense and loss of life, having conquered the hardy mountaineers of the Caucasus, has firmly established her boundary in that direction, and is now, slowly but surely, making her way through the vast steppes of hitherto independent Tartary, Mongolia, and Manchuria, towards the British possessions in India, the Chinese Empire, and Japan, absorbing in her giant grasp, countries until now considered integral portions of independent states, so that it would be simply impossible to define correctly the boundary of the Russian Empire in Asia; all we know being, that it is somewhere between the 50th and the 40th degrees of latitude.

The recent extension of our empire in the East, by the acquisition of Scinde and the Punjaub, the gradual opening up of China and that *terra incognita* Japan, furnish to the traveller and naturalist a boundless field for research; and the still little known though lesser regions of the Corea and Formosa, must in the course of time succumb to the advance of civilization and science, and unfold their natural treasures to the philosopher.

The establishment of railways, now pushing their way through the very heart of our Indian possessions, will be the means of adding greatly to our knowledge of countries and peoples hitherto comparatively unknown, although under our rule.

The colonization of Cambodia and Cochin China by the French, offers a wide field for instructive research.

The great islands of the Asiatic group forming the two chains from Sumatra to Timor, and from Borneo to New Guinea, with whose outlines we are so familiar, are far from being exhausted with respect to their interiors; and much yet remains to be done in all, both by the naturalist and the geographer.

Turn we to Africa—that land of mystery and death. To Egypt and the Nile is now but a holiday trip, and the veil has been partially withdrawn from the fatal regions beyond by the exertions of heroic men, who, at the expense of their health, property, and life, have devoted themselves to dispel the mystery which had previously entirely surrounded them.

Much remains to be known of Madagascar and all beyond the seaboard fringe of the African continent, from Zanzibar to the Red Sea.

With Abyssinia, too, we are already becoming better acquainted, and ere long we shall know it as thoroughly as we do Egypt or Algeria.

In the great continent of America changes equally startling, but not so rapid in succession as those in Europe, have taken place. Commencing north, that large and apparently unprofitable country, heretofore known as Russian America, having been ceded to the United States, there can be little doubt but that the enterprising spirit of its new owners will soon reveal sources of wealth hitherto unsuspected; the exploration of the country, already determined on by the United States' Government, will shortly ascertain its capabilities.

Our own possessions in North America of British Columbia and Vancouver Island in the west (but a few years since merely a source of profit to a private company), and in the east of Canada, New foundland, Prince Edward Island, Nova Scotia, and New Brunswick, with the land stretching northward towards the Pole, connected by that vast tract of unknown land between, and thus reaching from the Atlantic to the Pacific, when formed (as is intended) into one great British North American Confederacy, dwarfing in superficial extent the united kingdoms of Europe, will be our great principality of the western hemisphere as India is of the eastern.

Great geographical changes have taken place in the United States, adding to their national flag year by year a star (indicative of a State), as civilization travels west and those new States are formed. By this advance, the geography of the country becomes more known, and the contemplated railroads, to connect the Atlantic with the Pacific, in these States, as well as also in our own possessions, will, if constructed, also add much to that geographical knowledge. Agitated as this colossal nation has lately been by internal war, and even now in the throes consequent on exhausted energies, the spirit and enterprise of its people in matters of science have never flagged, but conjointly with ourselves they despatch missionaries and travellers through all the countries of the known world, and strive, with honourable emulation, to excel in usefulness the mother country.

In the unfortunate empire, or territory, of Mexico, and the scarcely less unfortunate countries skirting the western shores of South America, the proverb that "Where God does most, man does least," may be said to be exemplified: with the greatest opportunities that nature could bestow on them, it would be difficult to point to a single item which they have contributed to the general store of learning or science.

Brazil, on the contrary, though still possessing her antient boundary, and although in arts and sciences still behind the nations of Europe, has made much progress of late years. The liberal spirit of the Emperor, the establishment of railways, and consequent development of her internal resources, the opening her giant river Amazon to trade and commerce, and, not least, the abolition of slavery, have greatly advanced her status as a nation, as well as in science and art.

Of those wonderful countries, not inaptly termed the fifth division of the globe—Australia and New Zealand—could we, like Rip Van Winkle, have had a geographical nap of but fifty years, what marvellous changes would meet our view on waking! Australia, from being a country suited only to send our convicts to—what has it become? States have been created, with cities, springing, like Aladdin's fairy palace, into existence in a night, rivalling in wealth, by the discovery of gold, the nations of Europe, and inhabited by a race of Englishmen and their descendants, possessing all the spirit and energy of the mother country.

Of these exalted qualities the map of their country is a noble monument, on which long lines of detailed information mark the course of men who struggled, even to the death, in the cause of geographical discovery; still leaving, however, vast tracts of country to test the spirit of enterprise in those willing to follow their example.

Little Tasmania, although nearly the size of Ireland, hanging like a small pendant to Australia, is yet destined to occupy a position of greater importance than the world at present is willing to accord; separated from Australia by a narrow strait of about 120 miles, its features are essentially different from those of the gold-strewn plains of Victoria; and its fertile soil and temperate climate will ensure a steady, though slow progress.

Proud may we be of both, for the pursuit of wealth has not caused them to neglect the gentler calls of that purer wealth—science—which, like the widow's cruse of oil, seems inexhaustible, and yields the more the more that is drawn from it; and great and rich promise to be the contributions to science and natural history, to be poured into the common lap by our brethren at the Antipodes.

New Zealand would equally astonish our Rip. From being a country at which our ships touched occasionally, and brought home, as curiosities, a few rudely designed, but elaborately carved implements, or a scarcely less elaborately tatooed head of a chief, it has in a few years sprung into an important colony.

The legend of the New Zealanders, that their islands would never be conquered until a woman fought against them, may, in the person of our Queen, be said to have been fulfilled; and although, like a brave people as they are, they struggle in their bonds, it is but a last effort. With whatever show of reason we may satisfy ourselves of our warranty in taking possession of this large group of islands, it is to be hoped that the apparently inevitable fate of the aborigines, in all countries where the white man's foot rests, will not be the fate of this fine race, who, even as savages, won the admiration of our forefathers, and who, in their struggle to retain New Zealand for the New Zealanders, have not been without their "gold side to the shield," although we may have doubted and disputed it.

So sudden have been the changes in these islands that a few months only seems to have converted a wilderness into a habitable region. The west coast of the middle island, to which but a few months back only one or two individuals had travelled from the east, and the ship sent to survey the coast passed at such a distance from its unpromising and forbidding shores, as scarcely to do more than trace its principal and most prominent features, now teems with a population estimated at fifty or sixty thousand Europeans.

This sudden change is to be attributed to the discovery of gold, which, while it enriches those who labour to attain it, is not of less importance to the geographer and naturalist, as opening up a mine of wealth for them.

If we have dwelt longer in considering this portion of the habitable globe, it is because the greatest physical and moral changes have taken place, and are still taking place in it; and from which we hope to have to record, from time to time, important discoveries in the branches of science of which we treat.

Polar discovery is still a temptation to our nautical and Arctic heroes; and the recent discussions in the Royal Geographical Society, proves that we have still many, who, undeterred by the fate of the gallant Franklin and his companions, are ready as ever to spring forth and stem the dangers and hardships of the icy North: and the hope is entertained that expeditions, which add so much to our knowledge of geography and natural history, have not been given up, but may, for the time, be considered only dormant; and that opportunities may yet be offered for the daring enterprise of our younger officers and men, before the old school of Arctic men die out.

The French, who have ever had an honourably jealous feeling at our appropriation of all the honours to be reaped by Arctic discovery, are even now, while we are writing, organizing an expedition to endeavour to attain that coveted goal of all Arctic travellers—the Pole itself; and without one feeling of jealousy in the cause of science, we wish them success.

Nor are the South Polar regions free from a threatened invasion; and, doubtless, the Astronomer-Royal meditates much on the probability and possibility of observing the transit of Venus across the Sun's disc in 1882: the only places from which it can be observed, being in those far regions of the South, where, at the season of the year in which it will occur, man has never reached; but no doubt we have many ready to try, and who would not feel dishonoured at failure.

In writing of the present position and prospects of geographical science, it would be ungrateful to ignore a source of our own, from which so much has been drawn, and without which our status in regard to it would not have attained its present prominence. To the Royal Geographical Society, in its corporate capacity, we owe much by bringing its influence to bear on the government of the country, for the advancement of its objects, or by helping, rewarding, or despatching at its own expense, travellers in search of geographical and kindred knowledge, whilst individually its members are ever contributing to the treasury of knowledge; and although it was our intention to have avoided names, we cannot refrain from alluding to one to whom this progressive state of the science is greatly due, and stating, as geographers, how much we are indebted to Sir Roderick Murchison.

Want of space compels us to avoid dwelling on the advantages geographical science will derive from the extension of railways, steam communication, and the telegraph, bringing us, as they do, by the ties of commerce and science, nearer to our fellow men, and more closely uniting the great scattered family of mankind; rendering, it is to be hoped, war more difficult, and thus advancing that great consummation of the best human efforts—"on earth, peace."

J. E. D.

*SYMMETRY AND HOMOLOGY IN LIMBS.**

DR. JEFFRIES WYMAN is publishing, in the "Proceedings" of the Boston Society of Natural History, the results of many years' studies upon the Symmetries of the Body and the Homologies of the Limbs in Vertebrates. "The fundamental idea of the organs of organic life," he says, "involves the condition of symmetry"—a symmetry which, however distorted, is apparent on either side of every plane (not diagonal) dividing the body into equal halves. At the outset he urgently insists upon the necessity of examining this subject by the light which embryology affords; this will furnish ample proof of the complete symmetry of plan in the extremes of vertebrates.

In the early stages of development, symmetry is maintained at the two ends as well as at the two sides of the body; but, subsequently, it is more or less modified as the animal is adapted to its special conditions of life. This symmetry of fore and hind parts—a most important guide in determining homologies—results quite naturally from the mode of growth of an embryo and of its organs. The growth of the embryo is from a central point forward and backward; the nervous axis, in its earliest stage, is a groove which is symmetrically enlarged at either end, and gradually closes from the centre outward; the lung and allantois—in air-breathing animals—arise as simple sacs at opposite ends of the straight symmetrical intestine. But it is in the limbs that the most striking feature of this kind of symmetry can be traced. Placing the body of an embryo in an horizontal position, the limb buds in their earliest stage are simply tegumentary outgrowths, projecting at right angles from the body; when these limbs subsequently bend at a point near the trunk, their ends are directed downward; the hands and feet become vertical, facing inward; and the upper arms and thighs project at right angles from the body. At a later period, the elbow swings backward and the knee forward against the body, while the fore-arm slowly rotates inward, until the palm, like the foot, faces almost backward.

Bearing these embryonic changes in mind, the homotypes in

* "On Symmetry and Homology in Limbs." By Jeffries Wyman, M.D. 8vo. pamphlet, 45 pages. Boston, 1868.

the two limbs may be readily determined, for, normally, they will have the same relative position in both limbs, and be symmetrically opposed to each other. Thus, the humerus and femur are considered homotypes, and symmetrical rather than parallel bones, because their normal will then be their natural position, the axis of the humerus inclining backward, and that of the femur forward; all the corresponding parts facing in opposite directions. Dr Wyman combats, at length, the views of Owen and Humphrey upon the homologies of the bones of the fore-arm and leg, trusting to the relative position of the two as the safest means of determining homologies. "If," writes Dr Wyman, "the two bones of the fore-arm and of the leg are placed in planes at right angles to the axis of the body, those bones must be considered homotypes which occupy corresponding positions. The bone on the outside of the fore-arm—viz., the radius—can only be the homotype of that on the outside of the leg—viz., the fibula. But few anatomists have made any allowance for the pronation of the fore-arm, and most of them overlook the fact, that the proper position of the bones of this segment, for comparison with those of the leg, is supination. If the position of pronation is to be retained for the fore-arm, the leg should go through a corresponding rotation in the opposite direction. Viewed in connexion with the idea of symmetry, the homotypes are determined without difficulty." The patella is considered a sesamoid bone.

In the hands and feet the homologies are not so apparent; there can be no question of the correspondence of the wrist and ankle, but the relation of their several parts present peculiar difficulties. Leaving form out of question, and comparing those bones which occupy symmetrical positions, we must consider the inner bone of the wrist articulating with the ulna, the homotype of the inner bone of the ankle articulating with the tibia. In this way Professor Wyman homologizes the pyramidale with the scaphoid, the lunare with the calcis, the scaphoid with the astragalus, the unciform with the first cuneiform, the magnum with the second cuneiform, the trapezoid with the third cuneiform, and the trapezium with the cuboid; the pisiform he is inclined to place among sesamoid bones.

The homologies of the thumb and great toe are still obscure; the difficulties surrounding them cannot, in Dr Wyman's opinion, be satisfactorily met. We notice, on the one hand, throughout almost the whole series of vertebrates, the constancy with which only two phalanges occur in these organs, whatever their variety in other respects; on the other, the fact, that when the limbs are placed in truly symmetrical positions, the great toe is found on the inside, the thumb on the outside of the limb. Other minor considerations are discussed, shewing that our author inclines to view the outer toe as the homotype of the thumb.

It is not, however, to these special parts alone that the principle of reversed symmetry may be applied; the scapular and pelvic arches may be compared, and the scapula shewn to be homologous with the ilium, the clavicle with the ischium, and the coracoid with the pubes. Believing that the scapular arch cannot be considered an appendage to either the cranial, cervical, or thoracic vertebræ, Dr Wyman objects to the view of Owen and those of his predecessors who have regarded both of these arches as ribs, and suggests that we need to seek further evidence from embryology before drawing any definite conclusions. From his own observations he has furnished only negative evidence, shewing that the development of the pelvis in frogs is dissimilar to that of the ribs.

Nor does he agree with most authors in considering the limbs appendages of the vertebral column. Struck by the fact, that in the embryo they bear so strong a resemblance to the median fins of fishes or the flukes of cetaceans, he thinks "there is ground for the hypothesis, that limbs belong to the category of tegumentary organs, and that their connexion with the vertebral column through the scapular and pelvic arches is only secondary." Like the adipose fins of fishes, they are outgrowths of the tegumentary cells, which, for a time, undergo no differentiation into bones or other tissues; they are not forced outward by the protrusion of the bones, but the bones are afterwards developed *in* the limbs and grow *pari passu* with them. Moreover, the limbs have no connexion at first with the scapular and pelvic arches, but become at a later period attached to them as teeth become connected with the jaws.

In his discussion of the different kinds of symmetry, and especially of that maintained at opposite ends of the body, Professor Wyman has drawn a curious comparison between symmetry and polarity, between the distribution of matter around the nervous axis of an embryo, and the distribution of polarized matter around a magnet. Just as in the latter case there are two neutral lines, one extending along the middle of the magnet, and the other at right angles to it—the particles divided by the second line forming the north and south curves—so we have a symmetrical arrangement of parts in an embryo not only as regards the sides, but in the relation of fore and hind parts to each other. The analogy is still more striking between the structure of double monsters and the arrangement of polarized matter about two adjoining magnets. Two parallel magnets brought near together, produce in the matter around them a compound figure, the middle portion of which consists of curves from the adjoining sides of the magnets; the particles belonging to either series never pass the line of equilibrium, but are deflected symmetrically upward or downward. The symmetry of the whole figure is thus retained, although the right and left curves of the same magnet have lost their balance. So, in the abnormal development of embryos, where two nervous axis occur side by side, a series of intermediate limbs or organs will be formed where the respective influences of the two axis come into contact, and the two bodies will be symmetrical with each other, but not in themselves.

Again, if the magnets, touching at one end, are divergent at the other, the isolated ends will have the usual symmetrical double series of independent curves; but, as the magnets approach each other, these curves will become gradually modified or suppressed until a single symmetrical figure is formed at the end where the magnets unite. So, if the axis of double embryos are inclined, the separated ends will have each a head, but as the two axis converge, the intermediate organs will be altered or obsolete. The body will be provided with two legs, one under the control of the right axis, and the other under that of the left. Precisely such a case occurred in the well-known instance of Ritta Christina. The type of any double monster may be imitated, by the combined action of two magnets.

Thus a vital force is displayed in the development of animals, which, like a magnetic force on polarized matter, tends, when undisturbed by external agencies, to produce symmetrical figures.

SAM. H. SCUDDER.

BAIRD'S REVIEW OF AMERICAN BIRDS. *

THE standard works of Wilson, Audubon, and Nuttall, on the Ornithology of the United States, have of late years been superseded by the "Birds of North America," of Messrs Baird, Cassin, and Lawrence. This volume, as originally planned, was one of the "Pacific Railway Reports," that is, a report upon the collection of birds amassed by the numerous exploring parties sent out some years ago to investigate the best route for the Great Trans-Continental Railway. But under the able superintendence of its general editor, Professor Baird, who was likewise author of the greater portion of the work, it was expanded so as to embrace an account of all the known species of North American birds, and has become the most recent standard work on the subject.

Upon this foundation, Professor Baird has commenced the construction of the new work, the title of which is above given. At the same time he has rather enlarged its scope, including in his "review" not only the birds of North America, but also all those of the central portion of the New World down to the Isthmus of Panama. Ample materials for this arduous undertaking are found in the daily increasing collections of the Smithsonian Institution, which are under Professor Baird's command, and which are probably unsurpassed for richness and variety as regards the subject proposed to be treated of. It should be mentioned that the volume now before us, which contains an account of the first families of the Oscines, does not appear to have been published, but, as stated in the advertisement, has been "distributed by the Smithsonian Institution, in advance of the completion of the whole work, with a view of eliciting criticisms and suggestions."

As regards systematic characters, not only of the higher groups but also of the genera and species, the present work of Professor Baird goes into much greater detail than his "Birds of North America." The most salient points of distinction of the closely allied genera of Turdidæ, and other families of American Oscines, are contrasted in a series of well-arranged tables, and the more noticeable parts of their structure fully discussed in the additional

* Review of American Birds in the Museum of the Smithsonian Institution, by S. F. Baird. Part I. North and Middle America. Vol. i. Washington.

remarks. Great care is also bestowed upon the synonyms both of genera and species. As regards the former, not only is an exact reference given to where each generic name is founded, but the species considered to be the type of the genus is named, and the date of its formation accurately recorded. The synonymy of the species is also very carefully attended to, and the different localities in which it has been obtained are accurately recorded. There is likewise appended to the description a complete list of specimens of the species in the Smithsonian collection in a tabular form, so that it appears at once what materials Professor Baird has had before him to enable him to form an opinion as to the characters and limit of the species.

In this laborious way Professor Baird has treated of the first portion of the families of the American Oscines, commencing with the Turdidæ, and proceeding through the allied groups down to the end of the Hirundinidæ. In the latter portion of the volume woodcuts illustrating the structure of the beak, wings, and feet, are introduced into the text, rendering the work of still greater value to the student.

From the above particulars the great importance of Professor Baird's work to those who are interested in the study of ornithology will be at once apparent. It is important not only from the abundance of materials under Professor Baird's command, but also from the laborious and careful manner in which these materials have been worked out. The task undertaken is truly an arduous one, but has been well commenced, and when completed will form one of the most valuable contributions to the ornithological literature of the present era.

PH. L. SCLATER.

*FLORA ORIENTALIS.**

THIS is a work which has been expected from its author for many years, and which, now that it has made its appearance, will be everywhere welcomed with satisfaction. It was in the East that Botany first took its rise as a science. When at the commencement of the eighteenth century it awoke into new life—Tournefort, Sherard, Buxbaum, Hasselquist, and Forskahl traversed Greece, Asia Minor, and Palestine, and obtained that knowledge of their vegetation which we find marshalled in the writings of Linnæus and his cotemporary disciples. But though from generation to generation explorers have not been wanting, post-Linnæan Floras for parts of the East are few and far between. The materials for the magnificent "Flora Græca" (a work originated and carried out in this country), of which the drawings were executed by Bauer, and the descriptions principally by Sir J. E. Smith, were amassed by Sibthorp between 1786 and 1795; and Delile's "Botanique de l'Expedition de l' Egypte" carries us back to the beginning of the century. The only recent Floras which contain descriptions are those of the Russian provinces included in the general "Flora Rossica" of Ledebour, and the Spicilegium Floræ Rumeliæ of Grisebach, neither of them for tracts which fall within the bounds of the East as the term is usually applied. During the last twenty years especially, many of the European residents in the East, some of our own consuls noteworthy amongst them, have collected plants, and numerous expeditions have been undertaken for the purpose of gathering specimens for distribution upon an extensive scale. There is a large stock of Oriental plants in all the principal herbaria; but no general Flora, and, as we have said, very few local ones have been undertaken. We are helped, it is true, to some extent by such works as Tchihatcheff's "Asia Minor," and Kotschy and Unger's "Die Insul Cypern," both of which contain full catalogues for the tracts to which they relate, with the descriptions of novelties. Two extensive works have been devoted entirely to the

* Flora Orientalis sive enumeratio Plantarum in Oriente a Graecia et Egypto ad Indiæ fines hucusque observatarum—Auctore E. Boissier. Vol. i. Thalamifloræ. Geneva: H. Georg.

novelties which have been amassed: the "Illustrationes Plantarum Orientalium" of Count Jaubert and M. Spach, six volumes in quarto, containing one hundred species, with beautiful full-page uncoloured illustrations; and the "Diagnoses Plantarum Orientalium" of M. Boissier, nineteen fasciculi in octavo, which bind up into two stout volumes. But the descriptions of a large number of the new species, and a great number of records respecting the affinities and geographical range of those which have been incorporated in the large works, are scattered about in small pamphlets, and in the "Transactions" and "Journals" at home and upon the continent. The consequence, of course, is, that a large number of species have been described in various places under different names, and that, even with a full command of the necessary books, and access to an herbarium containing the authentically-named sets of specimens, it has been a most intricate and time-consuming task to attempt to name a packet of Oriental plants, and that in the largely-represented and more intricate genera—as, for instance, Ranunculus, Delphinium, Dianthus, Silene, Campanula or Crocus—a work that seemed utterly hopeless to separate the known from unknown. M. Boissier is a Genevese gentleman of ample means and experience, who has himself travelled extensively in the East, and the botanically-allied tracts of southern Europe, for the express purpose of studying their botany; and for the last twenty-five years or more has devoted himself specially to the subject. He, as we have just indicated, has named and described a large proportion of the novelties which have been discovered during that period, and has undertaken the management and classification of many of the sets of specimens which have been so largely distributed. It has been for many years a most necessary and desirable task, both in the interests of descriptive and geographical botany, that a general "Flora Orientalis" should be undertaken; and it has been fully understood by all those who know anything about the matter, that M. Boissier was the man of all others best fitted for the task.

The tract of country included in the work embraces—1. Greece, including the islands of the Adriatic and Levant, and European Turkey as far north as the Balkan; 2. The Crimea, Georgia, and both slopes of the Caucasus; 3. Egypt up to the first cataracts of the Nile, and Arabia north of the Tropic of Cancer; 4. Asia Minor, Armenia, Syria, and Mesopotamia; 5. Persia, Affghanistan, and Beloochistan; and, 6. Tartary up to the 45th parallel of latitude; a region which measures some 3000 miles from east to west, and 2000 from north to south, and includes, on a rough estimate, an area of between 4,000,000 and 5,000,000 square miles of land, and about a twelfth part of the surface of the globe. Taking the most productive portions of this tract and comparing them with our own country, the number of plants they yield within a given area is very much greater. Palestine, which is not far different in area to Wales, probably yields three times as many species; and the same will hold true of Asia Minor and Greece; but from this proportion there is a gradual decline in those tracts where the range of altitude and situation is smaller, and there is a wide extent of surface included within the 4,000,000 miles of an entirely desert character. The districts included in the area which are best known botanically, are Greece, Roumelia, Egypt, the Russian provinces, and certain parts of Asia Minor, especially Armenia. M. Boissier gives a detailed account of the explorers of all the different tracts, and of the scattered writings that relate to them; and this in itself is a valuable document. Even for a country that has been so much visited as Palestine, we believe that such a Flora as it would be possible to compile from the books and herbaria in London would not include more than two-thirds of the plants that are to be found there; so there is an ample margin left in which the botanists of the Palestine Exploration Committee may work. Of Arabia and Persia, of course, our knowledge is much less than of Palestine. Tartary we know only through an excursion of Dr Lehmann, who penetrated from the north to Bokhara and Samarcand, and gathered about 1500 species, which were published by Professor Bunge of Dorpat. Affghanistan we know only through the researches of Dr Griffith, who accompanied the English expedition in 1839, and collected about 1000 species, the first set of which is at Kew; and Beloochistan only through two excursions which Dr Stocks made from Scinde, at great risk, in 1850 and 1851.

This first instalment of the work carries us down through the Thalamifloræ: at this rate we shall need at least four more volumes of equal size to complete the Phanerogamia. Just as in the European Flora, more than half the species belong to three large orders; but, whilst in Europe Ranunculaceæ, Caryophyllaceæ, and Cruciferæ bear to one another a proportion of about 3, 5, and 6, in the East Caryophyllaceæ increase and Cruciferæ fall, and the proportion becomes about 3, 8, and 5. Of the other orders, omitting the very small ones, Geraniaceæ, Malvaceæ, and Violaceæ, are almost on an equality in Europe and the East. Hypericaceæ are fewer in the East than in Europe; Cistaceæ still more decidedly so. The orders where the East has a decided advantage are Zygophyllaceæ, 42 species in the East against 5 in Europe; Rutaceæ, 53 species against 16; Tamariscaceæ, 50 species against 8; Capparideæ, 27 species against 8; Papaveraceæ, 59 against 25. The only orders added in the East are Sterculiaceæ and Simarubaceæ, represented, the former by 4, and the latter by 1 species.

Of what M. Boissier says about the botanical regions in which the East is divisible, we can give here only a very brief abstract, and must refer our readers for fuller detail to the work itself. He adopts four principal divisions, which are as follows:—

1. *Region of Central Europe.*—Characterized climatically by rain spread throughout the year, summers of moderate heat, and winters in which the thermometer sinks below freezing point; the bulk of the Flora composed of plants diffused throughout Central Europe, and forests often occurring composed of deciduous-leaved trees and Coniferæ. To this belong the upper valleys and plateau of the interior of European Turkey, the northern slope of the Caucasus, and the northern shores of Asia Minor. In Armenia the winds which sweep across the Black Sea encounter the high chain of mountains which rises almost from the shore, and give out the vapour they hold in suspension. Thus, in the lower levels the summer is very wet, and in the middle region of the mountains there is a perpetual fog, but upon the summits these have disappeared completely, and on the southern slope we have a serene sky and a continental climate. From this state of things we obtain in the low ground near the shore a Flora where many of the plants of temperate Europe mix with citron and orange trees, and higher up amongst the hills an abundance of rhododendrons, azaleas, vacciniums, and other plants which require a humid and temperate climate. On the southern shores of the Caspian the state of things is very similar, but here the winter is colder and the summer extremely warm and humid. In this tract most of our common fruit trees grow wild, with several trees and shrubs which are peculiar to it, and interlaced by ivy; vine and smilax form almost impenetrable forests. The common herbaceous plants are those of Central Europe. A little higher we meet with forests of oaks, elms, maples, ash, and lime trees; and higher still, in a less humid zone, the olive, myrtle, paliurus, and other bushes of the south of Europe.

2. *Mediterranean Region.*—In this region the winters rarely sink below freezing point; the summers are warm and dry, and the rains fall only in autumn and spring. Evergreen shrubs and trees predominate, and a crowd of herbaceous plants occur, which are found also upon the shores of the Mediterranean in Italy, France, Barbary, or even Spain. In the East this Mediterranean region includes the shore and lowlands of Greece and European Turkey, the isles of the Mediterranean, and the western sides of the Crimea, Asia Minor, and Palestine. In the western part of Asia Minor this Mediterranean region is rather colder in winter and warmer in summer than in corresponding latitudes in southern Europe, and in Cilicia and Syria the difference between summer and winter is still greater. The mean summer temperature of Tarsus equals that of Bombay.

3. *The Oriental Region, properly so called.*—This is much the most important, both as regards the extent and peculiarity of its vegetation. The climate is continental, the winters always cold in proportion to latitude, and rigorous at the higher levels; the summers almost without rain, and very warm, even at great altitudes; the sky almost always clear, the air very dry, and rain confined to spring and autumn. This dry and extreme climate is detrimental to the growth of trees, and forests are quite absent. This region includes the plateau of Asia Minor, Syria, Persia, Affghanistan, and Beloochistan, as well as the plains of Mesopotamia and Tartary, and may be subdivided into three sub-regions: 1. Sub-region of the plateaux; great undulated spaces of a varied but mostly considerable altitude. In every part chains of mountains rise from the plains which reach the regions of perpetual snow. There are very few trees, and, as already said, no forests; but the Flora of these plateaux is exceedingly rich in undershrubs and perennial plants, which have often a very restricted area. Many of the genera are represented by a large number of species. Of these we have examples in Erysimum, Dianthus, Gypsophila, Silene, Acanthophyllum, Hypericum, Astragalus, Onobrychis, Hedysarum, Centaurea, Cousinia, Echinops, Campanula, Convolvulus, Onosma, Alkanna, Scrophularia, Verbascum, Nepeta, and Salvia. The higher the mountains the more spiny plants predominate, Caryophyllaceæ, Astragali, Thistles, and Acantholimons, of which a great number form tufts or small hemispherical bushes. Here and there, at all altitudes we encounter salt marshes covered with Statice, Lepidium, and Salsolaceæ. The Flora of these plateaux and mountains is

much the richest and most varied in all the Orient. 2. Aralo-caspian sub-region. Distinct from the last by its lower altitude and less undulated surface. It includes the deserts of Tartary, the east of Persia, and west of Affghanistan. The winter is very cold in the northern parts, the summer very dry, the rains of autumn and spring fewer and more irregular than in the last sub-region. During the spring these solitudes are overspread by a number of small plants, principally annuals, of very different families; most of them have an extensive area, and grow also on the Siberian steppes, of which this region is the continuation. There are no trees except in the cultivated oases, and a few poplars and willows along the streams. The perennial plants which occur are usually more local than the annual species, and there are a few shrubby genera not met with elsewhere in the East or at all, of which Sophora, Ammodendron, Eremosparton, Atraphaxis, Calligonum, Lycium, and Ephedra, are examples. The salt plains occupy here a much greater space than in the last sub-region, covered with Salsolaceæ and Zygophylleæ, and bushes of Tamarix, Haloxylon, and Nitraria. 3. Mesopotamian sub-region. Vast plains of alluvium, and the deserts of the valleys of the Tigris and Euphrates. As on the preceding sub-region, the altitude above sea level is small, the summers burning and prolonged, but the rains are more abundant, and the winter much less rigorous. In the west and north the Flora resembles that of the plateaux, but southward there are immense plains covered at the beginning of summer with great Cruciferæ, Umbelliferæ, and Cynareæ. All the fruit trees except the orange are known only in a cultivated state in a few favoured oases; and for this the winter is a little too cold and the summer too warm and too dry.

4. *The Date Region.*—This is characterised by irregular and unfrequent rain in autumn and winter, which is quite absent from the southern and lower parts of the region; the summer is burning, the winter mild, but in the north, as at Bagdad for example, there are occasional frosts. This includes Egypt, the north of Arabia, and the shores of Persia and Beloochistan. The most remarkable character of its Flora, consists in the presence of a number of plants and shrubs of which we find the genera, and often the species, to stretch through the desert tract from Scinde to Senegambia. The date is a characteristic tree, spread through all Egypt, mounting the valley of Euphrates to Bagdad, extending in Persia to the thirty-third parallel of latitude, and in Beloochistan,

to a height of 4000 feet. Other characteristic trees are the palm of the Thebaid (Cucifera Thebaica), the sycamore (Ficus sycomorus), Tamarix articulata, Balanites ægyptiaca, Salvadora persica, Zizyphus spina-christi, Salix ægyptiaca, and many species of Acacia. The herbaceous plants are usually spiny, or fleshy, or covered with a thick down. The following are genera which may be mentioned under this head:—Farsetia, Morettia, Anastatica, Schouwia, Zilla, Cleome, Silene, Polycarpæa, Astragalus (annual species), Neurada, Aizoon, Fagonia, and Plantago. The Flora of the higher mountains of this district resembles that of the plateau sub-region of the last.

If we were to separate the plants of the three great continents of the old world into geographical types of primary value, it is probable that six would be the best number to define for Europe and Africa, as follows:—

1. Arctic-alpine European type of distribution.
2. Germanic or Central European type.
3. Mediterranean type.
4. Arabo-Saharan or Desert type.
5. Tropical African type.
6. Cape type.

In which case the second, third, and sixth would include a very much larger number of species than the three others. The characteristic plants of M. Boissier's first region would then belong to our type No. 2, and of his fourth region to our type No. 4; and in making divisions of primary value, it would probably be best to unite those of his second and third region with type No. 3. But our remarks have already extended so far that we must not enlarge upon this head.

As the work is certain for a long time to come to be used as a basis for all statements respecting Oriental plants which involve figures, there is a matter which has important bearings in this direction which we must explain. M. Boissier's theory, or what is still more to the point, his practice as regards the limitation of species, is very different to that of the English botanists who write upon other than British plants. Many forms which they would pass over unnoticed, or class as varieties, he ranks and duly describes as species. Connect this with what has been said about the characteristics of the third botanical region just described, and it will be seen that is a Flora where the consequences of this difference will affect any question of figures materially. It is probably quite fair to count numbers as between the "Flora

Orientalis" and Nyman's "Sylloge Floræ Europeæ," as we did a short time ago; but take the nearest adjacent tract on the other side, and it would lead to a misapprehension to do so as between the "Flora Orientalis" and Hooker and Thomson's "Flora Indica." But on this head it is only right that we should allow our author to speak for himself; and, be it remembered, we say this principally by way of enforcing the practical caution which his remarks convey, that these are the views founded upon a practical experience of plants, both in a fresh and dried state, which falls below that of very few living botanists:

"It is always difficult to recognise and to characterize species, and for a country imperfectly known, the difficulty is aggravated by want of material. Very often a botanist only knows a plant through unique or incomplete fragments; intermediate forms which may exist escape him, and he describes a specimen instead of a species. To these ordinary causes of error, there is in the Orient very frequently this also to contend with in addition—that in many large genera there are no important and well marked characters for the species. Of this in the present volume, Dianthus, Alyssum, Tamarix, and Haplophyllum, furnish instances. We must not hide from ourselves, that the limitation of species will remain always a difficult problem to settle, and that unanimity is a thing impossible. The modes of experiment are uncertain; hybridization gives results so much the less conclusive as the species with which we work are near to one another; and culture itself should be interpreted with much prudence, because it brings the plants out of their natural position, and creates influences of contact between species which are not brought together in nature. Sometimes, besides, these experiences of culture are capricious; and, somehow or other, those who make them find always results which fit in with theoretic ideas. Thus experimentisers, whom I could quote, say that they have obtained from the single sowing of a species, one or many other species of which the specific value had never before been called in question; whilst, on the other hand, botanists who attach importance to very minute differences, say that they always find these forms immutable in their slightest characters. For my own part, I have cultivated for twenty years plants from all parts, and have seen nothing like this, neither strange transformations nor absolute fixity. What I am struck with most, is the facility with which hybrids form themselves in a garden between species of the same genera of very distinct geographical areas. Thus it is almost impossible to cultivate together, and to keep well marked, the species of Aquilegia, Erodium, Antirrhinum, &c. This fact, joined to many others, shews what minute precautions it is needful to take in making experiments of this kind, to obtain truly incontrovertible results, and how we must guard against concluding too hastily that we know what passes in nature from that which we see in this way. Not accepting, for my own part, the Darwinian hypothesis at all, which is in disagreement with the intimate essence of organised beings, and with the resistance we see them oppose to exterior agents, I regard species, not as arbitrary conceptions of the human mind, but as creations which have gone out at different epochs under the powerful hand of God, which cannot change one into the other, but which are often variable within limits which are more or less extensive, which are sometimes difficult to trace, but which exist always without possibility of being exceeded. To seek those limits, I have proceeded by direct observation, by studying species upon as many specimens as possible, by following them in their different stations, and their geographical area, in order to obtain a knowledge of the manner and degree of variability, of the importance and the fixity of the characters in each family or genus. When two or many forms have seemed to me linked clearly by intermediates, I have regarded them as forming part of the same species. Thus, in many places, plants which I have proposed in my 'Diagnoses' as species, are described here as varieties, because new material has shewn that there were passages between them. On the other hand, I have not united, and have described as distinct species the forms which up to the present time have not shewn me any transitions, reserving myself free to reduce if these are brought to light; holding that it is less harmful to err in separating than uniting; the latter error being less prominent, and, therefore, more difficult to correct, and producing less harmful consequences, especially as regards geographical botany."

A single suggestion on a point of typographical arrangement, and we will conclude. It would make the book much more easy to use, if the names of the genera were printed at the head of each page. As it is, the species are preceded only by the initial letter of the genus, and one often has to turn over several pages to ascertain what the initial letter means. J. G. Baker.

Correspondence.

I.—SCIENTIFIC INTELLIGENCE.

NOTE BY THE EDITOR.—In deciding on the matter of which this Journal should be composed, two very important subjects claimed attention, the one Reports of the Proceedings of the Learned Societies at home, and the other those of the Learned Societies abroad. At first we started with the intention to overtake both, but we soon found that each of them would require the whole Journal to itself, and still remain not half done. We, therefore, had no alternative but to give up the attempt. We felt, however, that probably the more important object of the two (at all events for our readers in this country) was to make them acquainted with what was going on in Natural Science abroad, and we propose to endeavour to supply the place of regular Summaries or Reports, by obtaining from some of our foreign friends and correspondents of eminence, who have been kind enough to undertake the task, periodical letters, mentioning the most important contributions to Natural History in their respective countries during the previous six months—in fact, giving a colloquial reply to the question, "What has been doing in your country in Natural History during the last six months?"

It appears to us that this will have many advantages over an attempt to compile at home a summary of the publications of the different foreign societies. It secures us from the risk of omitting important works which may not have come under our notice. It conveys a knowledge of the estimate formed of the different works, by those best able to judge—viz., a man's own fellows. It will, we hope, often give us information in advance of the receipt of foreign *Transactions*, some of these being long in finding their way into this country. By not attempting too much, it will allow sufficient to be done to direct the attention of our readers to the sources of further information if they desire it, and it will secure a more comprehensive sifting and picking of materials than could be attained at home; for instead of a summary of all that has been written, both good and bad, we shall only have a selected notice of the most important items.

We are happy in having the privilege of commencing with a letter from Professor Van der Hoeven, of Leyden.

1. *HOLLAND.—Letter from Professor Van der Hoeven.*

"LEYDEN, 11*th February* 1868.

"As you have expressed your wish to receive some information concerning the works and memoirs on Natural History published in my country during the last six months, I have the pleasure to send you a short indication of what has come under my eye; I hope this will be sufficient. You will not require an analysis and critical examination of those works; that would claim more time, and also the review would become too long; and, as it is your intention to complete those communications for nearly the whole civilized world, I suppose you want no other information than such as can direct the attention of fellow naturalists to the recent publications on subjects of their chief study.

"Mr Francois Pollen, after his return from a voyage to Madagascar,* undertaken with the intention to explore the Fauna of that great island, has begun the publication of a great work, with illustrations, on the Lemurina, 'Contributions a l'Histoire Naturelle des Lemuriens.' The plates, in large folio, will give full size coloured representations of the species. It was only at the end of the year 1867 that the first number appeared, with the figure of a species of Lemur of the Mayotte Isle, one of the little group of the Comores, between the coast of Mozambique and the northern part of Madagascar. This species was discovered by our explorer in 1864; it comes very near to the Lemur collaris (Lemur nigrifrons F. Cuvier nec Geoffroy) of Madagascar.

"Another publication was undertaken by Mr Pollen, in conjunction with Dr Schlegel, under the title of 'Récherches sur la Fauna de Madagascar et de ses Dépendances.' It is, however, but a comparatively small part of the Fauna that will be the subject of these Researches, viz., the Mammalia and the Aves. The whole will be completed in four numbers, each number will contain ten coloured plates, in 4to. The first contains four plates of the mammalia, and a part of the birds. The figures in the three first plates are Lepilemur mustelinus, Cheirogaleus furcifer, and Microcebus Coquereli.† The fourth plate represents the skull of Cryptoprocta ferox. The authors believe that this mammal has a great affinity to the feline genus, or is even no more than a slight modification of that genus. This will not be, however, I suppose, the opinion that even the mere inspection of the figure will give to other zoologists, and it seems more fitting to place the genus in the family of the Mustelidæ;‡ and it is difficult not to think immediately of the skulls of Meles, for instance, on looking at that of Cryptoprocta.

"I published in Dutch a monograph of the genus Menobranchus, having received specimens of this American Proteida from the Smithsonian Institution instead of Menopoma I had asked for. ('Ontleed-en Dierkundige Bijdragen tot de Kennis Van Menobranchus,' Leiden, 1867, 4to., met 3 platen.) I described chiefly the skeleton, the hyoid bone (or rather cartilage), a good deal of the muscles, the lungs, the heart, the organs of generation, both in the male and female. From all these investigations the result was that there is no other genus nearer to Menobranchus than Proteus, the subterranean animal of Europe. Even the blood discs confirm this affinity, having the same long and slender form, and being hardly distinct in size. I formerly believed that there was a much greater affinity between Menobranchus and Menopoma (or Cryptobranchus) than between Menobranchus and Proteus. This result confirms me in my opinion that even in the minor divisions of the animal kingdom comparative anatomy is the only safe guide to a correct and natural arrangement.

"A large volume in 8vo. was published by P. C. T. Snellen on the Macrolepidoptera of the Netherlands. It is certainly the result of long researches, and is one of the best contributions we have till now to the elucidation of our Fauna. The author's list comprehends 686 species. Amongst the Nocturna he inscribes as a new species discovered by him Caradrina sericea, but it is to be regretted that he has seen, till now, only one specimen of this species. The diurnal Lepidoptera are represented by 73 species, the Sphingidæ 25 (or if we enumerate here also the species of Zygaenidæ and Syntomidæ, 30); 580 species are referred to the Nocturna. (De Vlinders van Nederland Macrolepidoptera Systematisen beschreven door, P. C. T. Snellen, S. Gravenhage, 1867, 8vo.)

"The most considerable botanical work which is now in course of publication in our country is intended to give a comprehensive knowledge of at least some parts of the Herbarium of the State, under the title of 'Annales Musei Botanici

---

* This voyage was performed at M. Pollen's own expense; and after Mr P.'s return, his companion, Mr Van Dam, remains at Madagascar, in order to collect new materials for the knowledge of the animal creation, in that much promising field of inquiry.

† A Review of the portion of this work already published is in type, and will appear in next number of this Journal.

‡ In my "Handbook of Zoology" I placed Cryptoprocta according to the opinion of L. T. Bennet in the group of the Viverrina (civets), but it was only with doubt. The genus Cryptoprocta was at that time only known by Bennett's description after a young specimen

Lugduno Batavi,' Ed.: F. A. G. Miquel. This Herbarium, or as Professor Miquel calls it, Museum Botanicum Lugduno Batavorum, was formerly placed at Brussels under the direction of Professor C. L. Blume, a name well known over the whole world by the large collection of plants made in Java and other parts of the Dutch Colonies in East India, by the edition of his 'Flora Javæ' and of the 'Splendid Rumphia,' etc. After the separation of Belgium from the kingdom of the Netherlands the Herbarium was removed to Leyden, and Blume (not attached to the Leyden University, but invested with the title of Professor) remained its director at Leyden till his death. Since that time the distinguished Professor of botany at the Utrecht University, F. A. G. Miquel, was appointed director, but he retains his Professorship at Utrecht, and comes only some hours every week to visit the Herbarium. Those particulars, not of a true scientific character indeed, may be perhaps interesting to your English readers, strangers having in general a very imperfect notion of foreign institutions. Of the Annales, a work in large folio, two volumes are already completed. In 1868 four parts were issued of the third volume (Fascic. II.-V.), all relating to the Flora Japonica (Prolusio Floræ Japonicæ). The fifth number (Fascic. V., was published in the last six months. It contains an enumeration of the species represented by specimens in the Herbarium of no less than 28 different natural families. To this number a plain lithographic plate is added, representing Meldea gibbosa, Miq., and Parinarium macrophyllum. Professor Miquel has also given a short paper, De Piperaceis Novæ Hollandiæ (Verslagen en Mededeelingen der Koninklijke Akadamie van Wetenschappen, Afdeeling Natuurkunde. Tweede Reeks, Tweede Deel, p. 53-64). This paper of the author is interesting as containing a new revision of the whole system of the Piperaceæ after new discoveries. It is well known to botanists that Professor Miquel, 23 years ago, has given an elaborate monograph on that group of the vegetable kingdom. J. V. DER HOEVEN."

2. *BELGIUM.—Letter from Dr Candèze, Glain.*

"LIEGE, 20*th January* 1868.

"The Belgian Contingent of Zoological Works is null for the second part of 1867. My task for this time is thus easy. In fact the last works which appeared bear the date of 1866, such as the 'Revision Générale des Clivinides,' by M. Putzeys *(Ann. de la Soc. Entomol. de Belgique)*, that of the Amara, by the same *(Mem. de la Soc. Roy. des Sciences a Liège)*, and some memoirs published in the Bulletins de l'Academie de Bruxelles.

"It is true that a very important work by M. Van Beneden, on the 'Polypes du Littoral Belge,' has indeed appeared in the 34th volume of the *Memoires de l'Academie Belge*, but the separate copies of this remarkable work bear the date of 1866, belonging in reality to that year. The year 1868 will be more fruitful, for some works are in the press. E. CANDEZE."

II.—LETTERS FROM TRAVELLERS AND NATURALISTS ABROAD.

1. *NEW HEBRIDES.—Letter to Dr Hooker from the Rev. J. Atkins.*

"NORFOLK ISLAND, 29*th October* 1867.

"I returned in August from a short cruise amongst the New Hebrides, Banks, Santa Cruz, and Solomon groups. I had no opportunities for collecting specimens, except a very few ferns and grasses, but I hope to be able before very long to give accurate accounts, on some points, of some of these islands. Their endless variety of languages in process of formation are, I think, a most important and curious study; their natural history and botany scarcely less so. The vegetation of all the groups is similar, allowing for differences of climate, and in its general character differs altogether from that of Australia, and probably is connected with that of the islands to the north, for I find Java is also a habitat of several ferns that I have found. At Christmas I am to take holy orders, and in April next to be left at Sans Christoval for a month or two. During this time I also hope to visit all the southern Solomon Islands, and after that to accompany Bishop Patterson on his annual visit to the other groups. On my return, I hope to have something to write about that will interest you, and perhaps some specimens to send.

"The coco nut is planted, the banana, yam, taro, a sweet potato (not Convolulus batatas), and a herbaceous plant used as a vegetable. There are scarcely any native fruits, but several sorts of nuts. Bread fruit grows best in the Banks's group. At one island of this group thirty varieties of yams are named. In the Banks' Islands and northern New Hebrides, shell only is used for adzes. In the Solomon Islands stone for adzes and knives. No pottery is made at any. At Santa Cruz a loom is used in weaving their elegant mats, and they seem, in other ways, more advanced than their neighbours. I suppose that they use stone, for their word for iron is the Maori name for a stone adze. I have only met with two tree ferns, one a polypody and one a marattia; both are very common. Palms are very plentiful in the northern islands of the Solomon group. The areca nut is chewed there and at Santa Cruz, but they become fewer as we go south. I have not seen the areca in the Banks' Islands, nor the sago in the New Hebrides, where indeed I have only seen one palm beside the coco nut. A club moss and the fern Asplenium nidus, common here (Norfolk Island), are found throughout these groups. It is possible that the tree fern may be the same, I have not got a piece of the island fern with me to compare.

"The natives of the Solomon and Santa Cruz groups are very much more civilized, although perhaps fiercer than the Banks' islanders. This is easily accounted for by the difference of race of these islanders,—the Polynesian is an active, energetic race, the Melanesian more indolent and uninventive. The canoes of the Solomon Islands are beautiful in design and workmanship, and, like their houses and weapons, highly ornamented. The only way of procuring fire that I have heard of in use amongst them, is by rubbing one piece of wood on another. M. J. ATKINS."

III.—GENERAL CORRESPONDENCE.

RHINOCEROS HORNS.—Letter from Edward Blyth, Esq., formerly Curator of the Museum of the Asiatic Society, Calcutta.

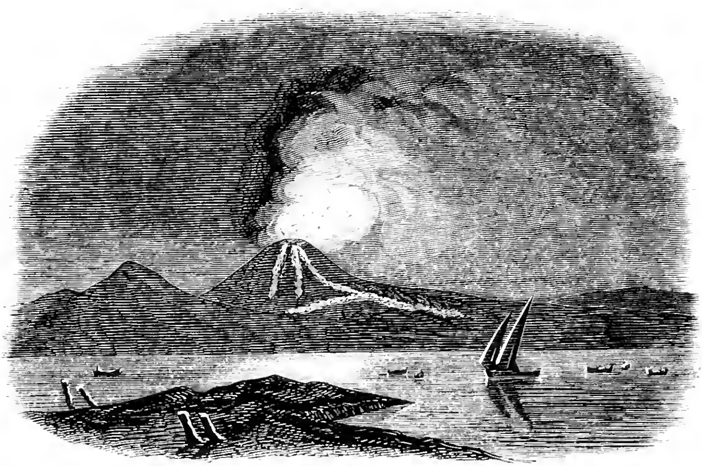
"LONDON, 16*th March* 1868.

"As in the first No. of your 'Journal' (p. 70), you called attention to some remarks which I made, in the course of a discussion at one of the Scientific Meetings of the Zoological Society, upon the occasional shedding or loss by violence, followed by the renewal, of the horn or horns of a rhinoceros, I may mention that the particular instance adduced was given upon the authority of the Count Alexis Bobrensky, of Moscow; and that my suspicion of the occasional occurrence of such a phenomena arose from my obtaining the facial portion of the head, with the two horns attached to the skin, of a recently killed male of R. Sumatranus, which I supposed at the time to have been rather a juvenile animal, from the small size of the horns. It was obtained in the Yunzalia district of the province of Martaban, by means of a heavy falling stake, such as the natives set for tigers and other large game (as represented in C. J. Anderson's 'Lake Ngami' 2d edition, p. 258); and I was already aware of the superb development which the horns of this small species of rhinoceros attain in some instances, as exemplified by the beautiful specimen of an anterior horn in the British Museum, upon which Dr Gray founded his supposed R. Crossii (*Proc. Zool. Soc.* 1854, p. 250, where a figure of it is supplied). That horn, which is very highly curved, measures 32 inches along its front, and is 17 inches in span from head to tip. I have also recently seen a fine pair of horns attached to the head, in the possession of my friend Colonel Fytche (now Chief Commissioner of British Burma), and those upon the specimen obtained in Upper Martaban were short and small as in an adolescent animal. On my return to Calcutta I had the specimen in question macerated, and the skin, with the horns upon it, detached from the bone; and then I was surprised to find that the nasals were completely anchylosed and united, and that the animal accordingly had been a tolerably old one, notwithstanding that its horns were so little developed, and I consequently inferred that the particular individual had probably shed and renewed its horns, however unusual such an occurrence might be. I have now to call attention to the tendency which probably all of the existent species of rhinoceros have to develop a rudimentary or small horn on the forehead. This may now be observed in the instance of the large female of R. indicus, in the Zoological Gardens, Regent's Park, and when I called the attention of Mr A. D. Bartlett (the superintendent of the establishment) to the circumstance, he surprised me much by telling me that the present appearance is a second one of the kind, the animal having broken off a previous frontal hornlet, which he afterwards shewed me. On the occasion of its being violently broken away from the skin, I was informed by him that the animal bled profusely from the place, the blood streaming down its face; but that the site soon healed over in the usual way, and now a new hornlet has begun to shew. That broken off from the skin is of a subquadrate form, measuring about an inch every way, and the summit of it is ground off by attrition, or it would have been at least half an inch longer. Sir T. Stamford Raffles, in his paper on the Animals of Sumatra (published in the thirteenth volume of the 'Transactions of the Linnæan Society'), remarks of R. Sumatranus that 'The natives assert that a third horn is sometimes met with; and in one of the young specimens procured, an indication of the kind was observed.' In Mr C. J. Anderson's 'Lake Ngami' the same is remarked of one or more of the ordinarily two-horned rhinoceros of Africa. This traveller writes:—'I have met persons who told me that they had killed rhinoceroses with three horns; but in all such cases (and they have been but few) the third or hindmost horn is so small as to be scarcely perceptible'. It is remarkable that Linnæus referred to rhinoceros bearing a third horn. It seems a not unlikely character to have been developed more frequently in some of the extinct species of the genus. As regards the horns of the Asiatic two-horned species (R. Sumatranus), I have seen a pair of them, beautifully carved and polished, and set with the bases upwards, and on a parallel, in a carved black wooden stand, similar to those upon which Chinese metallic mirrors are mounted, and the Chinamen give such extravagant prices for fine specimens that they are exceedingly difficult to be got hold of; and hence their extreme rarity in mansions. The anterior horn of Colonel Pytche's specimen (before referred to), which is not half the length of that in the British Museum, is worth about 50 rupees, or £5, as I was assured by him; the price increasing, as usual, with the size and length. Both R. Sumatranus and R. Sondaicus, are extensively diffused over the Indo-Chinese countries, and I have been credibly informed by a gentleman, who saw, when in the province, the two horns upon the preserved skin of the head, that an example of the former which had been killed was regarded even in Asia as an exceedingly great rarity. A full-grown female has recently been captured alive near the station of Chittagong, which became moderately tame in the course of a few weeks, and it is probable that we shall see it ere long in the Zoological Gardens. EDWARD BLYTH."

Miscellany.

British Museum Entomological Collections.—Those who have felt aggrieved by the long-continued neglect with which this part of the collection has been treated for years past, will be pleased to learn that the recent appointment of two additional assistants (Mr Waterhouse and Mr Butler) to this department has already begun to make some impression upon the chaotic mass of material. In the Coleoptera Mr Frederick Smith has now finished the arrangement of the Curculionidae, and Mr Waterhouse that of the Lamellicornes, at all events to such an extent as to make them a credit instead of a discredit to the National Collection. The collection in these two immense families is now not only the largest in the world, but also the best arranged. We have especial pleasure in recording the excellence of Mr Waterhouse's work. Mr Frederick Smith needs no praise from us: he only brings to the classification of the Coleoptera that scientific talent which so long made his former department, the collection of Hymenoptera, the one bright particular star of excellence in the midst of general disorder. But Mr Waterhouse has only recently joined the staff; and as much of the future usefulness of a very important part of the collection must necessarily depend upon his fitness, his success was felt to be a matter of some importance by those who wished well to the institution. The able manner in which he has put the Lamellicornes in order, must, therefore be a source of gratification, not only to the Museum authorities, but to the general public. It is an earnest of good work to come; and the next group which he takes in hand (which is to be the Heteromera) will test his abilities still more severely. As he is at the beginning of his work when improvements can be most easily made, and when it is as easy to follow a good plan as an inferior one, we would suggest a reconsideration of the manner of labelling, and the adoption of a fuller style, such as that first, we think, introduced by M. Reiche, which contains not only the name of the genus or species, but a reference to its author and the place and date of its first description. It will be a little more troublesome at first, but will save time to every one in the end. The National Collection should adopt the best system known, and full and judicious labelling is a very important point to be attended to from an educational point of view. Mr Frederick Smith is now engaged on the difficult work of reducing the Phytophaga into order, and incorporating with the Museum stores the contents of the late Rev. Hamlet Clarke's collection, which, we learn with much pleasure, has been secured for the Museum. It served as the basis of the portion of the British Museum catalogue of Halticidae, written by him, and contains types from most of the great collections of Phytophaga, which had come into his hands by purchase. Mr Butler, the other new aid to the Insect-room, likewise promises well. He has been told off to the Lepidoptera, and has already brought the difficult though attractive group, Erycinidae, into order. He has also published several good papers in the *Annals and Magazine of Natural History* and the *Zoological Society's Proceedings, &c.*, on different groups of the diurnal Lepidoptera. We have every expectation that he, too, will be a credit to the institution.

Animals and Plants found in the Hot Springs of Soda Creek, New Mexico.—In the springs, both hot and cold, confervæ and a few grasses grow; no fish are found in them; no crustacea, except perhaps one about 1¼ inch long, which is found in the hot springs, and which has a hard covering and rudimentary legs. The mixed crustacean, or whatever it may be, is very much of the colour, size, and shape, of the kind found in Great Salt Lake by Captain Fremont in 1843-4. The temperature of the hottest springs is 98° and 99° F.—Berthould in *Proc. Acad. Nat. Sc. Phil.*, 1866, p. 342.



Eruption of Mount Vesuvius.—Our readers may be pleased to see a copy of a little sketch which a friend has sent us from Naples, representing the appearance of Vesuvius during the night of the 9th of December, as seen from the opposite side of the Bay. It is from one of the little sketches in distemper which are sold in Naples, but we have the assurance of our friend that it gives a perfectly correct representation of the scene. We had applied to him for a photograph of the scene, but he found it impossible to get a satisfactory one.

South African "Patch Hats."—Amongst the specimens recently received at the Kew Museum from the late Paris Exhibition is a hat, of some thing of the ordinary "deer-stalker" shape, from the Cape of Good Hope. It was called a "patch hat," and at a first glance one might suppose it to be made of the shola (Æschynomene aspera, L.) which is so much used in the East Indies for hats and other light or ornamental articles; but as the shola does not grow in Africa, it was scarcely possible that the hat in question could be produced from that plant. Upon a closer examination I found the material to be the tuberous root of an Erythrina (E. acanthocarpa, Mey.) which covers whole districts in some parts of South Africa, sending its roots to such a depth in the ground as to make it almost impossible to exterminate it; consequently it is a most troublesome plant to the farmers in the cultivation of the land. The plant grows to a height of about three feet, the flowers, which are a brilliant scarlet with orange or greenish tips, appear from November to the end of January. The roots when first dug up are very heavy, owing to the large amount of moisture they contain ; when dried, however, they become exceedingly light and cork-like, though without the elasticity of cork, so that it is useless for stoppers for bottles; nevertheless, owing to its extreme lightness, and being a non-conductor of heat, it is much used for hats and such like purposes. And it has been applied for the lining of entomological boxes ; but it is not suitable for this purpose, as, owing to its non-elasticity, it does not hold the pins sufficiently firm. Slices of the dried root burn readily like tinder, and in many districts in South Africa it is said that little or nothing else can be had wherewith to light a fire. One root in the Kew Museum measures about three feet long, and about five inches in diameter, tapering at both ends and covered with a dark-brown epidermis. This, however, is very small compared to some which are said to grow eight feet long and eighteen inches in diameter.—*J. R. Jackson*, *Kew.*

Geographical Relations of the Reptilia and Batrachia of Sonora.—An instructive paper by Dr Cope on the Reptilia and Batrachia of the Sonoran Province of the Nearctic region, is published in the *Proceedings of the Academy of Natural Sciences of Philadelphia* (October 1866, p. 300), in which will be found a good deal of information as to the geographical distribution of the different forms. It concludes with the following remarks :—Professor Baird has regarded (*Proc. Acad.*, 1859, p. 300) the Sonoran and Lower Californian Provinces as identical, and has pointed out the slight affinity of the latter to the Pacific district. It appears from the preceding, that, in respect to the reptiles, they constitute provinces nearly as distinct from each other as the Sonoran is from the Central, a conclusion agreeing with that allowed by Dr John L. Leconte, from a study of the Coleoptera (vide *Proc. Acad.*, 1861, p. 335.) That these and the Pacific Province are more nearly related to each other than to the Eastern Province, is sufficiently apparent on general Herpotological and other grounds, as set forth in Professor Baird's masterly review of the distribution of North American birds. (*Silliman's Journal of Science and Art*, 1866.) Dr Gunther has indicated the Tropic of Cancer as the approximate division line between the Nearctic and Neotropical regions ; the writer (loc. cit., 1861, p. 306), has regarded this as the parallel of its eastern extremity, and placed the western several degrees further north. More recently, Professor Baird has indicated a less oblique division, raising the eastern extremity to the mouth of the Rio Grande, and terminating it on the west at Guaymas. While he characterizes the line as "arbitrary" for the birds, it is much less so for terrestrial vertebrates. In these the transition of Faunæ is striking and quite abrupt.

Notes from Honolulu.—A letter from Honolulu, under date Oct. 31st, 1867, says, "About three months since, a steamer belonging to the United States, left that port to survey a small coral island called Middle Brook Island, in 28.30° N. lat., about 163° W. long., some 500 miles distant from the Honolulu group. It was thought that this small island might afford a suitable coaling station for the Californian-China steamer line. An officer on board that vessel, at the request of the writer of the letter, collected specimens of the plants growing on that 'small piece of rock' about half-a-mile in diameter, and

40 feet above the level of the sea. Amongst the plants so collected were Ipomæa maritima, Capparis Sandwicensis, Tribulus cistoides, Boerhavia diffusa Scævola sericea, Lepidium Owhaiense," &c. The same writer says, "I lately had the misfortune to lose my only Sabal umbraculifera, raised from seeds received from the late Sir W. J. Hooker, about six years ago, by the ravages of our sugar-cane borer, the larva of a kind of weevil; and, since, that pest has destroyed several Pritchardias, and begun to attack other palms. I cut them out when their presence can be detected outside. Of course I have removed every stump of sugar cane from my garden. Our Vaccinium reticulatum produces a very palatable fruit; it grows at an elevation of 47,000 feet, so that it would probably stand the climate of the south-west coast of England or Ireland. Antigonon leptopus is a great favourite in our gardens here, and when fully in flower, with its graceful festoons of pink or crimson spikes, may well be compared for beauty with the Bougainvillea. I have another species in my garden with white flowers."—*J. R. Jackson, Kew.*

Pill-rolling Beetles.—M. Piochard de la Brulerie, in making a report to the Entomological Society of France of the results of the Society's Entomological excursion in Spain in 1866, gives the following information concerning the habits of the pill-rollers (the Ateuchus of the Egyptians). He thus speaks of Ateuchus cicatricosus, a species common in the Mediterranean district:—"I saw it roll its balls. The female alone charges herself with this duty, and, like the other species of this genus, walks backward, employing its hinder legs to support her precious burden. The male superintends the work with a visible interest, but without taking any active part in it. When an obstacle is encountered, and the ball, which contains his progeny, falls into an inequality in the soil, it is well worth seeing how he is agitated, turns round and round, pushes the female with his head, and excites her, I was about to say with his voice, but rather by making the noise which is produced by the rubbing of his elytra on his abdomen resound in a despairing tone. If the observer takes the female and puts her on the ground at some distance, the male redoubles his despairing cry. The female hears him, appears undecided, consults the four cardinal points, and at last sets off with the greatest rapidity, stumbling in her haste to repossess herself of her ball, the object of her maternal solicitude. You accuse the male of being a lazy fellow, playing the part of the fly on the coach. Fly, possibly enough! But fly indispensable, for if you take him, the female stops and remains with her head bent upon the sand with the most pitiable air imaginable. She continues to clasp her ball with her hind legs, but nothing will make her budge; and, if her companion be not restored to her, I believe that she would remain on the spot till she died."—*Ann. Soc. Entom. France*, 1866.

Black Siberian Wolf shot in Thibet.—(Trip to Thibet, Kylas, Source of the Sutlej, and the Mansurwur and Rakhas Lakes, by Captain H. U. Smith, Indian Army.) From the Lake Mansurwur, which we found to be about 15 miles from Dachin, we marched about 50 miles to the east and north; the first two marches were on the high road to Lhassa. We then turned to the north and kept under a large range of hills running north and south. After shooting a snow-antelope and gazelle, we turned to the left and went up the valley of the Kylas range, where I was lucky enough to shoot a black wolf, the first ever shot in that part of the world. Although this may appear irrespective of what I am writing to you about, I think it as well to mention that this animal appeared to be totally unknown in the country; so much so, that when I brought it in, none of the natives could inform me what it was. On inquiry I find it is known in Siberia; but, in this part of the world, this is the first instance in which it has been met with.—*Proc. Roy. Geo. Soc.*, vol. xi., No. 3.

Age of Kitchen Middens of Cape Henlopen, U. S.—Dr Leidy in the course of the summer made a visit to the kitchen middens of Cape Henlopen, in company with Mr Cassie, Mr Robert Fraser, and Mr Canby of Wilmington. They had noticed the shell accumulations extending from just below the town of Lewes on Delaware Bay, for about the distance of a mile or more, to the base of a huge sand dune between the bay shore and the lighthouse of Cape Henlopen. They had provided themselves with ample means to examine the extent of the shell heaps, and had been surprised to find that they were all quite superficial, from a few inches to less than a foot in depth. In a number of places they appeared to form hillocks but they were only accumulations around the former sites of trees, as indicated by the traces of stumps and roots. They visited similar accumulations on the shore south of the Cape, and were told that they were found in many portions down the coast. All of those which were examined contained fragments of pottery, chips of jasper, and stone arrow-heads. A few copper rings were also found, and in one heap Mr Canby found several English coins. Dr Leidy thought the shell heaps were of no great age, and were probably contemporary with the discovery of the country by Europeans.—*Proc. Acad. Nat. Sc., Phil.*, 1866, p. 290.

Steatornis caripensis.—Ever since Humboldt's time this bird has maintained its place as a sub-family of the goatsuckers, rather from the difficulty of finding a more suitable place for it elsewhere than from any very strong belief by ornithologists that it really was a goatsucker, whatever its outward resemblance. A bird which was known to feed upon fruits so hard as to require a hammer to break them, could never be very confidently arranged in the same group as the small-billed insectivorous goatsuckers. The scarcity of specimens, however, more especially of the skeleton and soft parts, has hitherto prevented a proper ascertainment of its affinities. The Zoological Society has now procured the means of clearing this up. From one of their corresponding members, they have received a supply of specimens in spirits, some of which have been presented to the Royal College of Surgeons, the British Museum, &c., and a portion retained for examination by their own prosector, Dr Murie. Complete accounts of the anatomy of this bird may, therefore, be soon looked for from the labours of Professor Huxley, Dr Murie, and others.

REPLY TO MR WALLACE'S THEORY OF BIRDS' NESTS.

MR WALLACE'S paper on birds' nests, which appeared in last number of this Journal, was a welcome contribution, not only from its intrinsic excellence, but for its bearing on the great questions of the origin of species and development of form, which now occupy men's minds. It is unnecessary to say, however, that it only expressed his own views, and that our publication of them by no means implied their adoption by us, or any recantation of our own opinions, elsewhere promulgated on similar subjects.

The pages of this Journal will always be open to both sides of any question falling within its province. *Audi alteram partem* is one of the principles which we lay down for our guidance in conducting it. On that principle we now propose, as we have placed Mr Wallace's arguments before the reader, to say a few words in reply to them, or rather to those parts of them from which we dissent. On the greater part of the paper we have no remark to make, except to express the pleasure and interest which we felt in perusing it. We think he has completely made out his case, that in the main it is female birds with gaudy plumage which construct their nests under cover, and those with dull plumage which make them open. No doubt there are exceptions to the rule; for example, the hedge sparrow is not more gaudy than the house sparrow, and yet the one makes its nest open, the other usually under cover. Our little favourite Jenny Wren is not a whit more gay than the wife of her friend Cock Robin, and yet the female robin makes an open nest, and the wren a covered one. Still, looked at as a whole, and disregarding exceptions (which may be capable of individual explanation), the rule is nearly universal, that wherever the plumage is so bright as to attract attention the bird makes its nest under cover, and that where it is not, this precaution is dispensed with.

All will admit that this phenomenon, from whatever cause proceeding, is a means of preserving the bird and eggs from discovery, marvellously well-fitted to attain its object, and calling for our admiration as a work of design, whatever may be the laws or the process by which it is brought about. What that process has been is the point on which we differ from Mr Wallace. He says it is "natural selection," and thoroughly convinced, as he is, of the soundness of his theory, he shuts his eyes to its imperfections and unwarranted assumptions, and with pardonable complacency demands that, "until at least an equally wide range of facts can be shewn to be in harmony with any other theory, he should not be expected to abandon that which has already done such good service, and which has led us to the discovery of so many interesting and unexpected harmonies among the common (but hitherto most neglected and least understood) of the phenomena presented by organised beings."

This can only be meant as a fashion of speech. He cannot mean that, until a better theory be produced, he will adhere to his present faith, even if proved to be wrong, merely because it has done good service. No one seeks to deny that it has done good service, but it is neither its confirmation, as Mr Wallace thinks, nor its refutation, as we regard it, but its ventilation which has done the service. Thousands of exploded fallacies have in their time done good service. Whatever tends to make men think and search after truth does good service. To the theory which does so we own our obligations, whether it prove true or false. But our gratitude stops there. As soon as it is shewn to be wrong we give it up, whether we have a better theory to put in its place or not; and so here we have no doubt Mr Wallace would do the same, could we only convince him that he *is* wrong. *That* we despair of doing. We are afraid that he has too long and ardently laboured to build up and strengthen the theory of natural selection to be able to see any defect in it now, or rather to attach any importance to those flaws which he cannot but see, but which appear to him as mere motes in the sun. We may, however, be more fortunate with others who have not yet such confirmed conviction upon the matter; and shall at any rate make the attempt.

The present theory is the natural and legitimate sequence of the Darwinian theory of natural selection carried out to its full extent, and although not more startling than Mr Darwin's original position in regard to design, gives better means of testing it as being carried to a greater extreme. Natural selection—the belief in constant, unceasing, slow, and gradual change—and, to a certain extent, the influence attributed to the struggle for life, are the three points of the Darwinian creed from which we dissent. These are the points which are usually regarded as specially Mr Darwin's own. Others, such as "derivation," the "homologies," &c., are regarded as less original, because first suggested by older authors; but, putting aside the abstract reflection, that there is no such thing as originality (everything that enters the mind of man being suggested by something else), we have always considered that in this estimate an injustice is done to Mr Darwin. According to our conception science owes vastly more to him for the way in which he has established the principle of derivation on a firm basis than for his other speculations, which have not brought the same conviction to our mind. Our objections to the latter may be briefly indicated in a few words—we have not space for more than an indication.

Mr Darwin regards the struggle for life as a means by which the less perfect conceptions of nature, which he assumes to be constantly appearing, are wiped off; it is as a destructive agent that he chiefly regards it. We regard it from the opposite point of view—as a preservative rather than a destructive agent—as a means of strengthening and maintaining the life of *species*, in the same way that pain maintains and restores the life of individuals. Without the blessing of pain we should succumb to every accident and ailment—without sorrow, happiness would be impossible—without grief there could be no joy. In the same way, but for the struggle for life, general degeneracy would be the result, and the species would come to an end from the degradation of its constituent parts.

Next, as to the slow and gradual change which Mr Darwin maintains to be in constant operation in all organic beings, we maintain that if such a change really were constantly in progress without intermission, the inevitable result must have been the confusion of all species. It could not be otherwise. No mathematical problem can be more inexorable. If there were no pause or resting-place in the course of change there could be no distinction of species—the whole of organic life would be one confused mass of individuals. To mark off that mass into sections, there must be some pause in the process of change. We have elsewhere ("Geographical Distribution of Mammals") argued that the real explanation of what we see is, that organic life is endowed with a plasticity and readiness to change whch only requires stimulus to force it into operation, and that the usual stimulus is change of conditions of life; without change of condition the species rests undisturbed; with it, it produces new forms. This would explain both the continued endurance of species and the appearance of new species, a double phenomenon which appears to us inexplicable under Mr Darwin's theory.

The last of the Darwinian theories to which we demur, is that of natural selection. Our objection to it in wholesale is, that it implies constant succession of failures and a never-ending waste of power on the part of nature, both of which we believe to be inconsistent with her working; she never errs and never wastes. No instance has ever been pointed out of a failure by nature. No species has ever been discovered which is not the fittest for its place. Mr Darwin admits the absence of all evidence of the transitions which his theory requires, and endeavours to explain it away by the imperfection of the geological record and the shortness of our current living experience. Of course, if that is a sufficient apology for the absence of transitional forms, it is equally so for the absence of any unfit forms. We are of those who think that it is not sufficient. Our creed is that nature not only does everything well but everything best, and that it is an inherent part of the constitution of the laws of development that they must produce the fittest—that they have no power to produce anything but the fittest—just as in minerals, however various the forms of crystals may be, they are all crystals. In minerals nature never deviates off into vagaries, making them globes or ovals. Whatever may be their constituent elements, the inherent necessity of their constitution compels them to appear in angular forms. So the laws of development of organic beings leave only one course open to them, and that leading to the production of the fittest. This hypothesis is at least in accordance with known facts. The theory of natural selection has to assume its facts and apologise for their absence.

It is the attempt to explain the evidence of design by natural selection, which is the weak link in the theory. Had the origin of that been left unexplained, or simply assumed to be the product of laws bearing that result *in gremio*, and natural selection limited to dealing with the fate of species after their appearance under such laws, or applied only to explain or maintain a progressive advance in the scale of life in general, it would not have been open to the same objections, nor would it have encountered the same opposition.

The simple proposition that when two competing forms of life appear, the weakest will go to the wall, and disappear from the strife, leaving the other as the fittest in possession of the field, is not calculated to draw forth much opposition. The failure lies in the attempt to refer to blind chance (the chance of the production of an accidental combination of design or an element which, by continued selection, shall ultimately assume the form of combined design) structures which all—Darwinites not less than their neighbours—admit to be examples of skilful and elaborate contrivance.

But formidable as the objection is when stated merely to the production of *species*, or instances of design in *species*, it becomes infinitely more so when we are asked to extend its application to sexual differences and periodical changes. See what Mr Wallace's theory of birds' nests requires. Take his explanation of the origination of dull-coloured female mates to bright-coloured male birds. He starts with the assumption that originally both male and female had bright plumage. There seems no reason why he should begin with the assumption that they were both bright rather than both dull-coloured; but his argument is only directed to that side of the question, and it would obviously have required a different line of reasoning to convert a dull male into a bright male from that which would convert a bright female into a dull female. In the case of both being originally bright-coloured, there is a *quasi* necessity for the female to become dull-coloured. There is the supposed compulsion of the struggle for life. But in the case of both being dull at first, that compulsion would not apply to the male bird. There is no controuling necessity for him to put on a finer coat than he had before. However, pass that, and let us accept the question from the side which Mr Wallace presents to us—both male and female bright; female sitting on an open nest; species like to be extinguished from the exposure; all enemies at once see her, and seize upon the eggs; ruin stares the species in the face. It has two modes of escape: one, an easy and natural one, no ways beyond the instinct of a species or the intellect of an individual, by building the nest in a more concealed position; the other, a more difficult one, wholly beyond its own control, the female becoming converted, by Darwinian process of natural selection, from a bright-coloured bird into a dull-coloured bird. According to Mr Wallace, some adopted the easy remedy; others did not, and in them a change in the colour of the plumage was effected by natural selection. All the females of the same species were, of course, not equally bright in plumage; and as the least brilliant females escaped observation better than the gaudier ones, natural selection perpetuated their offspring in greater numbers than that of the latter, and so ended in producing a race of duller-coloured females. But is it so? Had it been a *species*, and not merely the *half* of a species, the argument would at least be consequent. But a female produces males as well as females, and the result of breeding in-and-in from dull-coloured females would be to dilute the colour of the whole breed, both male and female—not preserve the male bright and turn the female dull. The hereditary qualities of father and mother are no ways special to the respective sexes of the offspring. In our own species it is very commonly said that the sons take after the mother, and the daughters after the father, which would go against Mr Wallace's theory, if true; but we believe it is not true, and that we have no reason to suppose that one parent has on an average a greater share in producing the physiognomy of their offspring than another.*

The explanation of the phenomenon seems to us of a totally different nature. Although the plumage of such males and females as we have been speaking of is often apparently very different, there are grounds for believing that they are both the same, only developed to different degrees, according to the amount of vital action operating on each. Thus we see, in the pheasant and common fowl, old hens assuming more or less of the plumage of the males. In them it is obviously not a different livery, but the same livery at different stages of its production. It is the same with young birds, their plumage is different from that of their parents, and we do not suppose that Mr Wallace would refer that to natural selection. It is a parallel case to the down on the chin of the boy and the beard on that of the man. Why this immaturity of plumage (if we may so call it) exists in some female birds and not in others we do not pretend to explain; but it appears most probable that the building of open nests was at first the normal habit with all birds, and that the instinct of building them under cover, and in concealed places by those whose bright plumage would betray them in open nests was acquired by experience. We all know that in

---

* On this subject see the evidence collected by Mr Darwin in his new work, "Animals and Plants under Domestication," vol. ii., p. 72, which seems to us to confirm the above conclusion, although Mr Darwin regards the facts as shewing that peculiarities appearing in either sex "strongly tend to be inherited by the offspring of the same sex, but are often transmitted in a latent state through the opposite sex."

birds, intelligent modification of the ordinary construction of their nests is by no means rare under exceptional circumstances.

Mr Wallace and Mr Bates have, with their usual ability, argued also for natural selection as the explanation of the instances of mimicry or disguise which are to be met with in many animals, such as moths pretending to be bees, flies to be wasps, and generally the resemblance which exists between the colour of animated beings and that of the scenery in which they live—white in snowy regions, sand-coloured in sandy-deserts, heath-coloured in moors, and so on. These, however, do not appear to belong to the same category of phenomena as the sexual differences in plumage above referred to. In sexual differences the theory relates to modification of colour previously existing; in mimicry to the causes by which it is originally determined. It is part of the Darwinian theory that surrounding objects and extraneous circumstances are without influence on the development of structure, or on the appearance of species produced among them. We do not see that such a belief is essential to that hypothesis; for although, if it were once admitted that such causes had some influence, it would not be easy to say where it stopped, still it would always leave natural selection and the struggle for life full scope for work. The fact is, however, that unless he has changed his mind, Mr Darwin holds that surrounding objects or conditions *have* no determinate influence on the formation of species. The wonderful resemblance between the colour of the ground and that of the animals which inhabit it, seems to us to furnish at least a *prima facie* case to the contrary; and seeing that neither view has any direct evidence to offer in its favour, it seems to us more reasonable to suppose that an adjustment of the particles of colour in harmony with surrounding colours should be inherent in the laws regulating its development, than that all animals have come to wear the colour of the scenery in which they live, by those which were produced of any other colour having been wiped off as less fitted for surrounding conditions. It is a strong call on our faith to admit that power of natural selection to extend not only to making the colour once for all, but to varying it regularly twice every year, as in the case of many animals inhabiting arctic regions.

Every artist, every admirer of scenery, is familiar with the harmony of colour in nature. We do not believe that this is fortuitous. It seems as if there were a polarization of colour as there is of magnetism and electricity, which reduces everything into harmony.

In last number of this Journal, in a notice of Dr Wyman's views of the symmetry and homology of limbs, the reader will find facts mentioned which go to prove the presence of a magnetic or electrical polarization in the development of the embryo of vertebrate animals. We are fearfully and wonderfully made, and there are many things in the making of which we have as yet no idea—the distribution of colour one of them. If the theory of natural selection does not give a satisfactory explanation, why the colour of animals corresponds with that of the district in which they live, then neither will it give one in the cases of mimicry by one animal of the pattern of colour or appearance of another. We believe that more of the instances of mimicry than is usually allowed are explicable on the ground of actual affinity between the imitator and the imitated; others, perhaps, by the colour of the species having been produced under similar original conditions. A gaudy butterfly, of a staring pattern, may not, when taken separately, look as if very much in harmony with the scenery where it was produced; but seen alive in its native woods it no longer appears so. There it is natural, and, if we give the fancy vein it would not be difficult to imagine a mixture of flower and foliage, dewdrop and sunshine, making a gorgeous effect, as bright and not unlike the most gaudy butterfly; and if to that influence the pattern is due, in one instance, similar causes might produce similar results in another, as in the case of the colour of the animals in the desert, &c. These resemblances, taken from tropical forests, may be mere harmonious representations of common general effect. Still, there remain many most remarkable imitations, both in form and colour, which are not so explicable; but in most of these we know of no habit of life or advantage derived from the similarity, which could be explained by referring the resemblance to natural selection. The cases where such a reason has been assigned are very few, and at least requiring more investigation before it can be said that it accounts for the resemblance on the ground of natural selection.

In examining Mr Wallace's able paper we have not put his cases under any critical examination. We have taken his facts as stated by himself. He is most careful and accurate in all matters falling under his own observation; but we think his fondness for generalizing sometimes leads him to accept as settled and admitted statements which are only conjectural hypothesis not yet generally allowed. For example, he adopts the statement as a proved fact that the bright colour of flowers is confined to those which require insects to fecundate them, and that the object of their being provided with gay colours is to attract the attention of insects to them. Now, both of these assumptions are without warrant. As to the first, many bright flowers in the garden need no insects to fecundate them. For example, what colours can be brighter or more gaudy than those of our orange and tiger lilies, the campanulas, the poppies; almost every gay flower, indeed, which has a long flexible stalk, that will bend with the wind, fecundates itself without help of insects. The stalk and the wind do it between them. As to the second assumption, that the gayness of the colour attracts insects, we have only to observe that insects are provided with very imperfect and inferior means of vision. They have the power of smell very largely developed, but that of sight is very feeble. What is more, the defect is chiefly in the distance to which they can see; they are very near-sighted, as any one can convince himself, by watching a butterfly attempting to fly over a high wall. In approaching it, it obviously does not see it until it is close upon it; it retreats a little, and flies a little higher up and again approaches it: again finds the barrier, again repeats the process, and it is only after several attempts that it at last surmounts it. This defect is inherent in the structure of the insect's eye; and therefore any argument founded upon the analogy of our own vision would lead us wrong; and it is plain that if the insects cannot see the gay flowers, their bright colour cannot answer the purpose of attracting them.

For the above reasons, we cannot agree with Mr Wallace in the views he has arrived at; and we have been the more disposed to canvass them, because any hypothesis proposed by him deserves full consideration, not only from the ability with which it is sure to be advocated, but from the weight attached to whatever proceeds from his pen. If his views are erroneous, it is of the more importance that they should be questioned; if they are doubtful, that they should be sifted; and if correct, ventilation will make them only better known.

HEUGLIN'S "REISE NACH ABESSINIEN." *

WHEN we turned over the leaves of this book the other day, in Messrs Williams and Norgate's back-shop, and saw them plentifully besprinkled with the scientific names of plants and animals, we thought we had got a prize, and, clutching it under our arm, made off with it to feast in private. Arrived at home, we ensconced ourselves in our sanctum, paper-cutter in hand, and prepared for enjoyment—

> "Shut, shut the door, good John, we said,
> Tie up the knocker, say we're sick, we're dead."

According to rule we should have been disappointed, for it is in the nature of things that all enjoyments should be greater in anticipation than in reality; and in one sense this book is no exception to the rule, for we found the rather prominent display of scientific names which attracted us at first wholly without arrangement, and of little novelty; but, on the other hand, the reader will see that some of the facts mentioned by Von Heuglin furnish very interesting subjects for meditation and speculation, although he has not worked them out for us.

In one respect indeed, and for one set of people and one purpose, there is no room for disappointment. By those visiting the country, as for instance the officers of the British army, it will be found of much value. Von Heuglin followed a route nearly parallel to that taken by the present expedition in its advance on Magdala, and until he reached that stronghold almost every step that he took will be found traced in his diary—every watering-place, every stoppage, and the time taken between each marked; every cluster of huts and every church recorded, and the height of almost every mountain range determined. In fact, in this book the topographical department has a portion of the work done to its hand, which, if it had had the oppor-

* Reise nach Abessinien—den Gala Landern ost Sudan und Chartum in den Jahren 1861 und 1862. Von M. Th. von Heuglin. Jena: 1868.

tunity, it would doubtless have sent some one to execute in anticipation of the present campaign. It is an itinerary, and so far as we can judge of one through a country which we have not seen, we should say it is exceedingly well done. The details of an itinerary, however, are caviare to the general reader or the naturalist, who will look rather for incidents of travel and instructive observations in natural history. As to the former, it is difficult to believe that the country passed through by Heuglin is part of the same land visited by Sir Samuel Baker, and that lions, leopards, elephants, rhinoceroses, and hippopotami, were or might have been encountered by the one as well as the other. But so it is; while Sir Samuel's course was one continued scene of dangerous encounter with these animals, Von Heuglin, so far as can be gathered from this book, seems to have seen little more of them than their traces, and not have come into close contact with any of them. It would be quite a sufficient explanation of this that Heuglin's route was along a tolerably frequented line of march, the "Great North Road" of Abyssinia, while Baker's was purposely in the pathless desert wilds, where the larger game had sought shelter from the intrusion of their dreaded enemy, mankind; but a still more important reason was that the one hunted in the lower grounds, while the other was in the high plateau, to which the larger game does not ascend. The lion does not go higher than 7000 or 8000 feet, the elephant than 5000, and the rhinoceros 7000, while the height of the main plateau is 10,000 feet.

Another reason may possibly be a difference in the constitution of the two men; for, although it is plain, from the number of birds and animals collected by Heuglin, that he is by no means an indifferent sportsman, he either met no adventures to recount, or he has not the faculty of making the most of them. Keeping in view that the work is published in 1868 (although the journey was made some years before), and that he visited King Theodore, whom, besides, he had known in former years, we think he might have given us a little more about that potentate than a couple of pages. We cannot suppose that Von Heuglin does not know more about Theodore than the best informed special correspondents; but he may hold it not honesty in one occupying his position (Austrian Consul at Chartum) to set down all he knows. It is a good rule to speak well of the bridge that carries you over, and if you cannot, the next best is to say nothing at all.

If this be the principle on which Von Heuglin has regulated his account of what passed between him and the King, we can congratulate him on the success with which he has carried it out. The most nubigenous diplomatist could not have told us less, although he might probably have taken more words to tell it in. The naturalist, indeed, may think that the space is better bestowed upon natural history than on the elucidation of the phases of mental variation in a semi-savage chief, and were it not for the interests now involved in the chief's proceedings we should be very much of the same opinion. Von Heuglin, however, gives us no option, so we gladly, though "on compulsion," pass on to what may be called the proper subject of his work—The Natural History of Abyssinia.

First, one word as to his route. Starting from Massowa (for we pass over the journey from Vienna to that port), he gained the highlands somewhat to the north of the route selected for that of the present expedition, and continued eastwards for a short space until he reached Keren on the track usually followed in journeying from north to south, and then, turning southwards, continued to follow it until he reached Gondar. Thence he passed on to Magdala to visit King Theodore, passing in his way along the shores of the Tana Sea. On reaching Magdala he found that King Theodore was encamped in the Gala country, considerably to the south, and he prosecuted his journey until he reached his camp at a place called Etsebed. After paying his respects to the King, he retraced his steps until he reached the head or northmost point of the Tana Sea, then turned north-eastwards, striking for the Nile, which he reached at its junction with the Rahad, and then descended it by vessel to Chartum.

The coast region on the shores of the Red Sea—almost the whole of the Abyssinian highlands from north to south, and the upper Nile district—all contribute materials to the present work, and from such materials some contribution to the solution of the problem of the physical history of Abyssinia might reasonably have been expected. This last Von Heuglin does not undertake. The volume is crammed full of natural history information on three branches—mammals, birds, and plants, but none of it is what is called "applied." The information is all raw material, and is communicated in the simplest and easiest way—easiest for the writer we mean. It is given in the shape of a diary of each day's procedure, and the material thus collected is emptied at the reader's feet just as it has been accumulated. There is "a deal of fine confused feeding" in it, but the picking, the plucking, and the cooking are all left to the reader's self. These lists of the species collected at the different places would be nearly as instructive as, and in truth the narrative, so far it relates to natural history, is in many respects little more than, a succession of lists, except that, in printers' language, they "run on," and are lightened by slight characteristic epithets, such as "the blue-flowered myosotis," "the bitter-tasted cardamine," the "rich-blooming trifolium," &c. The materials thus collected, however, are sometimes very suggestive, and lead to important inferences regarding the past history of the region. Thus, for example, Heuglin examined one or more of the uninhabited islands of the Dahlakian archipelago opposite Massowah, and in a list of the birds and mammals observed at one of them (Sarat), mentions the jackal, the hyena, the wild ass, and the Antelope Sœmmeringii. How came they there? They cannot have swam from the mainland, for Sarat and the Dahlak archipelago are by the map some twenty miles distant from the mainland, and it may be taken for granted that no jackal, hyena, wild ass, or antelope ever swam twenty miles; or if we go to the extreme of possibility, and suppose that it is not absolutely impossible that in extremity one of them may have done so, we imagine no one will maintain that herds or else single gravid females of all four species had made their way out to this small island without compulsion or without attraction. It seems equally clear that they cannot be there through the introduction of man. It might, indeed, be argued that the wild ass may be a descendant of the common ass, left there by man, which had reverted to the original type. But putting out of view the fact that the island is uninhabited, this would not apply to the hyena, the jackal, or the antelope. There seems, therefore, no escape from the conclusion, that at some former period these islands were united to the mainland, and by a depression of the bed of the Red Sea have been severed from the mainland where those same animals are common. In the same way the opposite coast of Arabia is peopled by these very animals, and it is scarcely logical to suppose that there was a depression of the ground between the Dahlak islands and Abyssinia, and yet none between these islands and Arabia. It appears indeed, from the antient Port of Zullah being now two miles from the shore, and other facts of a similar nature, such as the extension of the land at the head of the Persian Gulf, that this action is now reversed, but at a former and no very distant period, a depression undoubtedly must have taken place.

But these facts not only prove the depression of the Red Sea, but give a date for its occurrence. It must have taken place subsequent to the appearance on the earth of the present jackal, hyena, wild ass, antelope; in fact, during the recent epoch. But more than that, it tells us that it must have taken place subsequently to the elevation of the Sahara, for the same desert inhabitants are found in both. We know from the shells found in the deposits and sands of that desert that it was a sea during the Miocene and Quaternary epochs. A similar desert exists in the southern half of Arabia, and but for the intervention of the Red Sea and the highlands of Abyssinia, there would be one continuous stretch of sandy desert, the bed of an antient sea, from the Atlantic to the Persian Gulf. But the Red Sea must be subsequent in date to the appearance of these desert animals, and, so far as regards Abyssinia, geology teaches us that whenever a great elevation of one portion of the earth's surface has taken place, it has been accompanied by a corresponding depression of another portion parallel to and alongside of the part elevated; and the compensatory relation of the two phenomena shews that their occurrence must be nearly simultaneous, or rather that the depression must have slightly preceded the elevation. For, assuming that the earth is a liquid molten mass in process of cooling, surrounded by a crust already cooled and solidified, it is not easy to understand how any first impulse of ebullition causing a movement of elevation should be given; but it is very easy to understand, that as the process of cooling goes on, and the consequent shrinkage follows, the hardened crust will in some places be left without support, and in these it will settle down like the roof of a coal mine when the props are withdrawn; as it does so on the molten matter it will sink in it, to a certain extent displacing some, and causing it to surge up on either side, producing earthquakes, breaking the cohesion of the superincumbent strata, and finding exit by fissures and volcanoes. Eruptions are usually spoken of as the result of an access of intensity in the igneous action—a fresh hand at the bellows; but although at the immediate scene of action they assume this phase, in point of fact they are the very reverse—they are indications of greater cooling instead of greater heat in the interior of the earth—they are the mere splashing caused by the falling in of a portion of the cooled roof. In the present case the depression of the Red Sea and the elevation of the highlands of Abyssinia must be counterparts in the same transactions. By his list of Saharan and Arabian mammals which occur in the islands of the Red Sea, Von Heuglin furnishes proof that they have been cut off from the mainland by the sinking of the bed of that sea; and, curiously enough, if information which he received regarding the animals which occur in the Tana Sea turns out to be true, he, in like manner, furnishes us with means of proving the elevation of that inland lake from the bottom of the sea, and that too at a date subsequent to animal life having put on its present form. The Tana Sea is a large sheet of water 5732 feet above the level of the sea—according to Ruppell—lying in a hollow, surrounded by lofty mountains. It is very deep. Heuglin found no bottom with a line of 197 yards. Its bed is said to be cone-shaped, and Ruppell has supposed it to be an immense extinct crater. This supposition we think wholly untenable: craters are not things that increase indefinitely in dimensions according to the force and magnitude of the forces engaged. They are phenomena which have a natural limit, as the bubble of foam at the base of the falls of Niagara is no larger than that from a mill wheel, and the size of the crater must bear a determinate proportion to the height and spread of the cone. Now, the Tana Sea covers sixty square German miles, and a crater of that extent must have had a cone at least four times as many miles in height, or else have speedily been cooled over and reduced to several distinct cones of normal size scattered over the space. Rejecting, then, all idea of the Tana Sea being an extinct crater, it may be a collection of water accumulated from the rainfall of the surrounding mountains, or the remains of a part of a sea-bottom, raised up—mountains, bed, basin, sea, and all—during the course of the elevation of the district generally. There were, no doubt, both general elevation and special increase of height by the pouring out of volcanic matter. The fact which suggests this view is the following remark by Heuglin:—

"Besides the hippopotamus, which dwells in great numbers in the Tana Sea, there is, as I am well informed, here found another animal, probably a manatus, called the *Ja-Baher-Dedsa*, or Aila Auli; the first name means a sea calf."—(p. 289.) "Probably this animal is identical with the Arha-Bih, a large beast called the Sibda that is met with in the tributaries of the Mareb."—(p. 247). The Tana Sea is not the only inland habitat assigned to the manatee in Africa. It is said by Barth and others to occur in Lake Tsad;

but there is nothing very extraordinary in this. It is known to ascend the Niger and its tributaries; a young specimen, of which the skull was sent home from thence, having been described by Prof. Owen under the name of Manatus Vogelii; and the feeders of Lake Tsad arise in the same tract of level, spongy country as some of the tributaries of the Niger. In the rainy season the whole country there is overflowed, and a boat can pass from the tributaries of the one system into those of the other.

We have, moreover, elsewhere* recorded (on the authority of Dr Kirk) the probable occurrence of a manatee in Lake Shirwa. Like Heuglin, Dr Kirk only spoke from report—but he believed the report; and if it were true, the remarkable thing is, that although the lake communicates with the sea, it is above the Murchison Falls, which it is perfectly impossible any fish or water animal ever could have surmounted. If it is a manatee the explanation of its presence there must be sought for in geological changes of level.

It is right to say, with regard to the supposed occurrence of the manatee in Lake Tana, that Dr Fitzinger, in a paper in which he, from the information communicated by Von Heuglin, enumerates with details the species of mammals found in the north-east coast of Africa, considers the information a mere fable. After speaking of the Dugong, which occurs in the Red Sea and along the shores of the Indian Ocean, and which the species in the Tana Sea would most probably be, (the West African manatee, although it rounds Cape Horn, and has been met with as far north as the mouth of the Zambesi, not appearing to have been met with further to the north)—he adds the following "Note—In Dembee Sea" (Tana Sea), "according to the assertion of the natives, a marine mammal occurs, which they distinguish by the Amharisch name of 'Ja-baher-dedja' (sea calf) or 'aila.' Apparently this report is founded only on a fable."—(Fitzinger in Sitzungberichte der Kaiserl. Academie der Wissenschaften, Wien, 1866. liv. 4 and 5, page 610). Von Heuglin, however, from whom Fitzinger had his information, does not regard it as a fable, for he has repeated it without any indication of mistrust—indeed, rather the reverse, for his words are, "Wie ich schon berichtet habe," (as I am well informed).

The inquiry leads to another important question, and that is

---

* Murray's "Geographical Distribution of Mammals," p. 120.

the origin of the Blue Nile, for if the Manatee exists in the Tana Sea, and the Blue Nile issues from the Tana Sea, one would expect that the Manatee should be found in it too. In all maps the Blue Nile is laid down as issuing from that sea; a considerable part of its course, after leaving it, is, however, marked with dots, signifying that it has there not been explored, and is laid down from supposition. There is at least one cataract in this unexplored upper part of the river, which may prevent the Manatee passing into the Nile, although such obstructions are more powerful obstacles to the ascent than the descent of river animals. But the reason why the Manatee is not known in the Nile may be that the Blue Nile does not, in reality, flow out of the Tana Sea at all, or rather that the river which does flow out of it is not a tributary of the Nile. Heuglin, in his map, destroys all connexion between the Blue Nile and the Tana Sea, but unfortunately says nothing in explanation of his doing so. There are, however, one or two facts which, although not absolutely inconsistent with the Tana Sea being united to the Nile, are in perfect harmony with its not being so. Bruce mentions one—namely, that there are no crocodiles in the Tana Sea. Heuglin states that most of the species of fish found in it (they belong chiefly to the Cyprinidæ) are not found in the Nile, a fact, however, of less value than it looks like, for many of the fishes of the Upper Nile themselves are different from those which inhabit the lower part of its course.

There still remains another interesting point for inquiry relating to the Manatee in the Tana Sea, and which we may hope that our expedition will be able to clear up—and that is, whether it is a Manatee or a Dugong—the one being the representative of the sea cow in the Atlantic, the other in the Indian Ocean. The Dugong has been found in the Red Sea, so at first sight we may anticipate that the Manatee in the Tana Sea will most probably be the Dugong; but seeing that through the Sahara the Atlantic so recently flowed across Africa, we confess that we should by no means be surprised should the animal be the same as, or at least nearest to, the Atlantic Manatus Senegalensis. The steps by which such changes in level, as we have been speculating on have been effected, will hereafter be matter for the study of geologists. At present all that we know about the geological structure of the Highlands of Abyssinia is, that it is almost entirely composed of granite, basalt, and trachyte. Great quantities of pumice-stone are scattered over many parts of it, and the volcanic character of the country is apparent at a glance of its scenery. Fig. 1. copied from the chromolith frontispiece of Heuglin's work, is a striking example of it. When the traveller once reaches the lofty plateau he finds that the road keeps as much as possible along the ridges. If it were to go as the crow flies it would be constantly plunging down precipices on one side only to ascend them on the other. It therefore maintains a high level as much as possible, and in doing so has often to wind along the edge of precipitous crags leaning over the gulf below. These form the sides of natural cuttings (like the canons in Mexico), which are often 1000 feet in perpendicular depth, and are, moreover, so narrow that a gunshot

Fig. 1. A sketch of Abyssinian scenery.

would reach across. Wherever in these twilight defiles they can find space and footing, such plants as the Colqual, the Dodonæa viscosa. the tall shrubby Echinops and Andropogon grow clustered together. Before dismissing the allusions to geology we may merely add, by way of parenthesis, that there are in the Dammerde some places where gypsum and a dolomitic limestone occur, which is burnt by the natives and used to make mortar. The mineral products are described by Von Heuglin as few in number and of little commercial value. There is gold in the Gala country in small quantities, and iron is also widely spread or disseminated; but he says that the per-centage to be got out of the stone is so small as to make it useless for working.

The number of species, both of plants and animals, in the Highlands of Abyssinia is very large—a fact characteristic of all mountain regions. Some have attempted to explain the general fact by supposing the mountain a sort of centre of creation, in which species from all the surrounding districts have taken refuge, as in an island when the neighbouring lands have been submerged through geological changes of level. To us it appears better accounted for by the modification of Mr Darwin's theory of the origin of species which we have proposed (viz., that the change in species is produced by change of condition, and that so long as the conditions of life are the same no change takes place). No change can be greater than one from a plain to a mountain region, and nowhere can there be a greater change of condition. It should follow, therefore, on our hypothesis, that there should be a greater amount of alteration in species, both in number and degree, in mountainous regions, than in those which contain less varied elements of condition of life—and so we find it to be.

To make out lists of these from Heuglin's work would be easy, but, of course, out of the question here; we must refer the reader to the work itself for them, and to the lists which he has published in Petermann's "Mittheilunge," and in the Sitzungberichte of the Imperial "Akademy der Wissenschaften" of Vienna. We can only notice one or two of the incidental remarks which he makes on some of the species.

The Abyssinian lion is distinguished from the Sudan variety by its dark mane, which in winter is developed very strongly. Heuglin had many opportunities of seeing lions of enormous size, but those of the Gala Land were the finest that he ever saw.

The leopard or panther ranges from the lower Oola to a height of from 11,000 to 12,000 feet high. Dr Fitzinger in his paper, above referred to, considers it still doubtful to which of these two species the kind found in north-east Africa belongs; he might have added whether there really are two species at all or not, which we doubt. It is the commonest and boldest carnivorous mammal in Abyssinia—so common is it that it sometimes appears even in the town of Gondar itself. "The walls" says Heuglin (we presume he means those of the sanctuary and different churches, for the town itself is quite open, and these alone are surrounded with large half fallen walls); "the walls are often clothed with thorns, in which wild beasts harbour, and nightly enter the town, or live in the ruins (of which there are great masses in different parts of the town), and not rarely the leopard, the spotted hyena, the ratel, the rhabdogal, and divers foxes, genets, and ichneumons, appear in the high places" (p. 216).

Perhaps, however, the most interesting point in relation to the Abyssinian felidæ, is the possibility that the tiger is an inhabitant of that country; at least, so we are inclined to interpret the information reported by Heuglin, under the head of the "Wobo." "There is" says he "a variety of the leopard which must be either a hybrid between the lion and the leopard, or a peculiar species hitherto unknown, which, however, I had no opportunity of seeing. It is described by the natives as the wildest, cunningest, and strongest of all the carnivora, and, according to some reports, is yellowish, with dark longitudinal stripes (mit dunkeln langstreifen). It appears to occur over the whole of Abyssinia, but none of the Europeans living there know how to make a correct description, and those of the natives giving an account of it do not agree entirely with one another." (p. 236) Regarding this reported animal, Dr Fitzinger in his paper above referred to says:—"In Abyssinia one hears frequently spoken of two large, highly-dangerous species of the cat tribe, which must be distinct from the 'Felis Nimr' (panther). The one of these must, from the reports of the natives, be a tiger-like animal, and should be found particularly in south-east Abyssinia, where it bears the name of 'Wobo.' The other is apparently a blacker leopard, known as the Gesella of the Abyssinians. Also, in the island between the rivers Dendet and Rahad, in Eastern Senaar, is a dangerous leopard-like beast of prey, that is known by the Arabs on the Dender, under the name of 'Abu Sothan,' and according to the testimony of Osman Beg, the late commandant of the troops of the line in Senaar, and that of the independent reports of the great Arab sheiks of that country is somewhat larger than the 'Nimr' (leopard), and has a white or whitish ground-colour, and is striped black like the zebra." But those in the animal of whose appearance Heuglin gives the reports should be completely long striped, and not cross striped as in the tiger. According to the information collected by Von Heuglin two large, very dangerous beasts of prey appear (under the names of the "Wobo," or the tigerish appellation "Mendelid") in Abyssinia, which are wholly distinct from each other, and of which the natives tell a heap of fables.

At one time the "Wobo" was described as precisely the same as the "Abu Sothan" from the Dender; at another time, again, as a beast that lurks, sitting crouched up, and has hands like men. Also, it is reported that it is especially by night that it goes out to prey, and is very fleet and nimble. May this not be some such thing as an Ursus? Also, Lefebvre in his voyage (p. 20) communicates a notice on the Abyssinian "Wobo." (Sitzungberchle Akad. Wissensch. Wien. 1866., vol. liv., p. 556).

On referring to Lefebvre, we find the following notice of it by St Hilaire, under the head of the bear:

"The bear, although very rare in Africa, nevertheless exists there, as everywhere else, in the mountain forests; but its presence has not yet been ascertained in each of the principal localities of this great continent. Thus, never until this day has it been, so far as we know, brought from Abyssinia. No traveller has ever seen it. Neither Bruce nor Salt indicates this genus of mammal in their list of Abyssinian zoological names.

"And, nevertheless, it is certain that it exists there. That animal has even a special name in the language of the Abyssinians, who call it the *ouobo.* M. Lefebvre even cites this fact, that the first time that the Abyssinians who visited France saw a bear in our menageries they called out, 'it is the *ouobo!*' This proof may assuredly appear decisive, for this name is applied to no other animal. There is thus no doubt about the existence of the bear in Abyssinia, and if there is anything to be wondered at, it is certainly not its presence in that country, for from the moment that it is met with in Syria it may readily be admitted that it ought to be re-found on the east coast of Africa, and by consequence in Abyssinia; but its rareness is such, that no traveller who has run over that country has spoken of it, nor ever heard it spoken of, with the exception of M. Lefebvre."

The exclamation of the Abyssinian natives would indeed be strong evidence were it not that we are told in the same breath that it was so scarce that we should scarcely have expected that they could ever have seen it before. One would like, too, to know something about the interpretation of what they said; for it is plain that if the "ouobo" be a bear, it cannot be a yellow animal with black stripes. There may be two unknown quantities here confounded under one name—a bear and a tiger—but it is plain that Heuglin's beast cannot be a bear, for he expressly says, that although some authors have spoken of an Abyssinian bear, he is satisfied that that is a mistake. What seems pretty well vouched is, that there is a Felis larger than, or at any rate as large as, a leopard, of a yellow colour, marked with black stripes. May it not be the tiger itself? Heuglin no doubt says the stripes were reported as longitudinally arranged; but there are plenty of mammals that are vertically, or more or less obliquely striped. but very few indeed that are truly longitudinally striped; and there are several of the cats that have irregular semi-longitudinal oblique patches or broken stripes, but the banded tail in all these shews the true direction of the stripes. The ground colour in the Abu Sothan is whitish, but this is no discrepancy, for the tiger in Siberia has also a whitish ground colour. The known range of the tiger is from the Malayan peninsula northwards to the Amoor, and from the Pacific to the Caspian Sea, and we know of no reason why it should not also be found in Abyssinia. The lion as well as the tiger is found in India and Persia, and there are very good reasons for holding that the original specific centre of both was in the northern hemisphere, and that it was only when the elevation of Abyssinia bridged the dividing Saharan Sea, between Europe and Africa, that the lion found its way into India and Africa proper, and it is only since then that it established its supremacy over the whole of it. That the tiger did not do so too is explained by the fact, which is of so universal application as to have been laid down by naturalists as a general law, that two species of the same genus of the larger animals almost never inhabit the same district, the one or other apparently obtaining the mastery, and driving the other out. The occurrence of the lion at Goojerat may be said to contradict this; but probably before man came to disturb the balance of power, the truth might be that there were all lions and no tigers at Goojerat; and certainly, so far as we can learn, there was a greater comparative preponderance of tigers on the east than on the west side of India. In a contest for possession, the lion would probably have the mastery wherever the country was suited to his requirements, and most of Africa being suited to these it is natural that under the supposed law he should engross it; but Abyssinia is one of the parts which does not suit him, but suits the tiger. Heuglin says the lion does not occur higher up than Moina Dega, a range near Gondar, about 7000 above the sea. The whole of the upper Highlands of Abyssinia are thus left free for the tiger, and as he can thrive in a much colder climate than the lion (as is evident from his being found in Siberia, and even on the skirts of Thibet, far up towards the snowy region), it would appear a not unlikely place to look for him. We trust that by the time our troops have reached Magdala some of our sporting officers will have settled this interesting question.

Many other mammals are mentioned in Heuglin's pages, but it is for the most part a mere mention—a record of their names as he meets with them, and that is all. Among them are elephants, rhinoceroses, hippopotami, one or two undescribed otters, one or two undescribed mice (of one of which he makes a new genus, Oreomys), the Manis Temminckii, the Orycteropus Aethiopicus (of whose underground proceedings against the ants he gives an account), and many antelopes. One general reflection flows from an examination of these notices, and that is, that there is in the high plateaus a decided preponderance of African over Mediterranean or European types of mammals—that is, of forms recruited from the south over those drawn from the north. Taking Fitzinger's list of the mammals of North-East Africa (as being fuller than the casual records in this volume), and picking out the mammals of Abyssinia from those not occurring within its limits, we find them to be ninety-six, including those of both Highlands and Lowlands. Of these, forty-two are found also in Central or Southern Africa, twenty-one in the Mediterranean district,* and the remaining thirty-two peculiar to Abyssinia. If again we separate the Lowland from the Highland species (*i.e.*, species found above 8000 feet above the level of the sea) we find thirty-five characteristic of the Highlands, and fifty-eight of the Lowlands, and thirteen either common to both, or which we are unable to place for want of information.

With regard to birds, again, in looking over Heuglin's lists, what has chiefly struck us is the gradual increase of South African forms which make their appearance as he goes on his way southwards. As in the mammals, the preponderance of African form is apparent from the first, but we think the gradual increase of these southern forms is fully more marked.

Another deduction from these records would seem to be that the range of the birds is not more extended than that of the mammals. It might naturally be expected to be more so, but we do not thiuk that this is the case in nature. This is a point, however, for further inquiry, which we scarcely vouch as to Heuglin's book, but think worthy of more careful investigation.

* The difficulty of drawing the line of separation between the Mediterranean and South African district in Nubia, Senaar, Darfour, &c., renders this point of the calculations less accurate than we should wish, but the approximation is sufficient for our purpose.

Of the lower animals, we have scarcely any mention of crocodiles in the rivers—a python, and one or two other serpents in the Lowlands, and a couple of lizards are almost all the other vertebrata noticed. Of the molluscs he mentions Tridnacna squamosa, as a shell found in the Red Sea (p. 70). The reader will remember that the Tridacnas are those large trigonal bivalves (some of them of enormous size) sometimes used as holy water vessels in Roman Catholic churches, which are now chiefly confined to the Australian seas, and of which fossil remains are abundant in the Eocene formations, giving support to the theory that a special similarity exists between the animals which lived at those epochs and those which now inhabit Australia and the neighbouring seas. He also speaks of the Alpine heights between Gondar and Magdala being rich in small shells. They live under a covering of mosses and lichens, under stones and rubbish, and in the rind of thistle heads. In the Tana Sea occur species of Paludina, Cyrene, and Unio, peculiar to Abyssinia—all genera with a very wide range of distribution, but having more relation with the northern regions than the south (p. 290).

As to plants, the proportion of African and European forms specified by Von Heuglin are very nearly equal in number; any one reading the book, however, with the idea of tracing anything like the successive preponderance of African forms, as the traveller proceeded southwards, is apt to be misled if he does not pay attention to the heights of the district where the species have been collected. The plants mentioned at first are much more frequently African types than European (three to one we should say), but further on in his journey, as he gets higher up, the more do the European types (many of them our own familiar favourites, wild roses, thyme, eyebright, &c.), preponderate until they quite reverse the proportion. The most noteworthy point in its botany is the very remarkable identity of its species, or generic forms, with those found by Dr Welwitsch in the mountain region of Angola.

There are a number of forms peculiar to Abyssinia itself, the most remarkable of which, perhaps, is the wonderful Jibara (Rhynchopetalum montanum) the zone of which begins at 11,000 feet, and continues, so far as the soil extends, up to the highest tops, at first mixed with Erica and Hypericum, then standing in thousands on the short grass of the meadows, blooming amongst the numerous small alpine plants (p. 222).

Fig. 2 is a representation of this remarkable plant. It has long been known as one of the most striking plants of the country. Jussieu and most botanists have ranked it among the Lobeliaceæ, but we think that Robert Brown formed a truer estimate of its affinities when he placed it in the neighbouring order, the Campanulaceæ. If it were blue (which it is not) it might be called the blue-bell of Abyssinia, rather a different looking Campanula from our humble little hare-bell. It is a tree 15 feet in height, with

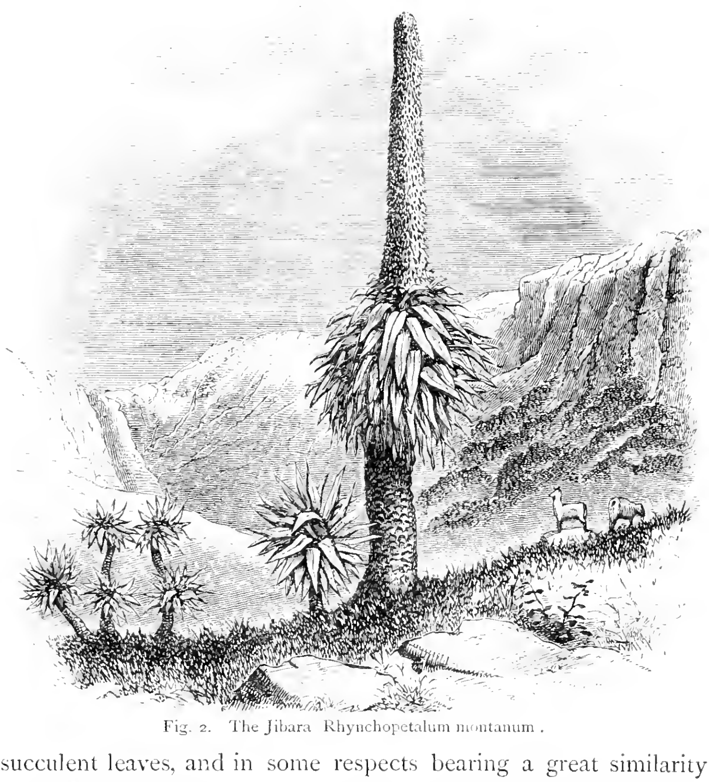


Fig. 2. The Jibara Rhynchopetalum montanum.

succulent leaves, and in some respects bearing a great similarity to the Agaves, with which it has the additional point of resemblance, that it lives until it flowers and then dies. The flower-spike is yellowish-red in colour, and very handsome. Its other qualities, however, are not so pleasant, its fresh juice has the smell of bugs. It is very poisonous, so much so that even its shadow is said to be fatal to those who sleep under it. A more credible report is, that even its smoke occasions vomiting.

Of trees, the Adansonia is perhaps the most remarkable, but the character of the woodland landscape is given by sycamores, acacias, euphorbias, and, near churches, by a lofty juniper, which seems to have been planted probably from similar reasons to those which induced our own ancestors to plant the yew in our churchyards. The ferns, mosses, and lichens are of species or types common to the whole world.

We have the less hesitation in passing over the botanical part ot the work thus hurriedly, that we do not imagine it to be the work of Von Heuglin himself, but is probably a compilation from Dr Steudner's notes, or from the published works of others. Dr Steudner was the botanist of the party, and his lamented death subsequently has probably compelled Von Heuglin to undertake a part of the work for which he himself was less qualified. The great majority of the indications of the plants is thus limited to their order or genus.

In conclusion, it would be most unjust to Von Heuglin to deny that the work is one of value, although, in some respects it may be open to adverse criticism. It is to be kept in view, too, that it has been brought out by an editor in his absence, and has doubtless suffered from the evils inherent in that mode of publication. One great fault is the absence of an index. It is, properly speaking, a book of reference, and should not have been issued without that indispensable accompaniment to such works.

*HAMLET CLARK'S LETTERS HOME.**

THIS is a posthumous publication. The author is beyond the reach of our praise or blame. The one cannot gratify him, nor the other wound him. Neither title-page nor preface tell us this, but we know otherwise that the author died after both were printed off, and when the plates alone were waited for to complete the work. As he tells us in his preface, it was a pleasant relief to him on a sick bed to look over and carry through the press the old "Letters Home," of which this little work consists. From that sick bed he never effectively rose. Within a few weeks after he wrote this, he passed from amongst us, leaving his "Letters Home" as a last little contribution to science and literature.

The reader may naturally expect that the work being posthumous, the criticism will be unbiased. We shall try to make it impartial, but we cannot make it unbiased. We knew him, we loved him—to know him *was* to love him, and to speak of him without a bias is to us impossible.

The Rev. Hamlet Clark was the eldest son of the Rev. Henry Clark, vicar of Harmston, Lincoln; born in 1823, he died in 1867, at Rhyl, in the 44th year of his age. He was educated at Beverley. Like all men who are endowed by nature with any special talent, he early shewed his gift. His talent was Natural History, and chance directed it to Entomology.

His first station as a clergyman was at Northampton, and there for some ten years he fulfilled diligently and successfully his clerical duties. His leisure hours he devoted principally to entomology. That science has reached such gigantic proportions, that it is impossible for any one man to master every branch of it. Hence a division of labour has become a necessity, and men now take up some single more or less extensive section of the subject, and, confining themselves to it, master it, resting content with a more superficial knowledge of what lies beyond it. Hamlet Clark began with British beetles, and from the chance circumstance that the locality where he found himself was especially favourable for

* Letters Home from Spain, Algeria, and Brazil, during past Entomological Rambles. By the Rev. Hamlet Clark, M.A. London: 1867.

water beetles, attached himself more particularly to them. His first papers were notices upon them in the *Zoologist* and other Natural History Journals.

After leaving Northampton, he took a curacy in London, and subsequently ministered in the Quebec Street Chapel, until within a couple of years of his death. Whilst there, notwithstanding the heavy duties of a London clergyman, he found time to continue his natural history pursuits—especially during the hours before breakfast. With the facilities which the London collections, libraries, and intercourse afforded him, his subjects now embraced a wider field. Besides a very good knowledge of beetles from all parts of the world (supported by a large collection which he had gradually accumulated), he specially followed out two important sections—the water beetles and the Phytophaga. On the former of these he had no rival, the most celebrated entomologists throughout the world referring to him as *the* authority on the subject; and on the latter he was almost as absolute, Mr Baly and he dividing the empire between them. On these subjects he undertook to prepare the Catalogues of the British Museum, and a considerable portion of the most difficult part of them had been already published before his death. Another portion waited only for his formal revisal, and the remainder was, we understand, far advanced. We trust that his labour will not be like water spilt upon the ground, and that the Trustees of the Museum will take the necessary steps to get his work finished and published.

Few but those who have been behind the scenes know the wear and tear of a city clergyman's life, when he is zealous and sincere. Preaching is but a small part of the labour; the schools and different schemes occupy much more of it, but probably the private visiting and assisting the poor is the most arduous part of it all. As it is the most arduous, so is it the most dangerous. Many a valuable life has been sacrificed in that field. The long hours which they pass on their feet, the exposure to the infections of the sick-room, to the unhealthy atmosphere of the dwellings of the poor, the mental distress and anxiety caused by the misery it is their lot to see, too often without ability to relieve, combined with the overwork from their other duties, have lost and are constantly losing us lives infinitely more valuable than those, to try to save which they give their own. True it is, the toil and the danger is of their own seeking. If they so choose, they need not go near the poor, but to those who are zealous in their calling, it does not come in the shape of an option. It presents itself to them with a face of duty, and like gallant soldiers they obey her voice, regardless of consequences to themselves.

In that command, on that field, Hamlet Clark found his death. His constitution, never strong, gave way under the strain, and disease set in which finally disabled him, and compelled him to abandon the scene of his labours.

He retired to Rhyl, in Wales, where it was hoped that country air and abstinence from work might restore his health. There he passed two years of suffering. Burke speaking of poor Marie Antoinette says, that "we are interested that creatures made to suffer should suffer well." Assuredly Hamlet Clark suffered well. The courage, modesty, and piety with which he faced approaching death is to us beautiful beyond expression. The coolness and Christian composure with which he made ready to die, reveals itself in every line of some letters which we received from him at a time when he knew that death was not far off. One or two short quotations may do some reader good, as they did us. On 14th of last April he wrote:—

"I have just been reading my Greek Testament—John iii.—and have been pondering inter alia over the good old man's request, 'greet the friends *by name*.' I suppose he meant that his friend Caius knew perfectly to whom he referred; and that (besides this) he desired a *special* personal greeting to be conveyed to them from him. The 'by name' could mean nothing else. Well, I too offer my insignificant greetings 'by name' to your breakfast table, and rejoiced much to accept your very kind expression of sympathy from them all in your last letter. It is strange, physiologically, how a word or two of sympathy, when one quite believes in it, has such real power to help to triumph over pain and weakness. Even now the mind has vast power over the body; what will it be hereafter? Why, this wretched body of ours will be wretched no longer; but the *able* and willing *servant* of the intelligence. Thanks for the offer of ——'s book. Don't *give* me anything, it is of no use, for my time is short; but the more you *lend* me to read the better. I *can't* work now much, and hard study seems more and more impossible—a fortiori, the more is chance reading, or gossip, or a visit from a neighbour welcome."

In the last letter which we received from him, 4th May, he says:—

"I have just received and been reading 'Bentham's (Pres. Linn. Soc.) Address and Obituary of Past Fellows,' a sadly long list; and it set me musing on the preciousness of life, and the vastness of God's natural world of life, and the possible future of the next coming, more brilliant still, world of life, and the value of time, and it all made me turn over myself with my face to the wall, as I lay in bed, and wonder and long that it were possible for me to have strength given me to lay lance in rest once again, and add one little stone—ever so little would do—to the great temple that science is erecting. So you see, friend, that absolute contentment, even after all the discipline I have had, is not my happy gift yet; but that I sometimes fidget in the bonds of this overpowering weakness and pain, like a half bred hound in leash when his game is afoot."

On 10th June he was no more.

His "Letters Home" consist chiefly of letters to his father, containing his *impressions de voyage* (suppressing personal and family allusions), during a yacht trip to Spain and Algiers, and a short visit to Rio Janeiro, both made in the course of the year 1856, in company with his friend Mr Gray. They are written in a fresh and pleasant style, with an occasional sparkle of fun, and with admirable powers of description, and there is a total absence of all affectation or thought of self in the volume.

The trips were undertaken partly for health, but still more for natural history purposes, and, of course, notices of natural history and entomology are frequent, more especially in the excursion to Brazil. But before giving an example or two of these taken from it, we shall cull one little piece of practical advice suggested by something Mr Clark saw on the passage out, which may perhaps be useful to some parent who reads it :—

"Of course in such a crowded varying life as this [on board the steamer to Rio] I could give you page after page of gossip and anecdote ; but with all the inclination, I have not the means of writing amply. One idea, however, I will give you, the experience of the last day or two ; it is this : whenever any one having girls to transplant to another country, is looking out for some materfamilias to whose charge they may be entrusted with comfort during the voyage, let the first (not the second, but the very first) requisite be the *sailing* qualities of madame. She may be most superior, and discreet, and watchful, and anxious to do her duty to her young friends, but all this avails nothing at all if she is unhappily confined to her berth by sea-sickness. One or two ladies here have been making acquaintances which older and wiser people could see at once were not desirable, by no fault of their own, but by almost pressure of circumstances. They had only one friend on board, who was taking them to their family at Madeira ; and she is always ill in bed below ; they cannot be for ever with her in her berth ; under these circumstances the generality of chance acquaintances are those which are the least eligible," p. 84.

How gently and charitably he apologises for the young minxes, and how sound and judicious the advice ; unfortunately in such cases there is rarely much choice of matrons. It is too often a choice of difficulties.

The steamer stopped for a day to coal at the St. Vincent Islands, and Clark and his friend Gray took advantage of the opportunity to entomologize, but with very trifling success:

"There is nothing here where we have been working; during the whole day we have not taken more than twenty species among us. I worked as hard as I could but there was hardly anything. In the ravines, they say, trees will grow, bananas, canes, &c.); and in the ravines, to any one who has the courage to come and explore them, would be found, at the proper season, all the entomological fauna of the island."

The enthusiasm and enjoyment with which the two friends Clark and Gray set themselves to study the natural history of the neighbourhood of Rio is charmingly told, and the acuteness of their observation, the innate talent of the naturalists, is constantly and unconsciously displayed:

"The forest trees, without being giants, were well-grown, and they had many species of parasitic orchids on their trunks. I noticed that although parasitic plants were in abundance, they seemed to affect special trees; most of the trees had their trunks clean and bare; but if any had a growth of parasites, that tree was probably covered with them from root to topmost branches, and with several other quite different species. I accounted for this in my own mind, not by any greater age of the tree, but by some probable greater rugosity of the bark, which would give better holding powers to the little parasitical roots; at all events the effect was curious; here was a tree three or four times its proper diameter, bulging out like one of our ivy-clad ash trees at home, but not with one special overgrowth, but brilliant with scarlets, and many-hued greens, while all around it were other trunks of trees clean and bare; why had not they, too, their coat of many colours?" p. 115.

The following observation on fire-flies is interesting, and the fact observed difficult of explanation:

"This is a pleasant boarding-house in the very midst of the wood, with virgin forest on all sides of us, and plenty of insects, even in the rainy season. I have been out two or three evenings, hardly with the expectation of getting anything, but for the sake of seeing the fire-flies. It is no figure of speech to say that on still evenings, especially after a rainy afternoon, they eclipse the stars; their lights are of all sizes and magnitudes, and more than one colour. The large Elateridæ of the genus Pyrophorus have a brilliant steady and very bright light; these are very difficult to catch, inasmuch as they sail slowly round the tops of the high trees, looking exactly like wandering planets; and others, smaller but of brilliant lustre, fly hither and thither among the brushwood, also Pyrophorus perhaps, at all events Elateridæ, and not Lampyridæ like our English glow-worm, that haunt especially damp situations. On one side of the road leading to the house is a deep gully, conducting a little stream to a small lake of water; this road on such evenings presents a marvellous sight—the whole of the gully is lighted up with thousands of sparks. I am not romancing, they are in thousands, and the wonderful part of the sight is, that while many of the rank and file evidently wander only according to their individual will, there are others, and these the majority, which keep perfect time and sway in their flashings one with another. For perhaps twenty yards you see every light (of this *second* set of lights) evenly and slowly flying in one direction ; then all at once in a moment every light will vanish ; in the next moment every light flashes forth again, and progresses in another direction. It is impossible to resist the conviction that all are acting in harmony and conjunction with each other, and that the impulse of forward progression, and then of a momentary obscuration of light, and then again of a brilliant simultaneous flash and another onward movement at another angle, is felt by each individual, and directed by one the leader of the brilliant well-drilled band. The sight (when one remembers that these are insects, and not birds or beasts) is quite startling, so complete is the precision of united action, and so continuous—going on, for anything I know, all the evening or all night long. I can call to mind no parallel to it, not even an actual parallel in birds or fishes."

To which he appends a recent note :

"As similar scenes must have been observed by any entomologist who had ever spent a few days in the Organ mountains, I applied to my friend Mr Alexander Fry, who in knowledge of the Coleoptera of the southern region of the Brazils, and in the practical experience of their habits, which he had gained by careful examination of them during several years' residence in Rio Janeiro, is among European entomologists facile princeps ; and he entirely corroborated the observation noted above. He replied : 'I can confirm your observation that the fire-flies of the genus Aspisosoma of Castleneau flit at night in great numbers over low-lying damp fields, chiefly under water, emitting light by short flashes, at intervals of three or four seconds, *the majority keeping time with each other as if in obedience to the baton of a leader*.'"

May not the intermittance be due to the action of the wings in flight, and its regularity to their all taking the same space of time to open and shut them (most insects of the same species being uniform in size), and may not its concurrence in action be due to a flight of them having all started at the same time; and may not their all having started at the same time be due to some common cause, whether a general alarm or a general invitation, as from some female having come within hail.

One other instance of intelligent and inquiring observation, and we shall pass on to less speculative matters :

"I think I never mentioned to you one of the interesting sights that we always took care to inspect whenever we ascended the aqueduct road from Botofogo. There was near the road-side a large tree standing by itself in the sunshine, towards the top of it a branch had been torn off by the wind, and the wound gave forth a stream of dark resinous sap which ran nearly to the ground ; this resinous sap was a very favourite haunt of Lepidoptera and Coleoptera, and indeed of all orders. I always made a point of visiting this tree; it was manifestly a well-known luncheon-room for all insects whose morning duties led them into that part of the forest: they kept coming in from all quarters and going away in all directions: the big butterflies were fussy and unneighbourly, running up and down in the sunshine and disturbing all around them; the beetles, though lively enough on occasion, were more demure, and sedulously attended to the main object of their visit. The Ichneumons are unpopular among the insect tribes, everybody gives one of them a wide berth, and interchange of civilities as between butterflies are of the curtest; one big black steel-coloured gentleman is so obnoxious that as soon as he alights every one in that neighbourhood departs. What a vast deal there is for us to learn! these creatures, I suppose, have their traditions, or if not traditions (by these I mean of course the natural tendencies that they derive from their parents) their own personal experiences. I know that they were right about those Ichneumons, perfectly right; but how do they know it? How do those little creatures know that the steel-coloured Ichneumon would as soon have a luncheon off them as off the gum, perhaps prefer them! or indeed that he, in *his* experience of life, visits this tree in the full expectation of being able to get a wholesome meal off one or two flies? or do they know it at all? and why, when they cannot endure the shadow of a carnivorous wasp, will they permit, without difficulty, the blundering swing of the antennæ of a Trachyderes right across their bodies, or let a big Papilio almost walk over them? There is a degree of discrimination in all these actions that is quite superior to the instinct of, we will say, a Chlamys, which, on the approach of danger makes itself in an instant exactly like a bit of caterpillar's dung! That is inexplicable enough, but that is simple and uniform: the rule of life among the Chlamydeæ is, "If ever you are in the least frightened roll yourself up as tightly as you can:" it is their misfortune or their good fortune that the result is that the sight of them would turn the stomach of any respectable bird on the hunt for food. To this rule there is no exception; a harmless butterfly accidently touching them would metamorphose them into an unpleasant-looking cylinder just as soon as the touch of my very dangerous finger and thumb. But here on this gummy tree, the rendezvous of insects, you find something very superior to this. There is a discriminating power which is always exercised aright, and which seems very much like the result of memory and of experience: certainly the absence of any such discriminating power might be in a moment fatal, putting an end to all experiences: it is the quick-witted who live, it is the dullards who are food for Ichneumons; although whence they got their wits I can tell as little as I can tell why the old hen-partridge makes her brood cower down in the stubble at the sight of a distant hawk while she cares nothing at all for fifty crows or gulls: all that is evident is that such knowledge has been imparted to them by the Creator." p. 155.

We see similar instinctive antipathies in every branch of the animal kingdom. Every one knows how the voice of the lion makes all the beasts of the forest tremble and fly. Gardener, in his travels in Brazil, remarked:—

"My horses, which were feeding at a little distance, came closer to us when they heard the almost unearthly sounds produced by the fierce inhabitant of the forests (the jaguar): even those I had brought from the coast, and which I am certain had never been exposed to the attacks of these animals, followed the example of the others, p. 298.

Owing to its being the rainy season Clark did not find animal life in Brazil so abundant as he expected:

"Wild animals are rare about here; tapirs are to be found in some of the hills, and we are exhorted to have a day after them. Birds are rare, at least large birds; I can see none that I know of by pictures or collections: humming birds are more abundant, of all hues, and brilliant like precious gems: spiders and beetles, too, want looking for, but their absence is accounted for by the excessive rain." p. 120.

There is another and a truer reason which he hits upon afterwards:—

"I have had one or two expeditions lately into the virgin forests: they are *not* the places, as a rule, for entomologists, insects congregate rather on the outsides, in the clearings, or by the sides of paths, or anywhere where they can get air and sunshine; but the forests are worth seeing over and over again, if not for their insects at all events for themselves. They impress one with the sense of vastness and silence and solemnity, and teach me (as I can conceive nothing else could teach except, perhaps, a bed of sea-weed on a tropical shore) the marvellous exuberance of nature's powers; ferns and mosses intertwined with parasitical orchids, giant trees, climbing plants, each or many with their special flowers, darken the air that they perfume: the air is full of life: you can hear but you can see nothing. *I suspect there is a great world of insects high up above in the thick bushy tops of the trees that can bask in the sunlight.*"

We know that there is: Mr Fry, the eminent Brazilian entomologist, has told us that many insects are never taken except high up the trees, and that the only means by which he could procure them was by nets fastened to the end of excessively long poles.

"You have the deep distant hum as of thousands of insects, occasionally the note of a bird, sometimes, perhaps, the fall of a branch, or it may be a strange sound that is inexplicable, but nothing can you see but the vegetable world, and this arrests the whole of you; sight and smell as well as hearing make you pause with charmed surprise at every step: always there is something to wonder at or to examine."

The following is an interesting statement relating to the distribution of life in different parts of the globe:

"That which is most remarkable in the general character of the coleoptera is the wonderful exuberance of species and the real scarcity of individuals; most of our species are represented only by a single specimen. We go out three or four days consecutively along the same walk, visit the same shrubs and trees, and yet each day's captures are different from the preceding. We both walk along the same track pretty nearly at the same time and yet each will bring home many species that the other has not seen, and with this abundant variety of species there is an absolute dearth of individuals. I have taken at Deal or the Chesil Bank, or in many English localities, six or ten times as many insects as I ever captured here in any given number of hours. At present insects don't come to us by any means, we have to go to them at their own homes. Geodephaga are at this altitude, 3000 feet, very scarce indeed, except the leaf-loving arboreal Geodephaga, the lovely genera Lebia, Agra and their allies, Buprestidæ are rare too; Elateridæ, Curculionidæ, and Galerucidæ are the dominant groups for the moment: perhaps in Longicorns we take eight species every day, and of course single examples: of Elateridæ and Curculionidæ I have often taken enough in an hour to occupy the whole of the next morning if I were to set them out after the fashion of precise order-loving symmetrical entomologists in England. Water beetles are at present most scarce, or indeed impossible; we are in the midst of the rainy season, and violent rains, sometimes all day or all night long, have so deluged everything that lies low that I cannot get at the pools and brooks for the water." p. 139.

Of the biting and stinging vermin, to which all tropical countries are obnoxious, he had his fair, or rather more than his fair share. Reptiles are not very troublesome in Brazil. They are plentiful enough. Clark generally killed two or three a-day, for they lie in just the very places that insects, and of course entomologists, delight in, but such an occurrence as any one being bitten is very rare. But if snakes are more feared than felt, ants, at least, make themselves felt sore enough.

"Brazil is one great ant's nest; they are of all sizes and dispositions. Some are a plague to us in the house, for they will come at night and prey on the insects in our store-boxes; some are a plague to us in the forests, they get inside ones clothes and bite and sting; others are a more serious evil still, vegetable eaters, which will take a fancy to the leaves of some tree, and strip every leaf off in one night. There are some long-jawed fellows that attack you by a jump, not by the spring of their legs, but of their back-bone (only they have none.) They can fling themselves about a foot, and live under fallen timber and such places: they are not so cruel as the little ones. The *small* species are my terror; their stings are like red hot needles, and they do not, like some others, keep hold with their mouths, thus making only one red mark on the skin till they are picked off. Much less do they run off, having done their duty; but they go, say just two inches forward, and then go through the stabbing process again. On one occasion I was in very great trouble; inadvertently I stood still for a moment examining the contents of my net, just in the midst of their run—a forage expedition of the whole tribe. I did not see them, nor indeed did I look, so intent was I on my precious beetles; when all at once I felt their sting over a great part of my body. The whole legion had walked up my boots. The pain was really dreadful. But happily, when I had changed my quarters, and thrown off in desperation half my clothes, a slave youth came by who helped me to pick the wretches off my body and clothes, and to get in order again. Since that adventure I have always been careful not to interrupt the social migrations of ants." p. 133.

With fleas and flies, cockroaches, et hoc genus omne, he had many little distresses, which are pleasanter to read of than to have experienced.

"I have been badly bitten since I have been here by a little pest of a fly which abounds near the house; it raises small swellings or blisters about the size of a small pea, which are most irritating, and, if scratched, speedily turn into sores. The backs of my hands and knuckles are so swollen that I cannot close my left hand at all. Every one suffers, but I far worse than any one else. At last I discovered the reason; it is only because I wear black clothes, and every one else avoids black. An engineer said to me the other night, 'I always like to sit next to you in the verandah." I began to feel flattered, and to give my neighbour much more credit for discernment than I had supposed. Clearly his was an appreciating mind, which could understand and value respectable society. 'And I'll tell you why, Sir; because then I am never bitten by these beggars of flies; the heat of your clerical black clothes draws together all the *borrachados* in the place. Yes, Sir, you are a public benefactor; they will never hurt any one in white, so long as you are dressed in black.' I am doomed to be a benefactor, I fear (for my wardrobe will supply little but black), and to be bitten for my improvidence before I left England. May all men sing my praises as they ought." p. 146.

The skimmings we have given are a fair indication of the contents of this work. Biased or not, we have no hesitation in saying it is one of the pleasantest books we have read for many a day.

THE PRESENT STATE OF SCIENCE ON THE NORTH-WESTERN SLOPES OF THE ROCKY MOUNTAINS.

By Robert Brown.

WITH most people the region in question is less associated with scientific workers than with bowie knives, "difficulties," gold-mining, and fur-trading; and although we are fain to confess that the majority of the sojourners in that wild region are still not a little addicted to these more or less harmless popular pursuits; yet, as I propose to shortly indicate, in a review of the present state of science in these countries, there are some who are labouring even there to add to the common fund of knowledge.

First in geographical position and importance comes *California* and the state recently constituted of the region in the vicinity of the Sierra-Nevada mountains—*Nevada.*

First in that section comes *San Francisco*, a city which in eighteen years has risen from a collection of cotton tents on some sand-hills to a substantial city of 150,000 inhabitants. In San Francisco the California Academy of Natural Sciences is the principal object of attraction to naturalists. It meets monthly at its rooms at 622 Clay Street, and is now in a tolerably prosperous condition. The Society lingered from its organization in 1853 until recently with a membership never exceeding forty, contributing many interesting facts to the general sum of scientific and practical knowledge, but unable to attain that broader field of usefulness which numbers and money can alone secure. It is now, however, likely to be more prosperous. The liberality of members has enabled it to obtain somewhat better rooms, which are fitted up to preserve and display its many thousand specimens of minerals, its 4000 conchological specimens, its 1500 specimens of palæontology, and its large herbarium, valuable library, and miscellaneous collection, historical and ethnological. They are now prepared to exchange with individuals and societies in other parts of the world, and thereby to extend much their scope of operations. Their "Proceedings" are published yearly in 8vo, with woodcuts, and though the execution, typographic and zylographic, is not superb, yet it perfectly answers every purpose, and suits the Society's limited funds. We believe that the woodcuts are all executed by one of the members (Dr Kellogg) free of expense to the Academy.

The following gentlemen have distinguished themselves by their labours in the different branches of natural science which they respectively chiefly affect, viz.: in geology, Professor J. D. Whitney (state geologist, President of the Academy), Messrs Gabb, W. P. Blake, J. E. Clayton, Ashburner, Dr James Blake, and Auguste Remond; in mineralogy, Messrs W. S. Keys, J. Ross Browne, and Dr G. E. Moore; in botany, Messrs H. N. Bolander, Brewer, Bloomer, and Dr Albert Kellogg; in zoology (general), Dr J. G. Cooper, Eugene V. Lorquin; in conchology, Mr W. J. W. Harford, Dr Newcomb, and R. E. C. Stearns; in icthyology, Dr W. O. Ayres; in zoophylology, Mr Gabb; in infusoria, Dr James Blake; in entomology, Dr H. Behr (lepidoptera); in magnetism, Col. Ransom; and in seismology, Dr J. B. Trask; all gentlemen willing to exchange observations or specimens with those in other countries.

The body is out of debt, perhaps for the all-sufficient reason that the credit of science has hitherto been rather weak in San Francisco. The State Geological Survey, under the efficient direction of Professor Whitney, is still pursuing its operations, though under many obstacles and difficulties incidental to the troubles about the annual grants from a practical-minded legislature. They have already published two volumes, and others will be forthcoming as soon as the necessary funds are in hand. The gardens of Mr Woodward, and the very excellent museum in the "What Cheer House," ought not to be passed without notice. I believe that the German Society of Naturalists in San Francisco does not now exist.

In various other parts of California are scattered a few naturalists, of whom we may mention Mr Andrew Taylor of Santa Barbara, an ethnologist well known in Europe, who is preparing a large work on the ethnology of California, on which subject he has already published a series of articles in the *California Farmer* some years ago, and Mr John Buttle, an Englishman, formerly of the Royal Engineers, and assistant to Dr Lyall, botanist of the North-West Boundary Commission, and also one of my most valued lieutenants in the Vancouver Exploration, a portion of which he afterwards carried on himself. He has now established himself as a land-surveyor at San Jose, fifty miles south of San Francisco, and is prepared to make collections of plants, seeds, &c., in any part of California. Dr Thomas Logan of Sacramento, is a zealous meteorologist. Better information is much to be desired regarding the natural history (and the geography as well) of Sonora, Arizona and the head of the Gulf of California; but though governments have been established there, yet the troubled state of the country through the interminable Apache and Comanche wars renders travelling anything but safe. Accordingly nothing has been done in that vicinity of great importance since the expedition of Ives, the Mexican Boundary Commission, and the Pacific Railroad Survey. There appears, however, to be some stray collectors there, for parcels of plants, &c., are occasionally arriving at the California Academy's rooms from that country.

(2.) *Oregon, Washington Territory, Montana, and Idaho.*

I wish I could make an equally satisfactory report regarding the broad quartette of partially-explored, and thinly-peopled states and territories embraced under this heading. I know of scarcely one naturalist resident in these countries, and what has been done has been by transitory visitors; and in Idaho and Montana, notwithstanding the visits of Townsend, Douglas, and others, there is still a good deal to be done in zoology and the botany of herbaceous plants. There are, however, one or two solitary individuals amid the rude backwoodsmen—mining population, trappers, rowdies, and ruffians—which compose the bulk of the population of these territories, particularly the latter two, by whom the wandering naturalist would be intelligently appreciated, such as Dr Thompson and Colonel Drew in Jacksonville, Rogue River, both of whom, though not scientific men in the strict sense of the phrase, are yet exceedingly intelligent collectors of minerals, antiquities (of the Indians), &c.; and at the Dalles of the Columbia resides the Rev. Mr Conton, a very enthusiastic geologist and successful collector.

In Washington territory, Mr J. G. Swan (author of "Three Years in Washington Territory"), resides at Neah Bay, diligent in collecting specimens, and not neglectful of his duties as a teacher of the Indians. At Whatcom, Mr Bennett "picks up" anything he thinks of interest, and sends to the all-engrossing "Smithsonian."* My good friend, the Rev. Father Cherouse of Snoqualami

* In relation to this, I may remark that, wherever I went in Washington Territory, even among the rudest backwoodsmen, I found, at least, three literary documents, viz., a pack of cards, a quack medicine advertising almanack, and a Smithsonian Institute Report; and to the influence of the latter may be traced that intelligent appreciation of science so universal there.

Indian Mission, to whom I am indebted for several interesting specimens, also pursues a like laudable course, though on a smaller scale. The Hon. Mr Hines is always ready at Olympia to climb a mountain with any one, and Mr Victor of Portland, to note all about it. Dr David Walker, F.L.S., formerly well known as surgeon and naturalist of M'Clintock's *Fox* Expedition, is also in the Territory, engaged as a medical officer of the army; and when I last heard from him was at Fort Steilacoom busily looking after crustacea and shells. There may be more observers, but if there are Messrs Edward Geddings, and Jerard S. Hurd, of the Surveyor-General's Office at Olympia (whom not to know in that country is to proclaim yourself unknown), can and will supply the information.

(3.) *Vancouver Island, British Columbia, and north to the Arctic Sea.*

Though Vancouver Island and British Columbia are now united in one political division under the latter name, yet nothing has been done to explore the interior of the former large island since the expedition entrusted to my direction, ("Vancouver Island Explorations—Colonial Blue Book, 1864,"*) by order of the Colonial Government and Board of Explorations. Since the Alberni saw-mills have been stopped on the outer or western coast of the island, that extensive stretch of coast is only tenanted by wild Indians; and the removal of Mr Hamilton Moffatt, and Mr Pym Nevins Compton, from Forts Simpson and Rupert of the Hudson's Bay Company, has left the northern coast without any resident naturalist. In Victoria, however, a town not very prosperous commercially (just at present), there are several gentlemen who, though not publishing naturalists, are yet very intelligent collectors when opportunity offers, such as Messrs John Gastineau, C.E., Robert Homfray, C.E. Bushell, E. T. Coleman, F. Dally, and F. M. Spence. Dr Comrie and Commander Porcher of H.M.S. *Sparrow-hawk* were proposing to do something towards the natural history of the country; and as they are resident for some years on the coast might add to our knowledge. Sir James Douglas, ex-governor, is a good horticulturist, and gives great assistance to natural-

* *Vide*, also, Proceedings R.G.S., 1865; Petermann's Mittheilungen; "Le Globe;" Trans. Bot. Soc.; Edinburgh New Phil. Journal; the "Farmer," &c.

ists by his extensive acquaintance all over the country, and knowledge of subjects connected therewith. Messrs Robert King (a farmer near Victoria, and formerly in Messrs Veitch's employ), and Clayton, a nurseryman, are ready to supply seeds and trees, &c. Mr A. C. Anderson, long in the Hudson's Bay Company's service, and Mr Geo. H. Wilson-Brown, are also well acquainted with the natural history of the country. The latter gentleman especially is ready to collect, and enter into correspondence with naturalists at home. Mr Lloyd Jones is interested in plants (particularly ferns), as is still to some extent Dr W. F. Tolmie, chief factor of the Hudson's Bay Company, after whom Sir William Hooker named the genus Tolmieia, and Townsend his Sylvia Tolmiei. Mr J. Robertson-Stewart, one of the principal importers and merchants, is also at all times ready to assist in the pursuits of a naturalist. At Nanaimo Capt, Price makes extensive collections of the cretaceous fossils found in connexion with the coal; and lastly (but far from least), Mr James Hepburn, though really a resident of San Francisco, yet spends the greater part of his summers on this coast, collecting birds for the most part, and has accumulated a really princely collection of the Pacific Avi-fauna. He is probably the only thorough zoologist north of California. On the mainland there are still fewer naturalists, British Columbia being very sparsely settled, and to a great extent unexplored and unpeopled, save by Indians.

Dr Jones, at New Westminster, collects insects, and has an interesting set of Lepidoptera; and another medical practitioner, Mr Featherstonhaugh, takes meteorological observations, &c. At Lilloett, I found one of the traders (Mr Foster) very attentive to and interested in science, and capable of affording a good deal of useful information. Mr W. C. Cormack, of New Westminster, studies Coniferæ and other trees. Mr Joseph M'Kay, of the Hudson's Bay Company at Fort-Yale, is also a man of the same stamp, with some knowledge of natural history, and always very ready to advance the views of naturalists. The northern portion of British Columbia is very little known, and might still have remained a terra incognita, had it not been for the establishment, shortly after the close of the American Civil War in 1865, of "The Collins Russo-American Overland Telegraph Company," which, in the prospect of the failure of the Atlantic cable, proposed to run a line of telegraph right north through British Columbia and Russian America to Prince of Wales Cape in Behring's Straits, and then across Kamschatka, Siberia, and Russia, to St Petersburg. The project was a thoroughly wild-goose scheme, devised in total ignorance of the country, and, as might have been expected, fell through at an early period,—not, however, before extensive preparations had been completed, many most excellent explorations made, and a portion of the line built. Staffs of scientific officers were attached to all the surveying and exploring parties, and they have already added much to our knowledge of the country. Amongst those which I shall particularly notice, was the exploration made from Lake Tatla, in British Columbia, to the Stikeen River, over 700 miles of unexplored country, in the depth of winter, by Major Frank L. Pope, Mr G. Blenkinsop, and two Indians,—the party being encumbered with no baggage but a couple of buffalo robes and a little hand sledge, on which they dragged their food (a daily ration of six ounces of pemmican) and their guns and ammunition. They were seventy-five days in the open air, went over a flattish country, where they seemed to think the season was earlier than on the coast; and when I met them at Fort Rupert in May 1866, they looked exceedingly hearty, and nothing the worse of their extraordinary journey. A botanist wintered with the party at Tatla Lake, and Major Pope informed me that he had made a good collection of plants.

In other portions of British Columbia, Chief Justice Begbie and Mr Oliver Hare, may be mentioned as likely individuals for a naturalist to apply to for information on the zoology of the southern portion of the country. The government are also occasionally sending out little parties of surveyors, in different sections; but science has no part of these expeditions, nor is there any special scientific officer attached to the government, though the revenue depends upon mines for its support.

The immense region hitherto known as Russian-America (or *Alaska*, as it is now called by its new masters) is an almost unknown land, at least in the interior. The Telegraph Company have made some explorations, principally under the direction of Robert Kennicott, the well known naturalist;* and the recent

* By recent advices in the San Francisco "Bulletin," from Michaelowski, the Russian settlement in Norton Sound, the world is informed of the untimely death, in May 1866, of that gentlemen, one of the greatest explorers and naturalists in the annals of north-west America. Mr K. had travelled extensively throughout the country between the Rocky Mountains and the Pacific and Atlantic for

acquisition of this tract by the United States, will most likely be the means of greatly adding to our knowledge of the country. Already I learn that an exploring expedition has left for there. To this party, Dr Albert Kellogg, whom I have referred to as an eminent botanist, is attached as surgeon and naturalist; and we may expect from his researches, much new matter from the interior and on the coast, to our knowledge of which, Mertens, Bognard, Middendorff, Steller, Escholtz, Chamisso, Beechey, Seeman, and others, have already contributed.

I close this short and necessarily imperfect review of the present state of science on the Pacific Coast, by apologising to those whom in ignorance I have omitted to mention, as students of science in that broad field, where the harvest is ripe, but the reapers are few. There is still much to be done in these countries in zoology and botany, particularly in the lower orders of plants (Algæ, Fungi, Lichens, Hepaticæ, Mosses, and Jungermanniæ), and animals, and in tracing their geographical dis-

---

the last ten years, often in Government employ, in the exploring surveys for railroad and waggon routes, and as often on his own account as an ardent and skilful naturalist. From 1861 to 1864 he made several explorations in connexion with the Smithsonian Institute, and the Chicago Society of Natural Sciences, as a scientific naturalist, into the most unfrequented portions of the northern domain of the Hudson's Bay Company. In the latter part of this time he made a most adventurous and perilous journey to the head-waters of the Yukkon and Stickeen rivers of Russian-America and forwarded to his friends, through the liberality of the Hudson's Bay Company, an immense number of specimens in every department of natural history. His discoveries in geography and zoology were considered by the learned as of the highest importance; and the reports of the Smithsonian and of the Chicago Academy, are full of the results of his constant and multifarious labours. On the formation of the Russo-American Telegraph Company Expedition, under Col. Bulkeley, his valuable services were immediately secured, and great seems to have been the assistance which his experience and eminent talent enabled him to render to that enterprise, in which his whole heart as a naturalist and as a well-wisher to his fellow-men seems to have been concentrated. In the prime of life, and with hosts of friends well earned by indefatigable and unselfish labours in the cause of science and humanity, Robert Kennicott laid his life down, like the brave soldier, at the utmost frontier of the battle-fields of nature. In ten years he had, it may be said, coasted the Arctic shores from Hudson's Bay to one of the remotest points of Russian-America, at the very mouth of Behring's Straits. He had roamed for years amongst the wildest tribes of the Pacific Slope, often where the foot of the white man had never trod within 200 leagues, and there was scarcely any section of our domain which he had not personally examined as a student of nature.

tribution and the laws affecting that distribution. A monograph of the trees is also much required, and the fresh-water and lacustrine fishes, as well as the marine, would yield excellent results. With birds, less remains to be done, as they are, thanks to the labours of Mr Hepburn, Mr Lord, and of the Pacific Railroad naturalists, tolerably well wrought up. Our knowledge of the cetacea and seals of the North Pacific is almost a blank. Though I can scarcely think that, with the enormous expense of travelling through these countries, and the difficulties of transportation, it would "pay" a naturalist now-a-days to go on an errand to these countries, yet one resident there, could at odd times, without interfering with his professional occupations, do much towards elucidating some unsettled points in their natural history; and the hospitable generous character of people, would at all times lead his neighbours to assist him.

One word more and I have done. A naturalist should always remember, that a country is not "worked out" because so and so has been there. I have always found that a diligent naturalist does better when he visits a country after another, because he has then a sort of frame-work to weave his labours around—his predecessor's labour acting as a sort of lamp to guide him through the obscure paths wherein he is wandering.

*DELPINO ON THE APPARATUS FOR FECUNDATING PHANEROGAMOUS PLANTS.**

SIGNOR Delpino tells us that the observations recorded in this memoir, are intended as a prodromus to a general work on the apparatus and processes for fecundating flowers, in which he proposes to recapitulate the observations and experiments of C. Sprengel, Charles Darwin, U. Mohl, Frederick Hildebrand, L. C. Treviranus, and his own. He tells us that they originated in his having read the account of the mode in which the Barlia longibracteata, Parl., is fecundated by the intervention of Xylocopa violacea, described and figured in the contributions to the Flora of Mentone by J. T. Moggridge (1864), and more especially by the perusal of the work of Mr Darwin, on the fecundation of orchids (1866), which has restored the old and half-forgotten work of Sprengel to its proper place in the minds of botanists.

In that work intitled, "Das entdeckte Geheimness der Natur im Bau und in der Befrucktung der Blumen," (Berlin, 1793,) Sprengel, by means of a great accumulation of acute observations, had demonstrated the generality of the laws, which he called dichogamia; according to which the pollen of the flowers of a plant ought to go by preference to fecundate the ovaries of the flower of *another* plant (of the same species.) In diœcious plants the thing is manifest of itself; in monœcious plants it is also easily comprehended; but in plants with hermaphrodite flowers, it seems at first sight an absurdity, considering the vicinity of the stamens to the pistil. But the attentive observation of facts shews that it is not quite so absurd. A phenomenon that is met with in almost all plants, is that the maturity of the anthers is not always contemporaneous with the maturity of the pistil. In some it is the anthers which reach maturity before the pistil; in others it is the pistil which, on the contrary, becomes mature before the anthers, as may be seen in a few plants (Graminaceæ, Cyperaceæ, Luzulæ,

* Sugli apparecchi della Fecondazione nelle piante antocarpe (fanerogame). Sommario de Osservazioni fatti negli anni 1865-66, da Federigo Delpino. Firenze. 1867.

Plantagineæ, &c.). By this fact Sprengel considers the dichogamia is proved. Following up Sprengel's ideas, Signor Delpino carries them to their extreme limits. The following is pretty much the course of his arguments :

Generally speaking, the flower is an apparatus where all the organs conspire to effect the impregnation, in other words, the dichogamia ; and this is accomplished by means of two agents, either wind or insects. In the flowers predestined to be fecundated by the action of the wind, the anthers are, for the most part, borne upon very long and exserted filaments, which gives better purchase to the breeze, as we see in the Graminaceæ and Plantagineæ. The pollen is very fine and powdery ; often, as in the Conifers, in extraordinary abundance to supply the great dispersion which takes place ; or as in the Urticaceæ and allied families, the anther, incurved at first by the elasticity of its filaments, starts up like a spring, and scatters within a cloud of pollen. On the other hand, in the flowers predestined to be fecundated by means of insects, strange changes take place. The lively colours of the floral envelope are, according to the thinkers who adopt this line of argument, provided in order that the flowers may be discernible at a distance by the insects. The profusion of pollen which is generally met with in the plants, of which the impregnating agent is the wind, is not present here. The pollen is oily and fatty that it may the better adhere to the body of the insects. It may have an effusion of odours and special smells to allure insects predestined to act as scavengers. It may have a secretion of honey to serve as bait. There are most ingenious preparations to preserve that precious liquor, as well from the injurious effects of the atmosphere as from insects not predestined for the purpose, and to direct the action of the same in such a way that they must necessarily co-operate in the dichogamia. Under this hypothesis, if in any flower we meet with brightly coloured parts and organs secreting honey, we are, according to Signor Delpino, to rest perfectly assured that these two contingences exist there for no other purpose but that of dichogamia. In especial, this is said of such flowers as in their form seem to be or actually are what is called anomalous, and which present spurs, fringes, horns, and appendages of various kinds. Under Sprengel's theory, these anomalies are nothing but more or less ingenious means for the advancement of dichogamia.

The result of a multiplicity of observations made by Signor

Delpino in 1865 and 1866, are stated by him to furnish a constant confirmation of the laws pointed out by Sprengel.

One part of his hypothesis from which we wholly dissent, and which his observations seem to us never to touch at all, is that the vivid colours of flowers have the effect of attracting insects to them. As we have already said in a preceding paper in this number of the Journal, insects are short-sighted animals. However strong their other senses may be, and however powerful their sight may be close at hand, (a point as to which we know nothing), it is plain that the range of their vision is very limited. Any one who has noticed the light and jerky flight of a butterfly approaching a wall, must have seen it almost knock its head against it before it discerns it. It then falls back a little and lilts away upwards, again approaches the wall, again discovers the obstruction, makes another slight retreat and upward flight, and goes through the same operation until it reaches the top. The reason why we see the crushed remains of the "shard-born beetle" so often lying on the pathway is from their knocking themselves down, by coming against the passer-by or other obstructions, as they wing their drowsy flight. We could cite a multitude of other incidents to prove the absence of far-sighted vision in insects ; and, of course, if that really be the case it is impossible that gaudy colours, which they cannot see, can be given by nature to flowers for the purpose of attracting them. It may be said that although this infirmity of vision may exist in some insects, it may not be present in all. Some have large eyes, and some small, and some none at all, so that there must be various degrees of vision. We quite admit this ; but what we say is, that the kind of vision is the same in all; the plan of the optical apparatus is constructed on the same principle in all, and *that* an inferior principle, and one with less scope and shorter focus, than the plan of the eye in the higher animals.

We are less disposed to dispute the supposed final purpose of the nectary and its secretion (honey). Insects seem to have the sense of smell developed to a much higher degree than that of sight or any other sense. The multitudes attracted almost instantaneously by the presence of any putrifying matter, the crowds of males drawn in the darkness of the night to the entomologist's window when he places there a virgin female of the same species, and a multitude of other instances to the same purport, sufficiently shew that that sense is possessed by insects to a degree of acuteness far beyond what we enjoy. The supposition, therefore, that the honey in the nectary may be a bait by which the presence of insects is secured is not open to any objection on the score of insufficiency or unsuitableness of the means employed. The objection is of another character. It is the error of supposing that the hypothesis is not only a true explanation of the facts observed, but that it is the only one, and that it applies to all cases. Signor Delpino's observations, however, extend over a large number of species of various orders of plants; and whether the reader adopts his views to their full extent or not he will find in his paper a great deal of interesting information as to different contrivances and apparatus which in many cases it seems scarcely possible to deny have fecundation by insects for their purpose.

Of the Leguminosæ, which those who deny the necessity of the intervention of insects in the fecundation of flowers are fond of citing in support of their views, he gives the following as the different ways in which the fecundation in them is effected by means of insects, first premising that the constant occurrence of a nectary at the base of the insertion of the isolated stamen was in itself sufficient proof to him that fecundation must be effected by that means: the existence of nectaries being, according to him, solely for this use. He found the plan of the apparatus for fecundation reducible to four types. In all four it is the keel which plays the principal part, and, consequently, his observations can only apply to those Leguminosæ which have a keel. In the commonest type the keel enveloped in the wings forms as it were a guard to the stamens and stigma. A hymenopterous insect comes to place itself on the flower. The introduction of its proboscis to suck the honey causes the keel to diverge from its proper position. It yields, and in yielding lays bare the anthers and stigma, which thus rub against the back and abdomen of the insects, the anthers abandoning their own pollen, and the stigmas agglutinating a portion of that already attached which had been taken from flowers previously visited. We have not space to pursue the contrivances exhibited in the other three phases. The reader may trace them for himself in Lotus corniculatus, which is the type of the second phase, in Phaseolus caracalla, which is the type of the third, and in the species of the genus Medicago (M. sativa, M. arborea, &c.), which is the type of the fourth phase.

The general impression left on our minds by perusal of Signor Delpino's paper is that while he is probably right in considering much of the apparatus he describes as special contrivances for fecundation by the intervention of insects, but his zeal for his theory carries him beyond what his premises warrant. For example, he refers the fecundation of exotic plants in Italy chiefly to a Scolia and the Italian humble bee; and his theory would infer that the plan of the flower or of the bee were specially contrived to suit each other. But how if the plant comes from a country where no Bombus occurs at all. There may be something else which answers the same purpose, but the idea of mutual adaptation does not always apply to the instances selected.

In such questions, however, an independent and satisfactory judgment can only be arrived at by studying the observations and repeating for ourselves the experiments which have been made by others.

*FAUNA OF MADAGASCAR.**

THIS is the first part of a work intended to consist of the natural history of the mammals and birds collected by Messrs Pollen and Van Dam during their travels in the island of Madagascar and its dependencies. It is accompanied by figures of such species as are either new to science or only imperfectly known; and is to be followed by what is much needed, viz., a critical review and enumeration of all the mammals and birds indicated up to this time as natives of the geographical province of Madagascar.

It is printed in quarto, with fine paper and good type, and is to appear in parts, each of which consists of forty-eight pages, and contains ten beautifully-coloured plates; and, a not unimportant point for the naturalist to know before he subscribes to the work is, that it is to be completed in four parts.

The part now published contains the mammals and the birds of prey actually met with by Messrs Pollen and Van Dam; and, incidentally, a number of critical observations on the species generally are given, but not the enumeration of all those species.

The mammals noticed are the Lemur Macaco, L. Mayottensis (nov. sp.), Hapalemur griseus, Cheirogaleus furcifer, Lepilemur mustelinus, Microcebus Coquereli, Cryptoprocta ferox, Viverra Schlegeli, Pteropus Dupreanus; to which are added some notes on species the authors had not seen, viz., Lichanotus brevicaudatus, Avahis laniger, Lemur varius, L. Catta, Cheiromys Madagascariensis, Galidia elegans, and Galidia concolor, Centetes ecaudatus, Pteropus Edwardsii, Taphazous leucopterus, Dysopes sp., Sciurus Madagascariensis, Mus Indicus, M. musculus, M. rattus, M. sylvaticus, Sus larvatus—a species of Delphinus—and the Physeter macrocephalus. More or less information is given regarding the character and habits of all these, and it appears to be carefully and judiciously collated.

For some time past the conviction has been growing on zoologists, that the number of species of Lemurs is considerably over-estimated, and that a good many of those standing on our lists will, on

* Recherches sur la Faune de Madagascar et de ses dépendances, d'apres les découvertes de M.M. Francois P. L. Pollen et D. C. Van Dam—Mammifères et Oiseaux par M. H. Schlegel et M. Francois P. L. Pollen : Leyde, 1867. Part I.

better acquaintance, have to be deleted from them as varieties, or as the young or the sexes of other known species. The species noticed by Messrs Schlegel and Pollen furnish examples of this. The first in the list, Lemur Macaco, turns out to have two quite distinct dresses—one black, that of the male, the Lemur niger, Geoffr., and the other reddish yellow (subject to considerable variation), that of the female, the Lemur leucomystax, Bart.; and the experience of our authors, derived from a long series of specimens of all ages, is, that these special colours are distinctive of the male and female from their very youth, although variable in degree of intensity of colouring, especially in the female. The results in clearing up the synonomy of species is remarkable. From their study of the animals in life and in their own country, it appears that the most of the characters on which authors have erected new species and even genera, are not specific, but merely individual.

The weeding out of species thus accomplished, knocks off besides the above corrections, five of Dr Gray's species, and six of Geoffrey St Hilairé's. We should have expected that, after the warning conveyed by the discovery and correction of so many mistakes of others, Messrs Schlegel and Pollen would themselves have been careful to avoid such errors themselves; but they are no better than their neighbours, and sin with their eyes open. There are two species of Lemur described from the Commoro Islands, but none have been signalized from the easternmost of these islands, viz., Mayotte. Our authors have, however, got a species from it, and as they cannot get it quite to agree with the description of either of the other two species, or with the Madagascar species, to which all three may belong, L. collaris, (it being a little paler in colour of fur), they have given it a new name, L. Mayottensis.

M. Pollen gives an account of the habits of the Lemurs, which our knowledge of them, derived from the study of them in our zoological gardens, has somewhat anticipated; still, the history of a naturalist's actual experience in procuring specimens, living or dead, necessarily contains much that is interesting. To us the most interesting point in their economy, is the resemblance of their habits and mode of life to those of the Opossums and other marsupial animals. Like them they are nocturnal animals, and like them some of them live in hollow trees with two entrances. The interest of such similarities lies in the fact that there are also anatomical and structural as well as external resemblances between the Lemurs and the Marsupials. This is usually called a relation of analogy; but without going the length of saying that there is no such thing as a relation of analogy, or that all the so-called relations of analogy are in point of fact relations of affinity, it seems to us that in many cases they are so; and, at all events, we shall by no means be surprised if this should be hereafter acknowledged to be the case in the instance of the Lemuridæ and Opossums.

Cryptoprocta ferox, as to whose true relation so much discussion has taken place, is here figured and described, and our authors give the following brief estimate of its affinities:

"Compared with the Cats, the Cryptoprocta recals these animals to mind by its physiognomy, by the general appearance of its form, by its system of dentition, and its tolerably retractile nails; and, in particular, it approaches more nearly in respect of form to the Jaguarondi, in respect of colour to the Puma, (Felis concolor). The Cryptoprocta diverges, on the other hand, from the Cats in general, by its form, somewhat more elongated in all its parts, including the cranium; by being not quite so high upon the legs, by its well developed anal pouch, by an additional molar in each side of the under jaw, and by the bareness of the soles of its four feet, being more extended and not divided by bands of hairs into a certain number of compartments."

Occupying, as it does in these respects, a somewhat middle position between the true Cats and the Viverridæ, it is not likely that its nearest relations will ever be settled to the satisfaction of every one; but it is satisfactory to know exactly what the differences are, so that every one may put his own value upon them.

Of the Galidia elegans and concolor, we learn that they both frequent marshy places, covered by aquatic ferns and reeds, and prey on rails and other water birds and their eggs; but after their chase they retire into the forests, situated at a certain elevation, They also feed on mice, rats, and some fruits, such as the banana.

These animals were discovered by Bernier, in the north east of Madagascar. The Galidia concolor is commoner than the G. elegans, and G. olivacea is only a variety of it. M. Coquerel made some observations upon one individual, which was kept in a very frequented hotel at St Denis, in Bourbon Isle. It was completely free, and was constantly running about, giving utterance to a sort of purring or clucking, like that of some birds. It made continual war on insects and other vermin in the hotel. In a very short time all the rats disappeared. It pursued them into the narrowest holes, sucked their blood, and eat their brains. It got quite tame, and followed its master everywhere.

The Cryptoprocta, the Galidias (including Atilax and Galidictis), and a Genet (Viverra Schlegeli), now first described, and nearly allied to the Indian species (V. Indica), are the only carnivorous mammals in Madagascar, the Lemurs being essentially frugivorous, for although they occasionally kill small birds, and cracking their skulls like a nut, suck out their brains, they are scarcely flesh feeders, the rest of the body being thrown away. This paucity of Nature's police might be sufficient to maintain the balance of power in the island while in its natural condition; but now that the entrance of man on the scene has introduced elements of disturbance, the police is quite inadequate to its task. Rats and mice have come in the white man's ships, and have overrun the island to a degree unheard of elsewhere.

M. Pollen says of them:

> "The mammals which are most abundant in Madagascar, are beyond contradiction the rats and the mice, known to the inhabitants under the names of Valave and Sizi. The most common are the Mus Indicus and the Mus musculus. They have probably been introduced by merchant ships. The quantity of these animals is so great, that at night one can scarcely walk a step without seeing them running about in hundreds in search of food. I shall never forget the torments that the rats caused us, during our abode in the forests stretching along the banks of the river Kongony. Their teeth spared nothing, and we were often obliged to share our repast with these annoying gourmands. It happened even several times that they gnawed away the soles of the feet of my Malagese servants, who, plunged in deep sleep, did not perceive it until next day, when the burning pain of the wounds apprised them of it."

They are terribly destructive to the sugar canes, and all provisions not put in a place of safety, the most approved contrivance for which is a circular piece of wood, like the bottom of a cask, perched on the top of a pole. The first colonists of Bourbon Isle (the Isle de Reunion) suffered so much from the rats and mice between 1548 and 1664, that they were literally driven from the isle.

The account given of the Centetes ecaudatus, the Madagascar hedgehog, is full and interesting. These animals pass the half of the year buried in profound sleep—and this takes place in the cold season, and not in the hot season as has been generally reported. About the month of May or June these animals dig a hole in which they sleep from the month of April to December, with their head nestled between their hind feet. The place of these holes is often indicated by a little mound of moss or soil, like mole-heaps. At this time they are very fat, and the natives of Madagascar and the

Creoles of Bourbon Island eagerly hunt after them for the sake of their flesh, which they esteem highly. During that season, and more particularly on feast-days, the market of St Denis is well furnished with these animals, either fresh or smoked. The Creoles who inhabit the mountains usually come down to the town on Sundays, to supply the market with these animals. They sell them according to their size and weight, often even at the price of two francs and a-half each. According to some amateurs, the flesh of this animal is preferable to that of sucking pig; although others think it has a slight flavour of musk. The hunting of these Madagascar hedgehogs is performed by dogs trained for the purpose, but, more generally, they employ ugly little curs which seek out their retreat with ardour. As soon as they have found the retreat of one of these animals, they dig a hole and drag it out dead asleep. The hunter then puts it in his bag, and kills it afterwards.

The Tangue (as this animal is called in its native country) is very prolific, often producing twelve to sixteen little ones at a birth. This fecundity saves it from disappearing from the face of the earth, as is happening to so many animals which undergo continual persecution. Their food consists of earth-worms which they get out of the ground by means of their pointed muzzle and their feet, in the same way that pigs do. They also devour certain roots, fruits, and insects. In captivity they eat raw meat as well as the fruit of the banana, of which they are very fond. Their manner of life is more nocturnal than diurnal. They sleep all day, almost without interruption, but they are very active during the night. Mr Pollen has often kept them in captivity, and in the night they often broke with their strong teeth the iron trellis of their cage and escaped. They are subject to considerable variation. In some individuals the head and space between the shoulders and the fore-part of the sides are covered with very stiff and hard spines, while the other upper parts of the body are furnished with long hair. In young individuals the hair of the whole of the upper part of the body is mixed with spines of a whitish or brown and white colour. In other individuals the hairs are replaced on all the upper parts of the body, and even on the sides and posterior parts, by very stiff spines: hence Messrs Schlegel and Pollen regard the species C. armatus, Geoff., the distinguishing character of which is being wholly covered above with stiff spines, as merely an individual variety of the common C. ecaudatus.

Of Sciurus Madagascariensis, an animal whose existence has been rendered somewhat doubtful by a confusion between the nomenclature of it and of the Aye-Aye, our authors do not tell much. What they do say, however, is in favour of its existence. They say: "This animal is very rare in Madagascar, and is only found in the interior of the eastern part of the island." The Museum of St. Denis possesses an individual brought from the environs of Antananarivo by a Jesuit missionary. The Betsimsaracs know this animal under the name of Hansirac. On it and the correctness of the determination of the affinities of the Aye-Aye depends the question whether the rodents are aboriginally represented on the island or not. The opinion of the majority of naturalists places the Aye-Aye among the Lemurs. But if the Sciurus Madagascariensis exists, and really is a squirrel, that would settle the question.

The habits of the Aye-Aye (Cheiromys Madagascariensis) are now so well known that we have no right to be disappointed that we do not find much new information regarding it. It appears that it is very rare, and it is only met with by chance. It lives solitary or in couples, and never in bands, and is essentially nocturnal, sleeping all day in the thick tufts of large bamboos, in the heart of the most impenetrable forests. The name Aye-Aye bestowed on it by Sonnerat as the native name is merely a common exclamation of the Malagese when they see anything strange.

Of the Bats, one new species Pteropus Dupreanus is proposed, allied to P. stramineus, Geoff., of India. It was rare, having been only seen once. M. Schlegel considers that this new species, P. stramineus, and the P. paleaceus, Peters, may all be the same species; and also suggests that this species may be identical with the Pteropus medius of the continent of India, and supports his view of their variability by reference to three species from Halmahera, Ceram, and Arou.

The birds noticed in this part are all falcons and owls, and the information given regarding them is confined to their specific characters, their affinity to other species, and a few notes regarding their distribution. Beautiful plates of some species not yet noticed in the text accompany the livraison.

Correspondence.

NORTH COAST OF AUSTRALIA.

Extracts from letters from FREDERICK HOWARD, Master, R.N., (Surveying Schooner "Beatrice,") in charge of the Survey of North Australia, to CAPTAIN RICHARDS, Hydrographer to the Admiralty.

"ADAM BAY, 22*d January* 1866.—I have the honour to inform you that the 'Beatrice' arrived here from Sonabaija and Kœpang (in Timor), on the 28th of December 1865.

"We found the exploring party, under Mr J. M'Kinlay, camped about half a mile south of Escape Cliff. I beg to state that I have received a printed letter from the Chief Secretary of South Australia (a copy of which I enclose), instructing me to attend upon the exploring party, and in obedience to which we are now full of stores and provisions for the Liverpool and Roper Rivers.

"ADAM BAY, 21*st June* 1866.—I have the honour to inform you of the proceedings of the 'Beatrice' since leaving this bay on the 27th of January last.

"Mr M'Kinlay wished us to examine minutely the coast on both sides of the Coburg Isthmus; but as I deemed the examination of the western side would be attended with much danger and delay during the west monsoon, I at once proceeded round to Mount Norris Bay, and during the month of February and beginning of March made as much progress towards its surveying as the weather would allow.

"We were in friendly communication with the natives, several of whom spoke a few words of English; one native calling himself 'Bob White,' spoke it perfectly, and remembered all about Port Essington. The isthmus was well-stocked with small herds of buffalo, from which we easily procured fresh beef on two occasions; the soil appeared good and the grass adapted for cattle; this being the rainy season, however, the ground was very soft, and the low-land invariably swampy; there is, however, plenty of sloping land, the highest points of which we made to exceed 200 feet in height. The best looking spot for a settlement appeared to be east of Copeland Island, where the land slopes down to the beach, and deep water runs well into the beach, the land above rising to a height of over 150 feet. The roadstead would be protected from all winds but north, and during the south-east monsoon the water would be quite smooth.

"During our stay a couple of Malay proas made their appearance in the bay, and put up their trepang works at Copeland Sound, our own headquarters. They were manned by over 100 men and had 22 fishing canoes, in most of which we observed one or two natives; they seem to work well for the Malays, and many appear to speak and understand the Malay language. The proas hoisted Dutch colours as they approached, and we found them very quiet and inoffensive people; they did not interfere with us in the least. We were able to survey the coast-line of the bay from Cape Croker round to Point Brogden, &c.

"As Mr M'Kinlay wished us to be at the Liverpool River by the 25th of March, we left Mountnorris Bay on the 10th, with fine weather and very light north-westerly winds, and made a track survey round to the Liverpool River, arriving there on the 25th. Our usual mode of proceeding was to move the schooner along during the afternoon, when we generally had a breeze, and work the boats during the forenoon. The bays south of the Goulburn Islands we found shoal; but the King River, east of Point Turner, forms a small but good port, the country east of which is mostly low, sandy, and apparently worthless. We passed plenty of Malays at work in the different bays, and numerous natives with them. We anchored about 3½ miles south of Entrance Island; and on the morning of the 26th of March it commenced to rain heavily, and never stopped for a minute until the 3d of April. During the rain the wind veered round and blew hard from all points, particularly from the north-north-east, and we had much thunder and lightning, but the rain never stopped; the water alongside soon became quite fresh, and remained so for a week, so that we filled up our tanks. The stream never exceeded four knots; but the country was evidently much flooded, numerous trees floating down.

"The 'Beatrice' was twice up the river for a few days, and the boats explored as far as they could get, the tracing enclosed will give an idea of the size and shape of the river. The country in the immediate vicinity of the upper part of the river seemed to be low and swampy, with a very poor soil; we saw no bamboos, but numerous palms of various kinds. There seemed to be some better land near the mouth of the river. The natives from the very first held aloof from us, and although we tried every means to make them friendly, shewed great hostility towards us. A party on the east side of the river mouth waylaid Mr Grey and three men, on their return towards the boat, from making a theodolite station, and answered overtures of peace by a shower of spears, which was returned from the men's revolvers; the natives did not care a bit for them, and on our party making for the boat, gave chase, and flung shower after shower of spears, fortunately at such a distance that they were easily dodged, and none of our party were hurt. The arrival on the scene of the boat-keeper with a rifle, sent them to the right about. I am happy to say that none of our people were hurt. This is the only time we have come into open collision with the natives, though they are always watching for a chance.

"The party in camp, numbering twenty, have hitherto kept on good terms with the natives, in which they have had to practice much forbearance, as they are confirmed thieves, and manage to steal something every day. They are good friends with the natives permanently settled near them, but large parties continually come in from the surrounding country. At one time they had as many as 160 round the stockade; they then became very insolent in their demands, frequently poising their spears at the whites when they are not satisfied, and on one occasion, organised a regular attack, but were apparently frightened off by a few discharges of blank cartridge from a six-pounder. The friendly natives are very useful in providing fish for the camp, which they bring in large quantities (they spear them at night). One or two of the whites can speak the native languages (for there are four of them on the 'Adelaide') pretty fairly, but the natives do not seem to have picked up much English.

"We had much sickness at the Liverpool at one time, half our working hands, and two cases of scurvy, for the men had nothing but their salt provisions and flour to live upon (we could catch no fish), but luckily we discovered a grove of cabbage palms a few miles up the river, and managed to obtain over 150, so that when we sailed all hands were well.

"Not having heard or seen anything of Mr M'Kinlay or his party, and our provisions having completely run out, we were compelled to sail for this place on 11th of June, first burying two bags of flour, &c. . . . We have now got a sufficiency of meat from the stores here, to last us fifty days, and give us time to visit the Liverpool, bring some more provisions in a tank I have procured, and go on to the Roper River, where I expect the explorers have gone, finding it impossible to make the Liverpool, from the low swampy nature of the country round its head.

"TIMOR KŒPANG, 23*d August* 1866.—We sailed for the Liverpool River on the 25th of June, and arrived at Mount Norris Bay after dark on the 28th, and next day managed to shoot and bring on board three buffalos—a great addition to our stock of animal food. The aboriginal native, Bob White, came on board, and volunteered to go with us to the Liverpool River, and believing he might be useful to us, I took him on board. We weighed on the morning of the 30th, and whilst standing across the bay west of the Goulburn Islands, the same night White informed some of the men that he had heard of Mr M'Kinlay; that he was at a place called Arrah, somewhere at the back of the Tor, and that he had very little to eat. As this news was about a month old, I pushed on to the Liverpool hoping that the exploring party would have been able to arrive there during our absence, as the country seemed quite dried up.

"We came to off Entrance Sound, Liverpool River, during the forenoon of the 3rd of July. On our running in Bob White recognised the place, he having been there five or six months, with a party of Malays; so, shortly after we anchored, I manned a boat and sent Bob away to try and communicate with a canoe, which was fishing for turtle about 2 miles off; but we had no success, as the natives pulled on shore and abandoned their canoe among the rocks. On the 4th of July I proceeded to the sand hills at Point Hawkesbury, and ascertained that our bottles, &c., had not been disturbed, and no traces of white people having been in the vicinity. We cut some excellent hard wood while at this anchorage on south west point, to replace our cat-heads and repair windlass.

"We weighed with the flood on the morning of the 9th, and proceeded up the Liverpool River with a light northerly wind, and reached up to about 3 miles beyond our former anchorage. The natives hailed through the mangroves, and being answered by Bob White, came on board, about ten in number. Bob White seemed to understand their language perfectly, though it was quite different from his own. He ascertained that one of the natives had a brother who had seen Mr M'Kinlay about half a month before, and that he was then at Arrah, so I determined to proceed round to the Goulburn Islands and send Bob inland with a letter to the explorers to let them know where we were. Here the natives having once broken through their reserve, became very friendly, and came on board with their women and children; they all smoked like the Mount Norris people, and several spoke Malay. One woman who came on board had been to Macassar.

"We reached the south Goulburn Sound on the evening of the 13th, the natives making a great fire on the beach. We rounded to in 4 fathoms, about a quarter of a mile off shore, and came at once on a reef of rocks which we saw next morning stretching all along in front of the beach. The sails being backed the schooner came off before we could let go the kedge, and we came to in 5 fathoms. In the meantime a great shouting had been going on between Bob White and the natives on shore, and a number soon came off bringing a turtle for sale, They informed Bob it was no use his going to Arrah as Mr M'Kinlay had left there and gone towards the mouth of the east Alligator river, also that they were eating their horses and had only two dogs left, and a number of other things about the party which made me think the natives had really fallen in with the party, though their idea of time was so confused and limited that there was little faith to be put in their statement that they had seen M'Kinlay not more than a week previously.

"We weighed at 8 a.m. on the 14th of July and proceeded towards Mount Norris Bay, coming to at midnight in Malay Bay, and proceeding on to the head of the bay next morning, when I despatched White across to the east Alligator river with a letter, to which he promised to bring an answer in three days; in the meantime all hands were out trying to procure buffalo, but without success, and on the afternoon of the third day I met Bob on the beach not looking as if he had just come off a long journey. However he declared he had been to the east Alligator river, found that M'Kinlay had crossed it, and having no canoe came back again.

"As it appeared very likely that M'Kinlay really was returning to Adam Bay for some reason, I made up my mind to return to Point Hawkesbury, bury the provisions in the tank I had provided, and then make all sail for Adam Bay, where I expected to find the party; but just after 10 p.m. when we had got rid of Bob White and his friends (who went away loaded with presents) a canoe came rapidly from the shore, and after a short talk Bob returned on board and informed us that M'Kinlay, after killing all his horses and cutting them up into small pieces, had made a small boat of the skin, and that on that day he had arrived at a place called Endyalgoot, in a large boat which Bob called a 'long boat belonging to ship,' and urged me to give him the letter again to take over, as he was sure, he said, that M'Kinlay would come on the mainland to shoot buffaloes. I gave him the letter, and after accepting (at Bob's recommendation) a youth called 'Smike' as pilot and interpreter, we sailed for the gulf at daylight on the morning of the 19th July. The winds being light we did not arrive off Port Essington till 11 p.m.

"We weighed from Port Essington at daylight on the 20th of July, and next morning were about 12 miles S.W. from Mounts Bidwell and Roe, the only really salient features of the whole coast-line of the northern territory. Smike at first pointed out Greenhill Sound as Endyalgoot, but afterwards said it was a small distance inside, and advised us to go through the narrow strait dividing Greenhill Sound from the main, informing us that there were a number of 'stones' to the southward. We accordingly worked through the straits, having a flood-stream in our favour, running about three knots, and as much as 19 fathoms between the reefs. The channel was about half a mile wide and 4 miles long. As we advanced Smike changed the locality of Endyalgoot from the May-day Islands to some other site not then visible, and increased the size of M'Kinlay's boat to a vessel the size of the 'Beatrice,' with other stories which made us begin to doubt him altogether. However, I meant to visit Endyalgoot and judge for myself; but at 5 p.m. the vessel was in only two fathoms mud, so we came to. At low water we were aground in the mud. The real Endyalgoot was now in sight, so after moving the vessel into deeper water to the north-westward I left on the morning of the 22d July, and taking Smike in the boat with me, pulled down to that island, which we did not reach till nearly 5 p.m., having had the whole of the ebb stream to pull against and very little wind. Smike went into the bush to find the natives, and we made ourselves snug for the night after supper, pulling about half a mile off shore to escape the mosquitoes, which were very thick on shore.

"At daylight next morning Smike made his appearance in company with a number of natives, some of whom were wearing portions of his clothing, he himself coming back to us stripped. His story now was that M'Kinlay had gone back to the Alligator River after leaving word with these natives that I was to follow him on to that place, and on my asking one of the natives to repeat my name he gave it at once, 'Cappen Howard,' but I believe he had been well schooled by Smike. I had been along the beach and carefully examined it above high-water mark for more than a mile and could not find any traces of white men, although Smike declared that Mr M'Kinlay had landed at the very spot we did, and shot lots of birds, also that he had only one gun among the party.

"Whilst at breakfast Smike contradicted himself and altered his story so often that I began to think we had come all this way for nothing, and resolved to proceed to Adam Bay first, calling in at the East Alligator. Having a breeze up to nearly 9 a.m. we reached the vessel at noon, and as Smike refused to go any further with us we landed him that afternoon on the beach at the back of Port Essington. Our people here were also unsuccessful in getting any buffaloes, only seeing two and never getting a shot.

"Endyalgoot seems a fine island, about 8 miles long, east and west, and 2 or 3 broad; its eastern end is not filled in Captain King's chart. The water appears very shoal off its east side. It is wooded like the shores of Mount Norris Bay, the land having much the same appearance, with several red cliffs along its south side. We reached the entrance of the East Alligator River on the 25th, when we came to in four fathoms. The whole coast line from the Coburg Isthmus to the Alligator River is low and partly fronted with mangroves, and the three-fathom line is 2 or 3 miles from shore. We found the river of less depth than we had expected. I tried to effect a landing at noon to get the latitude, but was unable to do so in consequence of the depth of the mud at low water. Alligators are very numerous on the banks. At 2 P.M. weighed with the first of the flood, and the wind being light, drifted up the river broadside on, the vessel being quite unmanageable, the depth 12 feet, until we passed the mouth of a large creek, which joins the river from the northward, when the depth increased to 3 or 4 fathoms, and we were able to steer the vessel. As the river narrowed, the force of the tide stream increased to between 4 and 5 knots, and we had to furl sails, and keep her as nearly as possible in the centre of the stream. At 6.30, it being then quite dark, we heard a great roaring a head, as of water rushing over a reef of rocks, so we came to at once in 6½ fathoms, hard sandy bottom. Mr Guy, Mr Minnis, and myself started next morning in the boats, keeping a good look out on each bank; and about 9 A.M., came on a party of natives, who seemed rather frightened, and kept concealed in the bush for some time, until at length some came out, and made signs that somebody had gone to the westward far away. We concluded that they referred to Mr M'Kinlay, and not wishing to have them about us whilst taking observations, we pushed on for about a mile, and landed on the opposite bank, at a place where a large mass of rocks rose directly from the bank. I had a good view of the surrounding country, and of the windings of the river as far as we had come, but lost the river about 3 miles higher up, where the country seemed to rise slightly, and was thickly covered with scrub. The country to the southward appeared low and level, and the plains on each side of the river to have been flooded for several miles inland. The view from north-west round by north to south-east was interrupted by numerous extensive patches of rock, similar to the one I was standing on. To the eastward, as far round as south-east, appeared a high rocky range, nearly bare, and about 10 miles distant, towards which the river seemed to flow; and on a true bearing of north, 84° east, appeared a conspicuous column of rock apparently from 20 to 30 miles distant, and 600 or 800 feet high. We thought this was the 'Tor' at first, but the bearing would not agree with its position, and this pillar had a more slender appearance. We arrived back on board about 4 P.M., and found that the natives had been down abreast the vessel, but that the strong tide had prevented them from swimming off. This party appeared on the opposite bank to those we had seen in the morning. They asked for rice and tobacco, and said M'Kinlay was gone to the westward.

"We weighed at 10 P.M. on the 27th, and drifted down with the ebb; the boats towing. On the 29th, at 2 A.M., the vessel going then about 6 knots before the wind, we struck on some rocks, and then went fairly aground on an extensive reef, 4 or 5 miles in length north and south. After hauling off, we made sail for Cape Hotham, passing to the northward of the reef, and arrived off Escape Cliff at daylight on 1st of August.

"Mr M'Kinlay and all his party had arrived on the 5th of July from the East Alligator River, where he had been for more than three months, the whole country round being under water. He at last having killed all his horses, made a large punt, covering the frame-work with horses' skins sewed together, in which vessel he descended the river and voyaged round to Adam Bay, after burning and throwing into the river the rest of his equipment, to prevent it falling into the hads of the natives, who had surrounded the party, and made an attempt to steal everything. The exploring party had not been able to penetrate to any distance, being stopped in every direction by swamps, and we found that most of the stories told by the natives about M'Kinlay and his party had some foundation, if not strictly true; and the only case of an utter fabrication was the reported visit to Endyalgoot, evidently got up with a view to getting a visit from the vessel. The natives had all along, too, reported movements as happening about a week back which had really taken place two months or six weeks previously.

FREDERICK HOWARD."

STRAITS OF MAGELLAN.

Letter from Captain MAYNE, commanding Surveying Expedition to STRAITS OF MAGELLAN.

H.M.S. "NASSAU," GREGORY BAY,
December 30, 1867.

"At last we have made a move, and yesterday was a most successful day in all respects. We started for Magdalene Island and had one of the most interesting days we have yet had. As we approached the island we saw the beach covered with sea lions and penguins, while the small bay in which we anchored was full of seals and penguins playing about in the water. As we approached the shore 40 or 50 huge seals came close behind the boat, and as we touched the beach they remained at 15 or 20 yards off, staring at us, snorting, and then diving and playing all manner of antics, shewing that they were quite ignorant of who or what we were; 40 or 50 yards along the beach there were as many sea lions, quietly basking or sleeping, and though, as usual, two or three were keeping watch, they did not attempt to move until some officers fired rifles at them at a distance of 10 or 15 yards. As we ascended to the top of the island the scene was extraordinary, the whole ground being burrowed by penguins (they make holes for their nests), and covered by the animals themselves waddling about in all directions, or standing at the entrance of their holes and barking at any one who passed near—at least the noise they make is a sort of bark. These penguins are not so large as the one I sent, but rather more dumpy, and with shorter stronger bills.

"As we went across a second ridge to get to the summit of the islands a still more remarkable sight met our view. It was a cormorant rookery or village. The penguins had hatched all their young, but the cormorants were still sitting, and it was a most extraordinary sight. Some 200 or 300 yards of ground had been laid quite bare by them, and there must have been between 2000 and 3000 birds at least sitting. The whole company was divided into three or four villages, separated by small pools of very dirty-looking water; the nests were round saucers of mud, raised 5 or 6 inches off the ground, and placed in perfectly straight rows, each nest being just a foot apart, as several were measured by the officers, and each nest contained two or three eggs about half the size of a hen's egg. They did not seem the least afraid of us, and as we approached sat quite still; indeed, it was not until we commenced to shout and throw things at them that they would rise at all. When they did rise, however, it was like a cloud, but they soon came back again; altogether it was, as I have said, a most wonderful and interesting sight. No mention is made of any one having landed there in King and Fitzroy's time, and I should hardly fancy Darwin taking no notice of such a thing in his book had he seen it, for Cunninghame says it is the most interesting thing he has yet seen. If none of them landed there I should not wonder if we were the first people who have done so for perhaps 200 or more years, since the days when old Narborough and others salted penguins for food and found 'they made excellent meat.' There was no trace whatever of human beings; the natives of that part have no canoes, and it is far out of the way of any vessel passing through. RICH. C. MAYNE."

Miscellany.

Death of Professor Van der Hoeven, of Leyden.—We little thought when with natural gratification we commenced our scientific reports in last number of this Journal, with a letter from Professor Van der Hoeven, of Leyden, that before the reader could peruse his letter, the hand that traced the lines should be cold in the dust. His letter was dated 19th February, and he died on 18th March. It was probably his last contribution to literature and science. It was by his great work, "The Hand-Book of Zoology," that Professor Van der Hoeven was best known to English naturalists—his past works, his own brief notice of works in progress in Holland, in most of which he bore a greater or lesser share, shew what a loss our Dutch friends have sustained by his decease.

Birds Bred last year in the Zoological Gardens, Regent's Park.—Mr Bartlett, the superintendent of the Zoological Gardens, in giving an account of the success of the Society in rearing their fowls, gives the following list of the birds that had bred in the gardens during the past year: (1), Those which had bred in former years—the Impeyan pheasant, the Japanese pheasant, the Cheer pheasant, Swinhoe's pheasant, lineated pheasant, purple pheasant, black-backed Kaleege, wild turkey, Bankiva jungle fowls, Tallegalle, the Eurypyga (the so-called sun bittern, although it has nothing to do with the bitterns), the Turquoisine parrakeet, the dusky duck, Bahama duck, Carolina duck, ruddy shieldrake, New Zealand shieldrake, ruddy-headed goose, ash-headed goose. (2), A number which, so far as known, have never bred in captivity before, either in the Zoological Society's Gardens or anywhere else, viz.: Pallas's eared pheasant, the barr-tailed pheasant, the rufous tinamou, the common cassowary, the black kite, and the black crested cardinal. The most interesting of these is the rufous tinamou. Non-ornithological readers may have seen a very curious and most beautiful bird's egg from South America. It is about the size and shape of a small hen's egg, of the colour of mud, and with a most brilliant polish. It is like polished marble, of the colour of London clay or some limestones. That is the egg of the tinamou. There are several species of them, and the genus seems to stands between the bustards and the rails, but probably nearer the former. The most extraordinary thing in its breeding, however, is that it is the male which sits upon the eggs. He attended to the eggs of two females that both layed in the nest on which he sat; but he could not have sat upon all the eggs that they layed, for Mr Bartlett mentioned that in the short space of six weeks the two hens layed eighty-five eggs. The rufous tinamou is one of the larger species of that genus.

First discovery of Trichina in Pork.—In answer to a question put by a member of the Academy of Natural Sciences of Philadelphia at one of its meetings last year, whether he had noticed trichina in pork, Professor Leidy of Philadelphia stated that he had been the first to discover this parasite in the hog, the discovery having been made twenty years ago, as may be seen by referring to the *Proceedings of the Academy* for October 1846, pp. 107-8. This notice had attracted the attention of the German helminthologists, as proved by reference to Diesing's "Systema Helminthum," vol. ii, p. 114, and Leuckart "Untersuchungen in Trichina spiralis," p. 618. The circumstances under which the trichina had been first detected in pork was on an occasion when Dr Leidy had dined on part of the infested meat. While eating a slice of pork he noticed some minute specks, which recalled to mind the trichina spots seen in the muscles of a human subject only a few days previously. Preserving the remainder of the slice, on examination of it microscopically he found it full of trichina spiralis, but the parasites were all dead from the heat of cooking.—*Proceedings of the Academy of Natural Sciences of Philadelphia*, 1866, p. 9.

Predaceous Habits of Indian Frogs.—In a memorandum published in the recent collection of the Palæontological Memoirs of the late Dr Falconer, the following fact on this subject is recorded, on the authority of Mr J. Wright. About the end of August, 1860, Wright one evening was seated outside the house on the terrace, and saw one of the large yellow rain frogs of Hindostan quietly crouched under a raised piece of timber, close to the terrace. There happened to be a quantity of chaff and grain strewed over the adjoining ground near the terrace, left there after feeding fowls. Several sparrows were attracted by the sight of the grain, and settled upon the spot. The movements of the birds, hopping about and picking the grain, soon appeared to arouse the attention of the frog, who evinced his interest by raising himself on his hind legs and vibrating his body rapidly backwards and forwards, without leaving his cover under the wood. At length one of the sparrows hopped to within *four* or *five feet* of him, when in one spring he threw himself most accurately on the bird, and seized it in an instant, taking the head, neck, and body at once into his gape. He then sprang back to his cover, and was vigorously endeavouring to swallow the bird, when Wright, who was attentively watching what was going on, got up, pushed the frog into a corner, where he was able to lay hold of the reptile, and seizing the sparrow's legs, compelled the frog, after a determined resistance, to disgorge his prey. The sparrow had a spark of life remaining when drawn out. The correctness of these particulars is hereunder authenticated by Wright. "The above statement is strictly correct." A similar incident is mentioned by Mr Adams, in his *Naturalist in India*, (p. 17): "About half-a-mile from my bungalow, there were two large hedges of prickly pear, and between them a stagnant pool. I often took up a position under the cool shade of a peepul-tree close by, and watched the habits of the feathered tribe at mid-day. On one occasion, having shot a sun-bird, it fell on the margin of the pool, when some animal jumped from the muddy water, seized it, and instantly disappeared with its prey. A short time afterwards a large green frog appeared on the surface. I shot it, and discovered the bird in its mouth.

What do Fleas live upon.—Most people (at least most people in large towns) will probably think themselves qualified to answer this question, but although we do not pretend to more experience on this subject than our neighbours, we venture to express our doubts of the truth of the answer which would be given, for there are some facts which would imply that the perfect insect must either be able to live without eating at all or else must live upon something else than the blood of mammals. The entomologist occasionally, even in this country, finds specimens in the fields, and in the south of Europe we have heard of their occurring in excessive numbers in sandy places where travellers have encamped. In these cases no doubt it may be said that the visitors have chanced to pitch upon a spot where gypsies, vagrants, or dogs, plentifully stocked with the vermin, had been previously reposing, and that it was merely the surplusage that remained after their departure that had come under their observation. But the following instance told to us by a friend as having fallen under his own observation in Brazil cannot be so accounted for. A small isolated house or cottage stood on his property at some little distance from any other house. It had remained unoccupied and locked up for two years. At the end of that time a tenant offered and the proprietor and his overseer went to look over the house preparatory to letting it. They unlocked the door and opened the windows, and by the time they had done so when they happened to cast their eyes down they saw to their surprise a remarkable change on the colour of their garments. They had come in with white trousers but now up to the knees they were if not black at least more black than white : they were a moving mass of fleas peppered all over them and advancing rapidly above the knees. It is unnecessary to say that their retreat was rapid. It may be thought that another necessary corollary to the story would be that they lost their tenant, but they did'nt. There is a plant or flower in Brazil to which (as to the Pyrethrum in Europe and Asia) fleas have a personal antipathy, and wherever it is scattered, either in powder or fresh, they take themselves off. With this, and white lime, and soap and water, and perhaps a little personal indifference, the tenant got the better of the fleas ; but the question is, how they had subsisted and multiplied to such an extent during the two years in which the house had been locked up. During the portion of that time, indeed, which the most if not all of that immense population must have passed in the larva state, there is not the same difficulty ; for it is known that in that state they live on animal debris, of various kinds, such as fur, feathers, wool, &c., but from the time that they are provided with a sucking apparatus, they must have had something to suck the blood out of, or else have "gone without." The same problem applies to mosquitoes, gnats, and other blood-suckers. It is plain that in many of the districts where they abound, and where man or beast can scarcely live, the vast majority must pass and end their lives without ever having the opportunity of putting their sucking apparatus into operation. With the mosquitoes, it may be that like the ephemera, their life in the perfect state is bounded by a day. But it is not so with fleas. Many facts regarding them prove that they see many days. What then do they live upon?

*CHAPMAN'S TRAVELS IN SOUTH AFRICA.**

WITH the single exception of Dr Livingstone, no white man has probably ever had such an intimate and wide-spread acquaintance with the interior of South Africa as James Chapman. For fifteen years (from 1849 to 1863) he roamed to and fro in the interior of the country, trading and hunting over previously unknown regions, often unconsciously running neck and neck with Dr Livingstone in his discoveries. He was on the Zambesi near the Victoria Falls before Dr Livingstone, and, but for the obstacles interposed by the natives, he would have been their first discoverer; and the idea of crossing the continent seems to have occurred to the minds of both about the same time. Baines, Anderson, and other explorers, who had accompanied or met with Chapman, have made every reader of South African travel familiar with his name. They will be glad, therefore, that those who knew more of the man, and of the stores of geographical and other information which he possessed, should have urged him to publish an account of his travels, and of the districts he had visited. We believe the credit of having procured the publication of the two volumes which we are about to review is mainly due to Sir George Grey, the former governor of the Cape Colony, before whose intelligent appreciation and persistent recommendation Mr Chapman's reluctance to come before the public as an author has given way.

By employing a literary gentleman in this country to arrange and select from Mr Chapman's ample materials, the difficulties arising from his distance from England, want of time, and of special literary qualifications have been got rid of. Mr Chapman kept regular diaries during all his journeys, and these and other papers have been put in the hand first of one editor in London (Mr Forester), and on his death into those of another (we believe Mr Hunt), and the cream of an immense pile of matter has been thus skimmed, and is now given to the public ; or perhaps it would be a

---

* Travels in the Interior of South Africa ; comprising fifteen years' hunting and trading, with journeys across the Continent from Natal to Walvisch Bay, and visits to Lake N'Gami and the Victoria Falls. By JAMES CHAPMAN, F.R.G.S. 2 vols. London, 1868.

juster simile to say that the plums have been picked out of an enormous pudding of heterogeneous materials; for the editor tells us that the plan which Mr Forester adopted, and which he has necessarily had to follow, was to confine his labours almost entirely to the work of curtailment and omission, so as much as possible to leave Mr Chapman to tell his own tale in his own words.

That tale presents him under various phases. We have him in that of a trader, that of a hunter, of a geographer or physical geographer, and of a naturalist—in all of which he shews to advantage.

We shall present him to the reader in each of these aspects. In all they will find his narrative unaffected, intelligent, and interesting; and we venture to say that whoever reads them will close the volumes with respect and liking for the author.

One of the first requisites for success in any pursuit is said to be predilection for it. If it goes against the grain, it will be neglected, and failure in it will be the consequence. Whether intentionally or not, virtually it was on this principle that Mr Chapman selected the business of trader or dealer in ivory. His passion for hunting could in it be gratified on the grandest scale, and at the same time combined with duty and attention to business. The more elephants he hunted and killed, the more attentive and devoted to business he shewed himself. Of his attention to business, thus understood, the strictest disciplinarian could find nothing to complain; and the daring coolness and perseverance which he shewed in his encounters with wild animals was equally shewn in his dealings with the scarcely less dangerous children of the desert.

One most remarkable thing, which must strike every one who reads this narrative, is the impunity with which white traders penetrate into the territories of those savage people, put themselves and their goods into their power, in fact almost literally put their head into the lion's mouth, and yet come forth unscathed. Even in the wars and dissensions among themselves, in which whites have taken a side, the neutrality of other whites has been recognised, and their persons and property respected. It is a curious phenomenon, and certainly not due to any foresighted calculation of future advantage, or fear of prospective retribution on the part of the blacks. The chief Sekeletu, for instance, although anxious to secure trade with the whites, is, we are told, driving it away by refusing to deal with them except on terms so exorbitant that the traders could not purchase their goods in Natal for anything like the value he will give for them. Notwithstanding that he sees the traders refusing to deal on such terms, and leaving his territories, and abandoning them not to return, he does not alter his extravagant demands; and yet, when the trader refuses them, he does not attempt openly to seize upon the coveted goods and murder their owners, but allows them to depart. He throws all sort of passive obstacles in the way of their going: forbids his people to aid them, refuses guides, nay, is suspected even of attempting to poison them, but actual force is rarely had recouse to.

> "There's such divinity doth hedge a king,
> That treason can but peep to what it would,
> Acts little of its will."

The whites and traders are kings to these poor savages, and their homage is derived from the power which they see they possess. The tribes where this marvellous respect is paid occupy precisely the districts where the prowess of the whites as hunters is well known. When they see a man with a single gun face and conquer wild animals, which it would take their whole tribe to vanquish, it is not surprising that they should have a sort of superstitious awe of these wonderful whites. It is partly fear, and partly the instinctive homage of superiority which is paid by the dog to his master, by the mice to the cat, that paralyses the hand they would like to raise against them. Some of the more degraded tribes, indeed, are so cowed and abject that any one, whether black or white, with a gun in his hand, may bully and abuse hundreds without the slightest resistance being offered. But this does not apply to the generality of the savages. It is the coolness and courage of the white traders in their intercourse with themselves which has given them this divinity in the eyes of the blacks. The following incident, which occurred in one of Chapman's difficulties with them, throws a world of light upon the nature of the immunity which the whites enjoy at their hands, while it at the same time explains the means by which it has been acquired:—

"At this moment a Bushman arrived breathless from the east in search of the Makalakas, with a message from Shunkaan entreating me to fly without delay, as three of Moselikatze's towns were up in arms, and in pursuit of the Bamanwato, who had been in my track reconnoitering Moselikatze's cattle, and he feared his troops would fall on us by mistake if I did not get out of the way before they arrived. In the meantime, I had discovered from one of my guides that the Bamanwato and the Makalakas were leagued together. The latter, wishing to escape from Moselikatze's rule and place themselves under the protection of Sekomi, and join the tribes he had gathered, had invited the Bamanwato to come and inspect the country, and study the practicability of making off during the rainy season into the Bamanwato country with the whole of the cattle submitted to their charge by Moselikatze. Becoming aware of this, I refused to fly, being fearful of confirming the suspicion of the Matabale that I, too, was in league with the Bamanwato, and resolved that if they came on I would meet them amicably, hoping, as I still retained a smattering of the Zulu language, from my residence at Natal, that I should be able to explain how matters really stood.

"Having saddled my horses, I left my guides of the Shua in charge of my traps, and, under the guidance of some other natives, sought out the hiding-place of the Makalakas, which I reached about eleven o'clock at night. Contrary to my expectations, I found them quite prepared for my arrival, and drawn up in a formidable array, standing under cover of their long shields, evidently with hostile intentions. Surprised at this, I felt for an instant at a loss how to act, but a moment's reflection satisfied me that it would not do to exhibit any symptoms of alarm, that my safety depended on the composure and firmness with which I acted on this emergency. Having, therefore, ordered Molihie to stand with his gun ready at full cock, I rode up undauntedly to within a few paces of the dusky crew, whose appearance was doubly horrid as the bright moonlight did not penetrate the deep shade of the mopani trees under which they stood. At this moment, the leader of the gang sprang forward in advance of his comrades in a sort of war dance, as is their wont when threatening a charge, and rattling the shaft of his spear against his shield, yelling and whistling shrilly the while he demanded what we wanted there at this hour of the night. Springing from my horse, as did also Molihie, I was perfectly astonished at the effect produced by our assumed composure, when this brave of the braves hastily retreated into the ranks, evidently disappointed at the want of pluck amongst his followers, who slunk one by one behind the bushes. Following up my advantage, I rated them soundly in Sechuana in as loud and bold a voice as I could assume, threatening to destroy the whole of them in one instant if they did not instantly lay down their spears. Strange to say, with that superstitious dread which these unsophisticated savages entertain of the white man, but which I had never fully believed in till this day, the whole of the Makalakas laid their spears on the ground, trembling with fear, while nearly all the Bushmen disappeared in a twinkling.

"Having brought matters to this satisfactory conclusion, I demanded my ivory, which in another instant was forthcoming. After this I required eight Bushmen to carry the tusks; at first these could not be found, but, stamping impatiently on the ground, I insisted on having them, when the Makalakas set up a shouting, explaining that the danger of hostilities was passed, they one by one emerged from their concealment; I then demanded a bundle of dried flesh by way of compensation, for the trouble they had given me, with another Bushman to carry it, and at length having cautioned the gang to take care that I did not set the ground on fire under their feet, we took our departure, driving the bearers of the tusks before us to our bivouac"—(vol. i., p. 254).

The only instance which we meet with in these volumes where the whites were actually put to defiance, and an attempt at murder and robbery made, occurred among the Ovambo, an ignorant people of the lowest grade, living more to the west, and as yet perhaps less acquainted with their power and prowess. It occurred to Mr Green, the companion of Professor Wahlberg, and it was fortunately successfully resisted after a regular fight and a good deal of bloodshed. We have not space to copy the narrative, but we recommend it to the reader's perusal, as a stirring example of courage and conduct.

The attempts at laying the whites under contribution, which the natives who have seen more of them generally make, are confined to stealing, cheating, tricking, and deceiving. The most serious are the systematic plans to mislead, for the purpose of bringing them to their own villages, or retaining them near them, that they may profit by their liberality, by their traffic, or by the meat of the animals which they kill. Perhaps it would be unreasonable to pass a very severe judgment for this upon miserable Bushmen, who, by the arrival of a party of whites, are at once removed from the direst privation to the most profuse abundance, who exchange a miserable subsistence on roots for plenty of the most palatable animal food. But in the case of chiefs, rich in cattle, and living on the fat of a land teeming with abundance, it is different.

The inherent mendacity of the negro character is shewn in strong light by the constant attempts which these chiefs made to misdirect, retain, and mislead Chapman. Now he was warned not to go in this direction, because Sekeletu would kill him, then not to go in that direction, because Moselikatze was ravaging it; he would be told that such a route was unpassable for want of water, or such another from the presence of the tsetse fly—all afterwards ascertained to be pure fabrications. Again, after receiving the most friendly promises of men and oxen to help him on, the whole of his men would desert him, having received private instructions, and yet, with the most marvellous inconsistency, the waggons would not be plundered; nay, goods would be left deposited in the hands of some of these very chiefs, to remain until his return, and would be faithfully guarded and rendered up when he came back.

Of course, there were good and bad among the chiefs, as among ourselves at home. Some of them seem to have been gentlemen, others low scoundrels; but, on the whole, the impression left on us by Chapman's account of the natives in the interior of South Africa is rather favourable than the reverse. Perhaps the expression he uses in speaking of one of them, that he had "a pleasing but idiotic expression of countenance," may apply to more than one individual, and to the features of their mind as well as of their countenance.

Mr Chapman's qualities of coolness, courage, and perseverance are not less prominently shewn in his capacity of hunter. Here is an elephant adventure. It is one of his first encounters with the elephant, and took place before his nerves were hardened to the degree they afterwards became :—

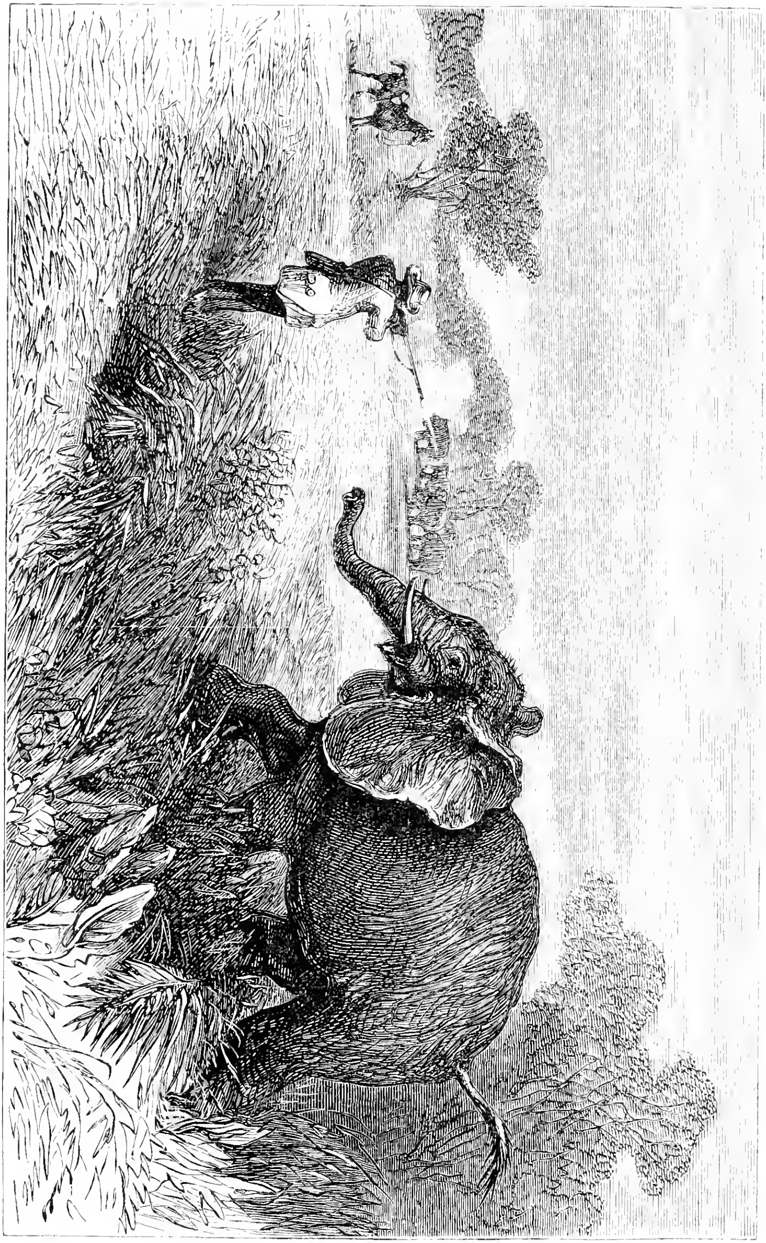
"The troop, finding their prostrate fellow deaf to their entreaties, moved on, and I soon followed, but was repeatedly driven back by a worthless old hag of a cow (elephant), who, with the air of a vixen, would not allow me to come near the troop ; and I found it was necessary to kill her first, if I wished to get at the rest. So dashing towards them she turned upon me just as I had dismounted, uttering a fearful cry. This was a desperate move ; it sealed her fate, though mine seemed in greater jeopardy. My horse, terrified at the elephant's thrilling cry, pulled the reins out of my hand, and left me on the open plain, staring death in the face, without any cover to flee to. At this critical moment, I despaired of life ; but presence of mind, together with unusual firmness, were now vouchsafed to me. I felt I had but one chance for life, and that I now held in my hand. Now for courage and a steady shot. It was the courage of despair, and it was Providence that directed my aim. I awaited the furious animal's approach, with my gun at my shoulder ; but my hand shook so violently that I could take no sure aim, and I felt reluctant to pull the trigger.

"Still the enemy approached with outstretched trunk ; her loud trumpeting had ceased, but she uttered a series of short-fetched grunts, which sounded in my ears like an exclamation of triumph at having her enemy in her power—a victim she would grasp in another moment with her powerful trunk, and crush to atoms with her ponderous feet. At this juncture, she happened to lower her trunk from before her ; and the slight movement leaving her forehead exposed, I instantly took advantage of it, and a bullet from my rifle crashed right into the centre of her skull, and she came down with overwhelming violence at the distance of seven paces from the spot where I was planted. But if before I had been sustained by Providence, and, indeed, I felt that something beyond my physical power had saved me, I now lost all my fortitude, and stood for a moment perfectly aghast, trembling, and most horribly bewildered.

"But, now, again recovering myself, and inspired by the first law of nature, to lose no time in retreating from a possible death-struggle with my now prostrate foe, I ran to my horse, standing at the distance of 200 yards, and cocking his ears in amazement at the fray. I then reloaded, and began to speculate on the prudence of following the rest of the troop."—(vol. i. p. 84.)

A terrible warning of the danger of elephant hunting on foot is given in the death of Dr Wahlberg, who fell a victim to this fashion of hunting, and of whose tragic end an account by his companion, Mr Green, is quoted in these volumes.

Professor Wahlberg and his expedition were better known to scientific men than is often the case with foreign expeditions, at least during their progress. He was in relation with the Univer-



Encounter with an Elephant—See page 206.

sity of Stockholm, and his collections were forwarded to that institution. That University, not having a purse like that of the British Museum at its back, is obliged to manage its affairs a little more economically; and as it cannot go into the market and make its acquisitions by purchase, it manages to do so by exchange. Whenever a scientific expedition, such as that of the "Eugenie," was sent out, or private arrangements made with collectors abroad, large stores of specimens were directed to be accumulated and sent exclusively to the museum. These were put in the hands of the keeper of the museum, our much respected friend, Professor Boheman, with free permission to use them for the benefit of the Institution; and by means of a very extensive correspondence, he distributed them among scientific men all over the world, receiving in exchange what they had to give. The results of this have been to make the University of Stockholm a first class museum, inferior, no doubt, in much to our own museum, but superior to it in such scientific types as are not to be had by purchase (except by the purchase of some entire collection, after the death of the owner, in which they have been accumulated by the same process as that followed by the Stockholm Museum). Wahlberg's collections were distributed this way, and while Lake N'Gami was almost unknown to the general public, specimens of its natural history, sent home by him, were spread over all Europe and America in the cabinets of men of science. Hence the drying up of the source whence these came, invested his fate with a special interest in the eyes of those who, like many of the readers of this Journal, formerly profited by his labours.

From Mr Green's narrative, it appears that his fate was entirely due to his practice of "foot-hunting." He had been frequently remonstrated with upon its danger, but he always insisted on its being the most safe, maintaining that he could always turn an elephant in its charge, by giving him a shot in the head. At the same time he had a presentiment of his fate, from his having previously had several narrow escapes from elephants, but turned a deaf ear to remonstrances and advice. "I cannot help myself," said he, "when I get sight of the brutes, I seem to lose all apprehension."

Our readers will remember Gordon Cumming's thrilling accounts of lying in wait at night, ambushed in a hole near a water pit, to shoot the wild animals when they came to drink. This is a plan familiar to all South African hunters, and Mr Chapman often speaks of it. Although effective and free from danger with elephants, rhinoceroses, and other animals, whose eyes are no better adapted than our own for vision by night, it has always seemed to us a very risky business with lions and nocturnal beasts of prey, there being a great chance that they might be the first to find out the watcher, when the consequences of such a mischance would be serious. That this might very well happen, appears from an adventure which Mr Chapman once had during a night's stalking, when no less than ten lions made strenuous efforts to spend the evening with him in his "skaarm," as the ambush is called.

"A number of lions being in the habit of resorting nightly to the spring, either to drink or to waylay the game, I went out early in the evening to kill some animal for a bait to attract them to some spot convenient to my skaarm. I knocked over two quaggas at my first shot, one of which I had dragged up to within five or six yards of my shooting-box, when my man, Molihie, declared his intention of occupying another position, where there seemed little likelihood of his being visited by lions; but he completely outwitted himself, for soon after dark, and before the moon rose above the horizon, I observed some object crouching towards his post, and my cry of warning was lost in the report made by his large rifle. The animal he fired at did not move; and five other lions, which were lying within a few yards of his position, now got on their legs, while two others were observed moving round the pond above the wind. My faculties being now also quickened I observed two lionesses facing me within twenty feet from another direction, at which I instantaneously fired, and probably prevented their springing into my skaarm. Abraham, who was with me, now discharged both barrels of his gun, and while I held my rifle pointed at them he reloaded his, when I again fired with the same success. The lions not seeming inclined to beat a retreat, Molihie's courage was well tested, and he cried lustily for his master to come to his aid. Of course I could not comply with this demand, being myself placed in a similar position. Having continued firing till nearly all my ammunition was expended, I became more cautious, and taking deliberate aim, was delighted to find the bullet tell, and to see the lioness bound off with a growl. In this movement she was instantly followed by the rest; the troop, numbering ten in all, having beseiged us for a short but anxious period, during which it seemed as if not even thunder and lightning could terrify them. After their retreat, we heard them for a long time tearing with tooth and nail at the second quagga which lay about 200 yards off, but having only three bullets left we did not dare meddle with them, although for the rest of the night we had the advantage of a bright moonlight. Having feasted themselves on the flesh of the quagga, and killed and devoured another, they came again towards the water to quench their thirst, but the recollection of our engagement with them some hours before probably checked their advance, as they halted midway and set up a terrific roaring. Two others also approached in a different direction with fearful roars, but Molihie having fired a shot which mortally wounded a white rhinoceros, the lions feared to venture near the water. Game of all sorts came and went in vast multitudes all night, many passing within a few feet of us; and I feel no scruple in affirming that, since the preceding evening, before sunset till the next morning after sunrise, excepting during the time of our being besieged by the lions, no less, at a moderate computation, than a hundred head of game drank at the spring every five minutes. This in ten hours would make the number 12,000, which, however enormous it may appear, is, I feel confident, far within the mark. The pool, about 400 yards in circumference, was all night kept in commotion, the splashing of the water, the din of clattering hoofs, and the lowing and moaning of gnus and their calves being mingled in discordant notes. The braying of quaggas was terrible, and the pond, excepting at one or two short periods while we fired, was never clear."—(vol. i., 239-40.)

Turning to Mr Chapman's contributions to geography and physical geography, we find that in some of the most valuable of his discoveries he has been anticipated. He was the first who crossed the continent from Lake N'Gami to Walvisch Bay, but his friend Mr Baines accompanied him on his return journey, and in his travels the geographical information obtained on that route was fully brought before the public. The country now for the first time filled in on our maps is chiefly that lying between Lake N'Gami and the Zambesi.

His observations on the physical geography of the countries he visited is very interesting and less known. Of Lake N'Gami we learn that it is the small remains of an immense sea, which, at a comparatively not very distant date, covered a vast extent of land now dry or turned into marshes and reedy swamps, one of which is upwards of seventy miles in circumference. The lake itself, although fifty miles in length and eighteen miles broad, is nowhere more than twelve feet deep, and it appears to be still further drying up and decreasing in size.

"This country, with all its pans, has the appearance of having been a lake of immense size. The supply of water which filled it in former days having no doubt been stopped far away to the north of Lebebés by some volcanic action, which has sent the water formerly coming hither in another direction. Dr Livingstone thinks the Victoria Falls have drained it. Is it not rather more probable that some gradual pressure from within has been slowly at work, which would account for the general desiccation of the country? Within the lifetime of some of the lake people and Mabobas the N'Gami has gradually receded a mile or more all round, and, within the knowledge of white men still living, fountains have everywhere been drying up. I have had abundant opportunities of noticing the same thing going on gradually during the last ten years. The natives coming from Lebebé also insist that one branch of the Teougé (or Okavango) diverges towards the west coast just in the same manner as the Tugela is said to diverge from the Orange River"—(vol. ii., p. 64).

"When I first entered this country (N'Gami district) I found many of those ponds (salt pans), with an abrupt bank all round, and the water then, as was usual, nearly up to the top; but even in ten years a wonderful change has taken place, the water has gradually diminished, owing no doubt to the general desiccation going on, and in places where formerly I could swim we have now to go underground for a supply of water. Whenever late and heavy rains fall the natives say that things are very much better, though never as it used to be of old. They say the country is dead"—(vol. ii., p. 62).

Anderson noticed that the lake is subject to an ebb and flow, which he supposed to be caused by the moon's attraction, but Chapman, rightly considering that the attraction of the moon could have no perceptible influence on such a small body of water, paid more attention to the phenomenon, and found that it was merely caused by the prevailing wind at a particular season (easterly in the morning) driving the water over the very low beach on the opposite shore (as far sometimes as half a-mile) when it is said "to go out and feed," and then receding when the wind subsides in the evening. The same phenomenon extends even to the river opposite the town (which is two miles east of the junction), rendering the water-mark of the morning and that of the evening very different—(vol. ii., p. 311).

He also corrects another mistake into which Livingstone and Anderson both fell, in supposing the Botletlie to be an outlet of the N'Gami Lake. He tells us that about thirty years ago, or more, this was indeed the case when the lake extended over perhaps nearly twice the area it occupies now; but ever since that time it has had two confluences, but no outlet. The waters of the Dzo, dividing, help to supply the lake, but send the largest quantity of water eastward, through Chapo's-lagoon or reedmarsh (the size of which has been under-estimated), into the large Salt Lake. When the Botletlie river is very low, the whole of the water coming from the Dzo into the Tamalukan and Botletlie first flows westward for some distance until it has filled up for a certain distance the deep channel leading lakewards, and not till this is filled up will it have scope to run freely to the eastward, the residue then going westward into the lake. Neither the river nor the lake now ever alters its former fulness. The position of the large mochuerie trees on its banks point out the original water-mark. These trees always grow on the water's edge, and, now that the river is receding so far, many die off every year—(vol. ii., p. 311).

He tells us, moreover, that it sometimes happens that when the Chobé and the Tso or Dzo, which flows into the Tamalukan out of the Teougé, are full the water runs up the Tamalukan, and the overflowing streams, meeting here, flood the Mahabe flats for many miles eastward, forming a sheet of water nearly twenty miles in breadth, where at other seasons not a drop can be found. At such times the river is navigable from the lake to Sebetoanes, and one might then travel in a canoe from Chapos at the terminus of the Botletlie to the mouth of the Zambesi, on the east coast, or for several hundred miles northwest of the lake from a very long way beyond Lebébés in the same direction. And if, as the natives assert, the Teougé branches off from another river beyond Lebébés flowing to the west coast, then it would appear that the continent of Africa is probably navigable for boats right across from east to west—(vol. i. p. 184).

A similar difficulty in defining the exact line of the water shed occurs in other parts of Africa, as between Lake Tchad and the Atlantic, and probably also more on the eastern side of the continent.

With regard to the numerous salt pans which mark the hollows in the country around Lake N'Gami we learn that some of them are of great size—that of Ntwetwe is 18 miles broad and upwards of 100 miles in length, and when in the middle of it the effect was that of being surrounded by a broad expanse of a calm and white ocean. To what cause are we to attribute these saline crusts or efflorescence? Does the salt proceed from beds of salt in older deposits? Are they the last dried parts of a salt sea? Do they proceed from the evaporation of fresh-water lakes, or are they the product of salt springs. Mr Chapman's description rather points to the latter two causes. He says:

"The underlying mud of these pans is an unctuous, tenacious, substance very like cement, and a hard greenish honey-combed cavernulous or vermiculated sandstone (?) lies scattered at intervals. In some of the smaller outside pans a hard white crust of limestone is found on the surface of the soil, which, having been broken by the hoofs of game, lies scattered around like flat pieces of ivory.

The springs on the north side of these pans have generally a bank of tuft which those south of the Botletlie, when they have a distinct bank, have it on the south side. Some of the springs are no more than little pits dug out of the bottom of sloping limestone hollows or ponds by the aid of a bushman's spade and a sharpened stick. Some of these ponds are broad and shallow, without any bank, and the surface is covered with loose shingle, while others are an irregular or more often a rounded fissure in limestone tufa, with two or three successive layers in the bank underneath. The pits or wells are generally filled with small rounded shingle, while outside is more generally a slope by which men and animals descend to the water. I do not think that the game has broken the banks to that extent, but they would naturally approach the water on the most accessible side"—(vol. ii., p. 61).

The deserts themselves are another very interesting subject of inquiry. We have often wondered whether the degree to which antient sea bottoms are covered with vegetation might not be used as a measure of the relative time which has elapsed since they became dry land. Of course a great deal would depend upon accessory circumstances, and more especially the amount of irrigation enjoyed by each, but we imagine it to be indisputable that, ceteris paribus, the longer the sea bottom has been exposed the more will it be clothed with vegetation, and the higher will be the character of the vegetation upon it. And in a general way we think that this is visible in all the different raised sea-bottoms of any magnitude with which we are acquainted. Which is the sea-bed which has been most recently raised? We imagine the Sahara and its continuation in Arabia, the deserts of Scinde, the deserts in Central Asia, and the salt lake deposits between the Rocky and the Cascade Mountains in North-west America. What is their state? Unmitigated barrenness, nothing but sand and gravel, without vegetation, except in patches and spots favoured by irrigation. We have not space to turn a digressive eye upon the relative conditions of age and vegetation in these and the North American prairies of older exposure, the Brazilian forest plains, the pampas, the interior of Australia, etc. It will be sufficient to contrast the Sahara with the Kalahari and other deserts in the interior of Southern Africa. The original condition and latitude are not unlike, but they are immensely different in age; the Sahara the youngest, the Kalahari perhaps the oldest desert on the face of the globe; and what is their present state?—waterless deserts both—but the one a mere deposit of gravel or shifting sand, the other provided with a dense vegetation peculiar to itself. Mr Chapman thus describes the latter:

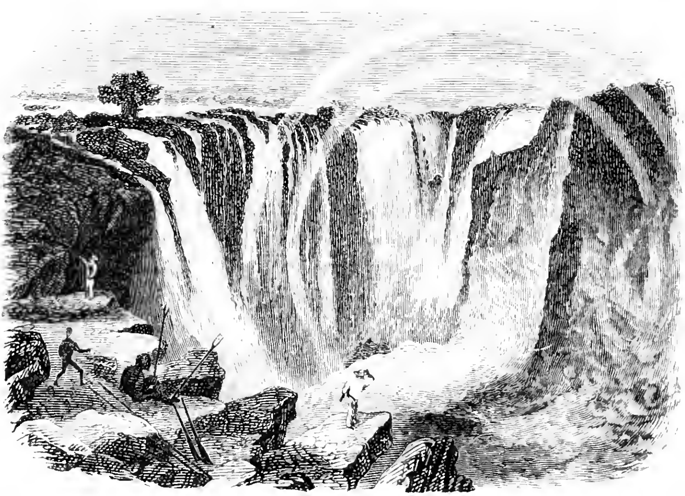
"The country over which we had been travelling since leaving the Bamanwato is called the "desert," and travellers going to "the lake" from the colony are obliged to go round it by the course we were now steering as the most practicable. Could they make direct for the lake through the country of the Bakwain or Bawanketze tribes they might reach their destination in half the time. Though called a desert the reader must not picture to himself another Sahara, for although a sandy country and devoid of water, excepting a few scanty wells at intervals of forty or fifty miles, it is nevertheless fertile, the grass growing most luxuriantly, and large forests of trees of many kinds abound"—(vol. i., p. 54).

"We started at one o'clock the next day, and laboured through the heavy sand and dense bush, the oxen coughing and nearly choked. Although everything in this so-called "desert" grows most luxuriantly, and grass and herbs most exuberantly, we found no water"—(vol. i., p. 50).

"The desert here consists of a succession of sandy zones or bults, as the Dutch call them, of whitish sand running parallel to each other in a direction nearly east and west . . .

In the sides of some of the bults, or sometimes on the summit, are found spots where water may be obtained by digging. These spots are known to the bushmen only, and yield abundance of water after a good rainy season; but sometimes the water recedes deep into the earth, and the bushmen then suck water from the damp sand several feet below the earth by means of a tube of reed buried in it, having a sponge-like tuft of grass inserted at the end. These water-yielding localities are indicated by the green colour of the grass in the dryest season, and are always in the more loose and white sand"—(vol. ii., p. 297).

Useful information is given as to the course of the Zambesi, so far as explored by Mr Chapman; but, naturally, the chief interest, so far as relates to that river, concentrates on the wonderful Vic-



toria Falls. He gives three different views of them, taken from different points, one of which the publishers have kindly lent us for illustration. It is that taken from Garden Island, in the middle of the Falls. Want of space forbids us quoting the relative description; but, except for the unusually vivid tints of the rainbow, dwelt on by all who have seen them, which, of course, cannot be done justice to in any picture, the sketch scarcely requires interpretation.

In like manner, the accompanying sketch of their crossing the river above the Falls to Garden Island, in the very middle of the Falls (so called from Dr Livingstone having fenced in a portion of it, and sown it with useful seeds, all now broken down and destroyed by the wild animals), must supply the place of his account of the passage. This descent must obviously have been rather a nervous affair; in the event of a capsize nothing could have prevented their all going over the Falls. The perilous course is conducted by the steersman in the bow, who steers as much by the pressure of his feet as by the action of his paddle; the skiff obeying their pressure something in the same way that a well-trained horse does the pressure of the knee of his rider. Looking at the sketch, and the description, we found ourselves soliloquizing "Facilis decensus averni—how in all the world did they get back?" Mr Chapman, assuming that his subsequent career is sufficient evidence that they did get back, omits to mention how; but on turning to Baines' book, we find that this, as we expected, was the

worst part of the job. The boatman, Zarzela, had to send repeated messages to the enraptured sight-seers, warning them that it was time to go, as the journey back was toilsome and dangerous. We do not know whether the Canadian boat song has yet penetrated into Central Africa, but "Row, row, brothers row, for the stream runs past, the rapids are near, and the daylight's past," would decidedly have been appropriate; we learn, however, from Chapman that "God save the Queen" has made its way there, and that he was surprised by hearing it and "Lucy Neal," and one or two others of our simpler melodies, sung in the kraals of native tribes who had probably not seen a dozen white men in the course of their lives.

But we must hasten on to what deserves more of our space than we have left for it—Mr Chapman's "Contributions to Natural History." His editor, in the preface, anticipates that this will prove one of the most attractive parts of the book, and in one sense he is right. If he speaks of his contributions as a field Naturalist, we heartily endorse his opinion—if he speaks of his work as a closet Naturalist, we are bound to say we cannot. Mr Chapman wants the necessary grounding and special education to fit him for dealing with natural history as a scientific Naturalist. He does not sufficiently know what has been already done; things which strike him as remarkable, and which are recorded as such, are familiar to the merest tyro in the schools. When a doctor reads this book, and comes to the information that, after Chapman recovered from a fever, the cuticle rubbed off his whole body—(vol. ii., p. 283)—he will need no ghost to tell him that the author is not a medical man; so, when a Naturalist finds him recording the discovery of a trap-door spider's nest as a great curiosity—(vol. i., p. 38)—and speaking with interest of the surveying caterpillars standing on the points of their tails—(vol. ii., p. 294)—he at once knows that he is not dealing with a trained Naturalist. Mr Chapman has all the natural qualifications for a first-rate Naturalist, but he wants the reading and training, without which it is impossible to perform the work of the scientific Naturalist—and yet he attempts this. In ignorance of the points requiring attention, and of the characters on which specific differences are based (or if not ignorance, at least in defiance of them), he gives descriptions of new species, and amendments of old ones, which, with all the desire in the world to speak well of them, we cannot, in consistency with our duty as an honest critic, refrain from condemning; when we mention that there are descriptions of mammals under native names, without indication whether they are new or not, and without a word as to their dentition, their feet, or anything but their colour, we have said enough. The editor, in his desire to do justice to Mr Chapman's labours, has shewn a want both of courage and discretion in not suppressing the whole of his attempts at description. It would have been an advantage to all parties had he done so, and, instead, given us more of his observations on the habits and peculiarities of the animals themselves. It is there that Mr Chapman shines—as an observant field Naturalist, he is everything that could be wished. The whole book teems with instances which we long to adduce. Some we must give, and we think that perhaps our best plan will be to select one animal, and bring together all the unconnected notices which we can find relating to its habits, instead of picking out single—perhaps more striking—anecdotes regarding a variety of animals or plants. It is plainly impossible that we can transcribe everything of this nature that is to be met with scattered throughout the volume. We shall take the elephant as our subject.

Here is an adventure that will remind the reader of one incident in the history of a still more celebrated elephant hunter, Sinbad the Sailor. It occurred in pursuit of a bull elephant that Mr Chapman had wounded—

"At length I found myself in an extensive mogonono field, swarming with lephants in every direction, crushing down the bushes with a sound resembling the roaring of waves. Not knowing in which direction to turn, I climbed a mokala (camel-thorn) tree, of which there were a few about, and which seemed to be the standing-place of numerous elephants every day. On reaching the top of this tree, I found myself surrounded by elephants, mostly cows, in every direction, in groups closer than I ever dreamt of. My position not being very enviable, I sat in breathless suspense observing the movements of the numbers of gigantic animals round me on every side. At the distance of about 120 yards to the eastward of my position, I soon discovered the old bull which I had followed, surrounded by a group of about a dozen cows, caressing and fondling him; some of them dashing him with water from their trunks, others with sand. Those elephants below his wind, probably scenting his blood, lifted their trunks, and after smelling a moment, gradually moved off. The elephants below me were working their trunks about, but made no effort to move out of the bush in which they probably considered themselves concealed; while groups, in other directions, that seemed to have got over the alarm caused by the reports of our guns, were moving slowly, followed by their calves, breaking down the branches, and pulling up young shoots and grubbing roots, which they strewed before their young with an air of the most maternal solicitude. A shot fired on the outskirts by my servant, Abraham, drove a troop towards my position, and another and another shot seemed to be bringing masses of cow elephants from every direction round me; but to my great relief, as if actuated by one impulse, the foremost began to move into two parallel files, one on each side of me."—(vol. i., p. 154.)

The following are some minor details:

"It is worth mentioning, by way of caution to South African hunters, that most elephants recover their powers of doing mischief after appearing to be mortally wounded, unless they have uttered their death-groan. I have known them to fall four or five times, as if dying, and then rise again."—(vol. i., p. 89.)

"In some places, and in some seasons, these animals (elephants) drink only every other night, and then go far to feed. In parts where they are much hunted, they remain two nights away from the water, and return every fourth."—(vol. i., p. 88.)

"In localities where elephants abound, they generally frequent the same forest at the same time every day, to stand (sleep) in the shade at noon."—(vol. i., p. 154.)

"The elephants in this part seem now quite to understand what a 'skaarm' (screen or ambush) is, and I observe at every watering place we come to, the old skaarms have generally been destroyed by the elephants, who have scattered the logs about and trampled the holes full of earth again."—(vol. ii., p. 92.)

"On the 21st we had another tedious and unsuccessful hunt, following the trails of a hundred elephants or more; but we could perceive by this processional sort of movement that the animals must have taken fright, and were on the move into another district. Indeed, many other troops of elephants that seemed to have been browsing fearlessly, discovering their trail, seem also to have taken the alarm, and followed it at once."*

"On the islands (above the Falls of the Zambesi) as we passed, I noticed the elephants had everywhere been committing their depredations, destroying numerous trees. These islands are their favourite resorts, abounding in fruit and other trees, of which they are very fond. They come regularly to pick the wild dates and almonds, mokachon, and the many other fruits that abound; and with the sagacity of a man, coil their powerful trunks round the stem of the palm trees, to shake the clustering fruits to the earth, not being able to break the tree. I have never seen one broken or overthrown, slender as they appear."—(vol. ii., p. 132.)

"The rest had now escaped, except one, attacked by Mr Campbell, whose gun I heard at intervals of a few minutes. Riding in his direction, I found he had expended all his ammunition, eighteen bullets, and wanted my assistance; so, having headed the animal after a smart gallop, one bullet from my double-barrelled Blisset brought him to a stand, and three more to the ground, just as the moon's beams began to penetrate through the foliage of the trees, which all around for several yards were besprinkled with blood dashed from his trunk. After receiving the last bullet, the poor beast twisted his trunk around a very frail tree, by which he tried to support his ponderous frame; but the tree, as well as his legs, soon gave way, and he sank expiring to the ground."—(vol. i., p. 151.)

"Occasionally we come across trees which have been broken by the almost irresistible strength of the wild elephant; trunks of even 3 feet in diameter being sometimes snapped in two."—(vol. ii., p. 289.)

"Looking round, I beheld Molihie in a somewhat similar plight to what had just been my own, being chased by the elephant he had singled out. But the most extraordinary part of the affair was this: the elephant not being able to overtake his enemy, I saw him pull up successively two trees by the roots, and cast them after Molihie, nearly striking his horse with one of them. This singular act of sagacity surprised me not a little, being under the impression at the time, as I am to this present day, that the act of thus hurling the trees was not accidental, but intentional. Each of these trees was nearly 20 inches in diameter [query circumference], and they were thrown 12 or 15 yards from the

* These sagacious animals always know by the appearance of the track of their own species whether it has been made in flight, though the track be several days old, and they are sure to follow. (vol. i., p. 71.)

spot where they grew, so that, leaving the intent out of the question, it was in itself a prodigious feat of animal strength."—(vol. i. p. 251.)

"Next morning we awoke at a late hour, and breakfasted on part of an elephant's trunk, which was baked in a pit during the night, in the way before described, and was soft as a jelly, resembling very much the flavour of ox tongue. The foot, a joint from which twenty men can dine, is also exceedingly fine, being a white, crisp, and grizzly kind of substance, strongly ingrained with fat, and, though rich as marrow, one may eat any quantity without feeling surfeited; but a certain portion of the head and cheek of a fat elephant cow is by far the most delicious morsel."—(vol. i., p. 33.)

"Elephants' lard is the most cooling and beneficial ointment for all inflammatory wounds, that can be obtained."—(vol. i., p. 160.)

"They had rubbed themselves well with the fat of the elephant, an operation in which they particularly delight, as it softens and cleanses the skin, cures all scrofulous diseases, and it is, moreover, a non-conductor of the heat of the sun."—(vol. i., p. 155.)

"I noticed, while walking the other day, that one of my men picked up quantities of almonds, far away from any signs of the tree. On inquiry I found they are dropped in the excrements of elephants, in an undigested state, and the natives tell me, that by following at this season on an elephant's spoor, they can always obtain a sufficient quantity for a meal in a short time. I noticed that wherever the elephant halted they found from a dozen to twenty or thirty."—(vol. ii., p. 141.)

The same thing is recorded of other similar fruits:

"A small dull-green fruit tree bears a fruit which is called in Natal an orange. It is of the size of a large orange, with a hard rind, is of a yellow colour when ripe, and has a delicious odour. The seeds contain a good deal of strychnine, but they are not eaten by man. Elephants however eat seeds and all in great quantities, but pass the seeds in an undigested state."—(vol. ii., p. 145.)

"The elephant apparently is very fond of the mosela (the finest of the acacias), which, so far as they can be reached by an elephant, about 25 feet, are everywhere nibbled off."—(vol. ii., p. 47.)

The following is a curious incident difficult of explanation:

"I bought here," says Mr Chapman "a piece of a bull tusk, weighing 18 lb. Dutch, which was found in the stomach of one of the elephants killed by them on the Shesheke. The two had evidently been fighting sometime before, but there were no external signs of the hide having been penetrated, the elephant being quite hearty, and the wound having closed up again."—(vol. ii., p. 176.)

It would have been interesting to know the form and dimensions of this piece of ivory; also, whether by the word stomach Chapman means the stomach literally or only the belly. Mr Baines, to whom we applied for particulars on the subject, uses the latter term. He writes us:

"The piece of ivory found in the belly of an elephant was deposited in the Cape Museum. Mr Chapman was well satisfied with the testimony of the hunters who found it. The only difficulty is to account for its breaking off in so soft a part as the belly of an elephant ; perhaps it might have been previously fractured."

We are more disposed to think (notwithstanding its great size) that the mass of ivory had been swallowed. It could never have penetrated the true stomach, and not only the animal survive, but the wound close up, leaving no trace; and it is only a little less difficult to suppose that it could have done so in the abdomen proper; still, that is possible; we imagine the other to be impossible.

But by far the most interesting novelty regarding the elephant recorded by Chapman, is the occurrence of an individual with nine tusks. This was also mentioned by Baines in his "Explorations in South Africa;" but his account seems not to have excited the attention it deserves. The reader will presently see that it is an abnormalty of the most intense interest. Mr Chapman's account of it is as follows:

"The elephant killed by Molefi, otherwise called Rapiet, six years ago on the Teouge, and which attracted notice from the singularity of its having no less than nine perfect tusks, was, he told me, a male. The tusks were ranged five on one side and four on the other. I purchased some of the tusks at the time, but they had been mixed up with many others, and, when I heard of the peculiarity, they could not be identified. I got Molefi to describe the affair over again, and Baines made a sketch from his description."—(vol. ii., p. 98.)

The above does not tell much, but Mr Baines has had the kindness to look out his sketches of the elephant for us, and most liberally allowed us to use them; and on examining them we find them so full of interest that we shall devote a separate paper to their consideration (see page 265), to which we beg to refer those readers who may be interested in the subject.

In the same way we might go over the lion, leopard, buffalo, rhinoceroses, giraffes, antelopes, and the other principal wild animals inhabiting the interior of South Africa, and give similar notanda of their habits and peculiarities; the reader will find the book a perfect storehouse of such information, but we must be sparing.

Of the lion we may note that although plentiful and daring in some places, and often heard, it must be rapidly diminishing in numbers. Chapman mentions that, notwithstanding all his advantages, he had only killed seven during all the years of his wanderings—

"In some parts, indeed, the natives do not kill either lions, wolves, or wild dogs, regarding these animals as hunters of game which they turn to their own account."—(vol. i., p. 93.)

On the other hand, the lions sometimes look upon the natives from the same stand-point of their own advantage, treating villages of them as private preserves of game. Chapman gives an instance of this in the district where he found them most numerous:—

"In parting with my cattle, I requested Awraal to permit me to send them on to the extreme eastern boundary of his country, at Elephants' Klof, but he dissuaded me from this project, assuring me that the lions had of late become so daring that no human being could live there. The Damaras and bushmen who had escaped their ferocity had been obliged to remove to a district north-east of this place. The cowardice shewn by these poor people had of late made the lions so bold that nothing but human flesh seemed to satisfy them, nor did their huts, fires, and fences, afford them the slightest protection. Some of Awraal's people who were returning the other day from a giraffe hunt, were assailed by a troop of these daring animals in open daylight. The lions sprang upon the pack-oxen, who ran wildly about under the weight of their rough jockeys, plunging madly until fortunately they had disencumbered themselves of their bundles of meat as well as their rude riders; the lions contenting themselves, after having a few shots fired at them, with the meat they had seized. Another party of these hunters the same day came upon the carcase of a Damara recently killed and partly eaten, and every night this same party were kept awake or had to make circular fires around them, leaving their dogs to fight off the brutes until daylight. So changeable and uncertain is the character of the lion that in some districts by daylight he is timid as a mouse, and will scarce venture to attack man even by stealth and by night; but when he comes upon a famished or mean-spirited race, he keeps near a village and treats its inhabitants as though they were his flock of cattle, killing them as hunger urges. A hungry lion is a most daring animal; there is nothing that he will not dare in broad daylight and in the most impudent manner, driving you off from your own game, or following you up in open ground under every disadvantage to himself. But such cases are rare, and they are generally either driven to it by hunger, past success, or a keen relish for human above all other flesh. The general disposition of a lion, like that of all other animals, is to avoid man, and the districts which he haunts in South Africa being as yet abundantly stocked with game, man seldom becomes his victim."—(vol. i., p. 420.) "The natives, too, assert that lions and all other beasts of prey are more daring when the men are away from their houses and villages, which they soon smell out."—(vol. ii., p. 303.)

Mr Chapman passes the different species of rhinoceros in review, and gives his opinion as to their distinctness. He is inclined to admit two species of white rhinoceros, in which we think the majority of naturalists will not concur.

Among the rare animals met with by him, the water buck (the only antelope of truly aquatic habits), the sable antelope, and the new quagga, first described by Mr Layard, and called Equus Chapmanni, after our author, are perhaps the most interesting: all, however, better known to naturalists in this country than he seems to be aware of. He speaks, however, of a variety of buffalo, which, from his description, seems not unlikely to be really a new species—although he has not included it in the appendix among those which he so reckons. Near the Banabea village of Borogo, near the Chobé, he shot two of them, which although aged, he found differing materially in the size of both body and horns from those he had seen in other parts. Their bodies were short, their horns very much so, and twisting very abruptly (vol. I., p. 184). It may be worth the while of future travellers to examine them more closely.

Chapman's new Quagga (Equus Chapmanni, Layard).

More than one antelope and a number of birds are probably new.

The spider referred to in the following passage is also apparently undescribed:

"The road is so crossed with the silken web of large spiders, that it is difficult work getting through them. I generally have April before me with a branch beating it down. Sam, who took his place on one occasion, is so short that he only half did the work, and I had constantly to hold my hands before my face. In spite of this precaution, my hat was coloured yellow, and my face frequently covered over as with a veil. The silk when taken from the branch is dirty, full of flies, beetles, butterflies, and locusts. I have seen birds securely bound in these strong silken cords. It has a very unctuous feel, and to this property is due the spiders' great success. I have got a small sample of clean silk also."—(vol. ii., p. 293.)

A good deal of desultory information is given as to the fruits and cultivated vegetables of the country, but too often without means of distinguishing the plants, except by the native names. The following statement as to producing bitter and sweet melons from the same seed by different treatment, may be interesting to horticulturists, not on account of different qualities proceeding from the same plant (*that* is known to occur in other species); but on account of the statement that the kind can be determined by the manure :

"It appears strange that one melon seed should produce both bitter and sweet or sourish melons, which is the fact, though it has puzzled many travellers, who generally believe the melons are two different species, but this is not the case, and it all depends upon the manure it gets. The seeds deposited with the dung of elephants are bitter, those manured by the white rhinoceros sweet. Sometimes they are mixed on one field, at other times the sweet melon are sought in the grazings and near the haunts of the rhinoceros. The bitter melons are not always eaten, on account of their extreme bitterness, but the seeds being taken out and pounded between two stones, the meal is boiled into a nice pottage, or eaten raw."—(vol. i., p. 297.)

A case exactly the converse of this is also mentioned, where the same plant is poisonous to one animal, and harmless to another. It appears that a Euphorbia and another milky bush is used by the Berg Damaras to kill numbers of animals, by infecting pools of water with their juice, and that they also kill the white rhinoceros with the drug, although the black one eats greedily of the same bush with perfect impunity—(vol. i., p. 342.)

There are instances of something similar occurring in other animals which prevent us hastily setting this aside as erroneous, but we have not space to describe them.

The kinds of domestic animals kept by the natives in the interior are not numerous.

"None of the natives that I have yet seen have any cattle or goats, but fowls and dogs are common. The latter are very small, but have great spirit and endurance, enabling their masters to kill the largest animals with their aid."—(vol. ii., p. 207.)

"The dogs kept by the natives are all a very diminutive mongrel species, very weak in giving tongue, and with little spirit."—(vol. i., p. 93.)

"We were under the necessity of driving them (the natives) off with our dogs, of which, owing to their superiority in size and bark over their own dogs, they have a great dread."—(vol. i., p. 92.)

They have domestic fowls, apparently a variety of the barn-door chuckie, which is found over the whole world; and finding them thus in the heart of Africa, although of a distinct variety, may suggest doubts as to that invaluable member of society having been derived from the Bankiva fowl, and give rise to the inquiry whether the Bankiva fowl is not an offshoot of our common species run wild, instead of the wild origin of the tame breed. At any rate Mr Chapman found that the Makololos had a breed of very small fowls, like bantams, not remarkable for beauty of plumage, but exceedingly prolific, some hens laying two eggs regularly every day; and he observed, that one of the hens with chickens only a month old, was again laying.—(vol. ii., p. 147 and p. 253.)

Of the geographical distribution of plants and animals something is also to be learned. It would appear that a ridge between the Shua and the Gwai rivers formed the boundary between two Faunas, or sub-Faunas. The rivers here flowed in opposite directions, and new birds came into view while others disappeared.—(vol. ii., p. 95, 96.)

North-west of Lake N'Gami, vultures were scarce. Elephants shot were not found by them for three or four days, during which they did not make their appearance. He remarks that the adjutants were more numerous on the carcases than the vultures, and must have come from a very great distance—(vol. ii., p. 20)—thus confirming Sir Samuel Baker's observation, that they occupy the highest stratum in the heavens, and come from the greatest distances.

At Kopjes (south-west of Lake N'Gami) one fennec and one guinea fowl were got. Giraffes were not rare near Walvisch Bay. The Cerastes or horned snake is common everywhere, from the Cape to Ovamboland, on the west side of the continent. In Ovamboland particularly, Chapman's brother found them so numerous after a fall of rain (for contrary to the general opinion Mr Chapman maintains that snakes do not like great heat) which succeeded a severe and long continued drought, that the ground was covered with these venemous reptiles, so that they could hardly walk without treading on them.—(vol. ii., p. 26.)

Glow-worms are plentiful in some parts, which is quite in accordance with their known geographical distribution; but we think he must be in error when he says that "there is a larger kind, which evidently belongs to the Elateridae"—(vol. ii., p. 245). If so, it is the first "fire-fly" recorded out of tropical America, with the exception of the remarkable genus Photophorus, which comes from the New Hebrides, Fiji Islands, and New Caledonia. He speaks of a bright scarlet glow-worm. If that is the colour of its integuments and not of its light, it will be interesting, as probably belonging to the Lycidae, many of which are brilliant red, the family next the glow-worms (none of which are red), but of which none have hitherto been met with that are luminous.

After quoting so liberally from Mr Chapman's pages, we need not occupy the time of the reader with further criticism on their contents. We have sufficiently shewn our opinion of their merits, and we heartily wish them all success.

*FALCONER'S PALÆONTOLOGICAL MEMOIRS.**

THE death of Dr Falconer on the 31st January 1865, left a gap which will not soon be repaired in the always scanty ranks of British Mammalian Palæontologists, who could ill spare one so justly regarded, both here and abroad, as among the first of living authorities. And the deep regret with which the announcement of his premature decease was received, was, if possible, heightened by the thought that with him had also perished the greater part of the extensive stores of knowledge he had acquired in many years of constant study. Of this knowledge, though at all times willingly and freely imparted to those who sought for information, it was feared that but little had been committed to paper in an available form. And some reason existed for this impression. His acute and penetrating intellect, his unwearied zeal in the collection of facts, and quick perception of their bearings, associated moreover as these qualities were with an ever active and fertile speculative disposition, were so completely subordinated to an inflexible love of truth and certainty, and accompanied with such a constant dread of loading science with avoidable errors, that it was at all times with difficulty, and more especially in the latter years of his life, when his knowledge more than ever shewed him how much he had still to learn, that Dr Falconer could be induced to commit himself to the final publication of his views. Nor did he ever do so until they had undergone a long and critical ordeal in his own mind, and been viewed in every possible aspect. Gifted also as he was with an uncommonly retentive memory, he scarcely seemed to require the use of written notes to secure for himself the retention of facts. The facility with which he could at will recall the minutest particulars of any subject upon which he might be engaged, was truly remarkable, and in this power may be sought perhaps an additional reason for the delaying or entire omission to place upon paper, things of which a permanent record would have been of inestimable value to others.

But this feeling, that with his life had also perished the greater

* Palæontological Memoirs and Notes of the late Hugh Falconer, A.M., M.D. Compiled and edited by Charles Murchison, M.D., Hardwicke. London. 1868.

part of the knowledge he was known to possess, has happily been removed by the posthumous publication of his literary remains, in the two thick and handsome volumes before us, and which include, besides all his printed papers on palæontological and cognate subjects, several important more or less completed memoirs, unpublished at the time of his death, and which, though doubtless reserved by him for further emendation, are still of extreme interest and value.

In addition, we are furnished with a copious mass of his scattered notes and memoranda, carefully collected and judiciously arranged, pregnant with the most valuable information, and which cannot fail to be of great use to all future inquirers. It should be remarked also, that the various papers, whether published or unpublished, have been abundantly illustrated by plates from the accomplished hand of Mr Dinkel, and which give this compilation an original value which it is impossible to estimate too highly.

The warmest acknowledgment is due from all Palæontologists, for the fraternal care and friendly zeal with which the compilation, illustration, and publication of the widely-scattered materials has been so admirably carried out. No better nor more enduring monument could have been erected to the memory of Dr Falconer.

Dr Falconer's scientific life may be naturally divided into two distinct periods, one comprising the time of his service in India, from 1830 to 1847, and the other that which elapsed after his final return to England. The Editor has followed a similar course in the arrangement of his papers.

The first volume, as stated in the preface, gives the results of the author's investigations on the Fossil Zoology of the Sewalik Hills and other parts of our eastern possessions; whilst the second is composed of memoirs and observations for the most part written subsequently to his return to Europe. The bulk of the materials thus brought together is very great, and although a considerable part of them has already been published, these have appeared in such an irregular and scattered manner in various periodicals, some not very accessible, that had the compilation comprised only these, it would still have been extremely useful. But the amount of original matter now for the first time given to the world is also very considerable.

It is of course impossible within any moderate limits to give more than a cursory survey of the contents of such an extensive compilation, but this we will endeavour to do as briefly as possible.

The first volume commences with a biographical sketch of Dr Falconer's career; from which we learn that he was born at Forres, in the north of Scotland, on the 29th of February 1808, and after the usual course of scholastic and academical education in Aberdeen and Edinburgh, took his degree as M.D. in the year 1829.

Earnestly devoted to Natural History rather than to purely professional studies, his attention, upon receiving an appointment as Assistant-Surgeon in the East India Company's service in that year, was at once directed to it.

He proceeded to London and spent the time he was compelled to wait before his departure to India, partly in assisting Dr Wallich in the arrangement of his Herbarium, and partly in the study of Geology, with the aid of Mr Lonsdale, and in the Museum of the Geological Society.

Well prepared by previous studies on the same subjects in Scotland, he could not fail thus to become an accomplished botanist and geologist; qualifications which were speedily turned to account on his arrival in India in 1830, where, almost immediately after his landing, he distinguished himself by the publication of a paper on some fossil bones which had been collected in Ava, by Mr John Crawford and others. Early in the following year, having been ordered to Meerut in the north-west provinces, Dr Falconer discharged his first and last military duty, in taking charge of a detachment of invalids proceeding to Landoor in the Himmalayahs. This march, however, proved to be the turning point of his whole subsequent career. The route lay through Suharunpoor, where at that time the late Dr Royle was Superintendent of the Botanical Garden, and whose duties, during a leave of absence, were committed to Dr Falconer, by whom in the following year he was permanently succeeded. Thus, "at the early age of twenty-three, did he find himself advanced to a responsible and independent public post," and this, fortunately, in a situation "which offered to a naturalist the most enviable opportunities for research."

Suharunpoor, situated at the immediate foot as it were of the Himmalayahs, from which it is only separated by a low intervening range of hills, was a field especially favourable to the naturalist. Of the advantages afforded by this favoured site, Dr Falconer lost no time in availing himself. He at once commenced the exploration of the neighbouring range of hills, and was the first to establish a strict definition of the name "Sewalik," which had previously been but vaguely understood. He restricted the term to "the tertiary elevations commonly separated from the Himmalayan range by valleys, or "dhoons," and this definition, after a little opposition in the first instance, has been since generally adopted by geologists.

One of the first results of his explorations was the establishment of the fact that the hills in question belonged, not to the "New Red Sandstone," as had been before supposed, but to the tertiary period. This opinion, however, was founded mainly upon geological and physical evidence, though strengthened by the occurrence of beds of lignite and fossilized dicotyledonous woods which had been already noticed by Lieut. Cautley in 1827. But although at the time, when he had thus satisfied himself of the tertiary age of the hills, the evidence of animal remains was wanting, his prescient mind, nevertheless, led him to foresee "that the remains of Mastodon and other large extinct Mammalia would be found either in the gravel or in other deposits occupying the same position in some part of the range;" and towards the end of 1831 he was able himself to confirm the truth of this sagacious anticipation by the evidence of a "black cylindrical fossil" which had been found some years before by his friend, Lieut. Cautley, but whose real nature had been previously overlooked. Stimulated by the knowledge of the true nature of this relic, he was led by further investigation to the discovery of bones of crocodiles, tortoises, &c., and of other fossil remains, a brief notice of which important discovery was given in the Journal of the Asiatic Society in March 1832.

Two years subsequently, or in April 1834, Dr Falconer discovered in the Simli Pass the shell of a fossil tortoise, and shortly afterwards Captain Cautley found in the Kalowala Pass numerous more perfect remains, not only of reptiles, but also including those of mammalian genera, belonging to the Miocene epoch. "The finding, therefore, of the fossil fauna of the Sewalik Hills was not fortuitous, but a result led up to by researches suggested by previous special study, and followed out with a definite aim."

Towards the end of the same year, also, Lieutenants Baker and Durand, pursuing a similar line of research, discovered the great ossiferous deposit near the valley of the Murkunda. On being informed of this important "find," Dr Falconer hastened to the spot, where "within six hours," as he states, he collected upwards of 300 specimens of fossil bones. Thus, not only were his previous expectations fully confirmed, but the most abundant materials afforded him for Palæontological study. The results of this study are given, as we have said, in the first volume, some of the earlier papers in which must have been composed under unusual difficulties, seeing that in the remote quarter of India in which he was placed, the "ordinary means resorted to by men of science for the purposes of reference and comparison were wholly wanting." "But Falconer was not the man to be baffled by such discouragement; he appealed to the living forms around him," and was thus enabled in some degree to compare "the extinct forms with their nearest living analogues."

The enormous extent of the valuable materials which were thus collected will be at once seen in the Palæontological Galleries of the British Museum, of whose contents they furnish so imposing an element. With respect to this, in more senses than one, gigantic collection, it may be well said, as remarked by the Editor, referring to Falconer and Cautley, "Si monumentum requiras, circumspice."

Speaking of this collection, and as a proof of the zeal with which Dr Falconer must have devoted himself to science during the first ten years of his residence in India, we find it recorded that, when compelled by the state of his health to return to Europe in 1840, he brought with him seventy large chests of dried plants, and forty-eight cases, containing not less than five tons of fossil bones, together with numerous geological specimens. The greater part of the fossils were presented to the India House, but a large number of unique or choice specimens, required to fill blanks, or complete series in the Cautley Collection, which was about the same time presented to the British Museum, were forwarded to that institution.

But this enormous mass of materials was almost useless until it was arranged and classified. Sir Robert Peel, consequently, at all times distinguished amongst our statesmen for his encouragement of science, at the instigation of the various learned bodies, made a grant of £1000 to defray the expense of preparing the materials for study and exhibition; and at the same time, rooms in the British Museum were assigned to Dr Falconer for the purpose of his preparing and arranging them. It was proposed that the result of his labours should be published in an illustrated work, to be intitled "Fauna Antiqua Sivalensis," which was to consist of six Parts, and which, it was estimated, would occupy about six years in publication. Within three years, however, nine of the Parts appeared, each containing twelve folio plates by Ford, of unexampled beauty and fidelity, and affording representations of more than 1123 specimens. But the descriptive letter-press, as is but too often the case, did not keep pace with the execution of the plates; for, after a little progress, Dr Falconer "found that the labour in comparing and identifying the enormous mass of materials was so great, that if he had given up his time to the letter-press, he would have been unable to finish the preparation and arrangement of the collection during the period to which his stay in England was peremptorily limited." In December 1847 he was, in fact, compelled to return to India, where he found it impossible to continue the work as he had hoped; and as circumstances, at a subsequent period, prevented his recurring to it, this grand design was left incomplete, to the grievous loss of Palæontology.

One Part only of the letter-press of the "Fauna Antiqua" was ever printed. It forms the commencement of an account of the "Fossil Species of Elephant and Mastodon found in the Sewalik Hills," and well serves to shew how much we have lost in the discontinuance of the work. So far as was found possible, this deficiency has been supplied by a detailed description of the plates, which has been compiled by the Editor from Dr Falconer's notes and memoranda, and will be found of great value by those who may be fortunate enough to possess one of the few extant copies of the plates, for whom this compilation has supplied a great desideratum. It also affords copious data, on many points, of extreme value to all engaged in the study, more especially of the Proboscidea.

The volume commences very appropriately with two highly interesting papers. One, drawn up from manuscript notes by Dr Falconer, of a discourse delivered before the Royal Asiatic Society in 1844, and from a paper apparently written in India some years previously, contains much interesting matter respecting the history of the discovery of fossil remains in the Sewalik Hills and their general relations, and shews how deeply, even at the outset of his career, Dr Falconer was interested in speculations concerning the antiquity of the human race. The second of these introductory papers is by Captain (now Sir Proby) Cautley, with whose name that of Falconer is so inseparably connected, on the "Structure of the Sewalik Hills, and the Organic Remains found in them," which originally appeared in the Geological Transactions in 1836, and has been very judiciously inserted where it is now placed.

The principal unpublished papers contained in the first volume are:—1. The "Description of a Fragment of Jaw of an unknown, extinct Pachydermatous Animal, from the Valley of the Murkunda." The fossil in question, which was discovered by Messrs Baker and Durand, contained two posterior upper molars, which, in general character, so closely resembled those of the Hippopotamus, that the fossil had been assigned to that genus. Further investigation, however, in Dr Falconer's hands, proved that it belonged to a hitherto unknown genus, to which he assigned the name of *Chærotherium* or *Tetraconodon*, which presents characters apparently connecting it with Hippopotamus Sus, and Anthracotherium.

2. Another interesting unpublished paper, which was written about 1839, is on the "Fossil Rhinoceros of Central Thibet, and its relation to the Recent Upheaval of the Himmalayas." It affords an excellent example of the care and skill with which Dr Falconer set about the unravelment of defective and uncertain evidence, and of the mode in which he employed his results in the solution of any question before him.

3. The paper "On Chalicotherium Sivaleuse" was fully prepared for the Geological Society in 1847, and it appears strange that it was never presented. It is here given, well illustrated by figures taken from the plates of the "Fauna Antiqua."

Passing over the highly interesting papers on the fossil Camel, and on Sivatheriu giganteum, that extraordinary link between the Ruminantia as represented in the Camelidæ, and the Pachydermata, which have been already published, we come to an account of the Colossochelys Atlas, perhaps the most extraordinary of all the strange forms disclosed in the Sewalik Hills, and with respect to which unfortunately no complete memoir was ever drawn up by Dr Falconer. The Editor, however, has endeavoured, so far as in him lay, to remedy this deficiency, and we are here furnished with a very interesting collection of all the documents relating to this subject, illustrated by original figures drawn by Mr Dinkel from the specimens themselves in the British Museum, so that but little is left to be desired.

The volume concludes with the "Official Report of an Expedition to Cashmere and Little Thibet in 1837-8," which, though drawn up thirty years since, is now for the first time published, and will, as the Editor remarks, doubtless still be read with interest.

The contents of the second volume may conveniently be divided into those papers, &c., which refer to special points in Palæontology, and those which relate more generally to the question of the antiquity of the human race, and to what Dr Falconer has somewhere termed "Cryptology," but which might more correctly, perhaps, be designated Antrology. A subject which of late years has acquired such gigantic proportions, and is at the present day pursued with such ardour in all parts of Europe. To the former class of papers belong several important and lengthy memoirs on he different species of Mastodon and Elephas, which have been or the most part already published; whilst among those which are now for the first time printed should be cited the most important perhaps of all the unpublished memoirs left by Dr Falconer—viz., that "On the European pliocene and post-pliocene species of the genus *Rhinoceros*."

It is well known that next to the Proboscidea no class of fossil mammals had attracted so much of Dr Falconer's attention as that of the Rhinoceroses, and as it was generally supposed he had written a good deal on the subject, the publication of his observations was naturally looked forward to by palæontologists with anxiety and impatience. As regards the later tertiary and the quaternary epochs, no class of mammalian remains is of more importance than those belonging to the genus Rhinoceros, whilst at the same time there are none perhaps in whose study such grave difficulties have been encountered; difficulties, however, arising not so much from the intrinsic conditions of the subject itself as from the almost inextricable confusion into which the synonymy had fallen. No one, it was universally felt, was in a better position to clear up this confusion than Dr Falconer, whose abundant opportunities of investigation at the fountain-head in all parts of Europe, quick powers of discrimination, and accurate judgment, plainly pointed out as the man to undertake the task. In the present paper, which appears to have been drawn up seven or eight years ago, we are presented with a clear and lucid interpretation of much of the vexed synonymy, and furnished with satisfactory distinctive characters of the species which existed in the period above named.

Much, it is true, yet remains to be learnt with regard to the extent of distribution and relative ages of the different forms, but a great step towards the solution of these questions has been gained when we can feel tolerably sure of the actual species to which a writer refers. This consummation has now almost been reached through the labours principally of Dr Falconer, his friend Dr Lartet, and Mr Boyd Dawkins.

No public collection in the world affords such abundant and authentic materials for the study of the fossil species of Rhinoceros as that in the British Museum. We here find either original typical specimens or authentic casts of nearly all the forms that have been described under a variety of names. Leaving these names out of the question, from twelve to fourteen distinct fossil species can be determined. Of these, however, only four belong to the pliocene and subsequent periods. But though the number of actual forms is so limited, and notwithstanding the circumstance that there is apparently no great difficulty in distinguishing one from the other—at any rate when brought together so conveniently for comparison—the mass of confused synonymy with which they have been overloaded is quite extraordinary.

We cannot here enter at any length upon this subject, and must content ourselves with a brief remark or two with regard to one species with which Dr Falconer's name will always be closely connected, and with respect to which we find, from a very recent communication in the "Annales des Sciences Naturelles," that M. Lartet entertains an opinion as regards the synonymy, in which, as at present informed, we cannot agree, and in which he also differs from Dr Falconer.

The latest arrangement of fossil Rhinoceroses adopted by Dr Falconer is this:—

PLIOCENE.

I. No bony nasal septum.
  1. Rhin. leptorhinus, Cuv. (*pro parte*).
     R. megarhinus, Christol.
     R. mercki, Kaup.

II. Partial bony septum.
  2. R. etruscus, Falc.
     R. leptorhinus, Cuv. (*pro parte*).
  3. R. hemitœchus, Falc.
     R. leptorhinus, Owen (*pro parte*).

POST-PLIOCENE.

III. Complete bony septum.
     R. antiquitatis, Blum.
     R. tichorhinus, Fisch. and Cuv.

And this arrangement, with the omission, perhaps, of the geological epochs to which the various species are assigned, appears to us perfectly natural and very convenient. As regards the names, also, we believe that it represents the real state of the case, and that these names ought to be universally adopted with the exception, perhaps, of the last species. For although there can be no doubt of the priority of Blumenbach's appellation, it would now be extremely inconvenient to employ it in place of that which has gained, it may be said, universal adoption. Right must some times yield to might.

The above arrangement was proposed, it would seem, by Dr Falconer in the year 1862, in letters to his friends M. Lartet and Colonel Wood, and it will thus be seen that before that date he had satisfied himself:—1. That no more than *four* pliocene and post-pliocene species of Rhinoceros could be recognised, two of which had been clearly distinguished since the time of Cuvier, whilst one had been established altogether by himself, and another first clearly defined and rescued by him from a confused synonymy. In M. Lartet's interesting paper, just referred to, the same classification is followed and the same synonomy adopted, but with one very important and curious difference with regard to the species last referred to. M. Lartet regards R. hemitœchus as synonymous amongst others with R. merckii of Kaup. Of the grounds upon which this opinion is based, we are not at present fully aware, although they are doubtless contained in an as yet unpublished communication read before the Geological Society of France in 1867. It is, therefore, with the greatest hesitation that we venture to express an opinion opposed to that of the distinguished French Palæontologist. Our reason, however, is simple, yet one which it seems difficult to get over. In the British Museum there are two or three sets of casts of three molar teeth of Rhinoceros, which were prepared, and presented to the Museum by Dr Kaup himself, as typical representatives, it would seem, of his R. merckii, and it is not improbable that these casts were taken from the teeth of the original R. kirchbergense of Jäger. They must, in any case, be taken to represent the true R. merckii of Dr Kaup. Now these teeth are manifestly those of a species identical with the larger of the Grays Thurrock forms, and consequently, in all probability, with the R. megarhinus, which M. Christol from Montpelier and the best authorities coincide in regarding as the same with the Grays Thurrock form, which is termed by Mr Boyd Dawkins R. megarhinus. Moreover, Dr Falconer (p. 309) remarks that he had carefully examined at Stuttgart the materials on which Kaup and Jäger's R. merckii was founded, and had satisfied himself that "it is not a distinct species, but is identical with the Grays Thurrock species, or R. leptorhinus (*mihi*)." And we further find in a note (p. 316), that Kaup himself in a later work (Beiträge, 1 Heft, p. 4) had given up R. merckii for R. leptorhinus; though we are not, in our inability to refer to the original, willing to place much stress upon this, as it is not improbable that Dr Kaup under R. leptorhinus may have understood R. hemitœchus. We shall be curious to see how M. Lartet explains the difficulty.

We are compelled to pass over without comment a number of the succeeding papers, amongst which are those on Plagiaulax, and numerous short notes and memoranda on Hyæna, Ursus, &c., and proceed to notice the concluding portion of the volume, which is chiefly occupied by various papers on antrological subjects—as the Ossiferous Caverns of Brixham, Gower, Sicily, and Gibraltar, together with an Essay, or rather the commencement of an Essay on "Primeval Man and his Contemporaries," which was written in 1863, and intended, as we are informed, "as an introduction to a distinct work with the above title, the object of which was to set forth the physical Proofs of the remote Antiquity of the Human Race and the physical condition of the earth's crust prior to and at the date of Man's first Appearance."

As we have before remarked, Dr Falconer's attention from the commencement of his scientific career had been much devoted to the above subject, and the present paper, appropriately placed at the end of a compilation of his labours affords clear evidence how deeply the subject had entered into his thoughts throughout his life. It would in fact be quite true to assert that the antiquity of man and the questions connected with it, formed a constant stimulus to his palæontological inquiries, whether on the plains and mountains of India, or in the caverns and superficial deposits of Europe. Nor would it be going too far to maintain that to no single individual can be assigned a greater if so great a share in giving the first impetus to those researches respecting the quarternary epoch, which have been so ardently pursued of late, and have already afforded such satisfactory and astonishing results.

He believed, and the fact can scarcely be disputed, that the investigation of the Brixham Cavern marked what might almost be termed the commencement of any really scientific investigations as to the conditions of priscan man and his relations to a now extinct fauna. Nor can the credit be refused to Dr Falconer of having been the first powerfully to call attention to the importance of a systematic exploration of that Cavern, which has since been so ably carried out under the superintendence of Mr Pengelley, and the results of which we have reason to hope will very shortly be laid before the world. A second great impulse in the same direction was, also about the same time given by the making known of M. Boucher des Perthes' important discoveries in the gravel beds of the Somme Valley; and here, again, we find that the general recognition of the extreme interest of these discoveries, which had before been almost derided in France, was, in the first instance due, or at any rate was materially hastened by Dr Falconer, who on his journey to Italy and Sicily, in October 1858, paid a visit to Abbeville, and was there so much struck with what he saw in M. des Perthes' collection, and at once so impressed with its value, that he immediately wrote to Mr Prestwich strongly recommending him to proceed to Abbeville. This advice was followed, and the results of Mr Prestwich's visit, who was speedily followed by a host of others, are too well known to require mention here. Suffice it to say, that from that time the fame of M. Boucher des Perthes, as one of those who have most contributed towards the history of priscan man in Western Europe, has been placed on an imperishable basis. Nor should it be forgotten that the discoveries made by Dr Falconer of and in the Grotta de Maccagnone, in the following winter, served in no slight degree to add to the impulse which M. des Perthes' discoveries, and those which had been made in the Caverns of Gower and at Brixham, may be said to have first given to Antrological and prehistonic research.

With this subject, therefore, above all others, the name of Falconer, as one of the earliest and most zealous pioneers, will ever be inseparably connected. Devoted to it all his life, he may even be said to have perished in its cause. It was his zeal in this inquiry, more especially as connected with the fossil Cave Fauna of the Mediterranean, that induced him to undertake a journey to Gibraltar in the autumn of 1864, to visit on the spot the caverns and fissures which had been recently opened on the Windmill Hill, and ably and indefatigably explored by Captain Brome, to whom Palæontology is so deeply indebted. The fatigue incident to a hurried journey through Spain and France there is too much reason to fear may have predisposed him to yield to the acute attack to which he fell a victim shortly after his return, and thus deprived science of one of its brightest ornaments and most zealous votaries, and his friends of one of the most genial, honest, and warm-hearted men that ever existed.

*THE BIRDS OF SOUTH AFRICA.**

THIS work of 382 pages has been a laborious undertaking, which could only have been satisfactorily carried out by an ornithologist of ripe attainments. The accomplished Honorary Curator of the South African Museum at Cape-Town is specially qualified for the task, not only by his long residence in the country where ornithology has been his favourite pursuit, but by his previous well-known researches in different branches of zoology in Ceylon and elsewhere. He has enjoyed opportunities of studying the bird-fauna of various parts of the world, from the United States of North America to New Zealand, and few have profited more by those opportunities. Accordingly, he was well prepared to supply a useful digest of the ample materials at his disposal, and to present it in a systematic form for the convenience of his brother naturalists in other regions.

In the preface to this work it is remarked, that "many birds are herein described that have no claim to be considered as South African beyond the dicta of the old authors. This has been done to serve as a beacon to others, that they may avoid the labour and trouble which I have had in determining their true localities." Well and good; but we cannot but consider it a blemish in the book that such species, or even alleged species, for some of them are entirely fictitious, and others well known inhabitants of India, South America, and elsewhere, which can quite safely be pronounced to be entirely foreign to South Africa, should nevertheless be numbered like the rest, so as to give a total of 792 species that exist or have been untruly reported to exist in the region treated of. Now, about 84 species so admitted require to be deducted, thus reducing the number to 708 species, or thereabouts. We should prefer to have seen all notices of doubtful species, and especially of those which are indubitably foreign to South Africa, printed in smaller type, or (as we hear that this was actually impracticable in Cape-Town, from deficiency of the requisite type!)

* The Birds of South Africa. A Descriptive Catalogue of the known Species occurring south of the 28th parallel of south latitude. By Edgar Leopold Layard, F.Z.S., &c. 1867. Longman, Green, & Co., 39 Paternoster Row, London.

they might at least have been distinguished by not bearing numbers like the authenticated feathered inhabitants of South Africa. There are, nevertheless, some well-known species of other countries which we are considerably surprised to learn are likewise met with in the region treated of by the author; for instance, a well-known Indian crested cuckoo (Coccystes melanoleucus), in addition to two exclusively African congeners; and, still more remarkable, a species of titmouse (Parus cinereus), which likewise inhabits the Himmalayas, the Nilgiris, and other mountains of Southern India, those of Ceylon, of Java, and of the Philippines—a truly remarkable range of distribution; but the most extraordinary instance of the kind would have been that of the North American cliff swallow (Hirundo lunifrons), the very singular discovery of which, or of a species barely distinguishable from it, in South Africa, may be given in the author's own words:—

"Procured in the neighbourhood of Middlebury, by Mr A. V. Jackson, building in companies under rocks. I was first led to a knowledge of this species, by observing an unusual appearance on an overhanging rock, photographed during the journey of H.R.H. Prince Alfred through South Africa in 1860. On applying a strong magnifying power to the picture, I distinctly made out that the appearance consisted of a cluster of birds' nests. I at once concluded that they were constructed by some species of swallow unknown to me, and requested my zealous contributor, Mr Jackson, to look well after them, if ever he found himself in the neighbourhood. This he has done, and tells me that he counted about twenty nests, under a rock, clustered together; he also obtained the only specimen which I have seen. Dr Hartlaub, to whom this specimen was submitted, states that it is a young bird of the American Hirundo lunifrons; a species which has of late years been extending its migrations from its real habitation in a most remarkable manner."

Quite recently we learn that Dr Hartlaub has come to consider this South African bird to be distinct from its American congener, as might well have been suspected, and he now designates it H. Alfredi, in compliment to H.R.H. the Duke of Edinburgh.* Specimens, also, of the supposed Cypselus melba and C. apus of South Africa were not long ago exhibited at a meeting of the Zoological Society, where they were considered to be distinct from the two corresponding swifts of the northern hemisphere, and they must now bear the names C. gutturalis, Vieillot, and C. barbatus, Sclater (*ex* Temminck, m.s.).

---

* A coloured figure of Hirundo Alfredi is supplied in the "Ibis" for April of the current year, with some further particulars respecting it.

That the hobby falcon (Hypotriorchis subbuteo) is occasionally met with in the Cape colony is a fact by no means new to us; several instances of its occurrence are recorded by Mr Layard, and a specimen having been sent by him to Dr Sclater, the latter gentleman wrote word—"Never before received from the south of the equator." Upon which Mr Layard remarks in a note—"This observation of Mr Sclater's opens up a curious subject of inquiry. Have this and other species only lately found their way down the Continent? Or have they escaped the notice of previous observers? I incline to the former supposition, as I cannot conceive that some of our common species should have escaped the notice of such men as Dr A. Smith and Le Vaillant. Look, for instance, at the extreme abundance of Cypselus apus" (C. barbatus) "and Hirundo rustica throughout the colony. How came Le Vaillant not to include them among his swifts and swallows? Surely not because they are European, as he enumerated and figured Cypselus melba" (C. gutturalis), "and other European species." The question of the swifts is decided by their proving to be sufficiently well distinguished as species from their European proximate congeners.

The celebrated traveller Le Vaillant is sadly shewn up by Mr Layard. Some of the alleged species of birds, figured and described by Le Vaillant, have proved to be absolutely fictitious, having been founded on *made up* or compounded museum specimens, certain of which are still extant at Leyden and elsewhere. In many other cases he has figured and described species of birds as occurring in South Africa, which are now well known to be peculiar to far distant regions, as the Melanocorypha tatarica of Northern Asia, and various familiarly known birds of India and of South America, with some also that are peculiar to Madagascar, of which last he even gives the Malagasi appellations in one or two instances. In a note to the descriptions of two Asiatic bulbuls, asserted by Le Vaillant to have been killed by him in Africa, and duly referred to their proper *habitats* by our industrious author, he remarks :—

"I have been at some little pains to trace Le Vaillant's footsteps in Southern Africa, in order, if possible, to identify such of the birds that have been introduced into his great work as South African, but which are supposed by some to have been obtained from other countries. A statement which appeared some time ago in the serial *Household Words*, to the effect that Le Vaillant never was in South Africa, also stimulated my desire to obtain full information regarding him. I need not follow him through all his wanderings at this moment. Suffice for my present purpose to say, that I do not believe that he ever crossed the Orange river, and procured this bird (Pycnonotus cafer) there. He describes in his travels how he was floated across the swollen river, and his chase after the giraffe. I question much if this account is true. There was living at Camiesberg, within the last few years, an aged woman named Van Zyl, who related to my informant that she well remembered the kleine Franschman (little Frenchman), as she called him; that during his stay in that part of the country he lodged entirely at her house; and that he never crossed the Orange river, being too much of a coward to do so. When told that he stated that he shot the giraffe, she scouted the idea, and declared that the skin which he took away was brought piece-meal from the opposite side of the river by his Hottentots. Mrs Van Zyl was a large raw-boned woman, who stood upwards of six feet, and usually wound up her narrative concerning Le Vaillant by laughingly relating how she had horsewhipped the 'little Frenchman' for attempting to be somewhat too free with her."

After reading the repeated exposures of Le Vaillant's mendacity, and wild flights of imagination brought to notice by Mr Layard, it is impossible to have any respect for his statements, and it is only right that his true character should be appreciated. Almost the first in his particular field of observation, at a time when little was known of the natural productions of South Africa, there was sufficient admixture of truth in his elaborate work on the birds of that part of the world to lend credit to his numerous unfounded assertions. It may not be generally known that he was sent to South Africa as a paid collector of objects of natural history by the father of the late venerable Professor Temminck of Leyden. Mr Layard also supplies a reminiscence of a naturalist of a very different stamp, the late W. Swainson, of whose writings and theoretic notions about classification, at one time so popular and much canvassed, we hear very little now. They have been pretty well consigned to oblivion. It appears that much of his property was wrecked in Table Bay, in the ship that should have carried his effects to New Zealand. "Several of his books were recovered and bought up by a number of gentlemen who admired his talents, and he was informed that they would be forwarded to him if he would indicate his address. This he never cared to do, and the books remained here (in Cape-Town). Of them, the South African Museum has Temminck's 'Planches Coloriées,' Le Vaillant's 'Oiseaux d'Afrique,' the first volume of his 'Histoire Naturelle d'Oiseaux Nouveaux de l'Amerique et des Indes,' and Wilson's 'American Ornithology.' They contain many curious manuscript notes on the plates and margin, all bearing on his ideas of the affinity of species." So writes Mr Layard, and we have been informed that some of the MS. notes referred to are not a little curious, even as a psychological study. Mr Swainson was Attorney-General of New Zealand for several years, but it does not appear that he continued his ornithological studies upon the feathered inhabitants of our antipodes.

The classification adopted by Mr Layard is antiquated, but this is of little import in a work of which the special object is to discriminate and determine the various species. A few of his identifications are erroneous, as that of Milvus migrans (seu ater) with the Indian M. govinda, which latter he includes as a synonyme of M. migrans. Again, the South African Casarca cana is surely well enough distinguished from the Asiatic C. rutila, the well-known "ruddy shieldrake" of the books, or "Brahmini goose" of Anglo-Indians. Calamodyta (or rather Acrocephalus) arundinacea, Turdus arundinaceus, V., Sylvia turdoides, Tem., is not the same as the Indian A. brunnescens. Strix affinis will bear the prior name of S. poensis, Fraser. His curlew, as we believe, is Numenius lineatus, Cuvier (N. major, Schlegel), the ordinary Indian curlew, which is quite distinct from the European N. arcuatus. The Plectropterus goose is probably the West African P. Ruppelli, not P. gambensis. Ardeola leucoptera we suspect to be erroneously introduced, the winter dress of A. comata being mistaken for it. But there is little else to criticise in the nomenclature adopted by our author. The name "wild turkey" is bestowed on a considerable variety of birds in different parts of the world, and we learn from Mr Layard that it is applied in South Africa to a species of ibis, the Geronticus calvus! The very unexpected fact is communicated by his correspondent, Mr Atmore, that the Indicator minor "kills and eats small birds as savagely as Lanius collaris. The very first I shot was in the act of eating a sparrow *that I saw him kill in fight.* I suspect the other species of Indicator of similar propensities." Mr Layard shot a specimen of Indicator major as it was "clinging to the upright branch of a tree like a woodpecker." The true affinity of the honey-guides (Indicator) is distinctly with the woodpeckers and not with the cuckoos, among which latter Mr Layard still classifies them; indeed, the feet are absolutely those of a woodpecker, as distinguished from those of any cuculine genus. Of a species of true woodpecker, the Geocolaptes olivaceus, he remarks—"This singular bird presents a remarkable instance of the adaptation of creatures to the localities wherein their lot is cast. Though belonging to the woodpecker tribe, it never pecks wood, but bores its way into the banks of rivers, sides of hills, or the walls of mud-buildings, in search of its prey, and for a home for its young. It also seeks for food on the ground, in the same manner as the golden-winged woodpecker (Colaptes auratus) of North America; its flight also struck me as being very similar to that of the American bird." Mr Darwin also describes a true woodpecker in South America, which is never seen upon a tree, for there are no trees on the bare lands which it frequents; and yet, if one general structure or conformation more than another would seem to be expressly modified for peculiar and exclusively arboreal habits, it is assuredly and most emphatically that of a woodpecker!

We incline to regret that our author has not favoured us with some slight notices of the anatomy of those very peculiar genera, Irrisor, Indicator, and Colius, which would have been exceedingly acceptable, as elucidating the disputed affinities of those isolated forms. The first we believe to be closely related to the Bucerotidæ or hornbills, the second to the Picidæ or woodpeckers, and the third to appertain strictly to the family Musophagidæ or the touracos, more especially approximating certain species of Schizornis, which even resemble the colies in the disposition of the toes, as well as in the texture and colouring of the plumage. Irrisor is included under Upupidæ by Mr Layard, and there is no doubt of the affinity of the hoopoes for the hornbills, the irrisors holding an intermediate position. Of Irrisor erythrorhynchus he writes:—

"This bird inhabits the Forests of the Knysna, and extends as far as the Great Lake. It frequents high trees, about the topmost branches of which it hunts unceasingly for insects. Its voice is harsh and resounding, and has acquired for it the name of kackela among the Dutch, which signifies 'the chatterer.' It is a difficult bird to shoot, being very shy and wary, and for ever whisking round on its perch, taking special care, however, of its long tail, by lifting it over the branches. Its motions at these times reminded me very much of the habits of the coucals or 'pheasant-cuckoos' (Centropus). I never saw or heard of one of these birds being observed on the ground. The residents in the Knysna district informed me that these birds breed in hollow trees, and that their eggs were pure white and round."

The predatory habits of Indicator minor, if not of the other species of this genus, have already been mentioned, as also the fact of I. major clinging to the upright branch of a tree in the manner of a woodpecker. Mr Layard describes three species, I. major, I. variegatus, and I. minor; but the genus is not quite peculiar to Africa, as generally supposed, there being one species of true Indicator in Borneo, and another in the Sikhim and Bhotan Himmalaya. Of I. variegatus he states that—"With respect to the oft-repeated story of the honey-guide leading persons to the nest of the honey-bee, it is as well to mention that the bird will perform the same antics, and with the same cries, to lead any one to a leopard, wild cat, or snake, or will even follow a dog with the same vociferations." Of I. minor we are told :—

"The lesser honey-guide is found on the Knysna ; and Le Vaillant gives the Swartkop and Sunday's Rivers as other localities. It probably extends all along the south-east coast. M. Atmore procured it at Blanco, and writes thus :—'I have had another good opportunity of watching the habits of I. minor. I used to wonder where they got all the bee's-wax that is usually in their gizzards, and the other day I found it out. There was a male at a bee-hive as busy as possible catching bees. After watching him for some time, my son shot him, and his gizzard was full of bees' legs, with the wax on them. He is held in no repute here as an Indicator ; but I. major is, and he is scarce.' M. Atmore has mistaken the pollen of the bee for wax. The bird's habit of capturing bees like a flycatcher is interesting. In another letter he writes—'Eggs white, in nests of Picus capensis and Laimodon unidentatus.'"

Are we to understand from this that the honey-guides are parasitic like the true cuckoos, entrusting their eggs to the charge of other species, or that they repair for incubation to the deserted nest-holes of woodpeckers and barbets? We suspect the latter, and the white eggs are decidedly those of a woodpecker rather than of a cuculine bird. Bruce notices the protrusile tongue of the honey-guide; but M. Atmore writes of its "gizzard," a term which, if properly applied, should intimate a much thicker muscular coat to the stomach than we find either in the woodpeckers, or in any of the diversified cuckoo family. Why has not Mr Layard supplied us with trustworthy information on these points? As regards Colius he informs us :—

"Of the three species of this genus found in South Africa, and known by the trivial name of muis-vogel, or 'mouse-bird,' C. erythropus is the only one that occurs in the neighbourhood of Cape-Town. It is not uncommon in gardens during the fruit season, ranging about in small families of six or eight individuals. They fly with a rapid, though laboured flight, generally at a lower level than the object at which they aim, and on nearing it rise upward with a sudden abrupt curve. They creep among the branches like parrots, and hang suspended, head downwards, without inconvenience ; indeed, it is said that they invariably sleep in this position, many of them congregated together in a ball. They are said to breed in holes of trees, laying three or four eggs, somewhat rounded at each end, of a dull white colour. In habits, the three species closely resemble each other; and at the Knysna, where they are all to be found, we frequently shot them, and could not distinguish which we had obtained until we picked them up."

The Turacus persa is denominated the "lory" in South Africa, and it is "very common throughout the forest districts. * * * * Strange to say, though I inquired carefully, I never could obtain any information respecting the nidification of this beautiful and common bird." M. Atmore, however, states that the eggs are white; but this must be from hearsay, as he writes—"How difficult it is to find these forest-birds' nests! The lories are breeding now; but for the life of me I cannot find a nest. The young ones go in troops, and are delicious eating; the old ones in pairs. We never shoot specimens out of a troop, except for the pot." Mr Layard does not include Colius among the Musophagidæ, but gives two species of Turacus, and one of Schizornis. All are alike peculiar to the African continent.

There are pleasing songsters in South Africa, as in most other countries. Of the Crithagra canicollis, a finch very closely akin to the domestic canary bird, we are informed that—"The Cape canary is a very common bird throughout the colony, congregating in flocks on the open and ploughed land, and feeding on grains and seeds of all kinds [?]. It sings very sweetly, and breeds in captivity with the tame canary, the male bird being very handsome; and, I am told, producing with either the yellow bird or one of its own species [*i. e.*, another mate of similar parentage?]. I purpose trying the experiment." Bessonornis phænicurus is the Cape robin, and decidedly deserves the name. It is common in all the gardens, even in the midst of Cape-Town, flitting along the gravel-paths, scraping in the flower-beds, perching on the leafless summit of some deciduous tree, or the ridge of the house-top, and pouring out a short, robin-like song, which when heard in the dusky twilight reminds the listener of the familiar note of the household bird of the red stomacher." Other instances might be cited; and there are two or three good mockers. Thus Saxicola pileata is "one of the most favoured and favourite birds of the colony, over the whole of which it extends. He is protected and petted on account of his own natural sweet notes, and for his great powers of imitation. Perched on a white-ant's nest, he pours out a flood of song, chanting long into the darkening twilight, when other songsters are gone to rest; and the morning light scarcely enables you to see the musician, ere he again commences his mellow notes or imitations."

Of that exceedingly remarkable bird, the ground hornbill (Bucorax Abyssinicus), the "Abba Gumba" of Bruce, we are informed that it is

> "Common on the eastern frontier, but in consequence of their feeding on carrion, and emitting a dreadful stench, I have not succeeded in inducing any of my correspondents to send me one. I am told that they associate in large flocks, and devour vast quantities of grubs and locusts. They get their name ("brom-vogel" of the colonists) from the droning cry they utter. The Fingoes seem to attach some superstitious veneration to them, and object to their being shot in the neighbourhood of their dwellings, lest they should lose their cattle by disease. Le Vaillant figures a head of this bird, in which the bare space round the eye, and the lower portion of that on the neck, are blue. In a single dried head which we possess those parts are deep orange-red."

The difference in colour of the facial and inflatable gular skin is sexual. In a crippled male lately in the London Zoological Gardens, the skin of those parts was bright red, whereas in three healthy females at the present time in the collection the same naked skin is livid blue. The "Abba Gumba" differs widely from all the rest of its tribe by its lengthened shank and chiefly terrene habits. As it stalks about on the ground, nobody unacquainted with it could suppose, at a moderately distant view, what manner of bird it is, or, in other words, to what family of birds it appertains. Its eyes are exceedingly prominent and very mobile, being usually half covered by the upper lid, which is fringed with strongly developed lashes, and with its projecting visual organs thus screened, as it steps about, the bird attentively surveys the ground around and about for the larger insects, and any small living vertebrated creatures that fall in its way, being an eager snake-devourer, and buffeting those reptiles with its wings. In that valuable repertory of ornithological lore, the "Ibis," there are sundry notices of the habits of this anomalous ground-hornbill. According to Mr J. J. Monteiro, the species is common in the interior of Angola, being seen "in flocks of six or eight (the natives say always in equal number of males and females). Further in the interior I was credibly informed that they are seen in flocks of from one to two hundred individuals. The males raise up and open and close their tails exactly in the manner of a turkey, and filling out their bright cockscomb-red bladder-like wattle on the neck, and, with wings drooping to the ground, they make quite a grand display. They do not present a less extraordinary appearance as they walk slowly with an awkward gait, and peer from side to side with their great eyes in quest of food in the short grass, poking their large bills at any frog, snake, &c., that may come in their way. They are omnivorous in their diet—reptiles, birds' eggs, beetles, and other insects, genguba or ground-ants, constituting their food in the wild state. In confinement I have fed this bird upon the same food, also upon fresh fish, which it shewed itself very fond of, as well as on entrails of fowls, &c. On letting one loose in Loanda, in a yard where there were several fowls with chickens, it immediately gulped down its throat six of the latter, and finished its breakfast with several eggs. The note or cry of the male is like the hoarse blast of a horn, repeated short three times, and answered by the female in a lower tone. It is very loud, and can be heard at a considerable distance, particularly at night. These birds are said to build their nests on the very highest Adansoniæ, in the hollow or cavity formed at the base or junction of the branches with the trunk. Their flight is feeble and not long sustained. When alarmed they generally fly up to the nearest large tree, preferring such as have thick branches with but little foliage, as the Adansoniæ. Here they squat close on the branches, and, if further alarmed, raise themselves quite upright on their legs, in the attitude of listening, with wide-open bills. The first to notice a person at once utters their customary cry, and all fly off to the next tree. They are very wary, and the grass near the mountains being comparatively short, with but little scrub or bush, it is very difficult to approach without being observed by them from the high trees."

The foregoing elaborate notice indicates an exceedingly different bird from the numerous and diversified other species of hornbills (Bucerotidæ), all of which latter (so far as known) are essentially arboreal and frugivorous birds in the wild state, however comparatively carnivorous as observed in captivity. But there are several instances of kindred genera of birds differing most remarkably in their customary or occasional diet. Who would have supposed that the Steatornis caripensis (one of the Caprimulgidæ) subsisted on berries? And the strong-billed purple swallows (Progne) of America are described to be partly baccivorous! Again, the true rollers (Coracias) are exclusively animal feeders, while the birds of the kindred genus, Eurystomus—as observed in confinement, at least—feed eagerly on bananas, as we have often personally witnessed. The ordinary cuckoos (Cuculus, &c.,) are mainly devourers of caterpillars, and in no instance, that we are aware of, partake of fruit or berries, whilst the nearly allied genus of koels (Eudynamys) are eminently berry-devourers. It may not be generally known that sundry ground-pigeons feed eagerly on earth-worms, as we have witnessed in the Zoological Gardens; and it would hardly be expected that the piscivorous mergansers (Mergus castor and M. serrator) would take to scrambling eagerly for fragments of bread thrown to them, a sight that may be ordinarily witnessed of those at present in the Regent's Park collection. All of these are instructive facts which should habitually be borne in mind when cogitating on the differences of the "Abba Gumba" from the other hornbills.

Another remarkable snake-devourer, also of a peculiar African type, exists in the famous secretary-bird (Serpentarius reptilivorus), which the acclimatizers of Australia should assuredly endeavour their utmost to introduce, especially as it does not attack poultry. Mr Layard describes it as

> "Widely distributed throughout the colony. When a pair establish themselves in any locality they speedily drive out all others of the same kind, and will breed in the same nest for a long period. The nest is a large structure, added to yearly, placed sometimes in a low bush, sometimes in a thick thorny mimosa. I am told they never lay more than two eggs, which are of a dirty dull white, profusely dotted with light brownish-red blotches at the obtuse end, and sparsely over the whole shell. The young utter a guttural, rattling cry, precisely resembling the call of the Stanley crane. They are a long while ere they can walk, as their legs seem unable to support the weight of their bodies, and snap with the least exertion. One which I was rearing for the Acclimatization Society of Melbourne and Sydney trod in a small wooden bowl sunk in the ground, and instantly fell, breaking his leg and wing. I spliced them both, but he died in ten days. Since the above was written I have lost several from similar causes. I have known them snap a leg if suddenly startled into a quick run. All who have tried to rear these birds notice this brittleness in their bones. I am informed that the texture of the nest is so loose that the legs of the young hang through the interstices until they acquire sufficient strength to be bent under them."

Several secretary-birds have been brought to London within the last year or two, but it is a long time since one has been exhibited in the Zoological Gardens.* We have seen one kept together with

* It is suggested in the "Ibis" for April 1868, p. 242, that the extreme brittleness of the bones arises in birds reared in confinement, from the fact that they are deprived of the lime derived from the bones of the small mammals and reptiles devoured by them in their wild state and brought by their parents. Sprinkling their food, usually raw meat, with chalk, as a substitute, is further suggested, and this, remarks Mr Layard, is not a bad idea for those who rear falcons.

a lot of poultry, with which it lived in perfect harmony. Another anomalous African form is known as the umbre (Scopus umbretta), which Professor Schlegel considers to be a stork, while Professor Sundeval regards it as immediately related to the Balæniceps, another strange African genus, which latter (in our humble opinion) is more nearly akin to the South American boatbill (Cancroma). The "strange antics" which it performs, according to Mr Layard, recall to mind those of the kagu (Rhynochœtus jubatus) of New Caledonia.

"The hammerkop (literally, 'hammer-head') is found throughout the colony, and all the way to the Zambezi, frequenting ponds, marshes, rivers, and lakes. It is a strange, weird bird, flitting about with great activity in the dusk of the evening, and preying upon frogs, small fish, &c. At times, when two or three are feeding in the same small pool, they will execute a singular dance, skipping round one another, opening and closing their wings, and performing strange antics. They breed on trees and on rocky ledges, forming a huge structure of sticks, some of them of considerable thickness. These nests are so solid, that they will bear the weight of a large heavy man on the domed roof without collapsing. The entrance is a small hole, generally placed in the most inaccessible side. The eggs, three to four in number, are pure white. On my late friend Jackson's farm, at Nel's Point, there is a singular rocky glen between two hills. In this spot, a beautiful permanent spring, called 'Jackals' fontein,' takes its rise. Of course, in consequence, there are a few wild almond and other trees, and the place is a little oasis amid the barren mountains. It is a favourite resort of wild animals, hyenas, leopards, jackals, &c., and here Mr Jackson has constructed one of his most successful hyena-traps. On the ledges of the rocks in this secluded spot, a colony of 'hammerkops' have built for years. Some of the nests are quite inaccessible, while others can be reached with a little trouble. I counted six or eight within 50 yards, all exhibiting the same form and structure, and some of them containing at least a cartload of sticks. Mr Jackson told me they occupied the same nest year after year, and added to it or repaired it as required. About some that I visited, I found brass and bone buttons, bits of crockery, bleached bones, &c. Mr Jackson said, if a 'Tottie' lost his knife or tinder-box on the farm, or within some miles of the place, he made a point of examining the 'hammerkops'' nests, and frequently with success; the birds, like the bower-birds of Australia, embellishing their dwellings with any glittering or bright-coloured thing they can pick up. In the Karoo, between Worcester and Robertson, I saw a nest placed on the ground on the side of a trifling rise; it was at least 3 yards in length, by 1½ across, with a small entrance hole at one end."

If the Guachos of the South American Pampas happen to lose any small object, they search the entrances to the burrows of the viscachas about the neighbourhood, and Mr Darwin relates an instance of a gentleman having thus found his watch, which he had dropped while on horseback the previous evening. Mr E. Newton found four nests of the Scopus, close together in one clump of trees in Madagascar. "Three of them were on the same tree; the fourth on another, which had been partly blown down, and not more than 6 feet from the ground. It was with some difficulty," he adds, "that I climbed over the nest, and so solidly was it built, that it bore my weight. There were two entrances to the nest (the others had only one each), and notwithstanding the great size of the nest, the chamber within hardly appeared large enough to contain its future tenants." Upon another occasion he found a brood of the Madagascar kestrel (Tinnunculus gracilis) within the large nest of Scopus umbretta.*

There are several remarkable nest-builders among the birds of South Africa, and amongst the nests the enormous compound and thatched fabric of the "social grosbeak" of authors (Philetairus socius) is about the most celebrated. The nests of Plocepasser mahali are "composed of the stalks of grasses, the thickest extremities being placed so as to protrude externally, and offer a defence against snakes," &c., as remarked by the late Sir Andrew Smith. Upon which Mr Layard writes:—

"Dr Smith's statement, that the protruding sticks of the nest are meant as a defence against snakes, appears to me to be as well founded as the idea that other members of this family construct their bottle-shaped nests at the extremity of branches, so as to be out of the way of monkeys and snakes. Why should these birds, beyond all others, be endowed with such prescient wisdom? Why should they depart from their custom sometimes, and build their nests on reeds? Or why take these precautions in places where neither snakes nor monkeys exist?"

Among the more active and well-informed correspondents of our author, Mrs Barber holds a conspicuous place, and this lady writes from "The Highlands," near Graham's Town:—

"I send herewith the nest of a kind of finch (Hyphantornis capitalis). They are common, and most likely you know both the bird and its nest, though I do not suppose that you know the material that the nest is made of; for in our youthful bird-nesting days it puzzled us amazingly, until at length we found out the secret, which was, that the nest of this bird is made of the fibres of the leaves of a species of Sanseviera, a plant belonging to the natural order Asphodeleæ; but as our Flora has not yet been published up to that order, I cannot give you its specific name with any degree of certainty. It is not the tall aloe-like one that grows in our forests; but the dwarf, thick-leaved, stemless Sanseviera, with the red edges to its leaves. The whole leaf is full of strong

* Ibis, vol. IV., p. 267 (July, 1862), and vol. V., p. 170 (April, 1863).

fibres, but from its tough nature the birds are only able to strip off the two marginal threads; and to construct one of these nests many thousands of Sanseviera leaves are deprived of their red-edged fibres: in the neighbourhood of one or two of these nests, you will not find a perfect leaf on any of those plants."

In the Zoological Appendix to Salt's "Travels in Abyssinia,' contributed by the late Earl of Derby, the curious fact is stated of Columba guineæ becoming a domestic house pigeon! The assertion has been currently regarded as a mistake unquestionably, but there is nothing extraordinary in a rock-building pigeon attaching itself to edifices. All of the house-frequenting birds of this country are rock-builders naturally, and even now the jackdaw, the starling, the house sparrow, the chimney swallow, and the house martin, may not unfrequently be seen to nestle in sea-cliffs. Columba guineæ is described by Mr Layard to be

"Common throughout the colony, nesting in rocky places, on inaccessible ledges and in holes; never in trees.* They fly in flocks when the crops are on the ground, and do considerable damage to the agriculturist. In the sea-face of the mountains, of which Cape Point forms the extreme south, there are numerous caverns tenanted by these birds. Some years ago I entered one of them in a boat, and for the first time had the pleasure of seeing this fine pigeon breeding in considerable numbers; every ledge of the cavern-side was tenanted by as many nests as could be conveniently stowed away, while the parent birds were continually arriving or departing on their busy task of feeding their young. The cave was unapproachable except by water, and one would have thought that the birds would have been careless in consequence of the choice of this eyrie; but not a nest was accessible. I have, however, obtained eggs of this species from other sources."

The allied C. arquatrix and C. delagorgui are forest birds, the former of these placing their nests on the tops of the tree-ferns, high upon the mountains, as well as upon trees in mountain ravines. In this country C. œnas is occasionally a cliff-builder, like C. livia, as discovered by Mr J. E. Harting, although exceptionally and locally, as it would appear. Mr Layard refers to "the tame white-breasted guinea-fowl," as if it invariably possessed some white upon its plumage, as Mr Swainson, too, formerly supposed; but we have seen very many of unbroken colouring. Of the wild South African species (Numida mitrata), Mrs Barber writes:—

"Our wild guinea-fowl are easily tamed, and you frequently see both sorts together upon the farmers' homesteads on the frontier. Our South African species is altogether a much handsomer and larger bird than the tame, and is of

* *Vide*, however, the "Ibis" for April of the current year, p. 141.

a much deeper colour, with the white spots larger and more conspicuous. They are good layers, and rear their young much in the same way as our [so-called] pheasants do. . . . Sir Walter Currie has upwards of a hundred of these beautiful birds upon his property (Oatlands) at Graham's Town; they are thorough-bred South African ones."

It is not mentioned that the two species ever interbreed, even when kept together. One more remarkable bird we will bring to notice, the Podica mosambicana, which Mr Layard arranges with the grebes (Podiceps), whereas the true affinity of this genus is decidedly with the gallinules. He also follows the old system of approximating the jacanas (Parridæ) to the Rallidæ, and subordinating them to the Palamedeadæ. The last we consider to be modified geese, not distantly akin to the spur-winged geese (Plectropterus), and especially to the semi-palmate goose (Anseranas melanoleuca) of Australia; while the Parridæ we consider to be allied neither to the Rallidæ nor to the Palamedeadæ. We cannot perceive that they approximate the Rallidæ in any particular whatsoever. We have watched the Malayan Podica personata through a glass, upon an alluvial island in the Great Tenasserim River, and are satisfied that it is a pre-eminently diving form of coot or gallinule, as the details of its external structure intimate. Of the South African P. mosambicana, Mr Layard shot at two without obtaining them, from their efficient diving capabilities; and of one of them he remarks—"At first I took it for a coot, but as the bird dropped its legs, I saw the feet were bright orange, and apparently webbed [*i.e.*, scalloped]; other peculiarities also convinced me that I had a stranger before me." We have not handled the Podica, nor the allied genus Heliornis, fresh, but feel no doubt that their anatomy will be found to remove them altogether from the grebes to associate them with the coots and gallinules. The eggs and covering of the chicks should do the same, as these are most diverse in the two families in question.

The more prominent characteristics of the South African avifauna may now be very briefly indicated. As many as seven species of Vulturidæ are enumerated, inclusive of the African lammergeyer (Gypaetus meridionalis); about forty authentic species of Falconidæ, inclusive of the secretary-bird, which M. Layard refers to this family; and ten species of Strigidæ or owls, or in all fifty-seven species of Raptores, a few of which are very rare or barely admissible. The splendid Aquila bellicosa, distinctly referred by our author to Spizaetus, is very scarce in the colony.

only two specimens having fallen within his notice. It is of this species that Mr. T. Atmore writes, *in epistola*,—"Just as we were leaving the Knysna, we heard of an eagle's nest in the forest, and under the tree, the person who found it counted 95 heads of the little blue-bock (Cephalophus cœruleus)." M. Layard next describes six authentic species of Caprimulgus, three of Cypselus, and as many as fourteen of Hirundinidæ, if the last of them be not rather a Cypselus. Next four species of Coracias, the one African trogon, thirteen species of Halcyonidæ, six of Meropidæ, the Upupa minor, and two species of Irrisor. Then he passes to the passerine honey-suckers, beginning with that very isolated bird the Promerops caffer, then twelve authentic Nectariniæ, and a Dicæum with two supposed synonyms that should be cancelled. At least twenty-seven admitted species are referred to Drymoica. Of the Phylloscopus group only three, one of them being the British P. trochilus. Ten good species are assigned to Saxicola, and three to Parus (inclusive of the Asiatic P. cinereus). Four species of Zosterops, three of Motacilla, and as many as eleven are referred to Anthus. Eight thrushes, including two species of Petrocincla; and six of the African genus Bessonornis. Three orioles; and six authentic bulbuls. Various flycatchers of different genera; three Campephagæ, and two Dicruri. Four genuine shrikes, with sundry forms placed near to them, whether or not rightly. Three species of Corvidæ, and fourteen of Sturnidæ. As many as twenty-six species of weaver-birds (Ploceus, &c.), and eighteen of Estrelda and Amadina. Twelve true finches, and four kinds of sparrows; six Fringillariæ; and twenty species of larks, inclusive of three Pyrrhulaudæ; nine Megalophoni (the African equivalent of the Asiatic Mirafræ), and four Certhilaudæ, the affinity of which last is perhaps closer to the pipits. Three of Colius, two of Turacos, and one of Schizornis. Five hornbills additional to the "Abba Gumba." Three parrots only; seven barbets (erroneously subordinated to the Picidæ); six woodpeckers, and the peculiar South African wryneck (Yunx pectoralis); three honey-guides; three coucals (Centropus), one malkoha (Zanclostomus aereus), and ten Cuculinæ.

There are two species of green fruit-pigeon (Treron), seven ordinary pigeons and doves, and three ground-doves (Peristera). Of gallinaceous birds, two species of wild guinea-fowl, ten assigned to Francolinus, two to Coturnix, two species of Turnix, and four of Pterocles. The south African ostrich, by some considered to differ from the northern race. Ten species of bustard. One Œdicnemus, and four species of Cursorius; two of Glareola; five of lapwing; the universal stone-plover (Squatarola helvetica); eight plovers; one oyster-catcher; the cosmopolitan turnstone; three cranes; sixteen of heron and bittern, with the night-heron; the Scopus; one spoonbill; four storks; one adjutant-stork; the Xenorhynchus senegalensis, and Anastomus laminigerus; five species of ibis; twenty Scolopacidæ, of which two only are foreign to Europe—the sole South African snipe (Gallinago æquatorialis), and the so-called painted snipe (Rhynchæa capensis) which is likewise common in southern Asia; two species of Parra (or rather of Metopidius); and sixteen Rallidæ, to which the Podica should undoubtedly be added.

Of Anatidæ, two species of flamingo are recognized; and fifteen of geese and ducks of various genera, most of the species being peculiarly African. Next follow thirteen petrels, and five albatrosses; two skuas, and only two gulls; six terns, and the very remarkable Dromas ardeola which is believed to be immediately related to certain of the terns, notwithstanding its grallatorial proportions. Last in order of succession come three grebes, one penguin only (Spheniscus demersus), one Plotus, one Sula, three cormorants, and two pelicans. Among the land-birds we have only cited the more prominent and characteristic genera; and the thanks of the naturalist community are due to Mr Layard for the great pains which he has taken in reducing to something like order and certainty a great deal of heterogenous material abounding in misstatements and redundancies, which required that the whole subject should be worked anew with the zeal, intelligence, and local knowledge which have enabled him to accomplish his somewhat arduous undertaking to so considerably satisfactory an extent.

E. Blyth.

Note.—Long since the foregoing article was written, the first part of an elaborate analysis of Mr Layard's "Birds of South Africa," from the pen of J. H. Gurney, Esq. (who has long devoted great attention to the avi-fauna of South Africa), has appeared in the "Ibis" for April of the present year. Mr Gurney's excellent contribution, however, does not partake of the character of a review, so that there is no occasion to suppress the present communication. He has added several species to the list of birds obtained within Mr Layard's prescribed limits.—Ed.

*FERNS OF EUROPE AND THE ATLANTIC ISLANDS.**

THIS work is a handbook in a form and at a price adapted to ensure for it a wide circulation, containing an enumeration and full description of the ferns (species, varieties, and forms) of Europe, the Canary, Cape Verde, and Azore Islands, and the northern half of Asia. So far as ferns are concerned, we can only regard the whole of the northern hemisphere, leaving out the Himmalayas, as forming one single and indivisible geographical region. In every part of it the species common to the whole region form a large proportion of the total number that occur. This is the case if we count the number of species, and still more so if we take their relative abundance into consideration. The total number of species which belong to this region does not rise above 150. There are twice as many ferns to be found in the Himmalayas as in the whole of the rest of the northern hemisphere. We have nearly one-third of the 150 in Great Britain. As they stand in the present work, the total number of European species is seventy, and for the rest of the area included forty-five have to be added. Perhaps it would have been better, looking at the matter in the geographical light, to have excluded the Cape Verde's, the affinity of the vegetation of which is with Senegambia rather than with the other outlying African Islands; but the number of Cape Verde species is only about twenty in all, which twenty, however, includes six or eight characteristically tropical species which would otherwise be omitted. For the last quarter of a century Dr Milde has made a special study of the European ferns, and he is well-known as a careful and painstaking observer. The ferns of our own islands have been so thoroughly studied and written upon that it is not to be expected that a foreigner should be able to throw any fresh light upon them; but we would none the less strongly recommend the book to such of our readers as devote themselves to the British species, because Dr Milde has traced out the varying forms of each so carefully throughout the entirety of their geographical range, as to make the work a profitable study for all our home-botanists. The extent to which false species have

* Filices Europæ et Atlantidis, Asiæ Minoris et Sibiriæ, auctore Dr J. Milde. Lipsicæ, A. Felix, 1867, 8vo., p. 311.

been manufactured out of some of the common ferns with a wide geographical area is perfectly astonishing. Osmunda regalis, an extreme case, for it is so striking and well-marked a plant, and so widely dispersed in Europe that it is certain to attract the notice of any person who pays attention to plants early in their botanical career, has received between ten and twelve specific names, given to it most of them by authors of high repute who have received the plant from some distant country, and named it afresh upon the principle that their old familiar acquaintance could not possibly have strayed so far. If it has fared so with the Osmunda, what can we expect with the widely-diffused species of the less clearly-marked large Polypodial genera, such as Aspidium (Polystichum), aculeatum, and Cystopteris fragilis? But we cannot impute any fault of this kind to the author of the work before us, and hence its merit. Dr Milde has carefully examined and compared together his specimens from over a wide geographic range without allowing himself to be biased by preconceived ideas of the kind to which we have alluded, and has, moreover, taken great pains to acquaint himself with, and to procure a sight of authentic specimens of the numerous species (a large proportion of them bad ones) which have been published during the last twenty years in the various continental journals and bulletins, and it is a great boon to the general student to have these all brought together into one view, and to have them described and revised (revision meaning in a large number of cases annihilation) by so good an authority.

We do not consider Dr Milde's scheme of fern-classification, so far as it possesses any novelty, an improvement upon the old methods. He divides, in the first place, the Filicoid plants into four, what he calls, families—Filices, Equisetaceæ, Lycopodiaceæa, and Rhizocarpeæ. These, we consider, may be fairly regarded as divisions equivalent to the natural orders of flowering plants, and we suppose that Dr Milde views the matter in the same light, as he calls his next divisions sub-orders; but if so, it would have been much better to have used the ordinary nomenclature. Filices he divides into five sub-orders—Hymenophylleæ, Polypodiaceæ, Cyatheaceæ, Osmundaceæ, and Ophioglosseæ. To this we have nothing to object, except that it is better to keep the termination *aceæ* for orders. He draws a distinction, which is quite a sound one, between a true indusium or involucre, quite distinct from the surface of the frond and destitute of stomata, and a false indusium passing insensibly into the parenchyma of the pagina, and furnished with stomata on the under surface. This is quite satisfactory, but, when following out the idea, he puts Pteris, Allosorus, Cheilanthes, and Adiantum, with Gymnogramme and Polypodium, into one tribe, makes a second of Blechnum, Woodwardia, Athyrium, Asplenium, Scolopendrium, Camptosorus, and Ceterach (defining this last as destitute of involucre) ; a third of Phegopteris, Aspidium, Cystopteris, Onoclea, and Woodsia ; and in a fourth puts together Davallia and Nephrolepis. he gets groups which, in our view, are neither natural nor capable of being characterized clearly.

Following principally the lead of Dr Mettenius, whose recent death in the prime of life is a loss to fern-literature which can scarcely be estimated too highly, the later German writers on ferns have adopted a much more technical and systematized terminology than has ever been used in this country. This has the disadvantage of making their books so much more difficult for the non-initiated to understand, and in some cases we certainly think they have gone further in this direction than is compensated by any advantage which they obtain in precision in defining species or the groups of various values. For instance, they recognize eight distinct types of free venation, which Dr Milde defines in his preface and refers to sometimes, but not invariably, in his descriptions, called the veining of Cænopteris, Ctenopteris, Pecopteris, Tæniopteris, Sphenopteris, Eupteris, Neuropteris, and Cyclopteris. We submit that this is overdoing the thing, and that it would be better to reduce the types to four, as follows :—

1. A distinct unbranched vein carried into each ultimate division, as in Hymenophyllum Tunbridgense.

2. Ultimate divisions with a distinct midrib and simple or forked veins branching from it, as in Scolopendrium, Lomaria spicant, Pteris aquilina.

3. Ultimate divisions with a distinct midrib and pinnated veinlets branching from it, as in Aspidium aculeatum, Nephrodium filix-mas, &c.

4. No distinct midrib but the veining flabellato-dichotomous, as in Adiantum capillus-veneris, and Botrychium lunaria.

Will not this, expressing the cutting of the frond in the ordinary way, simple, pinnate, bipinnate, tripinnate, pinnatifid, bipinnatifid, tripinnatifid, answer every practical purpose ?

It may be useful also to some of our readers if we explain their terminology of what may be called the architecture of the frond. For the general outline of the frond, Dr Milde has three terms, which certainly is not systematising too much, "pyramidata," narrowed gradually from a broad base to the apex; "decrescens," broadest half or two-thirds of the way down, and the lower pinnæ dwindling in size; and "ambigua," not distinctly either of the other two. Nearly all the compound European ferns are under the two latter, but there are a great many exotic ones in which the decrescent type is shewn very clearly. In the arrangement of the veining and divisions, he distinguishes between "anadroma," where the veins and pinnules begin first on the upper side of the midrib or pinnæ as the case may be, and "catadroma," where they begin first on the lower side. The three principal types of architecture are the Polystichoid, in which the veins and pinnules are entirely anadromous, the Phegopteroid, in which the pinnules are anadromous in the two lowest pairs of pinnæ, but the pinnules catadromous, though the tertiary veins are anadromous upwards, and the Cyatheoid, which only differs from the last in its catadromous tertiary nerves. He distinguishes two kinds of scales, "paleæ cystopteroideæ," with the cells not incrassated, but lax, elongated, prosenchymatous, and concolorous, and "paleæ-clathratæ," in which the cells are short and hexagonal, the centre colourless, and the walls thickened and coloured, and keeps up Athyrium as a genus, on the ground that, besides its difference from Asplenium in fructification, its scales are always of the former type, whilst those of Asplenium are of the latter.

The subject of hybrid ferns is one of the greatest interest. Dr Milde seems quite satisfied that they do really occur, and mentions four cases in which, if we understand him correctly, intermediate forms between well-known species were found in small quantity with the different plants. In three cases out of the four, Asplenium trichomanes was one of the plants, and the others respectively, viride, adiantum-nigrum, and germanicum, and in the fourth instance the two species were Scolopendrium vulgare and Ceterach officinarum.

In conclusion, we must not omit to say that the book contains a complete monograph of all the known species of Osmunda, Botrychium, and Equisetum, and that upon the latter family Dr Milde is by universal consent the first living authority. He admits in all twenty-five species, and seems to consider that sections of the stems furnish the best characters for their discrimination.

Those interested in Isoetes will find a full account of the fifteen species which are now known in Europe, two-thirds of which are quite recent discoveries.

J. G. Baker.

THE JARARACA.

THE Jararaca (*Bothrops Neuwiedii*, Spix.) is the substitute of the rattlesnake in Brazil. About Rio it is frequently met with in plantations, and in bushy and grassy places by the sides of woods, but is scarcely ever found in dense forests. The Rev. Hamlet Clark, in his "Letters Home," gives an account of his first introduction to it, which may serve for that of the reader too :

> "We were riding slowly along in single file, our guide leading, when, as we passed a broken horizontal limb of a tree, close to the side of the path, all at once he woke up into active life. He was off his mule in a trice, handed me (I was next in file) the rein and his whip, had cut down and whittled clean a cane sapling, and then with all his force whack came the cane on the broken branch! Now we knew what the man was after. At once there uncoiled itself and fell to the ground a splendid serpent (the man said 9 feet long, we thought not quite so much), the deadliest serpent known here. He was sleeping, twisted round the branch in the sunshine, black and bright yellow, very hideous in its beauty. A villainous flat broad head, made uglier by a thin neck, snapped at us in every direction as we stood round it, and a single snap that hit its mark would have been certain and speedy death to man or beast."

Deadly enough its bite certainly is, but not quite so invariably fatal as Mr Clark supposed. People are said to have died from it within the space of two or three minutes after having been bitten, but more generally they survive for ten or twelve hours, and many recover entirely or rather do not die, but their constitution is almost always broken, and they suffer much from ulcerated limbs.

Gardiner in his "Travels in the Interior of Brazil" mentions the case of a female slave, about thirty-two years of age, and the mother of four children, who, whilst weeding Indian corn on a plantation, about eight miles distant from the house, was bitten by a Jararaca on the right hand, between the bones of the forefinger and thumb. He describes both the symptoms and the treatment. The accident took place about eight o'clock in the morning, and immediately after she left to return home, but only reached half way when she was obliged to lie down from excessive pain and exhaustion. At this time she said the feeling of thirst was very great. Some slaves belonging to the estate to which she belonged happened to be near; one of them rode off to inform the manager. When he arrived he found the arm much swollen up to the shoulder, beneath which he applied a ligature. From a cottage in the neighbourhood he got a little hartshorn, some of which he applied to the bite, and caused her to swallow about a teaspoonful in water. Being in a state of high fever, he took about 1 lb. of blood from her, after which she became faintish. She was then removed to the Fazenda, and had two grains of calomel administered to her, and about an hour after a large dose of castor oil. Gardiner saw her the following day, when she still complained of excruciating pain in the hand and arm, to relieve which a linseed meal poultice was applied; and the pulse being 130, and full, about another lb. of blood was taken from the other arm. Next day a number of little vesicles made their appearance on the back of the hand, and a little above the wrist, which, when opened, discharged a watery fluid. For the next two days she continued to suffer much pain, to relieve which poultices were constantly applied. More vesicles formed, and the cuticle began to peel off in the vicinity of the bite. On the fourth day after the accident, when the poultice was removed, she complained of no pain at all in her hand, and on careful examination it was found that gangrene had taken place, all below the wrist being dead, and from the state of the arm there was every appearance of mortification extending. On making an incision into the living portion above the wrist, a considerable quantity of a very fœtid whitish watery fluid discharged itself; and on pressing the arm between the finger and thumb a crepitation was felt from the air which had generated beneath the integuments. She was now very weak, the pulse 136, small and feeble, and she appeared to be fast sinking. Amputation being the only means that seemed to offer her a chance of recovery, Gardiner at once decided to take off the arm. He accordingly performed the operation, and in a fortnight after the stump had healed up, and she was walking about the room. He tells us that four years afterwards he again saw her, and her general health had not suffered in the least, but she had become irritable and ill-tempered.*

This was an exceptionally favourable case. The reader will understand, therefore, that the reptile is looked on with no little dread and alarm, and that every one gives it as wide a berth as they can, although it is naturally timid, and never attacks unless in desperation, and when it imagines its retreat cut off.

Our friend Mr Alexander Fry, the well-known Entomologist, on

* Gardiners' "Travels in the Interior of Brazil, 1846," p. 51.

one occasion had an encounter with them which may be interesting to the reader, and as we have his permission to repeat it, we shall endeavour to do so as nearly as possible in his own words:

"One fine morning I left Rio for an entomological excursion up the mountain of Tejuca, and thence on to a neighbouring mountain called Pedra Bonita, which is situated between the Tejuca and the Gavia, and commands a most extensive and lovely prospect. Its top is nearly flat for a space of many acres, and is covered by small bushy shrubs a foot or a foot and a-half high, very like our bilberry bushes. The sun was high when I reached the top—at his highest and hottest—and the scene that opened upon my view as I breasted the crest of the hill, and gradually obtained a more and more extended prospect, was magnificent beyond description. Even in that land of paradise I remember nothing more beautiful. Pushing on with my eyes fixed on the ravishing scene, I had reached the centre of the plateau without looking at the ground over which I passed. I had brushed through the bilberry bushes as one would through the heather on a Highland moor. Wrapt in the heavenly view, I had paid no heed to my steps, but when I reached the middle something distracted my attention for a moment, and my eye unconsciously caught sight of an object which instantly banished all thoughts of the view from my mind. There! within a yard of my knee, coiled up on the top of one of the bilberry bushes, lay a hideous Jararaca, with his head raised up in the middle of his coils, his eyes fixed upon me, and his mouth gaping wide open. It is the habit of these creatures to open their mouths, and gape ready to strike when disturbed or irritated. Hallo! thought I, here is a dangerous neighbour; discretion is the better part of valour—I'll get out of his way; and I turned a little to the left to slip gently out of his reach. As I did so I just glanced carelessly in the direction to which I was turning, when I involuntarily started back, for there, within a couple of yards of me, on another bush, lay another Jararaca, coiled up like the first, with his head erect, his mouth open, and his eyes upon me. Lucky I noticed you, my gentleman! thought I, and began to slide off to the right, when there, full in my face, lay another Jararaca, coiled up on the top of his bilberry bush—head erect, mouth open, and eyes intent on me. I stood still, and glanced hurriedly round—the recollection raises the hair on my head even yet. There, on every side, lay Jararacas upon

Jararacas. Their black and yellow livery spotted the whole space. The hot sun had summoned them all out to bask in his rays. I had stumbled into a perfect nation of them. There they lay—every head erect, every mouth open, and every eye turned upon me. I thought the way by which I came must at least be free. I looked back. No! they appeared as numerous behind me as before. I must actually have brushed close by some of them as I pushed through the bushes. I was completely surrounded—the cynosure of all eyes—the object of universal attention. It was like a horrid nightmare. I had found my way into Pandemonium, and stood like Satan with all the evil spirits sitting around me in the shape of serpents. For an instant I felt chained to the spot; my heart stood still. But one thinks quick in such emergencies. I had escaped in my way in, and I thought my best chance of escape would be by following the same route out. Gently, gingerly, and slowly I backed my way out of the thick of them, until the bushes were more free from them, when I changed my tactics, took fairly to my heels, and in a series of bounds, more cervine than human, I found myself out of the conventicle."

Our friend may thus say that he has been present at a public meeting or parliament of the Jararacas. From its constitution one might rather describe them as members of the *lower house*, but the silence, decorum, attention to the business in hand (basking in the sun), and the look of quiet but dignified surprise with which they effectually repressed the intrusion of a stranger, must have more reminded him of our Upper House. The shortness of his stay, and the promptitude of his retreat, however, prevented him from obtaining information on some points which excited his curiosity. Where did they all come from, and where would they have all gone to when the meeting broke up and the sun went down? Although the creature is not unfrequently met with in the neighbourhood of Rio, it is generally solitary. It shews what multitudes there must be of them in some localities, and how, until favourable circumstances call them forth and reveal their numbers, we may form most erroneous impressions as to the relative numbers of the animals composing a Fauna.

Miscellany.

---o---

A Capybara Trap.—The Capybara is sometimes caught, or rather I should say killed in traps set for it near the rivers in Brazil. I have reason to know it. I was very nearly caught in one myself on one occasion. It was near Petropolis, a favourite country retreat of the inhabitants of Rio Janeiro. I went fishing one day in a stream which flowed not far from it. After whipping it for some distance without any great success, I came to a part of it where the forest and underwood encroached so much upon the banks that it was impossible to fish. At some distance further down, I knew that the banks were clearer; but I could only reach this clearer part by making a long detour, or else by forcing my way through the jungle along the bank. To save time I took the latter course. I took my rod to pieces and put it up. As I forced my way through the thick jungle I found it more difficult than I had supposed; the thick branches and strong llianas often nearly completely blocked the way, and I was more than once compelled to go down on my hands and knees and creep under them for a longer or shorter distance. In such places I had, however, generally the advantage of something like little sheep roads or hares' paths, made by some of the beasts of the forest—made in fact by the Capybara—they were to a certain extent clear below, but above their height passage was impossible. As I was creeping along one of these paths, on my hands and knees, my attention was most happily, but quite accidentally, drawn to a stake driven into the ground on one side of me—then two or three more in a sort of row; and when I cast my eyes on the other side there was a row of them there too, and obviously converging closer and closer, leaving little more than space for me to pass. What can this be? thought I. Presently I thought the place where I had got was even darker and more gloomy than before, and looking up I saw immediately, just above my head, a mass of something black, not very distinguishable but which looked like a combination of timber and rocks. Decidedly, thought I, discretion is the better part of valour here, and I backed my way most cautiously out. I began to guess what it was. It was a Capybara trap—the stakes on each side were to lead the animal into the trap, and the trap itself was an enormous mass of stone placed on some timbers which rested on the stakes on each side, poised so accurately and gingerly that the slightest displacement of one of these stakes would remove the support and allow the mass to fall. As soon as I got free from it I made my way to its outside, gave one of the stakes supporting it a kick with my foot, when the mass immediately came down by the run. Any animal under it must have been crushed to death. Had I not chanced to observe the stakes I should most certainly have been killed or disabled, and it was a place where, if I had been disabled, I might have lain for days or weeks without any one coming to my rescue or knowing of my fate.—*Alexander Fry.*

Mr R. Spruce on Insect Migrations in South America.—"The first time I saw a house invaded by Cazadoras was in November 1855, on the forest-slope of Mount Campana, in the eastern Peruvian Andes. I had taken up my abode in a solitary Indian hut, at a height of 3000 feet, for the sake of devoting a month to the exploration of that interesting mountain. The walls of the hut were merely a single row of strips of palm trees, with spaces between them wide enough to admit larger animals than ants. One morning, soon after sunrise, the hut was suddenly filled with large blackish ants, which ran nimbly about and tried their teeth on everything. My *chargui* proved too tough for them; but they made short work of a bunch of ripe plantains, and rooted out cockroaches, spiders, and other such like denizens of a forest hut. So long as they were left unmolested they avoided the human inhabitants; but when I attempted to brush them away they fell on me by hundreds, and bit and stung me fiercely. I asked the Indian's wife if we had not better turn out awhile and leave them to their diversions. 'Do they annoy you?' said she. 'Why, you see it is impossible for one to work with the ants running over everything,' replied I; whereupon she filled a calabash with cold water, and going to the corner of the hut where the ants still continued to stream in, she devoutly crossed herself, muttering some invocation or exorcism, and sprinkled the water gently over them. Then walking quietly round and round the hut, she continued her aspersions on the marauders, and thereby literally so damped their ardour that they began to beat a retreat, and in ten minutes not an ant was to be seen.

"Some years afterwards I was residing in a farm-house on the River Daule, near Guayaquil, when I witnessed a similar invasion. The house was large, of two storeys, and built chiefly of bamboo-cane, the walls being merely an outer and an inner layer of cane, without plaster inside or out, so that they harboured vast numbers of cockroaches, scorpions, rats, mice, bats, and even snakes, although the latter abode chiefly on the roof. Notwithstanding the size of the house, every room was speedily filled with the ants. The good lady hastened to fasten up her fresh meat, fish, sugar, &c., in safes inaccessible even to the ants; and I was prompt to impart my experience of the efficacy of baptism by water in ridding a house of such pests. 'Oh!' said she laughingly, 'we know all that; but let them first have time to clear the house of vermin; for if even a rat or snake be caught napping they will soon pick his bones.' They had been in the house a very little while when we heard a great commotion inside the walls, chiefly of mice careering madly about and uttering terrified squeals; and the ants were allowed to remain thus, and hunt over the house at will, for three days and nights, when, having exhausted their legitimate game, they began to be troublesome in the kitchen and on the dinner-table, 'Now,' said Dona Juanita, 'is the time for the water-cure!' and she set her maids to sprinkle water over the visitors, who at once took the hint, gathered up their scattered squadrons, reformed in column, and resumed their march. Whenever their inquisitions became troublesome to myself during the three days, I took the liberty to scatter a few suggestive drops among them, and it always sufficed to make them turn aside; but any attempt at a forcible ejectment they were sure to resent with tooth and tail; and their bite and sting were rather formidable, for they were large and lusty ants. For weeks afterwards the squeaking of a mouse, and the whirring of a cockroach were sounds unheard in that house."—*The Journal of the Linnean Society*, vol. ix., Zoology. No. 38, Dec. 13, pp. 359-60.

A NINE-TUSKED ELEPHANT.

IF the reader will take the trouble to turn to our review of Chapman's Travels in South Africa he will find there mention made of a most remarkable abnormality in the dentition of the Elephant, which occurred in an individual killed near the Zambesi. The phenomenon appeared to us to open up too wide a field of inquiry to be satisfactorily disposed of as a digression in the midst of a review, and we therefore reserved it for discussion in a separate article. The passage in Mr Chapman's work is as follows :—

"The elephant killed by Molefi, otherwise called Rapiet, six years ago, on the Teougé, and which attracted notice from the singularity of its having no less than *nine* perfect tusks, was, he told me, a male. The tusks were ranged five on one side and four on the other. I purchased some of the tusks at the time ; but they had been mixed up with many others, and, when I heard of the peculiarity, they could not be identified. I got Molefi to describe the affair over again, and Baines made a sketch from his description."—(Chapman's Travels, vol. ii., p. 98.)

The reader will remember that Mr Baines accompanied Mr Chapman on the journey referred to, and that Mr Baines had already, some years since, published an interesting account of his travels, entitled "Explorations in South Africa." In that work he speaks of the same elephant in the following passage :—

"One of the most wonderful freaks of nature I have heard of, is an elephant with nine tusks, shot about the year 1856 by this man. It had on the right side five and on the left four, all growing as usual out of the upper jaw. The pair occupying the usual place were of about thirty pounds weight each ; just behind them were a pair somewhat larger, pointing downward and backward ; between these was another smaller pair, and before and behind them in the right jaw were two others, but in the left only one behind, all these being much smaller. I made two sketches, one of each side in his presence ; and there is no doubt of the fact, as Mr Edwards, the partner of Chapman, bought six of the tusks ; the head unfortunately was broken up."—(Baines' "Explorations in South Africa," p. 454.)

Mr Chapman is in South Africa, beyond reach of our interpollations, but Mr Baines fortunately resides in London, and we have thus been able to obtain some additional details from him personally. That eminent traveller has not only most liberally placed his sketches of the nine-tusked elephant in our hands, with permission to use them, but has also had the kindness to make drawings from them for the accompanying woodcuts, the two first being taken from the original sketches, and the third, with the mouth open, an imaginary sketch made at our request to shew our idea of the real position of the teeth, and which he has been willing to execute notwithstanding that it is opposed to his own convictions on the subject.

The elephant in question was, as above mentioned, shot by a Bechuana named Mahura or Rapiet (that is, the father of Peter, it being it seems the custom in that country to call the parent after his first-born son), and both Chapman and Baines consider his testimony on this point honest and reliable—a conclusion in which the anatomists who have seen the sketches concur, from the intrinsic evidence of the apparent position assigned to the abnormal teeth. Although Baines and Chapman did not see Rapiet until some six years after he had shot the elephant, the subject had surprised himself so much, and attracted so much attention in the country, that it remained fresh in his recollection. Mr Baines made a drawing of the head and tusks in his presence, and took great care to place them according to his account of their actual position. Rapiet gave him no reason to imagine that any of them grew anywhere but in the upper jaw, and Mr Baines tells us that he is quite sure that if either of them had grown from the lower jaw he would have told him of it. Mr Baines consequently supposes that they all grew as usual from the socket of the tusk above the upper jaw. We think, for reasons to be presently mentioned, that he must be wrong in this, as he certainly is in an analogy which he suggests, and which we only note, that it may not be said that we have kept back anything relating to such an interesting case. He says :—

"I do not profess to account for it, but if I mention that the Kak tribes, by splitting the horns of the young calves, cause them to grow into any number of branches, as the animal attains maturity, it may be suggestive to those who wish to investigate such cases. I have seen many instances of deformed, distorted, or broken tusks, the fractured parts of which were overgrown with nodules or excrescences of ivory."

Mr Baines has also shewn us a sketch taken from a dead elephant, in which one of the tusks is turned up in the ordinary way, and the other turned down like the two additional large ones in this mammal. This is all that we know, or are ever likely to know, regarding this extraordinary case, and it was a most fortunate chance that sent Mr Baines to the spot to take the sketches from the description of the man who saw it, killed it, ate it, and sold it.

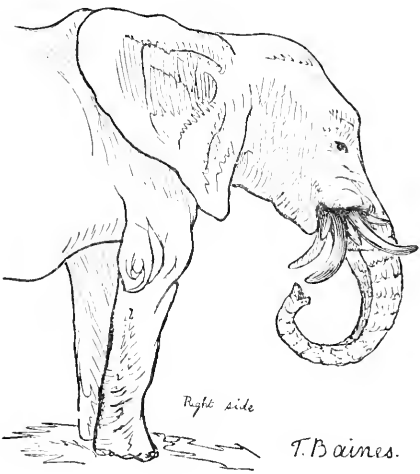


Fig. 1.

The woodcut, fig. 1, is taken from Mr Baines' sketch of the right side of the head, fig. 2, from that of the left side (both drawn in Africa).

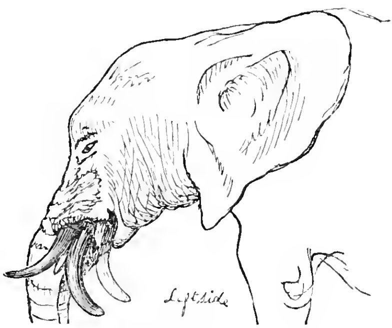


Fig. 2.

When Mr Baines put these into our hands, our first step was to endeavour to decipher the problem they presented—to bring the huddle of tusks into something like order, for, however incongruous in appearance, they could not be disposed at chance, or according to no law. It is true that Nature sometimes takes strange liberties, refusing to be bound by the strict rules to which our ideas of homological propriety would confine her; and our knowledge of teeth and their developments is still anything but satisfactory. Unaccountable, or rather unaccounted for, monstrosities are preserved in bottles in surgical museums, where teeth appear in strange and unwonted places, and extraordinary variations in the dentition of otherwise perfectly normal individuals occur. Falconer, for example, figures (Palæont. Mem., vol. ii., pl. 21) the right lower ramus of a rhinoceros jaw, which possesses two premolars, four nearly equally worn, for which it has no manner of excuse on the plea of ancestry—and many similar deviations might be collected. Speaking generally, however, there is a place for everything, and the only barrier to our interpreting every deviation from ordinary rule is our own ignorance of the laws regulating them. In the present case we entered on the inquiry with the advantage of being able to identify at least two of the nine tusks (the ordinary tusks), and were thus provided with a starting-point to serve as a guide to determine the character of the rest. Wisely distrusting, however, our own qualifications, we had recourse to the assistance of two experts, to whose judgment all would be likely to defer. Mr Boyd Dawkins and Professor Huxley have carefully considered the sketches and facts, and their opinion is expressed in the following letter from Mr Dawkins (which he allows us to print):—

"I thank you much for the remarkable sketch, which has a very important bearing on the theory of descent with modification. To go into the matter as it deserves would far exceed the limits of a letter. Before, however, I briefly recapitulate what strikes me at sight, I would say that I accept the truth of the story told, after the lapse of six years, by an African hunter, although the Africans, as a rule, beat even the Cretans in lying. The peculiar form of the tusks, and their insertion into the jaw, could not have been the offspring of African shrewdness. There is, however, one point in which the sketch seems to be rather obscure. The large downward and backward curving tusk *c* apparently springs from the same alveolar base as the large normal tusk *b*, in the sketch of the right hand side of the head. It is altogether impossible, so far as we know of the development of teeth, that two tusks of that magnitude could co-exist in the same pre-maxillary. Their diverse curvature also would oblige their alveoli to assume a diverse direction. Therefore, I take it that *c* and *b* do not belong to the same pre-maxillary, as is shewn in the sketch of the right side, but to the upper and lower jaws, as seems to be represented in the sketch of the similar tusks in the left side of the head. On the assumption of the truth of this inference, the incisive dentition is full of the deepest interest. Falconer wrote, in 1856, an essay to prove that the teeth of Deinotherium Elephas and Mastodon formed one series, and in 1862 (in his essay on E. Columbi, Nat. Hist. Rev.) he committed himself to the conclusion that those three genera sprang from the same common ancestors, and not from one out of the three. Now, had I to construct an ideal ancestor for the three genera, its incisors would assume very much the form of those of the sketch. Elephas would necessitate two large upward curving tusks in the pre-maxillary; Mastodon, two straight tusks in the lower jaw *g* and *h;* and Deinotherium, two downward curving tusks, also on the lower jaw. I cannot believe that anything happens by accident in nature, and, therefore, I would attribute this abnormal incisive dentition to the law of recurrence to an ancestral type, just in the same way as Darwin accounts for the recurrence of the colour in domesticated breeds of pigeons. On any other hypothesis it remains a stumbling-block, and a riddle without an answer. All the elephants possess $\frac{\text{di } 1 \quad 1\ 1}{\text{di } 0 \quad 1\ 0}$, but all the Mastodons $\frac{\text{di } 1 \quad 1\ 1}{\text{di } 1 \quad 1\ 1}$, all the Deinotheria $\frac{\text{di } ? \quad 1\ 0}{\text{di } ? \quad 1\ 1}$. This elephant possessed the incisive characters of the other two genera, plus other smaller teeth, normally undeveloped in the elephant Deinotherium and Mastodon. The teeth seem to be as follows :—

Upper	Left—Incis.	$1 + 1 + 1 = 3$	Under	Left—Incis.	$1 + 1 + 0 = 2$
	Right "	$0 + 1 + 1 = 2$		Right "	$1 + 1 + 0 = 2$

The smaller upper incisors *a* and *c*, which are found in none of the three genera, seem to me to be the result of a struggling after the full complement in the Herbivora. If the first small incisor *a* be in its true place, then the tusks of Elephas are not incisors one, as they have always been considered to be, but incisors two."

Fig. 3.

Fig. 3 shews the disposition of the teeth as thus deciphered. A glance at the lower jaw of the Deinotherium and Mastodon, will shew the acuteness of Mr Dawkins' diagnosis, and the *vraisemblance* of his interpretation. Fig. 4 shews the lower jaw of the Deinotherium, and, looking at Mr Baines' sketch of the left side of our elephant, it can scarcely be doubted that the large downward and backward curving tusk, which we shall denominate the Deinotheroid tusk, is the homologue of the tusk in the Deinotherium,

Fig. 4.

and that it must have grown in the lower jaw. As Mr Dawkins justly says, there is no room for such a tusk in addition to the normal tusk in the pre-maxillary bones, and although it is not even free from difficulty to imagine how it could find room in the lower jaw, especially from want of length, the difficulty is undoubtedly less there than in the upper jaw.

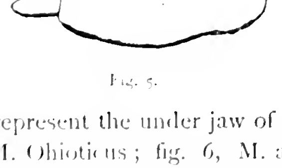


Fig. 5.

Figs. 5, 6, and 7 represent the under jaw of different species of Mastodon (fig. 5, M. Ohioticus; fig. 6, M. angustidens; fig. 7, M. longirostris), and we imagine still less difficulty will be felt in accepting the small straight projecting teeth (which we shall call the Mastodontoid tusks), seen between the two large tusks in our elephant as the homologues of the projecting incisors in the

Mastodon. But here an interesting question arises—What incisor, in point of order, do these tusks represent? Heretofore, we have been accustomed to consider the tusks of the Deinotherium as representing the same incisors (in their order) as those of the Mastodon—that, in fact, the lower jaw of the Deinotherium was merely that of the Mastodon bent down, and that these, as well as the tusk of the elephant and Mastodon in the upper jaw, represented one and the same incisor (in order) in all. We do not know that there is any authority for the belief, or that any one has made it actually the

Fig. 6.

subject of investigation; indeed, there have hitherto been no *termini habiles* from which such an investigation could proceed, but Mr Dawkins informs us that he considers that the current belief among palæontologists is, that the tusks in all three represent the same incisor, based, so far as can be made out, on a theory that if any incisors of any beast be undeveloped, they *must* be either I. 2 or I. 3; but, as he admits, *adhuc sub judice lis est*. Up to this time the theory could not be called more than a conjectural hypothesis. The new information contributed by this elephant, however, would seem to sweep this theory clean away, and teach us

Fig. 7.

that all the incisors are equally liable to non-development, and that in the same family now one, now another, and again a third, may in their turn be the subject of excessive development at the expense of the other.

Taking six incisors as the typical number in all herbivorous animals—that is, three on each side in each jaw, under the theory alluded to by Mr Dawkins—the incisor which should be most developed should always be the first, and if two only are present, then the two first; but we should read ordinary facts differently. In mammals generally, we think (*e.g.*, carnivora, cattle, deer, &c.),

where the full complement of incisors is present, the most developed incisors are the outermost—I. 1 is the smallest, I. 2 next smallest, and I. 3 largest; and if we carry the canines into the inquiry the position is still stronger: and we imagine that we may fairly on this point reckon the canines as outer incisors. Although springing from another bone, their form and intimate structure assimilates them with the incisors rather than the molars. Facts would appear, therefore, rather to tend to the opposite conclusion from that of the theory. It would seem reasonable that the incisor, which is most largely developed in general, should be that which would be preferably developed in the case of a diminution in the number. But the position of the tusks in this nine-tusker shews that both conclusions are erroneous. According to the theory the normal tusk of the elephant is incisor 1, but in the nine-tusker there is a small tusk in front of the large tusk, and it must therefore be No. 1, so that the normal tusk is incisor No. 2; and our supposed contrary position, that it should be No. 3, based on the outermost incisor being generally the largest, is also shewn to be untenable, because in the nine-tusker there is a small tooth behind the normal tusk, which must be No. 3. The truth seems to be, that any of the incisors may take special development as a specific character. And in the case of the Mastodon, Elephant, and Deinotherium, we think there is reason to hold that all three have been respectively so developed in turn. It appears to us that the tusk of the Mastodon represent incisor No. 1, that of the Elephant incisor No. 2, and that of the Deinotherium incisor No. 3.

We take the occurrence of a small tusk in front of and another behind the normal tusk in the nine-tusker to be *probatio probata*, that the tusk of the Elephant is incisor No. 2. If that is settled it breaks up the theoretical rule, and we have then only to go by probabilities drawn from analogies and resemblances.

Now, the very first of these probabilities, drawn from analogy, is, that as the tusk of the Elephant is incisor No. 2, so should the tusk of the Mastodon and the tusk of the Deinothere. But that this cannot be the case is at once shewn by the representative tusk of both the Mastodon and Deinotherium being *both* present in the under jaw of our nine-tusker. They cannot both be the second incisor; consequently, the analogy from the developed tusk in the Elephant being incisor No. 2 falls to the ground. The special development is obviously not the same in all three, and as the Mastodontoid tusk is the inner one, it cannot be the third. It must either be the second or the first. It must either be homologous with that of the Elephant, or else be incisor No. 1. Now, in estimating the probabilities for and against this, we do find some slight differences between the tusk of the Mastodon and Elephant. In dealing with the tusks of the Mastodon we are here assuming that both those in the upper and under jaw represent the same incisor. It is only an assumption, but the laws of symmetry will probably bear us out. We are obliged to assume it, or we should not be able to compare the two, for it is obvious, that if the upper and under Mastodon tusks do not represent the same tooth, we have nothing to compare with the tusks of the elephant. We might compare the upper tusks of the Mastodon with them, but if they are not the same as the under tusks the argument would not affect the latter. Assuming them to be the same, the differences between them and those of the Elephant's are, first, that they are somewhat differently shaped ; they project nearly straight forward, being only slightly deflected from the line of the molars. This at least, so far as it goes, is not an argument for identity of tooth, but rather the reverse. Next, they are proportionally smaller than the tusks of the Elephant and Mammoth. If we are right in regarding the inner incisors as the smallest, this points to their representing an incisor within that of the Elephant. Their texture may furnish another plea.

Mr Baines mentions one commercial fact relating to the teeth of the Hippopotamus, which may or may not have some bearing on this point. It appears that the canine teeth in the lower jaw of the Hippopotamus are of finer and better texture than the projecting incisors. Mr Baines says that the latter do not sell for ivory, while the canines do. We have above said that there seems no reason in such a question as this for putting the canines in a different category from the incisors. But although we were to do so, it would not affect our argument, which is, that if the dentine of the Mastodon's tusk is inferior to that of the Elephant, it is a symbol of inferiority of development ; and inferiority of development is the character of incisor No. 1, as compared with incisor No. 2—size and development being here convertible terms. Now, we have very little comparative knowledge of the dentine of the respective merits of the tusks of the Elephant and Mammoth. The only published information which we know on the subject is two figures of the microscopic structure of each highly magnified, given by Professor Owen in his "Odontography" plates. In these the dentine of the Mastodon certainly seem less dense and fine than that of the Elephant. With the view of throwing further light on this point, Mr Waterhouse of the British Museum has kindly caused a section to be made of a portion of the tooth of the lower jaw of the Mastodon and of the tusk of the Deinothere. Unfortunately the two teeth were not in an equal state of preservation, which somewhat vitiates the result, but so far as it goes it shews a closer and finer consistency in the Deinothere than in the Mastodon.

For these reasons, slight though they be, we are inclined to regard the tusks of the Mastodon as being incisor No. 1, the Elephant's tusk being incisor No. 2. The temptation is great to regard the tusks of the Deinothere as being incisor No. 3.

The wish, perhaps, is father to the thought. It would complete the series and harmonize with the succession propounded by Mr Falconer for the other teeth of the three genera. It seems, too, not unnatural that, when we find that the difference in the teeth of two out of three of the forms of the same type makes its appearance in different incisors, we should, when we find a third difference in a third species, expect it to be manifested in another also.

The most formidable objection seems to be that the symmetry of the two jaws in the nine-tusker would require that the large teeth in each should represent the same incisor in point of order. There is, however, what appears to us a good answer to this. In the Mastodon we know the tusks of the lower jaw are greatly smaller than in the upper, and if this is to be accepted as a guiding rule, it would follow that the Deinotheroid tusk in the lower jaw of the nine-tusker is actually larger than the normal tusk in the upper jaw, instead of being smaller, and, consequently, cannot represent the same tooth. And this is one of the reasons for supposing it to be incisor 3—for the incisors, increasing in size gradually outwards, the largest should come last. And if we increase the size of the Deinotheroid tooth in the same proportion that the Mastodontoid tooth has to be, to give it the proportions of an upper tusk, it would greatly exceed in size the Elephantoid tusk. And the same remark applies to the Deinothere itself. At first sight there would seem to be no means of comparison between the tusks of the Elephant and those of the Deinothere, the one being on the upper jaw, and the other in the lower. But if we take the proportion of the size of the head into account, the proportion between the lower and upper tusks of the Mastodon as a guide, and increase that of the Deinothere to the same degree, we should then have to enlarge it by three or four times before comparing it with the tusk of the Mammoth—when we should find it vastly thicker, and not much inferior to it in length; and the thickness is of more importance than the length, as indicating better the size of the socket. The enormous thickening of the deflected beak, or prolongation of the symphysis of the lower jaw in the Deinothere, is another argument indicating unusual size. How far the actual position of the tusk in this, as made out from young individuals, will further corroborate our view, we must leave to observers who have the opportunity of making the examination to determine. The texture of the tusk of the Deinothere, so far as we can make out from a microscopic examination of sections in the British Museum and College of Surgeons, seems to us to harmonize with this view—its density and closeness being apparently greater even than of the Elephant.

Before closing we should like to say one word on Falconer's view, adopted by Mr Dawkins, that the three genera must have sprung from one common ancestor, and not from one out of the three, to which the reduction of their dentition into regular distinct series (like three tunes played on different keys on the same instrument) lends support.

We may observe, however, that this is not a necessary corollary to there being in each a distinct series of teeth. As Mr Falconer says elsewhere ("British and European Fossil Mastodons," Palæont. Mem. ii., p. 17 and 18)—"Although the Mastodon of North America and the Mammoth are so widely different in the form of their molar teeth, that they must be ranked under distinct genera, the intermediate gradations are so complete as to establish a passage from one into the other." And we can see no necessity requiring the evolution of each form directly from the first common ancestor, possessed of the proboscidean qualities; they may be so evolved directly, but there is nothing to hinder one or more of the series remaining concealed and undeveloped through a long succession of only one of the forms; and when the proper conditions for its evolution occurred, that it should then, and only then, make its appearance. EDITOR.

ON MR WALLACE'S THEORY OF BIRDS' NESTS.

By the Duke of Argyll.

THE "Theory of Birds' Nests," published in No. 2, Vol I. 1868, of this "Journal," by Mr A. Wallace, is a theory which appears to me to be altogether unsound. It rests upon an ingenious but a very partial and a very arbitrary selection among the facts of nature; it takes no account whatever of many of those facts which are nevertheless conspicuous; and it is supported by arguments which are often inconsistent with each other.

The theory itself is prefaced by some general observations to which also I venture to take exception. I propose in this paper to deal with the various propositions of Mr Wallace in the order in which they occur, whether in the prefatory remarks, or in the more formal exposition of the theory itself.

In the first place, then, Mr Wallace condemns "the very general belief that every bird is enabled to build its nest by means of some innate or mysterious impulse," and he opposes to this belief, as the true doctrine, that birds are enabled to build their nests "by the ordinary faculties of observation, memory, and imitation."

Now, as the young bird which (in England) is born in May or June 1868 will proceed in April or May 1869 to build a nest as perfect and as beautiful as that in which itself was hatched, I do not see how either memory, or imitation, or observation can have anything to do with its architectural powers. It is true, no doubt, as Mr Wallace observes, that some birds (some only) shew considerable intelligence in "modifying the position, form, and material of their nests to suit the changed conditions with which the presence of man surrounds them." But this margin of variation, like all the modifications of mere instinct, is confined within narrow limits; and this degree of intelligence, whatever it may amount to, is itself hereditary and innate, so that it is no greater in an old bird which has seen many summers than in a young bird which has not seen more than one, and never can have seen any nest constructed. The innate character of the physical powers and tendencies which lead to nest-building, is well seen in the chick of the Telegallus, which begins scratching and scraping up the ground the moment it quits the egg, in unconscious but instructive exercise of the peculiar habit by which the Hatching Mounds are afterwards to be constructed.

Mr Wallace next observes that the habit of ascribing of nest-building to innate impulse "has had the bad effect of withdrawing attention from the very evident relation that exists between the structure, habits, and intelligence of birds, and the kind of nest they construct." But no such effect has arisen or can possibly arise from the doctrine he condemns. Those who believe that the nest-building instinct is innate, believe also, of course, that the structure and habits, and intelligence of birds are all equally innate, and are all strictly correlated together.

Mr Wallace next proceeds to give some explanation of the peculiar nests of some birds as necessarily resulting from the physical structure of those birds themselves. I do not think this explanation is successful. Thus the Caprimulgidæ are said to be physically incapable of weaving together moss, or fibres, or wool into a strong well-constructed nest, because of their small broad bills, and their feet weak in grasping power. But some of the most perfect nests in the world are made by bills apparently quite as ineffective—as, for example, the beautiful nest of long-tailed Tit. The bill of this bird is extremely short, and not very pointed. Nor does a strong grasp of foot seem necessary for the building of a nest on the ground. On the other hand, many birds with a "well-formed and pointed bill" make no nest at all—as, for example, the Terns and Sandpipers. Nor is it true that no good materials are to be found in the haunts of these birds. Dried sea-weed, and the grasses and other plants which grow in abundance on the margins of lakes and seas and rivers, are admirable materials for being woven, nor could any implement be apparently more admirably adapted for weaving them than the bill of a Tern or a Sandpiper. Mr Wallace has missed the real explanation in his determination to accept no explanation which is not rooted in a mere physical cause. There is a reason—a very manifest *reason*—why Terns and Sandpipers should not make elaborate nests; but there is no physical cause rendering it impossible for them to do so. The reason is simply this, that birds which require to breed upon the open ground, must, for the purpose of concealment, make nests as small and inconspicuous as possible. Even the very least collection of materials upon a particular spot attracts the eye at once as it ranges over any uniform or slightly varied surface; and the instructive knowledge and feeling of this fact has been given to the birds whose habitat is the ground, as a necessity of their existence and of the continuance of their species. Many species make no nest whatever, and, in general, the purpose of concealment is still more perfectly secured by an admirable adaptation of the colour of the eggs to the colour of the ground.

Mr Wallace next looks out for other physical causes as determining bird architecture. "Two other factors," besides the structure of the bird, he specifies—one is the effect of changes in external condition, producing corresponding changes in the form, or the material, or the situation of nests; the other is the influence of hereditary habit, tending to preserve such modifications even after they have ceased to be directly useful. But hereditary habit is merely another form of expression for an instinct. Hereditary habit is an inborn tendency to do certain things in a certain manner—a tendency purely congenital and quite independent of experience or observation of any kind. So far, therefore, I agree with Mr Wallace, although here he does not appear to agree with himself, that this is not only a "factor," but the most powerful factor of all in the nest-building of birds. I agree also with him that external conditions, or what he calls "environment," is another factor—for the very obvious reason, that both the structure and the implanted instincts of birds must be correlated with the external conditions in which they are intended to live. But this is an explanation only in the sense of indicating a purpose which we perceive, and which we see to be actually attained. It is no explanation at all in the sense of even suggesting any instrumentality which we can understand. The reason why such correlations should exist is as clear as day. The physical causes by which they have been brought about are as dark as night.

So far I have been dealing only with Mr Wallace's preliminary observations; but these are intended to prepare the ground for the new theory which follows. It is necessary, therefore, to look carefully to the drift of these observations, and to the direction in which they are intended to lead us.

Nest-building, then, is represented as determined--

1. By the ordinary faculties of observation, memory, and imitation.
2. By the organic structure of the bird itself—the shape of its bill, feet, &c.
3. By hereditary habit.
4. By "environment" or surrounding conditions.

It will be observed that of these four factors, all, except the first, are consistent and closely connected with "blind instinct." In as far as the nature of a bird's nest is determined by its own structure, and by hereditary habit, and by surrounding conditions, in so far it is determined by conditions over which the bird itself has no control, and which belong to it as part of its very constitution and nature.

We now come to the first sentence which foreshadows the coming theory. Specifying the structure of a bird, and its environment as to the most important elements in determining its kind of nest, Mr Wallace proceeds thus :—

"If, therefore, we find less important and more easily modified characters than these correlated with peculiarities of nidification, we shall be justified in concluding that the former are dependent on the latter, and not *vice versa*."

The obscure wording of this sentence makes it rather a hard one to construe or to follow : but, taken with the context, I believe the argument to be this—When two things, or two sets of things, are correlated together, the one being more fixed or less changeable in its nature than the other, we may conclude that the most changeable is "dependent on" the least changeable (as on its physical cause ?). The reasoning, then, as applied to the question in hand, may be stated thus :—

"The structure and habitat of birds we find to be correlated with certain peculiarities in their nesting ; but structure and habitat are both comparatively fixed and difficult of change ; the peculiarities of nests are therefore dependent on the peculiarities of structure and of habitat in birds. But if, on the same principle, we can find any other circumstance about birds which also is correlated with peculiarities of nesting, but which is more easily capable of change, then we may conclude that this circumstance is one dependent on the nature of the bird's nest and not *vice versa*."

The fallacies which lie hid in this argument are about as numerous as the words which it contains. In the first place, the definition of the peculiarities which are selected as correlated together may be altogether fanciful and arbitrary ; in the second place, things which are really correlated together, whether always or only in general, may have no "dependence on" each other as physical cause and effect, but may be and often are the result of some cause or causes which lie above and behind them both ; in the third place, the changeability of any peculiar character may be an assumption as arbitrary as the definition and conception of the peculiarity itself.

To test these fallacies we may take a case. Sandpipers, Grouse, and in general all the larger birds which lay upon the ground, make a very scanty nest, some of them no nest at all. Let us, then, apply the argument of Mr Wallace. As nests are determined by structure and by habitat, they are comparatively fixed. The colour of birds is comparatively unfixed, and liable to change. Therefore, the scanty nests of ground-laying birds are the cause of their peculiar colour—the peculiarity of that colour being, that it is in general assimilated to, or correlated with, the colour of the ground which they inhabit.

But there is no need of testing the fallacy of Mr Wallace's argument by referring to any cases beyond those which he has himself selected. His classification of facts is as arbitrary and unnatural as any which could possibly be chosen for the purpose of shewing how arbitrary and how unnatural a classification can be made. Let us see what it is. "Considering," he says, "the main purpose of birds nests to be the protection of the eggs, and the *security and comfort* of the young birds, we may group them under two primary divisions, *according as they more or less completely fulfil this important function.*" But there are no such primary divisions in nature, from this very obvious cause, that all birds are on a perfect equality as regards the completeness with which these two great objects are attained. The young Guillemot or Fulmar, which is hatched upon a naked ledge of rock, without a scrap of nest, and exposed to all the storms and rains of the Atlantic, is as "comfortable" and as "secure" as the young of the Golden-crested Wren which sways in a dome of well-woven moss under the breezes which reach it in a wood of pines. These modes of nesting are indeed very different, but in respect to providing for the "comfort and security" of the young, the one is as perfect as the other; and amidst the vast variety which prevail in the nests of birds, this one great purpose is secured with equal certainty in them all.

The very idea of this classification, then, is erroneous from the beginning. But the manner in which it is applied brings out its artificial character still more clearly. "In the first of these two primary divisions," continues Mr Wallace, "we place all those in which the eggs and young are hidden from sight, no matter whether this is effected by an elaborate covered structure, or by depositing the eggs in some hollow tree or burrow under ground. In the second (primary division) we group all in which the eggs and young and sitting bird are exposed to view, no matter whether there is the most beautifully-formed nest or none at all." Here we have a classification of birds which professes to be founded on their nests, but which, nevertheless, treats as matters of perfect in·difference the structure, and the material, and the situation of those nests—which brings into one group the long-tailed Tit, which builds a receptical for its eggs and young of the most exquisite beauty, and the Kingfisher, which vomits a few bones in the bottom of a hole and lays its eggs upon them. In like manner it groups together in the second class birds which build with every variety and degree of skill, and birds which build no nest at all, but lay their eggs upon the bare ground. Mr Wallace is so absorbed in his preconceived idea that he faces this result without any apparent consciousness that it makes a very near approach to a *reductio ad absurdum*. "It will be seen," he says, "that this division of birds, according to nidification, bears little relation to the character of the nest itself. It is a functional, not a structural, classification. The most rude and the most perfect specimen of bird architecture are to be found in both sections."

But Mr Wallace does not see that even his idea of the "function" of birds' nests, as distinguished from their structure, material, and situation, involves total forgetfulness of some of the most important circumstances which determine their fitness for the discharge of that function. The one circumstance on which Mr Wallace fixes his attention, regardless of all others, is the circumstance whether the eggs and young of sitting birds are or are not what he calls "exposed to view." That is to say, he makes, or professes to make, the one circumstance of concealment his principle of classification. But this principle he applies only to the contents of nests, and not to the nests themselves. He forgets that the very form or structure of nests which most completely covers up the eggs, or the sitting bird may, and often does, render the nest itself only more conspicuous. Thus a domed nest is a larger structure, and one more easily observed than the smaller nests, which are nevertheless open and uncovered at the top. But, for the purpose of security and concealment, a nest is perfectly useless which merely covers up the eggs, but attracts attention to itself by its bulk, or its peculiarity of structure. It is the situation of nests, and their closed or open character, on which their safety from concealment depends. Predatory animals, from which danger to nests arises, do not require to see the eggs if they can see the nest. If they can find a nest, they know very well what they will find inside of it. Any schoolboy who has ever nested in the woods of our own island would detect the fallacy of classifying nests as regards their efficiency in point of concealment according to their open or domed structure. Many of the nests which are the best concealed are the slightest, the shallowest, and the most open. Some of those, on the contrary, which are most easily and most commonly found are those which are necessarily bulky from the very perfection of their architecture. Few nests are more easily found than those of the common Wren, and this in spite of the most wonderful constructive skill in adapting the material of the nest to the vegetation among which it may be placed. But the compactness of the structure, its size, and its beautifully domed shape, very readily betray it to the eye. On the other hand, the comparatively shallow and loose nests of the Blackcap, Garden Warbler, and Whitethroat, are most difficult to find, on account of their very slightness, rendering them singularly inconspicuous among the tangled growths in which they are skilfully concealed.

So far, then, it does not appear that Mr Wallace's idea of the functional perfection of nests, if consistently applied, would at all justify the classification which he seeks to found upon it. On the contrary, the function of concealment is secured very often with the least degree of efficiency by the very kind of nest which he represents as securing it most completely.

We now come to the special theory for which Mr Wallace has been preparing the way. "Turning from the nests to the creatures who make them, let us consider," says Mr Wallace, "birds themselves from a somewhat unusual point of view, and form them into separate groups, according as both sexes, or the males only, are adorned with conspicuous colours." There is, no doubt, a very remarkable difference among birds in this respect. There is a large number of species among which the rule prevails, that bright colours are confined to the male, the females having plumage of dull or neutral tints. There is, on the other hand, another large number of species among which this rule does not prevail, and in which both sexes are equally brilliant in their colouring. Now, two questions arise in respect to these facts. One question is this, "Can any reason be assigned why dull colouring should be given to the female birds of any species?" The second question is this, "Can any physical cause be discovered by which this object, if it be an object, has been carried into effect?"

To the first of these questions, at least as regards many species, there is an obvious and satisfactory reply. There is a reason, and a conclusive reason, why the female bird in some species should be dull coloured. Take the case of the common Pheasant, which is a type of a large class similarly conditioned. If the hen Pheasant, which lays its eggs upon the ground, were as brilliantly coloured as the male, she would be so conspicuous an object to every predatory animal that the species would be speedily exterminated. This, therefore, is a sufficient reason why she should be dull coloured, and totally dissimilar from the male. But as regards the second question, by what physical cause it is brought about, that this good reason should be met and complied with, no answer can be given. Mr Wallace himself makes an observation which effectually disposes of the one "law," in the sense of a physical connexion of cause and effect, which would most naturally suggest itself. The observation I refer to is this:—That the fact of both sexes being equally brilliant in many species shews that there is no absolute and physical connexion between the male sex in birds and a brilliant plumage. All, therefore, that can be said is, that it is one of those special adaptations for special purposes which are so abundant in nature, but which leave us absolutely in the dark as to the physical agencies by which they are secured.

And if this be the object, or the reason, or the "final cause," of the dull colouring in the female in Pheasants, it is extremely probable that the dull colouring which prevails in the females of other species is connected with the same great purpose; and it is equally probable that when brilliant colouring is given to female birds, the circumstances and conditions of their nesting are such as to dispense with this particular protection, which is so necessary under other circumstances and other conditions.

Accordingly, Mr Wallace announces the law, or the generalized expression of the facts in this matter, to be as follows:—"That when both sexes are of strikingly gay or conspicuous colours, the nest is of the second class, or such as to conceal the sitting bird; while, whenever there is a striking contrast of colours, the male being gay and conspicuous, the female dull and obscure, the nest is open, and the sitting bird exposed to view."

Such is Mr Wallace's statement of the facts—and now we have his explanation of the physical cause. "The mode in which this has been effected is very intelligible, if we admit the action of natural and sexual selection. It would appear from the numerous cases in which both sexes are adorned with equally brilliant colours, that the normal action of sexual selection is to develop colour and beauty in both sexes by the preservation and multiplication of all varieties of colour in either sex *which are pleasing to the other*. The female bird, however, while sitting on her eggs in an uncovered nest, is especially open to the attacks of enemies, and any modification of colour which rendered her more conspicuous would lead to her destruction and that of her offspring. All variations of colour in this direction in the female would, therefore, sooner or later be exterminated, while such modifications as rendered her inconspicuous by assimilating her to surrounding objects, as the earth or the foliage, would, on the whole, be preserved the longest, and thus lead *to the attainment* of those brown or green and inconspicuous tints which form the colouring (of the upper surface at least) of the vast majority of female birds which sit upon open nests."

Let us now analyze the assumptions which are involved in this theory of the physical causes, whereby opposite systems of colouring have been produced in birds.

It assumes that there is some innate tendency in the plumage of all hen birds, or at least of the hens of certain species of birds, to become as brilliantly coloured as the cock. It assumes, in the second place, that this colouring, when produced, is always more pleasing to the other sex than dull colouring. It assumes, for example, that a cock Pheasant would be much better pleased if he could have a wife coloured like himself than a wife coloured like the ground—an assumption which, by analogy, as applied to our own species, would require that men ought to prefer for wives the most masculine-looking women. It assumes, in the third place, that this innate tendency to the development of bright colours has no other limit than the extermination of the unfortunate hens on which it is exerted. It assumes, in the fourth place, that somehow, as these individual bright hens come to be all killed off, this dangerous tendency gets so snubbed and discouraged in some other individuals that it ceases to act upon them. It assumes, in the fifth place, that alongside of this tendency to produce bright hues there is all the time another tendency opposite but equally innate to produce dull colouring, imitative of the colours of the ground or of the habitat of the bird. It assumes, in the sixth place, that this opposite tendency of colouring becomes encouraged and confirmed in certain individuals by some kind of knowledge or intimation conveyed to it, that the birds upon which it works have a better chance of life than others, and that other hens have been killed as a penalty for their brightness.

I need not comment on the gratuitous and highly imaginative character of these assumptions. But there is one peculiarity attaching to them which is well worthy of attention. The whole theory is intended to substitute what Mr Wallace would call a self-acting system of causes for the purpose of a contriving Mind. And yet it is very curious to observe, that the only plausibility which the theory possesses is in the appeal which it involves to the idea of experience, and the effects of experience upon Mind—that mind being supposed to exist in some such abstraction as "nature," or "correlations," or in some other form of words which serves to cover up and conceal the essentially mental attributes which are nevertheless invoked. For example, there is clearly no causal or physical connexion between the destruction of one bird and the cessation of a tendency to bright colouring in another bird which is not yet born or begotten. If that tendency be a blind force it must act blindly constantly, and irrespective of all consequences. If it ceases to operate because of the bad effects which it produces, it must be conceived of as a sort of living thing. The stopping of its works, and the need of that cessation, can no otherwise be brought together. The only idea which can lead any mind to place these two facts in such a connexion is an idea founded on its own consciousness of experience and observation, and of the course which itself would take to avoid and prevent evil consequences. It then ascribes (unconsciously) a similar self-consciousness to nature or to the correlated forces of nature, and under this assumption the connexion between the facts is represented as intelligible. And no doubt if the tendency to bright colouring is conceived of as a power or force gifted with the attributes of Mind, and able first to see and then to foresee the result of its own works, then the cause of the cessation of that working does become intelligible enough. But if it be a blind material force always present and always operating, then it is utterly unintelligible how it should cease to operate because of the mischief it does.

It will be observed, too, that as this theory always represents the actual colouring which we now see in any species as the result of a long process of "selection," it must assume that the species has started from a condition of colouring different from that which we now see. Thus, the cock Pheasant has "attained" to the brilliant plumage he now wears by the admiration and selection of successive hens. Therefore, the cock Pheasant is assumed to have begun originally from a dull colour. But the hen, on the contrary, has "attained" to her dull colouring by the continual destruction of preceding hens. Therefore, the hen Pheasant is assumed to have begun originally from a brilliant colouring. Of course this is a theory of such admirable elasticity that it is capable of being adapted to any facts whatever. If they don't suit the theory, when read straight forwards, it is only requisite to turn them round and read them backwards, and one way or another they can always be made to fit.

I wish, however, to observe that in my opinion it is not possible to assign a reason any more than a physical cause for many of the peculiarities of nest-building. Take the case of the Blackbird and the common Thrush—birds closely allied, and building very much in the same situation. Why should the Thrush always line her nest with mud, and the Blackbird always with fibrous roots? No answer can be given. In like manner may other species, closely related in structure, in habitat, in food, have fixed and persistent differences in their architecture. I am more and more convinced that variety, mere variety, must be admitted to be an object and an aim in Nature; and that neither any reason of utility nor any physical cause can always be assigned for the variations of instinct.

I would, however, suggest to Mr Wallace that one great object and use of domed nests, and also of many nests being made in holes, is one which has no connexion whatever with concealment, or consequently with his theory. That use is the very obvious and simple one of the better conservation of animal heat in cases where, from the extreme smallness of the bird and of its young, special provision has to be made for this purpose. It is at least remarkable that in our own country the most perfectly domed nests are made by the smallest birds, and these, too, by birds whose colouring requires no special precautions on account of its conspicuousness. So far as sombre and neutral tints are concerned, no birds could more safely sit upon open nests than the golden-crested Wren or the common Wren, or the long-tailed Tit, or the Willow Wrens. But the very diminutive size of all these birds, and their delicate organisation, do require that special provision should be made for the retention of warmth, and for protection from wet as well as from cold. This is the reason why the birds should make domed or covered nests. I have no doubt whatever that the same reason applies in numerous other cases, wherever the conditions of climate establish the same conditions of existence as regards birds whose bodies are so small as to need great economy of their little store of animal heat. As to the physical cause of this need being met, there is no other explanation possible than this—that the Creator has implanted in every creature those instinctive desires and powers which are necessary for the preservation of its existence. And this, too, is the explanation, and the only explanation, of the adaptive or assimilated colouring, which, not being dependent on any instinct or desire of the bird itself, can only be the result of Mind directing the forces of Nature in a preconceived and preordained direction.

*THE INDIANS OF THE WESTERN SHORES OF VANCOUVER ISLAND.**

IN the autumn of 1860, two armed vessels sailed slowly up a deep inlet of the sea on the wild western shores of Vancouver Island, and let go their anchors in front of a savage-looking Indian village at the head of it. On board were a young British merchant and fifty determined backwoodsmen, and their object was to take possession of the land, over which the Indians had roamed from days immemorial, for the Colonial Government had, in lieu of certain dollars, rights, and privileges, granted, with scant consideration for the aboriginal lords of the soil, all the region in question for timber cutting, fishing, and fur trading, or whatever else in their good discretion this company of merchants should select, with full power over the natives thereof; and had granted unto "our right trusty and well-beloved cousin Gilbert Malcolm Sproat," the honours, dignities, and emoluments of a justice of the peace over many a hundred league, with full liberty to chastise evildoers (if he could), and to convert them from war dances, and the heathen vanities of Quateaht and Clayher, to the more benign doctrines of holy mother church! It seemed for a while that this gift was of the nature of the Siamese White Elephant, for Kaloewesh, chief of Opichesah, and the Kekean Lord of all the Seshaahts were inconsiderate enough to look upon things in a totally different light, and drew out their shirtless followers in war muster, and prepared to do battle. Guns were run out, and rifles were much thicker than could be wished on all sides, but gradually peace reigned, and with barges of biscuit, tobacco, vermilion, and fish hooks, the natives drew off, and in this wise the ethnologist who writes the work, title of which we give below, commenced his first acquaintance with the strange people whose history he commemorates. Soon the woodman's axe rang through the primeval forest—a huge saw-mill sent the smoke of its engines up through the frosty wintry air, a little church spire rose amid the gloomy pines, and so commenced the foundation of an embryo "city," which, in memory of the gallant gentleman of Spain who

* Scenes and Studies of Savage Life. By Gilbert Malcolm Sproat. Smith, Elder, & Co. 1868.

first sighted this inlet, they named "Alberni." The savages dropped off, or came in to work for the whites, and by-and-bye acquired the dubious accomplishments of chewing tobacco, and flavouring their antient language with the oaths of British commerce. For four years did Mr Sproat, the founder of this place, at different intervals, live and labour in his capacity of magistrate and merchant, a hundred miles from any of his race, save his fellow-adventurers, roaming through the forest with the Indian hunter, or travelling circuit in their canoes, making peace between rival tribes or tall backwoodsmen, whose valuation of Indian life was of the rudest. For more than 200 miles of coast not a white man lived. In every quiet inlet and bay smoked the villages of savage tribes, nearly always at war with each other, and knowing nothing of the mysteries and civilization of the whites, who had thus unceremoniously taken up their quarters among them. They were only a small section of the Indians of the colony, but perhaps the largest, though least known (if the term can be allowed, where all are unknown, or worse, erroneously so) ; and speaking as they did one language with varying dialects, our author called them the Aht nation from the terminal syllable of their tribal name, and commenced the studies which are given in this little volume. The Ahts are a rather squat nation, addicted to painting, and adopting a canoe life more than that of a hunter—flattening the foreheads of their men and women, but withal a bold race (so far as boldness in their murderous night attacks goes), skilful in building and navigating cedar (Thuja gigantea) canoes, and patiently whittling out the broad boards which their long collier-looking villages are built of. They number about 1700 men, fit to bear arms, and are divided into twenty small tribes, scarcely two of which are friendly to each other. The race is fast decreasing, but they seem at one time to have been a powerful people, extending from Port San Juan on De Fucas Straits, to Woody Point, on the western shores of the island. They run swiftly, as Mr Sproat well knows, when he had, in the rough life of a north-western Justice, to pursue a thieving fugitive through the dense forests which everywhere cover their country, except when lakes and rushing rivers intersect the valleys. Their skill in paddling and managing their light canoes has always been a subject of eulogium since the days of Cook, Meares, or Vancouver. Their land abounds in game; salmon in incredible numbers, and deer sometimes so plentiful that you can buy them from the natives for 6d. a-head, while the beaver builds its dams in the streams, and elk (Cervus Canadensis) roam through the mountains, and wild fowl settle in clouds at the sedgy debouchment of the rivers. The natives accordingly supply themselves abundantly, and are rarely troubled with starvation, even in the inclement season of winter, which they pass in jollity and dancing, when the amusements, if not very refined, are at least very hearty. Not much addicted to soap or garments they may be, but yet the Aht Indians are a people punctilious in etiquette, and the social chimera of Mrs Grundy weighs heavily on the unfortunate wight who breaks through the observances made and established among them. They rarely quarrel in their own tribe, and know nothing of the "noble art of self-defence." Fish and shell-fish form their principal articles of diet, varied in the summer with berries, the tender shoots of the Rubus Nutkeanus, and the roots of the bracken. We recommend our lady readers to the Aht cookery receipts given in Mr Sproat's volume. At these feasts orators rank high, and the author describes some of their speeches as being far from contemptible, while the voice fills the house or echoes through the forest. Those who wish to hear what real savage earnest oratory is, should visit Klah-oh-quah and hear Seta-kanim "on his legs." Boys practice the recital of portions of celebrated speeches, which they retain in memory, and occasionally as the old men sit on the beach, watching the sun set on a summer evening, they point out future orators and envoys among the youngsters who play before them. Singing they like, but do not excel in : but some of their actors are excellent, and would be the making of a minor London theatre. Blankets constitute the *summum bonum* of *Aht* happiness, and the acquisition of such portable property is diligently sought after. They are wonderfully sharp in a bargain, and territorial influence is far from small, though all land is owned in common. Yet, occasionally, some individual will claim a river or the borders of a lake as his peculiar hunting or fishing ground. There is little division of labour, as among all savages, but yet some individual will have a monopoly of some trade, such as canoe making, and the "middlemen" intervene in the land of Aht, as well as in another country nearer home. The "peculiar institution" prevails to its full extent among these people ; prisoners of war, if not slain, and the heads stuck up on poles in front of the victor's lodge, as in old days above Temple Bar or London Bridge (the uncultivated mind is in all ages the same), being reduced to slavery, and certain tribes maintain the unenviable reputation of being distinguished in this traffic. The slaves, generally speaking, though treated—they and their offspring—with contempt, are not on the whole cruelly used. The mental capacity of the Aht race is by no means small, but a mind travelling for ages in one groove can scarcely be looked to readily shew alacrity in subjects foreign to it. Mr Sproat has a very able chapter on the language of the people, with a full vocabulary, which establishes one important philological point—viz., that, contrary to the generalization of Max Muller, the *Aht language does not change.* With the exception of a few words, which the surgeon of Cook's voyage (Mr Anderson) mistook, the language is the same as at the date of Cook's visit. The language of the Indians in the interior of America, owing to their roving habits, is constantly changing. In the case of these Aht tribes, on the other hand, who have remained for generations—perhaps for centuries—on one spot, their language is less altered. The limits of this review will not permit us to do more than refer the reader to the chapter itself. Polygamy prevails—the number of a man's wives being only limited by his purse—but the women are much better treated than among the horse tribes in the interior, having a voice in nearly all bargains, and being often scolds of the first water. Many curious customs connected with betrothal, marriage, and divorce prevail, and adultery is (or was) punished with death. Wives are in reality bought, but he is looked upon as a mean father-in-law who does not return, in dowry with his daughter, as much as he received. Marriages are sought among other tribes to strengthen the influence of the chiefs, and with an idea of preventing the degeneracy of the race. A patrician marries a woman of equal rank, and like other folks, often affection has nothing to do with the marriage, the idea being to prevent the *sangre azul* from being corrupted by a mixture of common blood. Before the house of the head chief of the Klah-oh-quahts, there is a large stone which a man must lift and carry in the presence of the people before he may aspire to woo the chief's daughter. "Gentle blood and long descent" is much valued, and though wealth may procure a certain status, and prowess in war achieve another type of military aristocracy, yet the old family rank can only be acquired by descent from a long line of chieftain sires, and is very different from such *parvenu* dignity. A certain rank can even be conferred on a woman, and the various shades of "nobility" are carefully described by our author. It is satisfactory to think that the aristocracy are not addicted to evil courses. "It is only among the idle, poor, and low born youth, and the last-named" (*i.e.*, the rank and file) "that the worst Indians are found; as a rule, well-born natives, and especially the heads of families, are quiet and well-behaved." They are rather vindictive, and some ugly stories are told of their cold-blooded cruelty to prisoners taken in war. Their notions of *meum* and *tuum* are somewhat loose, as in most savage tribes, but it is right to say that they are honest among themselves—"honour among thieves" is a redeeming virtue. To their children they are very affectionate, never chastising them; and though generally friendly to strangers, yet are habitually suspicious, and are continually thinking "how can I turn this person to my own account, and how can I defend myself from his designs against me?" Want of foresight, absence of faith and ingratitude, are among the most cardinal sins which they are accused of as a nation. There are several interesting sections on their fishing and hunting, presenting some new details of the zoology of the north-west coast; and the chapter devoted to an account of their sorcerers is particularly worthy of the study of those interested in the wide-spread belief in charlatans, and the similarity of superstitions in all ages and among all races. The traditions and mythology of the people are very extensive, and it is to be hoped will soon be undertaken at greater length than the few pages the author devotes to it. Extraordinary occurrences soon drop into tradition. Already the blowing-up of the "Tonquin," so graphically described in Washington Irving's "Astoria," has got to be looked upon as a wonderful manifestation of their great spirit *Quahteaht*. The author does not think that events can be handed down for more than two or three generations. On the other hand, the natives still remember Cook, and they talk of the loves and mishaps of Jewitt, armourer of the "Boston," who was captive amongst them, and wrote an account of his captivity. Though they remember the old Spanish settlement at Nootka, yet they have no recollection of Meares building and launching the "North-West" schooner. Vancouver's name is pronounced quite distinctly. The writer of this review remembers an old Indian who used to describe with great gusto Vancouver's boatswain giving three dozen to his men of a morning; and to those who are aware of the martinet character of the great explorer the reminiscence is quite characteristic! No more plaintive account can be given of the cession of Nootka by the Spanish cavaliers to John Vancouver in 1792 than the Indian tradition of it:—"The foreigners began to cultivate the ground, and to erect a stockade and fort, when one day a ship came with papers for the head man, who was observed to cry, and all the white men became sad. The next day they began moving their goods to the ship."

It is very hard to get at any notions of their religion. They believe in a great spirit called Quateaht (whose type under other names is found all over the American continent: the general reader knows him best as "Hiawatha" of the Ojibiways), who taught men all things, who parcelled out the tribes, and then went off to his home in the happy land. They worship the sun and the moon. Like the old Teutons, they regard the moon as the husband and the sun as his wife; hence their prayers are generally addressed to this superior deity. Even Quateaht, great as he is, is an inferior deity to the moon, who "looks down upon the earth in answer to prayer, and as seeing everybody." "When working at the settlement at Alberni in gangs by moonlight, individuals have been observed to look up to the moon, blow a breath, and utter quickly the word, Teech! teech!—'health' or 'life.' Teech! teech!—Life! life! That is the great wish of those people's hearts—even such a miserable life as theirs seems to the civilized observer.' "Teech! teech!" is their common and almost constant prayer. Unless Quateaht be ranked as such, it is said that they have no knowledge of a Supreme Being, but they have many good and bad spirits; but Quateaht seems to preside over the beautiful country where good men (according to the Indian standard) go when they die. Everything there is beautiful and abundant. There a continual calm prevails, and the canoes float lightly on the sleeping waters; frost does not bind the rivers, and the snow never spreads its white blanket over the ground. In this pleasant country, where there is continual sunshine and warmth and gladness, it is believed that the high chiefs and those natives who have been slain in battle on the earth find their repose, the chiefs living in a large house as the guests of Quateaht, and the slain in battle living by themselves in another house. No Indians of a common degree go to the land of Quateaht; like Odin, he drives away the pauper and the bondsman from the door of Valhalla! Their own account of their religion is a little dreamy, and the learned doctors of Algic theology differ widely. Once all the Indians were in animals, and when they die a transmigration of souls into birds and other animals—particularly owls—takes place. The writer has been implored by an

Indian woman not to shoot a fine specimen of the Bubo Virginianus, which, in his ornithological zeal, he wished to acquire, as it contained the spirit of her grandfather! "Clayher" is the personification of sickness and death. He lives in a country where there are few deer, no salmon, and poor houses. There the blankets are thin and the canoes leaky. Clayher is personified as an old man, with a long grey beard, and a figure of flesh without bones, and is believed to wander at night seeking men's souls, which he steals away: and unless the doctors can recover them, the losers will die. In wishing death to any one, the natives blow and say, "Clayher, come quickly!" Tootoosch is the thunder-bird flapping his wings, and the lightning is the serpent which darts out of his mouth. They have a medicine for everything—love philtres and death doses, but it is doubtful if they know anything of the action of poisons. Their medicine is principally sorcery, but invalids are often taken away from the lodges and left to perish. An ugly feature in the Aht ladies is their habit of producing abortion, but infanticide is (doubtfully) said not to obtain among them. They bury their dead principally in boxes up in trees, and have many ceremonies connected with death and sepulture. The great feasts in which the accumulated property is given away are very curious, as well as the custom of giving new names; but for these, as well as other sections which we cannot even touch on, we must refer to the work itself. The concluding chapters are worthy of the attention of philanthropists who are cogitating over the subject of our treatment of the aborigines, and the momentous question, "What is to become of them?"

ROBERT BROWN.

*THE NATURALIST IN INDIA.**

INDIA is a wide word. It may, therefore, be as well to say at the outset, that the portion of India over which Mr Adams' wanderings extended is North West India. Stationed first at Poonah, and afterwards in Scinde, his wanderings consist of expeditions undertaken from these head-quarters.

If we were to subdivide his volume according to the districts in which his observations have been made, we should do so as follows:—1. Poonah; 2. Scinde; 3. The salt ranges of the Punjaub; 4. The interior of the North West Himmalayan range; 5. Cashmere; 6. Ladak. At all these places Mr Adams has collected original information and specimens, and the present volume is a record of the stores of both which he has accumulated. A sportsman not less (perhaps even more) than a naturalist, he has picked up a good deal of the natural history in his book in his efforts to fill his bag. The general reader may, perhaps, think that there is an excess of ornithology in it, but this is rather due to the ornithological details being all mixed up with the narrative, even when they are nothing more than isolated notices of the occurrence of species at particular localities, which makes the book drier in appearance than it is in reality. It would, we think, have been an improvement if (unless when there was something more than mere locality to record) the birds met with at different places had been thrown together in separate lists in an appendix at the end. His observations on other topics would then have flowed more uninterruptedly and agreeably to the general reader; and the ornithologist and student of geographical distribution would have had all the facts more especially interesting to them collected together to their hands, instead of having to glean and pick them out piecemeal for themselves from the general matter in the volume. Mr Adams' department, by predilection however, is obviously ornithology, and it would be rather hard measure to refuse a man a ride on his own hobby in his own book. So far as regards the determination

* Wanderings of a Naturalist in India. The Western Himmalayahs and Cashmere. By Andrew Leith Adams, Surgeon, 22d Regiment. Edinburgh, 1867.

of various species, and the character on which they are founded, as incidentally touched upon by Mr Adams, we do not know that we differ much from his views, but as regards the value to be attached to small differences, we must confess that we attach more importance to them than he does. Speaking of the replacement of the harrier (Circus cyaneus) by its pale representative (Circus Swainsonii), in the more southern portions of Europe, Asia, and Africa, he says :—

"He who aims at uniting the meagre distinctions which are often made to separate species, may, in this instance, consider how much of the little that divide the pale and dull-chested hen harriers are the result of climate, food, and such like ; but until we care less for making new species, and think more of applying ourselves to the study of animals in nature rather than in the cabinet, there is no prospect that any great strides will be made in the discovery of laws which shall regulate the varieties and geographical distribution of species."—(P. 136.)

This is a very common flourish of field naturalists, but it is mere conventional tall talk, "palabras, neighbour Verges." The truth is, that the close examination and observation of the meagre distinctions to which Mr Adams objects, is one of the most important means we have of arriving at a knowledge of the laws which regulate the production of varieties and the geographical distribution of species. It is not the *amount of difference* between forms which constitutes species, but *its constancy;* and as much can be learned of the past history and geography of our globe, from the presence or absence of the same varieties in different places, as from the occurrence of full species in others. It must be understood that, in defending the species-maker, we do not refer to those who, for the childish gratification of seeing their names in print as the authors of species, bring out as new species everything that they do not themselves know, without taking proper care to ascertain that it is new, or without having sufficient materials in numbers of specimens, &c., to decide whether it really is so or not. These men are the bane of science, and have no claim to a place in its temple ; but we refer to the careful, painstaking, and laborious student, who, seeing differences himself, records them for the benefit of others. Mr Adams is justly severe upon the former class, but we think he scarcely gives sufficient credit to the latter. He says :—

"This rage for species-making is not confined solely to cabinet naturalists ; but I regret to think, for the sake of science, that, rather than be behind hand, or that another should make the discovery, it is the custom with even many of our best known field ornithologists, to give a separate specific name to every individual that differs in the slightest degree from another. It is a great pity, when a species is found somewhat different from a given type, that we should not allow it a place among the varieties of that type and species until such time as proper comparison has been instituted between them."—(P. 263.)

We quite agree that no species should be proposed upon individual specimens, unless clearly and manifestly distinct; but we have great indulgence to the mistaken species-maker who, by dint of long poring over long series, at last convinces himself that he has found a new species. Let us, therefore, not undervalue any portion of the naturalist's labours, nor attempt to elevate one mode or branch of study above another. All are working to the same end, and each throws light upon the progress of his neighbour.

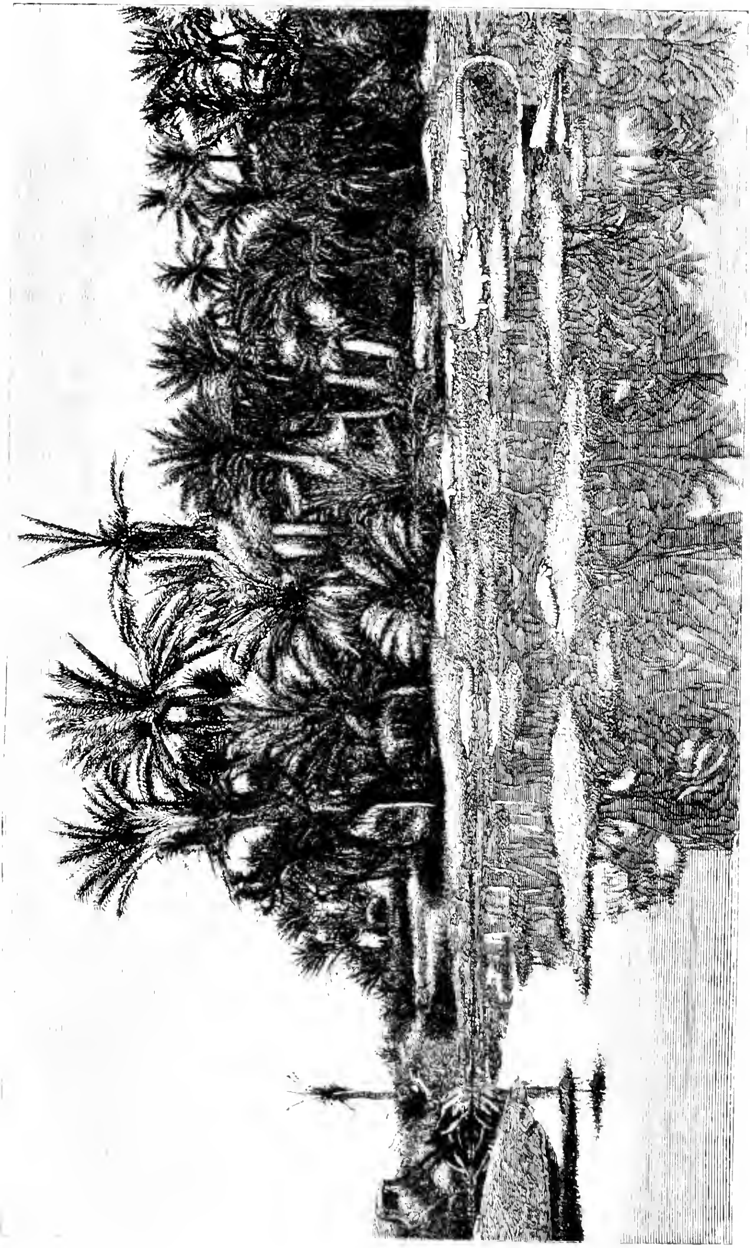
Mr Adams contributes a good quota of original field observations, and the closet naturalist will find many facts among them which he may apply to theoretical purposes. As an interesting example, we may take the account given by him of a visit which he paid to the crocodile pond called Mugger-peer in Scinde. This resort of crocodiles occurs in an oasis lying in the heart of sandy deserts, a considerable distance to the north-west of Kurrachee; and how these reptiles came there forms a subject of speculation somewhat akin to the puzzle of a reel in bottle, and as the reader will, we think, find only to be explained on the same principle.

The accompanying illustration sent to us from Mr Adams' work by favour of his publishers will help to give an idea of this reptilian depot, although his graphic description scarcely requires it:—

"The journey for the first few miles is of the usual uninteresting description—sandy plains, intersected with deep fissures and ravines, or studded here and there with 'scrub,' the oleander-leafed spurge (Euphorbia nerefolia), plentiful in all waste and desert parts of Scinde.

"Emerging from a defile, which leads through a low range of hills, the traveller enters on a desert waste, stretching westward towards the mountains of Beloochistan. In the far distance two oasis are visible, whose date and coco-nut trees are refreshing to the sight after eight miles of the most monotonous scenery. In the vicinity of the nearest grove is an antient burial-ground, where may be observed several curiously carved gravestones.

"I visited the crocodiles (Crocodilus palustris) on two occasions, at an interval of several years, and although during that time they had been seen by hundreds of Europeans, including a certain class of mischievous young Englishmen (whose chief amusement, we were told, had been to shy stones and sticks down the throats of the gaping monsters as they lay basking on the banks of the pond), yet there seemed no diminution in their numbers, and the wild and unearthly



Crocodile Pond.

interest of the scene was to us as great as ever. From beneath a little banyan-tree on the verge of the pond, the spectacle, during the steaming heat of a mid-day sun, might call up to the mind of the geologist the eons of the world, when the 'great monsters' wallowed in the seething waters of the oolitic ages, when the mighty 'Ichthyosaurus,' and a host of 'fearfully great lizards,' dragons, &c., reigned supreme over sea and land. And as the date-palm now waves its shady boughs over the crocodiles of Mugger-peer, so then did the magnificent tree-ferns, gigantic reeds, and club-mosses, shelter their extinct predecessors.

"The greater pond is about 300 yards in circumference, and contains many little grassy islands, on which the majority of the crocodiles were then basking; some were asleep on its slimy sides, others half-submerged in the muddy water, while now and then a huge monster would raise himself upon his diminutive legs, and waddling for a few paces, fall flat on his belly. Young ones, from a foot in length and upwards, ran nimbly along the margin of the pond, disappearing suddenly in the turbid waters as soon as we approached. The largest crocodile lives in a long narrow tank, separate from the others. The Fakirs, and natives who worship in the neighbouring temples, have painted his forehead red; they venerate the old monster, making a salaam to his majesty whenever he shows himself above water. A handsome young Beloochee, whose occupation it was to feed the animals, informed us that the said king was upwards of two hundred years old! (?) and that, by way of a 'tit-bit,' he was in the habit of devouring the young crocodiles. During our visit, this enormous brute was asleep on the banks of his dwelling-place, and seemed quite indifferent to our presence, although we came within a foot of him, and even attempted to arouse him, by rubbing his nose with a leg of goat's flesh, which, however, a young one greedily seized, and dived under water. Our attendant tried in vain to excite their ferocity, but beyond a feeble attempt to snap their trenchant teeth, the animals shewed no disposition to attack us.

"A pony was wading about in the pond, and feeding on the grassy hillocks, but the crocodiles took no notice of him.

"The water in the pond felt cold, although fed from two hot springs, one of which was of so high a temperature that I could not retain my hand in it; yet animal life existed, for I found where the water bubbled up from its sandy bottom, and in the little lade running to the tank, abundance of a small species of small black spiral shell, which Mr Woodward informed me is 'very like some in the British Museum, named Melauia pyramis, an allied species of which frequents the river Jordan.'*

"The other spring gushes from under a bed of limestone, containing numbers of fossils, chiefly coral, and other marine zoophites. We had a refreshing bathe in a reservoir close by; the temperature, though not so high as the last, was still warm and pleasant. I should be sorry, however, to repeat the experiment, not from the chances of meeting with a crocodile (for, I believe, the Fakirs of the temple guard well against such accidents), but from the circumstance that (as is generally the case all over the East) lepers and persons affected with loathsome diseases repair to such localities.

"The crocodiles dig deep in the sand, under the neighbouring date-trees, and

* The temperature of the water in the lade was 127° Fahr.

there deposit their eggs. Quantities of deciduous teeth of various sizes were strewn along the slimy sides of the pond.

"Strangers are expected to stand treat, not only by the Fakirs and natives who gain a livelihood by hanging about the pond and shewing the monsters, but even the crocodiles themselves seem to anticipate a feast, and on the arrival of a party, come out in unusual numbers. Accordingly, we had a goat slaughtered, during which operation the brutes seemed to rouse themselves, as if preparing for a rush. Then our guide, taking piece after piece of the flesh, dashed it on the bank, uttering a low growling sound, at which the whole tank became in motion, and crocodiles, of whose existence we had been before ignorant, splashed through the shallow water, struggling which should seize the prize. The shore was literally covered with scaly monsters, snapping their jaws at one another.

"They seize their food with the side of the mouth, and toss the head backward, in order that it may fall into the throat.

"A few were observed to bolt their portion on shore after very slight mastication, but the majority, anxious to escape from their greedy companions, made instantly for the water, and disappeared with the piece of flesh sticking between their jaws. Our young Belooch friend informed us that they generally swallow their food at once, and do not, as has been asserted, bury it until it becomes putrid; also, that other large individuals besides the old king frequently devour the young soon after they are hatched. Crocodiles wallowing in the mud of the Nile, or gavials in the Indus, are sights which one is prepared to encounter; but the traveller may wander far before he meets with a scene so strange and unexpected as that just described. How these animals found their way inland to this solitary oasis we could not discover. It can only be surmised that they had probably been introduced by the natives."—(Pp. 41-45.)

Noteworthy as are many of the incidental facts above noticed, by far the most interesting and important question is not, indeed, that put Mr Adams at the conclusion of the above paragraph, "How these animals found their way inland to this solitary oasis?" (for that is assuming a part of the question—that they did find their way inland), but how it happens that these animals are now found there? The reader sees that there is another way in which this fact may have come about, than that of the animals having come to the oasis; the oasis may have come to them. There are many facts which prove beyond doubt that at a very recent geological period, the now sandy deserts of the Punjaub and Scinde were covered with water. Falconer and Cautley have abundantly proved that the elevation of the Sevalik, or outer range of the Himmalayahs, took place almost, if not absolutely, within the human era; and it is, doubtless, to the influence which upheaved these mountains that the upraising and laying bare of the bed of this Scindian sea is due. It is more than probable that originally an estuary, or bed of the sea, united the Bay of Bengal with the

Indian Ocean. This estuary or sea seems to have been afterwards cut off from the Bay of Bengal by the elevation of the level between the Indus and the Ganges, and divided from the Indian Ocean by the barrier along the coast line. When so circumscribed, Scinde and the Punjaub must have been one vast inland fresh water, or brakish lake—doubtless inhabited by abundance of crocodiles. When the continued elevation of the level of the country in the direction of the Himmalayahs tilted up the basin which held the water, and it found its way through the barrier at Kurrachee, the bed of the lake would gradually become dry, leaving water only in the deeper holes and pools, which would become oases like that of Mugger-peer. In them, of course, the crocodiles and all other aquatic and amphibious life would take refuge; and it seems more than probable that those which we see there at the present day are the solitary remains of multitudes which once crowded the wide shores of that inland sea.

There can be no objection to this, from any doubt as to the present crocodile having, perhaps, not been in existence at the period in question. In fact, long anterior to that—viz., at the time when the Sevalik beds themselves were deposited, many animals now living in India had already made their appearance; and among these, it would really appear that the present crocodile, and, at all events, the gavial, were of the number, both of which now occur in these districts. The reptile in the crocodile pond at Mugger-peer is the crocodile Crocodilus palustris. The gavial (Gavialus Gangeticus), or Indian alligator, does not occur there, but abounds in all the great rivers of northern India, and in the Indus is found from its delta northwards to Attock. Captain Cautley, in a memoir published in the "Asiatic Researches," xix., 25 (1836), "On the Fossil Crocodiles of the Sewalik Hills,"* says—

"Of the crocodile of these strata I have attempted in the preceding section to shew, as far as measurements and my limited means point out, that the main difference between the fossil and the existing animal of the present rivers is in the breadth; a difference that might tend to an opinion of its being allied to the Cayman, did not other more distinct characters separate it at once from that sub-genus. In the Gharial (gavial) now under review, *I am unable to recognise any difference from the living animal;* and there are certain peculiarities about the external surface of the skull of the existing Gharial (gavial) in slight indentations and rugosities, which are singularly coincident with those of the fossil."

---

* See Reprint in Palæontological Memoirs of Dr Hugh Falconer, vol. i., p 351. Hardwicke, 1868.

If this is the case with fossil remains, so old as the Sewalik beds themselves, it can excite no surprise that, at any rate, the crocodile of a period long subsequent to the consolidation and upheaval of these very beds should be so.

This is not the only instance of such an occurrence. According to M. Duveyrier, exactly the same thing has happened in the desert of Sahara. He tells us ("Explorations du Sahara," p. 29 and 232), that the crocodile still lives on the north side of the Saharan desert, particularly in the little lakes of Mihero, which must have once formed part of the great Saharan sea.

The idea that a breed of the crocodiles could, or would, have been brought over the desert, and deposited in the oases by natives, seems to be wholly without foundation. It involves an anticipation of and preparation for the future greatly beyond the intelligence or practice of the present natives. The occurrence of a fresh water dolphin (Platanista Inda) in the Indus is another fact which seems to point to a change from a marine bay to a fresh water lake; for the dolphin is a marine animal, although capable of living for a time in fresh water. A slow change from salt to fresh might have kept the species alive until it, as well as the medium in which it lived, were changed. The only other fresh water dolphins (one in the Ganges and one in the Amazons) doubtless owe their origin to similar machinery.

The salt ranges of the Punjaub have no relation to this sequence of events. Any deposits of salt that might have been left, as in other cases by the drying up of a sea, could not occur here; for, by our hypothesis, before it was dried up, the sea had become fresh water, of course from the flow of fresh water into it from the snowy range of the Himmalayahs. No salt lakes or incrustations of salt or soda, as in the deserts in North-west America or the Sahara, occur in the sandy wastes of the Punjaub. The salt in the salt ranges is derived, not from surface deposits at all, but from beds in strata, at least as old as the new red sandstone, if not referable to the still older period—the carboniferous epoch.

Mr Adams' description of this remarkable district is as follows:—

"The salt range extends from the Himmalayahs across the Punjaub in about a straight line to the Suliman mountains on their west flank, and is composed of low hills, intersected by narrow ravines or prominent ridges, for the most part devoid of vegetation. Limestones, saliferous red and grey sandstones, would appear to form the chief geological formations, which, according to Professor

Fleming, belong to the carboniferous period (Quart. Journ. Geol. Soc., 1853 and 1862; also, Journ. As. Soc., Beng., 1853, &c.). The plateaus, excepting where extensive denudation has taken place, are covered with rounded pebbles, mostly formed from the breaking up of the limestone beds. Salt is found in veins in various situations, more especially among the sandstone and marl beds in the neighbourhood of Kuller Kahar, where there are extensive salt mines. The barren and sunburnt appearance of these mountains strikes the traveller; indeed, it is chiefly on that account that they become a safe retreat to the wild sheep, for, except in the cultivated districts, these dreary and desolate wastes are seldom disturbed by man."—(P. 138.)

"The ravines in the district of Jubba have a peculiar appearance. Viewed from a height they present a series of worn and angular-shaped hillocks, intersected by narrow defiles, by no means inviting to the traveller, for not a blade of grass is visible, and the disintegrated red sandstone and marl suggest the idea of sleeping volcanic embers, which we found during the heat of mid-day had more than a mere resemblance. I do not think I have ever witnessed a scene so perfect in its desolation. However, we determined to descend in spite of the stewing heat and reflection from the hillocks on each side. Whilst threading our way among a series of narrow lanes we came on a young houriar (Caprovis Vignei), just dropped, and evidently abandoned by its mother on seeing us approach. Several herds of rams (which separate from the ewes during the breeding season) were observed dashing across ravines, offering a snap shot occasionally. As we anticipated, the heat by noon became excessive, and our thirst intolerable. No water could be procured save what was strongly impregnated with salt. At last exhausted, I gave in, and must have been verging on a *coup de soleil*, as my senses began to leave me, and I felt that both eyesight and hearing were rapidly failing, accompanied by a loud buzzing sound in both ears. In this condition I lay stretched on one of the red banks, whilst the Shikaree set off in search of a spring. I think I may have remained for nearly half an hour in this condition when I was aroused by the voice of a native, and looking up, beheld a half naked man carrying a basin of milk and platter full of cakes, which he at once begged I would accept. This good Samaritan had seen my distress from his grass-built hut on the top of a neighbouring hill, where he resided for the purpose of guarding a vein of salt. Never can I forget the kindness of the poor fellow, who, unsolicited, came to my aid at a time his services were so sorely needed."—(P. 150.)

In strong contrast to the desolation of this region is the country near the Chor Mountain in the sub-Himmalayan district.

"We recrossed the Gerrie on the 26th of March. The day was charming, and the scenery of that beautiful and sylvan description so characteristic of many sub-Himmalayan valleys. At our feet rolled the river, dashing furiously over its rough limestone bed, and gradually becoming less turbulent, until settling down to a quiet yet mighty flood, it moved steadily onward through the valley, the sides of which were clad with the gayest attire of spring. The oak, plane, wild apple, apricot, &c., sent forth their various shades of green. Many were in blossom, and the deep purple of the pomegranate's petals added a richness to all around. Above us rose a hill covered with profusion of bush and tree, where we had spent the day hunting kalij, pheasants, and pea-fowl; and now, tired and weary, were enjoying the evening around the log fire, while a barking deer clamoured loud in the jungle close by as if in defiant reproach for a young buck which had fallen to my gun."—(P. 102.)

This is a favourite habitat of the Impeyan pheasant or monal, perhaps the most gorgeous of all birds. It is becoming rare; and, although once profusely abundant in the Western Himmalayahs, is now, comparatively speaking, restricted to certain localities in the wooded slopes of the higher ranges. "Whole tracts of forests, once dazzling with the gorgeous forms, are now without a single specimen." Knowing this, we should have liked to have read that Mr Adams had been contented with a specimen or two for Natural History purposes, and done his best, at least, to preserve the race from the extinction which their splendid beauty is sure to bring upon them sooner or later. But this does not appear to have occurred to him.

Laying the consoling unction to his soul, that "it will be long before it is extirpated, for its haunts are high up among the craggy rocks, where few ordinary sportsmen venture," he seems to have gone at them as if he were bent on making a rival bag on a Highland moor on the 12th of August.

"The pine and oak forests of the Chor were reached on the sixth day, when, to our intense delight, we soon found the pheasants far outnumbered previous expectations, for the ravines resounded with their loud screams, and the higher we went and the deeper we penetrated into the dense forests the more plentiful they became. The cool days, cold, even frosty nights, added increased vigour to our exertions. Our table actually groaned with game; and if there is one gastronomic remembrance of those days more agreeable than another, it is the delight we felt on returning at nightfall with a hunter's appetite to enjoy the monal cutlets, which our excellent Bengal cook prepared in what he called 'his own way.'"—(P. 110.)

"One morning we happened to get into a narrow defile leading towards the summit of the mountain, profusely covered with ferns, balsams, dwarf bamboo jungle, and long dank vegetation, through which we could scarcely pick our way, much less see the great number of monal pheasants which were continually arising around us. I had just discharged my gun at a flock of upwards of twenty monal, which rose in front of us, when within one hundred yards were two black bears (Ursus Tibetanus) ascending a service tree in quest of fruit; but they caught sight of us and were off long before we could draw shot and load with ball. My companion, in spite of the uncertain footing and obstacles, killed ten monal in an hour."—(P. 111.)

As attempts are being made to introduce the Impeyan pheasant into this country, we may note one or two of the particulars which Mr Adams gives of its habits and habitats.

It is found along the line of the Himmalayahs, at an elevation of from 6000 to 8000 or 10,000 feet, but is partial to localities. It is strictly alpine in its haunts, and prefers the cooler regions of the middle ranges, to the forests bordering on the plains of India, and it especially affects the deepest solitude of the forest, or the bamboo and dense jungle which clothe the sides and bottoms of the valleys. Its favourite food consists of acorns, earth-nuts, bulbs, wild strawberries, wild currants, and gooseberries, &c. The breeding season commences about April, when the wailing cry of the males resounds through the mountains, and might be mistaken for that of any of the larger falcons. The female lays four to six eggs, very similar in colour to those of a turkey.

The plach pheasant, the cheer pheasant, and the kalij pheasant, are plentiful in the same districts as the Impeyan. Other pheasants of scarcely less beauty and interest, such as the black headed pheasant (sometimes called the Argus), the horned pheasant, the great snow pheasant, &c., were met with in the higher mountains; but we must refer the reader to the work itself for the information regarding them.

Mr Adams' visits to Cashmere supply some interesting incidents of the chase of the wild animals which inhabit its mountains—the bear, the ibex, wild goats, or sheep, &c.—and he gives some information as to the specific characters of the different species of the latter, and their limits and distribution, all tending strongly to shew their very close affinity with each other.

The following quotation will give the reader a fair idea of the game met with in the mountains, and of the difficulties attending its pursuit, and of Mr Adams' style of description :—

"We were cautiously picking our footsteps with Alpen-stock across the dangerous rents and slippery pinnacles, peering down into yawning gulfs and projecting shelves below us, when suddenly Elli Shah's eagle eye caught sight of a herd of Ibexes emerging in single file from a narrow chasm underneath, led on by two fine males, one of which was standing on a spiral-topped rock, with his four feet close together, in an attitude of observation. Then the Shikaree seizing a handful of dried mat grass, tossed it up in the air to ascertain how the wind blew, and removing his turban, replaced it by a skull cap with the gravity of a judge about to deliver sentence, and gathering up his loins, and taking the spare rifle, led the way down a hollow, until peeping cautiously over the edge of the cliff, he suddenly turned towards me, crouching behind him, and with a nod and grin of satisfaction, and beaming countenance, as much as to say, 'We have them now,' retired, that I might take his place. Resting the heavy Westley Richards on the ledge, and raising the two hundred yards sight, I covered the fore-shoulders of a fine male. Thud went the bullet on his side, and up sprang the herd. One female stood out on a projecting rock, and whilst gazing downwards the contents of the second barrel pierced her heart, and she sprang into mid-air and fell bumping from rock to rock down into the yawning abyss below. The male, desperately wounded, was seen following the herd, which in a few minutes disappeared among the peaks above, whilst we in wild excitement set off in hot pursuit of the former, which was discovered in a dying state and despatched immediately. . . . . On our way down the mountain, the forest around resounded with the crowing of the plach pheasants, and as we neared the tent I came suddenly on a huge brown bear intently feeding on a clearing. Although his head was directed towards me, he did not seem to notice us until we were within a few yards, and it was too late to make his escape. . . . He had evidently taken up his abode in the glen for some time, for on the following day we traced his footmarks like steps or stairs up the face of the sward to the cliffs where his den was situated. No doubt he had continued for years pursuing the even tenor of his way to the little stream below and grassy slopes, seldom roaming beyond a short distance from cover, where in all probability these patriarchs end their days, and like the Ursus spelæus of old, enveloped in earthy and calcareous deposits, thus preserve their remains for unreckoned ages.

"I well remember, when on our way from Wurdwun to Pambur, halting one day on the banks of the Scinde, in the middle of a vast forest tract, and when my servants and Shikaree were employed in stretching bears' skins, I took a rifle and entered the forest in quest of musk deer. After penetrating the wilderness for some distance, it suddenly occurred to me that I had forgot the pocket compass, and must now trust to chance in finding my way out. After hours spent in vain attempts to discover the river, night came on and there seemed nothing for it but to wait patiently until the morning. The eternal stillness, not even the murmur of the pine tops broke the solitude; in vain I listened for the noise of the river, and longed for morning, when by the first dawn of day I was off on my anxious journey, now rushing down slopes and making my way down hollows, expecting to strike the river at every turn, but always in vain. Horrible feelings of going directly away from the river haunted me, and the cravings of hunger began to be urgent. At length, descending a densely wooded slope of deodars, and gaining a valley and stream, which, after following for upwards of an hour, I came suddenly on the Scinde, and discovered that I had struck the river four miles below my tent. When I reached my companions I was perfectly worn out from the exertion, fatigue, and anxiety, for except a crust of bread and a few pieces of the flesh of a musk deer I killed in the early morn, no food had passed my lips for upwards of thirty-two hours."—(P. 233.)

The excursion to Ladak supplies matter of considerable interest to the reader, probably fully more than to the traveller, scenes of continued desolation being less agreeable in experience than in description. There is perhaps no place in the world more desolate than these high valleys in the inner ranges of the Himmalayahs. The clouds, heavily charged with moisture, brought by the south-east winds from the Indian ocean, first deposit the greatest part of their contents in deluges on the Ghauts (the first high grounds they encounter), then proceeding on towards the Himmalayahs, drop the rest of their burden on the Sewalik hills and on the southern face and tops of the main range. By the time the currents of air reach the inner ranges, the whole of their moisture has been deposited, and, as Maury expressively phrases it, "they pass over into the thirsty land beyond with scarcely enough rain in them even to form a cloud." This is the explanation of the difference in humidity between the mountains of Cashmere and the rainless and cloudless regions of Ladak and Chinese Tartary, and their consequent barrenness and desolation. Some places Mr Adams describes as treeless and herbless, except a few clumps of birches. Others are dreary plains covered with scanty herbage and patches of furze (often the only fuel to be had, except Yak dung) and again rocky and stony regions absolutely destitute of all vegetation whatsoever. Among the animals mentioned besides the Yak, and its hybrid with the cow, the zo or dzo, are the ounce, two foxes, the Kiang (Ovis amnon), the Thibetan antelope, deer, hares, rats (Lagomys), and of course the red and white marmots. Of his introduction to the haunts of the red marmot Mr Adams relates the following incidents :—

"The sun was declining as we commenced the ascent, and by the time we arrived at the summit of the pass had dipped behind the lofty peaks of Haramuk. We had gained an elevation of 10,500 feet above the level of the sea, and were now in the region of snow. All was desolation ; and a cold cutting wind blew in gusts down the narrow mountain gorges which were filled with ice. In vain we attempted to peer through the gloom of the rapidly advancing night for our baggage and servants ; but darkness came on and found us still expectant on the mountain top. We had descended the northern face of the ridge, to a clump of stunted birch in search of a level spot on which to pitch the tents, when all at once, in the dismal solitude around, screams burst out of the ground, louder and louder became the cries ; the rocks sent back the sounds. We stood in astonishment, wondering what animal could be producing such unearthly noises, and various were our surmises, until one of our servants arrived and informed us we were in the centre of a colony of red marmots (Arctomys Tibetanus). The 'drin,' as the red marmot is named by the natives of these regions, is confined to certain situations at high altitudes, and prefers fertile and secluded valleys, where vegetation returns rapidly and is luxuriant. There this active creature spends the summer months, surrounded by a plentiful supply of food, until again forced to its burrow by the cold and snow of winter. Their excavations are formed on gentle slopes or under stones and rocks, where they delight to sit erect and scream. Often the burrows are scattered over the valley, where loud wailing cries may be heard for miles along the mountain sides."—(P. 258.)

Mr Adams visited the Lake Chimouraree (called Chuinoninil by

Gerard, the first English traveller who mentions it). It is a sheet of water ten miles in length by two in breadth, situated at an elevation of upwards of 17,000 feet above the sea. Several good sized streams flow into it, but there is no outlet. Some suppose that under such circumstances the water should become salt, others that the lake should gradually increase in size and depth; and as it is neither salt, nor increasing in size, the *Deus ex machina* of a subterranean outlet has been proposed by some to account for its condition. Mr Adams, however, tells us that this idea has no support from any appearances observable on the lake or neighbouring country, so that the waste and supply must be balanced by evaporation. Indeed, it appears that there are considerable fluctuations in its level, as there were high water marks, indicating an occasional greater height of water than when he saw it.

We had marked other passages for remark and quotation, such as his experience of the sensations from the rarefaction of the air at these great elevations, &c., but space fails us. We have said enough to shew that the book will be a valuable addition to the library, not only of the naturalist, but of the general reader.

ON THE VEGETABLE PRODUCTIONS OF ABYSSINIA.

By W. B. HEMSLEY, formerly Assistant in the Herbarium of the Royal Gardens, Kew.

AT a time when so much interest is still concentrated upon Abyssinia, a few words on its vegetable productions may be acceptable. In the following notes I have endeavoured to condense as much information as possible in a few sentences, so I shall not apologise for the disjointed character of their composition. It is now nearly a century since Bruce returned from Abyssinia, after an absence of about six years, and enlightened the world considerably on the history, geography, and zoology, and, to a certain extent, on the botany also, of that part of the world; but his imperfect knowledge of the art of describing plants renders his descriptions useless, except those accompanied by plates. The plates, however, are excellent for the period. Since then, numerous English, French, and German travellers have visited that country, and, thanks to their exertions, we are now tolerably well acquainted with its botany. The flora of tropical Africa generally, is not of that profusely abundant and luxuriant character prevalent in most tropical countries. In the mountainous regions, however, on both the eastern and western coasts, forests of considerable extent, and grassy uplands, exist where vegetable life is rich and varied. Trees of surprising magnitude, and flowers unsurpassed in brilliancy, are met with; and vegetable anomalies and curiosities are nowhere more abundant. The vast sandy plains intervening, are here and there enlivened by the presence of clumps of strange looking, gouty-stemmed dwarf trees, bulbous-rooted and succulent plants, which are peculiarly adapted to the ever-shifting soil. In this they are sometimes deeply buried, and lie dormant for several years, when the winds come and denude them as suddenly as they previously overwhelmed them; and they recommence growing, and produce their flowers as if nothing particular had happened to them. The flora of Abyssinia, and of the eastern coast generally, is, perhaps, less diversified than that of the western coast; but it is, nevertheless, on account of the great height to which the mountains rise, exceedingly interesting and very comprehensive in its features. From a rough calculation, the flora of Abyssinia, excluding the lower Cryptogams, may be estimated at about 2500 species. In certain sterile and arid districts it partakes in some degree of the desert character, abounding in fleshy-stemmed Euphorbias and Adeniums, thorny Acacias and Jujube bushes. In other places, again, the presence of balsam-producing trees and shrubs, indicates an affinity to the flora of the opposite coast of Arabia. Notwithstanding the immense desert lying between Abyssinia and the fertile regions of the western coast, a large proportion of the plants are common to both parts. This applies more especially to those occurring above an elevation of 5000 feet. In the lowlands, the species peculiar to each coast are more numerous; but even here the genera are to a great extent the same. Some Abyssinian species extend northwards to the Mediterranean, others southwards to the Cape of Good Hope, and a very few, excepting ubiquitous tropical weeds, to Madagascar, India, and Australia. Many genera and species are common to the mountains of tropical Africa and the plains of Europe. Several British species are found on the mountains of Abyssinia and Biafra—Cardamine hirsuta, Cerastium vulgatum, Oxalis corniculata, Umbilicus pendulinus, Galium Aparine, Scabiosa succisa, Myosotis stricta, Limosella aquatica, Sibthorpia Europæa, Solanum nigrum, Rumex obtusifolius, Deschampsia cæspitosa, Aira caryophyllea, Poa nemoralis, Kœleria cristata, Vulpia bromoides, Brachypodium sylvaticum, Asplenium adiantum-nigrum, A. filix-fœmina, and Lastrea filix-mas. Besides these species, common to Britain and Abyssinia, many of our other genera are represented by allied species, as—Viola, Silene, Arenaria, Sagina, Hypericum, Geranium, Trifolium, Rubus, Alchemilla, Pimpinella, Cynoglossum, Utricularia, Veronica, Hartsia, Stachys, Calamintha, Polygonum, Thesium Avena, etc. It should be borne in mind, too, that many of the foregoing species or genera are also found on the Himmalayan mountains, and eastward to China and Japan.

With these European forms are associated many tropical or subtropical genera, as the following:—Vitis, Schmidelia, Desmodium, Vernonia, Mikania, Ubeia, Boleum, Plectranthus, Cyathula, Lasiosiphon, Pilea, Peperomia, Commelyna, Cyperus, Panicum, etc. But of these many, of course, do not ascend to the highest points. The flora has been described as poor in comparison with that of other tropical countries. But this must be understood as referring to the number of species dispersed over the whole territory, for the well-watered valleys are rich in species and individuals, while the volcanic mountains and sandy plains are either almost destitute of vegetation, or only occupied by very few species.

Cycadaceæ, Lauraceæ, Ternstrœmiaceæ, Dipterocarpeæ, Ilicineæ, Magnoliaceæ, Berberideæ, and other families, are entirely absent from Abyssinia. The large family Myrtaceæ is sparingly represented, while the neighbouring family, Combretaceæ, is abundant. There is no family of plants exclusively confined to Abyssinia, nor indeed to tropical Africa; but several genera are limited either to Abyssinia or tropical Africa. Many genera, formerly supposed to be peculiar to Abyssinia, have recently been discovered by explorers on the western side of the continent, as Brucea, Nathusia, etc.

I will now pass in review a few of the more important and interesting families represented in Abyssinia, specially noticing those plants employed either medicinally or economically. It is almost superfluous to remark, that the Abyssinians have tilled the ground, more or less, from time immemorial, and have introduced and cultivate many useful plants from the surrounding countries. Of the Gramineæ no fewer than 200 species are reported; and several species peculiar to the country are cultivated for their grain; wheat, barley, maize, and oats are grown, the first and second extensively.

The principal indigenous cereals cultivated are the Teft (Poa Abyssinia), the Dagussa or Tocusso (Elleusine Tocusso), and the (Michella), Andropogon Sorghum. Of the foregoing, Teff is the most important, being extensively cultivated throughout the country, at an elevation of between 6000 and 7000 feet above the level of the sea. There are many varieties of Teff, such as white, red, green, and purple.

According to M. Richard,* four months from the time of sowing are necessary to bring the seed of Teff to maturity. In the environs of Gondar it is sown in August, and cut about the end of November or beginning of December; and in favourable seasons produces forty-fold, but oftener less than ten-fold.

Speaking of this grain Bruce says:—

"The Abyssinians, indeed, have plenty of wheat, and some of it of an excellent quality. They likewise make as fine wheaten bread as any in the world, both for colour and for taste; but the use of wheat-bread is chiefly con-

* "Flora Abyssinia."

fined to people of the first rank. On the other hand, Teff is used by all sorts of people, from the king downwards; and there are kinds of it which are esteemed fully as much as the wheat. The best of these is as white as flour, exceedingly light, and easily digested. There are others of a browner colour, and some nearly black; this last is the food of soldiers and servants."

Michella is largely grown, and offers innumerable varieties. Another grain extensively cultivated is the Tocusso. The meal of this is also used for making bread and cakes, but Tocusso is chiefly employed in the preparation of beer. Previous to being used for the latter purpose, it undergoes the same process as barley in this country. Barley is grown in considerable quantities in the highlands, and is also employed both in making beer and as food for man and beast. According to Bruce, their Bouza or beer is made in the following manner:—

"A jar of Tocusso contains as much as is sufficient to make two loaves, that are a tenth part of the whole jar; besides which, they use about half a votol of "Ghesh" leaves (Rhamnus sp.). The first part of the process is to grind the Tocusso, after which they take a fourth part of it, and knead it with water and leaven, as if to make bread. This they put in a jar to ferment for two days; at the end of which they make a good many thin large cakes, and dry them on the fire until they become as hard as stone, then break them down into crumbs, and put them into a large vessel full of water, capable of holding six times the volume of the grain. The remainder of the meal must be put into a hollow oven, over a fire, with a small quantity of water, and constantly stirred until it becomes a black paste, which, with the bruised ghesh leaves, is put into the jars containing the crumbs and water, let alone for a day, and then poured off, and preserved in jars well stopped. At the end of seven or eight days this liquor begins to be too strong, and is best when fresh, two or three days old."

Sedges, or Cyperaceæ, are numerous, and employed in various ways. The Papyrus, according to Bruce, is a native of Abyssinia, and boats made of the stalks were the only ones in use at the time he resided in that country; but subsequent travellers have not met with, or have neglected to collect it, and make no mention of it.

Palms are rare in tropical Africa, or rather the species are few in number, and three only are reported from Abyssinia—namely, Phœnix dactylifera, the Date, Hyphæne th aica, the Doum and an unnamed species, described as stemless. The Date is cultivated. The Doum or Doom is indigenous, and is found in the vicinity of Gondar, up to an elevation of 6000 feet above the sea level. This Palm is remarkable on account of its stem being often two or three times branched, deviating in this respect from all other known members of the family; the normal state being a simple or undivided trunk. There are five species of the Yam family, Dioscoreaceæ, natives of Abyssinia; and one, Dioscorea Schimperiana, is found in almost every part, but whether any use is made of its roots is unknown to me. Aroideæ are not largely represented. A species of Arum, called "Ambatcha," has tuberous roots, similar to those of our "Lords-and-ladies," which are, when peeled, eaten in a raw state.

The Banana tribe (Musaceæ) is represented by one native species, figured by Bruce under the native name, Ensete; but he was so ignorant of what constitutes botanical characters that he would not be persuaded that it was a species of Musa.

This species is now called Musa Ensete, and has long been cultivated in this country.* Besides its botanical characters, it differs from the other species in having a shorter stem, larger leaves, and an inedible fruit. M. Richard refers specimens collected by Quartin-Dillon to M. Paradisiaca, the Plantain, but with a doubt, and asks if it is not the same as the one figured by Bruce; but most likely M. Paradisiaca is cultivated in this, as in many other parts of tropical Africa, where it is extensively used as an article of diet. At any rate there is no doubt about the existence of a Musa, as described and figured by Bruce. The Ensete is also cultivated for the edible leaf-stalks and stem. Bruce says:—

"When you make use of this Ensete for eating, you cut it immediately above the small detached roots, and perhaps a foot or two higher; as the plant is of age, you strip the green from the upper part until it becomes white; when soft, like a turnip well boiled, it has the taste of the best new wheat bread, not perfectly baked, and is the best of all food, wholesome, nourishing, and easily digested. It is cultivated around Gondar."

The root of the Ensete is also eaten as a vegetable by the natives, and tastes somewhat like a potato; and the leaves are said to furnish good fodder for cattle.

Two species of Coniferæ are indigenous—viz., Podocarpus elongata and Juniperus procera. The latter is called "Zadd," and is one of the largest trees in the country, yielding a hard and durable timber, much sought after for building purposes.

Willows, or Salicineæ, so familiar to us, are not unknown to the Abyssinian, there being three species (Salix axillaris, S. cyathipoda, and S. octandra) on the mountains. One species of Gale (Myrica salicifolia) grows in the mountainous districts; it is, unlike ours, a

* In the "Gardeners' Chronicle" of January 25, 1868, is the following notice:—"A fine specimen of the grand Musa Ensete, generally known as Bruce's Banana, is now flowering in an orangery at Stowe, the seat of the Duke of Buckingham and Chandos."

tree of 30 to 40 feet in height. The most important and conspicuous Euphorbiaceæ are the species of Euphorbia itself, which, in some sterile districts, form the principal feature of the landscape. These are mostly fleshy-stemmed, leafless, or with very small leaves, spiny species, much resembling Cacti ; and some of them attain the dimensions of large trees. When cut or bruised, these Euphorbias exude an enormous quantity of an exceedingly acrid juice. E. Abyssinica, the "Kolqual," is employed for purposes of construction, and rags dipped in its juice are rolled up for torches. I must here quote a few lines from Bruce :—

"In that memorable day, when leaving the Larubar, or low flat parched country which forms the sea coast of Abyssinia, and turning westward, we came to the foot of that stupendous mountain, Taranta, which we were to pass in order to enter into the high land, we saw the whole side of that prodigious mountain covered from top to bottom with this beautiful tree. The fruit was ripe, and being carried on the top of the branches, the trees that stood thick together appeared to be clothed with a cloth or veil of the most vivid crimson colour."

Although his description and plates were against him, Bruce contended that this tree could not be a species of Euphorbia.

E. Petitiana, and E. Schimperiana, are sometimes employed medicinally, mixed with "Cussoo" (Brayera), to augment their activity. Urtica sinensis, a stinging-nettle, is cooked and eaten as a vegetable in Abyssinia, as our common one sometimes is in this country.

Trees of the Moraceæ, or fig family, are abundant ; sixteen species of Ficus alone have been reported. F. Sycomorus is a native of the low country between the Red Sea and the mountains of Abyssinia, where, Bruce tells us, he saw a number of very fine old trees. The fruit of this, as also of F. Vallis and F. pseudo-carica, is eaten. According to Messrs Fecet and Galinier, the inner bark of F. panifica is eaten by the natives, and tastes somewhat like bread.

Proteaceæ, a South African and Australian family, is represented by one species of Protea and one of Leucospermum. Amongst the few Polygonaceæ, is a Dock, Rumex Abyssinicus, or Mok-moks, the root of which is macerated and mixed with butter to prevent the latter from becoming rancid. It is largely employed, and imparts, it is said, no bad flavour to the butter. The singular genus of Bignoniaceæ Kigelia is spread over a great part of tropical Africa, and one species, called by the natives Meder-Deur, is met with in Abyssinia. It forms a large tree, and is a very conspicuous object from the long pendulous racemes of crimson flowers and woody seed-pods, the peduncles being from four to six feet long. This is said to possess aphrodisiacal properties of a most extraordinary nature.

The bark of the young branches of a Stereospermum, a member of the same family as the last, is rolled on sticks, and when dry made into flutes.

There are several plants belonging to the Dog-banes, or Apocyneæ, indigenous in Abyssinia. The fruits of Carissa edulis and C. tomentosa are eaten. Asclepiadeæ, numerous in Africa, especially the tuberous-rooted species of Southern Africa, furnish one or two edible roots. The boiled tubers of Ceropegia Vignaldiana resemble Jerusalem artichokes; and those of a Gomphocarpus are also eaten when peeled and boiled.

Solanaceæ are plentiful. Several varieties of tobacco are cultivated; and Capsicum conoides is grown in considerable quantities, and used as pepper. It possesses an aromatic pungency in a high degree, and a very small quantity is required to season a dish. If taken too freely it irritates the stomach and intestines, and induces dysentery. Solanum marginatum is made use of in tanning leather, and the fruit of another species is employed as a cathartic.

A jasmine, Jasminum floribundum, has intensely bitter leaves, which are used as an anthelmintic. The large family of the Compositeæ is well represented in Abyssinia; but the species are not so numerous as might have been expected. The aromatic leaves of Dichrocepha latifolia are used as a spice.

Carthamus tinctorius is cultivated, and an oil extracted from its seeds. Myrsinaceæ are few. The fruit of a species of Myrsine is mixed with barley, and given to mules and asses, and that of Mæsa lanceolata is regarded as vermifugal. Cordia Abyssinia (Coridiaceæ) should be mentioned. Bruce informs us that all the towns are planted with them. Every house in Gondar has two or three planted around it. The flowers are conspicuous, white in colour, and very profuse, so that in the flowering season the towns are exceedingly gay and pleasant.

Rubiaceæ, or Cinchonaceæ, are numerous, and many of them very beautiful and interesting. The most important is the coffee bush, Coffea Arabica, a native of the south-western part of Abyssinia, and commonly cultivated. It was, however, first known to Europeans from Arabia, hence the specific name; but it has since been ascertained that it was originally introduced into that country by the Arabs, and cultivated in Yemen, whence was derived all the coffee used for upwards of two centuries. It is asserted that the custom of drinking coffee was first practised by the Abyssinians, by whom it has been cultivated from time immemorial, and was introduced into Arabia in the fifteenth century.

Two or three species of Strychnos are indigenous; and the fruits are manufactured into snuff boxes. Tupa Rhynchopetalum (see a figure already given in No. 3 of this Journal), a Lobeliaceous plant, called Djibarra, is extremely venomous; the smoke of its wood, if inhaled, causes vomiting; and even its atmosphere is said to be fatal. Seeds of this plant, mixed with butter, have the power of facilitating parturition. Another plant of this family, Cyphia glandulifera, has farinaceous tubers, which are eaten by the poor people.

About thirty species of Umbelliferæ are recorded from Abyssinia some of which are remarkable in the family on account of their shrubby or arborescent character. One, Steganotænia attains a height of twenty to thirty feet, with a solid ligneous trunk.

Cucurbitaceæ are rare in a wild state. Cucumbers are cultivated and eaten.

Passifloreæ are comparatively scarce in Abyssinia, but on the western side of the continent, and in the south, there are several genera not hitherto discovered in any other part of the world, some of which probably will be found by future explorers in Abyssinia. They are, Tryphostemma, Basananthe, Smeathmannia, Bartonia, Crossostemma, Machadoa, Acharia, and Ceratiosicyos.

Leguminosæ are abundant, cultivated and wild, and many of them are of great beauty. Thorny gum-producing Acacias, Mimosas, and Indigoferas are common. Indigo is obtained from the Indigofera argentea, and the powdered fruit of a Nulletia is a fish poison. A valuable vermifuge is yielded by Albizzia anthelmintica, which has been successfully employed in various parts of Europe since 1846. It is known under the names of Mussena and Besenna. The pulverised bark is the part administered, which is taken in oil, honey, or preserve. It is said to be even more efficacious than Cussoo (Brayera). It kills the tænia, and facilitates its decomposition, so that it is the easier expelled. Moquin Tandon says, that in small doses it causes neither purging nor griping, but in too strong doses it acts as a cathartic, and may even become dangerous. To the Rosaceæ belongs Brayera anthelmintica, the Cussoo, or Cabotz, of Abyssinia, another vermifuge, formerly supposed to be the most powerful in the world. Upon the authority of Brayer, a French physician, after whom it was named, two or three doses of the infusion are sufficient to cure the most obstinate cases of tænia. It has also been successfully employed in Europe.

This is figured under the name of Banksia Abyssinica by Bruce, who devotes a long article to it, wherein he tells us that it is one of the most beautiful as well as most useful trees growing in the Abyssinian high lands. "The Abyssinians of both sexes and all ages," he says, "are subject to a terrible disease. Every individual once a month evacuates a large quantity of worms called ascarides, and the method of promoting these evacuations is by imparting a handful of dry Cussoo flowers in about two quarts of bouza or teff beer, which is taken by the sufferer."

This disease Bruce ascribes to their eating raw meat, for he observed that Mahommedans, who eat no uncooked meat, were free from it. Another plant of this family, Rubus apetalus, has, like our blackberry, an eatable fruit.

Ampelideæ, or Vines. There are three or four native species, and V. vinifera has been introduced, and is cultivated. The large fleshy kernel of Spondias Birrea (Anacardiaceæ) is eaten; and the fruit of Schmidelia Africana (Sapindaceæ) is employed as an anthelmintic. When the fruit is dry it is peeled, mixed with flour, and converted into a kind of paste, which is eaten. Of the Burseraceæ, or Balsam trees, there are several species found in Abyssinia. Myrrh is the product of Balsamodendron myrrha, a small shrub found on the sea-coast, and balm of B. Opobalsamum. The latter is also found in Arabia. Olibanum, it is supposed, is yielded by Boswellia papyrifera, but this is still doubtful. This tree, however, is one of the most remarkable in the country, where it is named Makker.

It furnishes a transparent resin, used as incense, and the bark is used to write upon. Quartin-Dillon and Schimper employed layers of this bark to pack their dried plants in which they sent to Europe. Brucea antidysenterica (Simarubeæ), possesses properties similar to those of Quassia, a member of the same family. This shrub, Bruce informs us, is spread over the greater part of Abyssinia, growing on the sides of valleys. He used it himself for dysentery, and it cured him after all other remedies had failed. The root is the part utilized; this is powdered, and taken in doses of about a tea spoonful in camels' milk. Several other species of this genus have since been discovered in various parts of the world. Rhamnaceæ are abundantly represented by Zizyphus, Rhamnus, &c.

The species of Zizyphus are extremely common shrubs, growing in all soils; but in poor ground the leaves are smaller, and the spiry stipules very strongly developed. The fruit of Z. jujube and other species are eaten. "Ghesh" is a species of Rhamnus, whose leaves are employed in the preparation of beer. The bitter fruits of Rhamnus Staddo are, also, used in the same way which, as well as the leaves of R. pauciflorus, are said to accelerate fermentation, and at the same time to impart an agreeable bitterness to the beer. Gunpowder is manufactured from the wood of Celastrus serratus (Celastraceæ). Plate 49 of "Bruce's Travels" represents the fruit of a Sterculia, which he erroneously states to be that of the tree figured in the preceding plate, which is probably Meliaceous or Anacardiaceous. That portrayed on plate 48 is probably the one referred to, as being the tree which the Abyssinians believe to be the tree that bears frankincense, and we are told that it does produce a gum much resembling it.

Malvaceæ are numerous. One of the most remarkable and interesting is the gigantic tree, Adansonia digitata, or Dina, the Baobab of Western Africa, belonging to the tribe Bombaceæ. This abounds in all the low valleys of the interior, especially in the valleys of the Tacagzze, where it attains enormous dimensions. The diameter of its trunk is out of all proportion to the height of the tree, being from twenty to thirty feet, with a height of fifty to sixty feet. The wood is soft and spongy, and of no particular value; but the bark is utilized in various ways, such as cord and net-making, and in the manufacture of cloths, &c. There is only one other species known, A. Gregorii, a native of N. E. Australia.

Cotton is frequently seen in cultivated ground; but I have not been able to ascertain whether it is made use of by the natives, though most likely it is to a certain extent. Dwarf prickly shrubs of Zygophylleæ and Cappcarideæ are common on sandy soil and volcanic hills. Menispermaceæ and Anonaceæ present nothing particularly worthy of notice, which brings us to the end of our epitome.

From the foregoing notes and extracts a tolerable idea of the Flora of Abyssinia may be formed; but in a sketch, necessarily short and fragmentary, much of interest has been omitted. The details of the preparation of vegetable substances, either for food or medicine, and for the manufacture of various articles, would have occupied too much space in a paper devoted to the general aspect of things.

*FERNS OF KILIMANDJARO.**

A VALUABLE paper on the geographical distribution of ferns was contributed last year to the Linnaean Society by Mr Baker of Kew. The little pamphlet, whose title we have placed at the head of this notice, treats of the same subject at some length in its introduction, and our first intention was to delay noticing it until we could pass both under review at the same time.

On perusing Dr Kuhn's paper, however, we think it will be better to discuss it at once, for his general data differ so materially from those of Mr Baker, that the one cannot be used to throw light upon the other: we must make our selection between them, and cleave to the one and reject the other. We cannot follow both Kuhn and Baker.

The total number of species admitted by Mr Baker is 2229, that by Dr Kuhn is 3334,† leaving a difference between the two of no less than 1105, or a third of the whole. If this difference were uniform in all the tribes and families, we might, by applying a correction of a third, keep the proportion the same, and make some comparison between the results of each; but it is not so, no two tribes differing in the same proportion. The difference between them, for example, is, on the whole a third; on the Hymenophyllaceæ, a fourth; on the Gleicheniaceæ, a half; on the Osmundaceæ, a tenth; and on the Schizæeæ, an eleventh—always in favour of Dr Kuhn's numbers. There are, therefore, no *termini habiles* for reconciling the two; and, as it is impossible that both can be right—perhaps impossible that either can be right—we shall content ourselves with endeavouring to ascertain which comes nearest to the true amount.

Mr Baker has attained his results chiefly from the actual examination of species in the Kew Herbarium (the richest in ferns in the world), so that his results are mainly derived from actual examination of the specimens themselves, and, if errors exist in regard to the admission or rejection of species, they are at least

* Filices Deckenianæ, Auctor. Max. Kuhn, Leipzig (1867).

† The entire number of Cormophytes given by Dr Kuhn is 3825, but this includes the Equisetaceæ, the Lycopodiaceæ, and the Rhizocarpeæ, amounting to 491.

applied on the same principle to all, and do not disturb the general proportion.

Dr Kuhn, on the contrary, has made up his lists from all kinds of sources; collections examined, and lists made up by himself; catalogues published by some authors, monographs and Floras by others, and isolated notices and descriptions of species; and with the information drawn from these heterogeneous sources, modified and corrected according to his own estimate of what was likely, or what had been suggested by others.

It may, however, be worth while for the use of others, to point out one or two objections which occur to us, to the mode in which he has tabulated his statistics. The plan he has adopted is to tabulate the species according to the continents of our modern maps; not into regions whose limits have been determined by the affinity of their productions. The continent of Europe, for example, is not the same Europe as that of the student of geographical distribution; in his Europe the north of Africa is included. Neither does the continent of Asia of our maps correspond with his continent of Asia. His continent goes no further south than the Himmalayan range—all south of that comes into another region—the Indo-Malayan, and so on. Dr. Kuhn (the subject of the body of his book being African ferns) naturally gives a table of the numbers of African species found elsewhere—viz., in Asia, in Europe, in America, &c. But, when he simply records a species as found in Asia of the maps, he leaves the student of geographical distribution in the dark on the most important point—whether it is found north of the Himmalayan range or south of it. The inferences to be deduced from its occurrence in the one being widely different from those from its occurrence in the other. If its Asian habitat means Kamschatka, we should infer that the species was of very antient origin, and that its range once probably extended all over the world, for everything is against any recent union or continuity of Africa and Kamschatka. Whereas, if its Asian habitat meant India or Java, it would suggest its common occurrence there and in Africa as the result of a former continuity of these regions, there being other grounds for believing this to have been the case.

The body of the essay consists of a list of the ferns, with descriptions of the new ones collected by Kersten and Linck, the botanists who accompanied Baron Van Der Decken in his disastrous expedition into the interior of Eastern Africa; and were obtained from the Seychelle Islands, the small island of Nossi-bey, near the west coast of Madagascar, Comoro Island, Zanguebar Island, and the neighbourhood of Mombas and Osi, towns on the east coast of Africa, and from Kilimandjaro itself.

After the claims of that lofty mountain to a crown of eternal snow had been indicated by Krapf, they were impugned by geographers, and so much ridiculed by Mr Cooley and others, that it led to a strong desire for the exploration of the geography and natural history of that region. It was that which led to Baron Van Der Decken's fatal expedition. He solved the problem, and finally established the real existence of perpetual snow on a mountain in the heart of Africa, but at the price of his own life—another sacrifice to the bloody Moloch of African discovery.

Knowing that the country he explored offered an immense field for every kind of natural history exploration, and that he was accompanied by collectors and all the appareil of science, naturalists have looked forward with peculiar interest to the publication of the results of the expedition. The present is one of the first publications of its botanical results (so far as we know, actually the first), and we confess that it has not quite come up to our perhaps somewhat unreasonable or exaggerated expectations.

The total number of ferns recorded by Dr Kuhn, as brought home from the whole voyage, is 44, of which, however, only 12 are from Kilimandjaro.

Now, if there is a spot in all Africa in which *a priori* ferns might be expected to occur in great quantity, it is the neighbourhood of Kilimandjaro, the conditions of the climate (moisture and heat) being there unusually favourable to the growth of this kind of vegetation. As every one knows, too, ferns are more easily collected and preserved than any other class of plants, a single day being often sufficient to dry them, where a week or a fortnight would be required for phanerogamous plants. We are therefore somewhat inclined to surmise that less attention had perhaps been directed to this than to the other classes of plants.

In estimating the actual Flora of the district, however, from the collections received from the expedition, we must ever bear in mind the hurry and distraction with which such expeditions are conducted, where men walk with their lives pinned to their sleeves, and have to keep their eyes more occupied in searching for an ambush of blacks than a cluster of ferns. This is no doubt the chief cause of the apparent smallness of the collection, and is probably also the explanation why even those specimens which have been brought home appear to have arrived in a fragmentary state, two of the new species being described from specimens without fruit, and more of them from fragments of fronds without root, stem, or apex.

The species (twelve in number) which Dr Kuhn records from Kilimandjaro are:—

Acrostichum Deckenii, Kuhn, nov. sp.; Pteris arguta, Ait.; P. aquilina, Linn., var. lanuginosa, Bory.; Asplenium anisophyllum, Kze; A. Sandersoni, Hook.; A. protensum, Schrad.; A. contiguum, Klf.; A. Linckii, Kuhn, nov. sp.; Aspidium Kilmanense, Kuhn, nov. sp.; A. squamisetum, Hook.; A. unitum, Mett.; Polypodium lanceolatum, Linn., var. latifolia, Schldl. Of these, excluding the three supposed novelties, one species, Pteris aquilina, is one of the most widely diffused of plants or animals. The plant which Dr Kuhn regards as Pteris arguta is the P. flabellata of Thunberg, which inhabits Cape Colony, Bourbon, Ascension Island, and West Tropical Africa, and is considered as distinct from the south-west European and Canarian Parguta by some authors. Polypodium lanceolatum belts the world in the tropics, and passes a little beyond them in a southern direction in both hemispheres. Aspidium unitum is like the last, but reaches into temperate regions both north and south of the tropics. Asplenium contiguum was before known only in temperate Asia, and the others, except A. anisophyllum, which is known also in America, are exclusively African; Aspidium squamisetum being the only one that is exclusively tropical, the others being common to the tropics and the Cape.

For this instalment of the Flora of Kilimandjaro, small though it be, the scientific world will be grateful, knowing the toils, privations, and difficulties under which they have been collected; risks which have been too palpably brought home to us in the present instance, by the loss of the life of the deeply lamented Van Der Decken.

Correspondence.

Letter to Dr Hooker *from* Dr R. O. Cunningham, *Naturalist to the Surveying Expedition at the Straits of Magellan.*

H.M.S. "Nassau,"
Sandypoint, Strait of Magelhæus.
November 26, 1867.

"I am very glad, indeed, to hear that the plants have arrived in a satisfactory condition, for I was feeling rather anxious about them. I only fear that the Zoological specimens may not fall into such good hands, and, in consequence, that they may have come to grief before I get a chance at working at them. I will keep in mind what you say regarding a diligent collection of the Strait grasses and Cyperaceæ; and, as I hope we shall spend a few days at Port Famine this season, I will do my best to get hold of King's plants. I hope to have no difficulty in procuring seeds of the Fagi at the end of the season, and saving and sending them home in the way you recommend; and I will keep a sharp look-out for seeds of all kinds.

Regarding the Fuegians, I am afraid we are not likely to have opportunities of intercourse with the eastern ones, who appear to be a distinct race from the western, but I have little doubt we will have many interviews with the latter in the western part of the Straits, and perhaps in Smyth's Channel, where we will probably be for some months this year. I think I mentioned in my September letter that I had procured at Tijuca a female land- or fresh-water crab, with fully developed young ones attached to the abdomen or tail-flap, in the position of the ova. I have been thinking over this circumstance since then, and it appears to me that this goes far to prove that this species of crab either undergoes no metamorphosis in the young state, or else that the changes take place while the young animal is still attached to the parent. I believe our British cray fish undergoes no metamorphosis, but I have not been able to find out from the books I have with me whether the same holds good with any of the short-tailed Decapods. We remained at Rio de Janeiro till the 14th of October, and I took many long walks about the neighbourhood; and, I think, added considerably to my knowledge of the plants and animals of the country. I collected specimens of all the ferns I could find, and if they are in a state of respectable preservation when we go north again, I will send them to you with the next relay of Strait plants, and you can dispose of them as you think fit. I had a pleasant excursion one day with Captain Mayne and Dr Campbell to Paqueta, one of the numerous islands near the head of the harbour. The vegetation of the island was very rich and varied. On a flat space of sandy ground a Eugenia, with oval leaves and ribbed red juicy fruits, was abundant. The Brazilians call it Pitayo, and are very fond of the fruit; but I must say I think it extremely bad, possessing a sickly sweetish taste, followed by a flavour of coal tar. Along the beach I found several bivalves (a species of Donax, one of the most abundant) and Gasteropods; and on a boulder in the water a large handsome gray Aplysia, which emitted a fine purple fluid on being handled. One day our screw was got up for the purpose of cleaning it. I found it covered with two species of zoophytes (one of them a small Coryne or Tubularia), in the midst of which minute Crustacea (among which a Caprella was specially abundant), small fish, and Molluscs clustered. It was rather curious, that though the metal was everywhere covered with the polypidoms of the zoophytes, not a trace of plant life was present. One thing that perplexed me a good deal in the course of several of my walks was the perpetual dripping of drops of water that took placē from the leaves of some Leguminosæ (Acacias, or some other closely allied form). The phenomenon was first mentioned to me by a very intelligent U. S. Lieutenant, and I frequently noticed it afterwards in the course of a walk, shaded with trees, leading into the Corcovada mountains. I could not satisfy myself whether it was due to the action of insects, or was a natural property of the plant. One day I took a walk along the sea-beach, behind Botafogo, outside the harbour, and was greatly amused watching the movements of a crab of the genus Ocypode, which I saw for the first time. Numbers of these animals were reposing on the dry sand, about twenty yards from the water's edge, and, on being approached, ran rapidly down to the water. So swiftly did they progress that it was impossible to overtake them, even running at full speed, and I only succeeded in capturing one specimen with the aid of two lieutenants of the 'Narcissus,' who were with me, by getting between it and the sea and surrounding it. Another day, Grey brought me a very fine long-spined Echinus from the island of Willegatgnarand; and on another occasion, I got several curious Crustacea in Five Fathom Bay, including examples of the genera Hepatus Lupa and Hippa. One thing that struck me in my excursions (which seems to have astonished nearly all who have travelled in tropical countries), was the operations of leaf-cutting ants of various species. The ingenuity displayed in the work of spoliation, and the enormous loads transported by single individuals, was most surprising. In some instances I observed armies of ants marching up the stems of large-leaved trees and shrubs, and cutting through the petioles with their jaws, so as to let the entire leaves fall to the ground, where they were sawn up into loads.

"As I have already stated, we left Rio about the middle of October, and we arrived at Monte Video on the evening of the 21st, having experienced a pampero, but having made a good passage, all things considered. The day after our arrival I took a walk along the coast, outside the town, and noticed a considerable number of plants in flower, that I observed in similar circumstances last year. Thus, there were a yellow Medicago, several yellow and white Compositæ, a small Malva, a purple Echium, an Echinocactus, a small Gnaphalium, &c. The beautiful white Petunia, noticed last year, whitened the rocks and the grass around them, and a beautiful rosy-purple Oxalis clustered in their clefts in many places. On the beach the only living thing, to all appearance, was a small crab, which was abundant in pools in the rocks, and I found numerous valves of a Cerati-solen in the sand. On the following day I went up to Buenos Ayres with Captain Mayne, my principal object being to call on Burmeister, and see the Museum under his charge. We left the Monte in the afternoon, and arrived at Buenos Ayres next morning. Here we remained for five days, and I enjoyed my stay very much. The city was so much more English looking than anything I had seen since I left home, and there are loads of hospitable English inhabitants. I went to the Museum twice, and saw Burmeister both times, being much interested by the interviews I had with him, not to speak of being a good deal amused by one of the most eccentric specimens of a scientific man that it has been my lot to come across. His knowledge of zoology, particularly as regards the Annulosa, is evidently very extensive, and, as I daresay as you are aware, since his residence in South America, he has paid a large amount of attention to its characteristic tertiary fossil Mammalia. Of these the Museum possesses some magnificent specimens. Those of the Glyptodon are, I should say, much finer than those in the British Museum or College of Surgeons, and there are some noble examples of Toxodon, Mylodon, Machairodus, &c. There is also a fine collection of the recent South American Edentata. He shewed me the new Chlamyphorus, which he described two or three years ago, and pointed out to me a very curious difference between the conformation of the pelvic bones in it, and that which obtains in the only other species of the genus (C. truncatus), which was described long ago (if my memory serves me right, by Yarrell in the 'Zoological Transactions'). He also shewed me a very curious monstrous Armadillo, possessing two pairs of hind legs. The most curious thing about it is, that the animal is a full-grown one. Another specimen that he evidently takes great pride in is the trachea of a dolphin, which possesses three equal sized bronchi, and the trace of a fourth. We remained at Monte Video for a couple of days, after our return from Buenos Ayres, and on one of these I called on Mr Lettson, our Consul-General, who is an accomplished mineralogist, and possesses an extensive knowledge of general science. He shewed me some very fine examples of the minerals of the country, and gave me a good specimen of amethyst-coloured quartz. The 'Narcissus,' which was at Rio along with us, left a week before us, and spent a few days at Maldonado, meeting us again at Monte Video. One of the Lieutenants gave me a few Maldonado plants, which he had kindly collected for me. Among them is a fern, which is very like Osmunda regalis. I got a single frond of the same plant at Tijuca. We left the outer roads of Monte Video early on the morning of the 1st of this month, with a favourable wind, which, however, did not last long, being succeeded by a dead calm, and that being followed by the severest gale we have experienced since we left England. You will be able to judge of the extent of the rolling of our craft when I tell you that the indicator of the instrument which we have for registering the amount she rolls, was jammed hard up frequently, and several yards of the upper part of our starboard bulwarks were driven in. I forget whether I told you that my cabin is on deck, attached to the chart-room, and during one night I was frequently roused by seas crashing against the door, and on the roof of it. On the evening of the 5th, when it was nearly dead calm, we put over a towing net, and by this means I procured a minute Velella, and some small Amphipodous Crustacea. The calm continued during the night, and next morning some small Ianthinæ, and various exquisite Acalephæ, for the most part Ctenophora, and among them several Beroes, were procured. The motion of the ciliated plates in the water was most beautiful. Some of the Beroes were colourless, while in others the plate-bearing ribs were of a beautiful rosy tint. A beautiful Acaleph also occurred, which seemed to be a Physsophora, and later in the day a few Isopods were met with. On the 7th, when we were 150 miles off the land, a land bird about the size of a thrush (I believe a species of starling or Icterus) flew round about the ship for a while. On the 8th, when we were still 150 miles off the land, numerous moths and sphinges made their appearance on board, and a little grey and brown warbler visited us and fed upon them. On the morning of the 10th the towing net yielded a few cirripeds of the genus Lepas, attached to air vessels of Macrocystis, a few minute Pteropoda, and three Coleoptera, two of them land and one a fresh-water species. On the evening of the 11th, a Cetacean, about twelve feet long (probably a species of Delphinus), appeared close astern, and followed the ship for some time, diving about in the neighbourhood of the towing net. We had a succession of fine bright days, with but little wind, so that as we sailed most of the way we made slow progress. We got under steam on the evening of the 16th, and on the afternoon of the next day Cape Virgins was sighted, which caused a good deal of interest. A little outside the entrance of the Strait we recognised old friends in a cormorant and a penguin; and on approaching Dungeness Spit we witnessed a most extraordinary sight. On the shelving beach, close to the water, were about a dozen sea lions (Otaria jubata), and further up upon it not less than between fifty and sixty were congregated together. It was most curious to watch the movements of these huge unwieldy monsters, as they reared up their heads, displaying their manes to full advantage, and floundered rapidly down the steep beach into the water, and there splashed about. A great flock of cormorants were also sitting packed close together on the Spit, and several specimens of the Sheath-bill (Chionis alba), a bird we did not see last year, flew near the ship. A party of us intended to have landed next morning, with the intention of making the acquaintance of the sea lions, but the weather unfortunately proving unpropitious, we were obliged to abandon the idea. We weighed between eight and nine, and proceeded on our way into the Strait, the Patagonian shore, as of old, exhibiting beautiful lights and shadows. It blew very fresh during the greater part of the day, and we anchored in Gregory Bay in the evening. We weighed again early next morning, and reached Sandy Point soon after eight o'clock, and here we have been since. The weather has been very fine on the whole, and I had a busy time of it last week, being on shore in general from half-past nine till between five and six, and putting away specimens in the evening. As we are a month earlier than we were last year I find some plants, that had nearly passed over as regards their flowering then, in full flower at present, and others that were out then have not begun to flower now. The morning of the 19th, when I first landed, was a delightful one, with that quiet sweetness that one often sees in spring mornings at home. The woods of the Antartic beech were in their fresh green, and the Magellanic thrush and a small warbler were singing deliciously. The Berberis impetrifolia rendered the ground yellow in many places, with its prostrate stems crowded with blossoms, which diffused a faint pleasant fragrance, and in the neighbourhood of the settlement, Taraxacum, a yellow-flowered Ranunculus, Cerastium arvense, a small prostrate Geranium, a Saxifraga, which I presume to be S. exarata, and a few Graminaceæ, were in full flower and very plentiful. Continuing my walk, I found the Magellanic Ribes flowering plentifully, as well as Berberis buxifolia and Primula farinosa, v. Magellanica. I was much attracted by the beauty of the last, which had almost ceased flowering last year. Its colour varies much, as it occurs under the shade of bushes, such as Chilobothrium, or grows in more open places. In the former case the flowers are often of that rather deep shade of purple which one sees in Verbenas, while in the latter it is often nearly pure white. The same day I got numerous specimens of Anemone decapetala, and one or two Cruciferæ. A small copper butterfly, very like our small copper, and a little dark brown one, were flying about; but, to condense my experiences, I may mention that a few blossoms are beginning to appear on Chilobothrium, and Calceolaria plantaginea, Valeriana lapathifolia, &c., are in bud. Geum Magellanicum, which is very common here, has not even pushed up its flower stem. Valeriana carnosa is in full flower, as is also a yellow Viola, which I imagine to be V. Magellanica. A minute Rumex, which looks like our R. acetosella, is out, and a larger curl-leaved one, growing a little above high-water mark, is in bud. Sisyrinchium filifolium is rapidly coming out. Cardamine geranifolia is fully out in the woods, and I have got beautiful specimens of a purple variety of Oxalis enneaphylla, which, however, appear to be confined to a limited space of ground. None of the Senecios are in flower as yet, a solitary specimen of one, a good deal like S. Falklandicus, excepted. Very few grasses are in flower yet; but I have got good specimens of all that I could lay hands on. I have got at least one plant that I did not get last year; one or two that I got in other localities, such as Asplenium Magellanicum, and Hippurus (the latter I have found abundantly in marshes, but not in flower), and better specimens of a good many plants that I got here last year. Berberis ilicifolia is magnificent in some places in the woods. Its flowers have a redder tinge than those in the specimens figured in the copy of the 'Flora Antartica' beside me.

"As to birds, gulls, steamer ducks, geese, and the large ibis, are plentiful. This is the breeding season of these birds, and I have at present a number of eggs in my cabin, brought from Elizabeth Island by the emissaries of the governor of Sandy Point. I have got a fresh-water Gasteropod, and a few Coleoptera, that I did not get last year, and a splendid specimen of a Crustacean of the genus Lithodes, which I only got imperfect specimens of last year. This is a genus which has interested me for some time. We have a British species which occurs now and then in the Firth of Forth. In it, as well as in all the foreign species that I have had an opportunity of examining, the plates of the abdomen or tail flap are symmetrically arranged in the male, asymmetrically in the female.

"We expect to leave the place to-morrow, and will probably go out to finish sounding the Sarmiento Bank at the entrance of the Strait. We go to the Falkland Isles about the middle of January for supplies, and till after that I fear I will not be able to accomplish much, for we will be chiefly engaged in sounding the deeper parts of various of the bays, and there will consequently be few opportunities of landing. Should anything occur to make it worth while doing so, I will write to you again from the Falklands; but if there is nothing worth mentioning, I will not write again till we go to Chiloe in the beginning of April. "ROBERT O. CUNNINGHAM."

Miscellany.

Geology of Central North America.*—Last year the Union Pacific Railway Company, Eastern Division, made an important survey for an extension of their line from the Smoky River, Kansas, to the Rio Grande, and with a liberal appreciation of the value of scientific discovery, they attached one or two naturalists and geologists to the surveying party. The head of this scientific department was the well-known naturalist of Philadelphia, Dr J. L. Leconte, and he has just published a summary of the Geological Observations made during the expedition, under the title given below. This is little more than a business report for the use of the Company and practical men, Dr Leconte considering that science will be better served by the more detailed results being published in another form at a later time; but, while his "Notes" are chiefly of this nature, he gives at the conclusion a brief sketch of the general inferences which may be drawn from the facts observed, from which the reader may judge of the philosophic spirit in which the inquiry has been conducted, and of the interest which will attach to a more deliberate and complete account of his observations. Dr Leconte's summary of the Geologico-Historical conclusions is as follows:—"1st, That the development of the present structure and surface of the continent from the Rio Grande, eastward to Kansas, has been by a series of gradual and extended elevations from the south to the north, lifting large tracts of land above the surface of the ocean, and connecting the islands of the Palæozoic age into a mass of land gradually growing towards the north and east. 2d, That the greater part of this elevation in the south took place at the end of the lower Cretaceous period, and was accompanied with upheavals of one or more mountain chains; that similar phenomena occurred further north, at the end of the Cretaceous or in the early tertiary. 3d, That after the first and during the middle Cretaceous period, the continent was developed further by the formation of a great peninsula, running eastward, contracting the inter-continental Cretaceous ocean, and preparing it for the division into two gulfs, which was finally accomplished at the end of the middle Cretaceous. 4th, As a result of this division of the inter-continental ocean, the fauna of the two gulfs became quite different in the latter Cretaceous period; so that but few of the fossils of that time are common to the Missouri basin, and the regions south of the Arkansas. 5th, During this gradual progress of the continent towards the east and north, circumstances favourable to the accumulation of beds of lignite occurred successively at different places, giving rise to independent basins: those of the Rio Grande belonging to the lower Cretaceous, those of the Raton (as shewn by the Inoceramus) to the middle Cretaceous, those of the

* Notes on the Geology of the Survey for the Extension of the Union Pacific Railway, Eastern Division, from the Smoky Hill, River Kansas, to the Rio Grande. By John L. Leconte, M.D. Philadelphia, 1868.

Denver region to the latest Cretaceous or oldest tertiary; but being in either case older than those of the Missouri, or Great Lignite beds of Dr Hayden, which are probably Miocene, and which thus continue the sequence as far north as observations have been made."—(P. 65.)

Mode of Capturing Hæmonia Equiseti.—The following incidental notice of the mode of securing good and early specimens of species of Hæmonia and Donacia, is from Dr Marmottan's account of the excursion of the Entomological Society of France into the Vosges and Alsace, in 1866:—"We did not wish to leave Strasburg without taking the Hæmonia equiseti, a species which is not rare, but which the singularity of its ways makes it difficult to find With our colleague M. Gerber, and the pastor Blind, who was kind enough to act as our guide, we got into a small boat and left the town, going up the course of the Ill. About two kilometres from Strasburg we fell into the true fluvial meadows, composed of Potamogeton natans and fluitans. Formed of long slender and flexible blades, which come to the surface of the water to bloom, these plants thrust into the bed of the river claws or roots, which sustain them firmly and prevent them from being dragged away by the current. It is these roots, in the form of claws, which it is indispensable to have, because it is there that the Hæmonia is found. It is necessary to arm one's self with patience and courage, because it is not an easy thing to procure the Potamogeton with its roots; the stalks are so very brittle, that the plant is broken before you can disengage the claws, and you only bring to the surface the leaves of the plant, which are entirely useless. It is necessary to plunge one's arm as deep as possible into the river, seize a bundle of stalks and pull them gently, giving them slight shocks. When you are fortunate enough to get a plant with its stalks and roots complete, you find agglomerated around the latter little groups of cocoons, of a reddish brown, exactly like the pupæ of the Diptera; these are the cocoons of the Hæmonia. On opening these impermeable envelopes, you find the insect surrounded with a slight envelope of air. It was a little too soon to make such a hunt, so we only found a few perfect insects; the greater part of the cocoons only contained chrysalids. Other cocoons, exactly like those of the Hæmonia, but larger, and adhering equally to the claws of the Potamogeton, contained the Donacia bidens."—*Annal. Soc. Ent. Fr.*, 1867, p. 671.

White Mammals.—Does any white mammal exist wild anywhere except in Arctic or Boreal regions? Dr J. E. Gray has lately described a white marmoset as a new species. It is in the Zoological Society's Gardens, Regent's Park, and has been received from tropical South America. To all appearance it differs in no respect from the common marmoset except in colour. It was suggested that it might be an albino, but the eyes are not red but hazel, and Dr Gray regards it as a distinct species. Red eyes, however, are not an invariable concomitant of albinism. In domestication, white varieties (as of horses, dogs, &c.), without red eyes, are common, and the same may occur with wild species; but we do not remember to have heard or read of any entirely white mammal from the tropical or temperate regions, while varieties or albinos of other species do occur.

*DR FALCONER AND HIS LABOURS IN INDIA.**

IN the annals of science there are but few who have had a greater share in original discovery than the late Dr Falconer, and there are certainly none who, with the same advantages, have left so little on record by which posterity might decide on the true value of their labours. With the exception of several brilliant essays, scattered through various publications in Europe and India, and especially with the exception of a fragment of the magnificent work on the ancient Siwalik Fauna of India, he left nothing behind worthy of his high ability and his enormous knowledge. As a speaker, he had few rivals in brilliancy of debate and vigour of repartee, and his influence in the Societies to which he belonged will not pass away with the present generation. In undertaking to edit Dr Falconer's papers, Dr Murchison has been confronted with very great difficulties. The immense quantity of crude scientific matter accumulated in Europe and Asia had to be reduced to some sort of order, and the notes taken at various times during thirty years had to be compared and revised. The scientific memoirs already printed, or existing only in manuscript, had to be modified to agree with the change in the views of the author, consequent on a more widely extended experience. The vigorous and critical "intellect which would have erased the errors of first impressions, and moulded scattered observations into one harmonious whole," was gone. The editor had to decide whether they should be printed, or remain hidden from the sun for ever. In choosing the former of these alternatives, he has thrown open to palæontologists a mine in which they will seek treasure for many a long year to come. We propose to discuss that portion of the work which relates to Dr Falconer's labours in palæontology and botany in India.

In the beginning of 1831, Dr Falconer was ordered to the station at Meerut, in the north-western provinces, where he performed his first and last military duty, during twenty-six years of service, in taking charge of a detachment of invalids proceeding to

* "Palæontological Memoirs and Notes of the late Hugh Falconer, A.M., M.D." Compiled and Edited by Charles Murchison, M.D. 2 vols. 8vo. Hardwick, London, 1868.

the sanatorium of Landour, in the Himmalayahs. This led him to pass through Suharunpoor, where there was a botanical garden under the charge of Dr Royle, with whom he became very intimate, and whom he finally succeeded in 1832. For this important post he was eminently fitted by his previous studies, and by the peculiar versatility of his mind. The locality itself was most admirably adapted for the study of botany and natural history, it being situated between the Jumna and Ganges, outside the belt of the Terai forest, twenty-five miles distant from the Siwalik hills, and within sight of the Himmalayahs. The rivers, plains, forests, and hills teemed with life of almost every form; and the varying altitudes caused Alpine vegetation to thrive on the hill tops, and to pass insensibly into the products of the tropics on the plains. In this remote station, inhabited at the time by only six European families, and far away from all the appliances necessary for scientific investigation, the young superintendent, then only twenty-three years old, was thrown altogether on his own resources. It was very hard to get philosophical instruments from Europe, and if once broken there were no workshops where they could be repaired. He was obliged, therefore, to have them made by the cunning hands of the native workman under his own eyes, or to forego them altogether. He was equal to the occasion. At one time he might be seen superintending the construction of a glass tube for a barometer, to be used in mountain explorations, out of broken tumblers, distilling mercury out of cinnabar bought in the native market, turning a reservoir for it out of boxwood, and standing over a native blacksmith as he cast and graduated a brass scale, and thus he obtained an instrument amply sufficient for his needs. At another time, when the supply of salad oil ran short, he devised a very good substitute out of the juice of some native tree. Prevented from following up his favourite study of osteology by the absence of means of comparison, he ransacked the plains, forests, and rivers in the neighbourhood, and soon formed a very fine museum of comparative osteology. This spirit of indomitable perseverance he carried into everything he undertook.

He had not been settled in his new duties more than a few months before he began to explore the geology of the sub-Himmalayahs, a work for which he was prepared by his former training under Professor Jameson. He restricted to them the term Siwalik, and defined their range to be from the Indus to the Brahmapootra, in a direction parallel to the Himmalayahs. Between the Jumna and the Ganges they are about eight miles in horizontal breadth, and they there attain their greatest height of 2000 feet above the plains at their base, or 3000 feet above the sea.

"They rise at once against the plains with an abrupt mural front; they are serrated across their direction, forming a succession of scarcely parallel ridges, with a steep face on one side and a slope on the other. The strata are inclined at an angle of from 25° to 30°, they are of recent tertiary or alluvial formation, and consists of friable sandstone or gravelly conglomerate, agglutinated by a calcareous cement containing subordinate beds of clay. The upper strata are entirely gravel. Beyond these plains lies the valley of Deyra, 1200 or 1400 feet above the sea, and then the great chain of the Himmalayahs."—(Vol. i., p. 19.)

Hitherto they had been considered by Captain Herbert to be of the same age as the New Red Sandstone. The discovery of beds of lignite and dicotyledonous wood by Lieutenant Cautley, coupled with the mineralogical characters of the strata, led Dr Falconer to infer that they belonged to the miocene group of rocks, and that they are closely analogous to the molasse of Switzerland.

We shall do well if we sift the ground for this conclusion, which has been accepted by the whole of the scientific world without question. One reason which he assigns is altogether inscrutable; because there is broken gravel on the northern flanks of the Siwalik hills, therefore they are of miocene age, which is equivalent to saying that because the gravel, on which London stands, rests on the London clay, therefore the latter belongs to the oxfordian zone. Nor, indeed, are the other two reasons of much greater weight. Lignites and fossil woods are not confined to the molasse of Switzerland, but are to be found in nearly all the older rocks dating back from the pliocene of Auvergne. The mineral character is of little or no value in the correlation of widely remote areas of deposit. All arenaceous rocks are more or less alike, the only difference between the older and the newer being the greater consolidation of the former, resulting from the pressure of a heavier mass of superincumbent rock. While a river is depositing in one place gravel, it forms a sand-bank in another, and is carrying out fine sediment to sea to compose beds of clay. There seems, therefore, to us no solid reason to be deduced from the mineralogical character or fossil botany of the Siwalik hills that they correspond geologically with the miocenes of Europe. Nor, indeed, is this latter view corroborated by the subsequent discovery of a large fossil fauna.

Captain Cautley in 1827 had made a collection of bones from the Siwalik hills, which, on being submitted to Dr Falconer, proved to belong to crocodiles and turtles. The first discovery of fossils, therefore, in the formation was due to the former, while their determination was due to the palæontological skill of the latter. In 1834 Dr Falconer discovered a fossil tortoise in the Limli pass, and immediately after Captain Cautley followed up the search in the Kalowala, and obtained a large number of mammals by means of blasting. In the same year, also, there were new labourers in the field. Lieutenants Baker and Durant began working the great ossiferous deposit near the valley of Murkunda and below Nahun, the former having his attention drawn to the locality by the present of part of the tusk and tooth of an elephant by the Rajah of Nahun. Dr Falconer was immediately on the spot, and obtained upwards of three hundred specimens of fossil bones within six hours. From that time the two original discoverers gradually accumulated an enormous quantity of mammalian fossils, sufficient to fill two hundred and sixty packing-cases for transmission to Europe. From time to time they published memoirs on the most important of the extinct species in the "Geological Transactions," the "Asiatic Researches," and the "Journal of the Asiatic Society of Bengal." In Europe the discovery attracted much attention, and was deemed by the Geological Society of such high value that the Wollaston medal for 1837 was awarded, in duplicate, to Dr Falconer and Captain Cautley.

Up to this time the ancient forms of life that dwelt in India before the establishment of the present species, had been altogether unknown. Now they were brought vividly before us. On the ancient plains of India, drained by the streams that deposited the Siwalik rocks, there lived a mastodon*, four species of elephant, of a type altogether unknown at the present day, two closely allied to the animal now living in India, and one of the type that is now con-

---

* Mastodon sivalensis. Elephas hysudricus. E. cliftii, E. planefrons, E. insignis, E. ganesa, E. bombifrons. Hippopotamus sivalensis. Merycopotamus dissimilis. Sus giganteus, S. hysudricus. Rhinoceros platyrhinus, R. palæindicus, R. sivalensis. Chalicotherium sivalense. Equus sivalensis. Hipparion (Hippotherium) antelopinum. Camelus sivalensis. Camelopardalis sivalensis. Sivatherium giganteum. Antelope palæindicus, A. gyricornis. Bison sivalensis, Bos occipitalis. Hemibos triquitriceras. Amphibos acuticornis, A. elatus, A. antelopinus. Machairodus sivalensis. Felis cristata. Hyæna sivalensis. Hyænarctos sivalensis. Ursus camis? Enhydriodon sivalensis. Semnopithecus entellus? Pithecus satyrus. Crocodilus bombifrons. C. crassidens, C. leptodus, C. gangeticus. Colossochelys Atlas. Emys tecta. Trionyx.

fined to Africa. There were also camels of more gigantic stature than any still living. Giraffes, horses, and hipparions, small animals closely allied to the horse, but possessed of three hoofs on each foot, three species of rhinoceros, two of which are closely allied to the species now living in India and Sumatra, and a remarkable herbivore, the Chalicotherium, lived on the foliage. There were also many kinds of extinct oxen, and two of antelope to feed on the grass; and the strangest of all known mammals, the great Sivatherium, that fed probably on a mixed diet of grass and foliage. Stranger than a dream, or one of Albert Durer's demons, was its form. Possessed of four horns, like the Antelope quadricornis of Hindostan, it had the trunk of a tapir, the stature of an elephant, and the teeth of an ox. Two kinds of wild boar, one of gigantic size, fed on the wild fruits and tubers that grew in the forests, and a hippopotamus of an extinct species dwelt in the rivers. These herbivores were also kept in check by a corresponding development of the carnivora. There was the great sabre-toothed lion, the tiger, a bear, an animal allied to the ratel, an otter, fox, and hyæna. Four species of monkey lived in the trees, one closely resembling the orang-outang, and another indistinguishable from the small Hoonuman. The reptiles, also, were not unrepresented. There was the common Crocodilus bombifrons of the Ganges, and the common gavial, as well as two extinct species—a small tortoise still living in the neighbourhood, and a most gigantic member of the same genus, twenty-two feet long and six feet high, the Colossochelys Atlas. Such is the fauna of ancient India revealed by the genius of Dr Falconer.

At what time in the history of the earth did it live? Dr Falconer himself oscillated between a belief, derived apparently from the mineral character of the rock, that it belonged to the miocene age,* and an inference drawn from the study of the fossil mammalia, that it lived through a vast and unbroken period of time, equivalent to that which elapsed between the miocenes and pleistocenes, or recent deposits of Europe.

> "The evidence," he writes, "from the vertebrate animals is of a double character; half of them are so like the fauna we have in India that they might pass for the creatures of yesterday, while the other half represents the characters of the middle and older tertiaries of Europe. That they belong to the vertebrate series which immediately preceded the existing race of animals is hardly susceptible of doubt, from the admixture of existing reptiles."—(P. 27.)

In Europe, and especially in the south, some of the forms of life

* Vol. i., p. 21; ii., pp. 557, 639, 642.

are represented in miocene deposits. Thus the sabre-toothed lion is found at Eppelsheim; an arboreal ape, the giraffe, camel, and innumerable antelopes lie buried in the plains of Marathon; the hipparion in France, Germany, Britain, and the Spanish Peninsula. The needs of their existence demanded a tropical climate throughout that vast area. In Europe from that time up to the glacial epoch the climate gradually grew colder, and with each successive lowering of temperature a new group of animals made its appearance, driving before it the former inhabitants that were fitted for warmer conditions of life, and leaving behind their fossil bones to mark the geological age of the deposits in which they are found. Thus the sole survivors out of the forms of life found in the miocenes of Europe are now to be sought in the tropical regions of Africa, whither they have been driven by the change in the European climate. No changes of this kind have taken place in India. The climate of the Siwalik hills is as hot now, if not hotter, than during the lifetime of the extinct Indian mammalia.

"Instead of numerous sub-divisions of the tertiary period with successive faunas, facts tend to the conclusion that India had one long term and one protracted fauna which lived through a period corresponding to several terms of the tertiary period in Europe."—(Vol. i., p. 28.)

This, in our opinion, is the true explanation of the mixed character of the Siwalik fauna. To assume with Sir Charles Lyell* and M. Gaudry† that it corresponds with that of Europe in the miocene, is to abandon the course of reasoning by which we have hitherto been accustomed to correlate the remains of life imbedded in deposits far removed from one another. The first step in any palæontological inquiry is to master the fauna and flora living *at the present time* in the country in which the fossils occur, and then to calculate the age of the latter in direct proportion to the correspondence between them and the existing forms of life. If there be many species in common then the fossils are of comparatively small antiquity, while, on the other hand, if there be no agreement whatever they are relegated to a period infinitely remote from the present. All the tertiary mammalia that have yet been found have been classified in accordance with this method. Thus the gigantic extinct sloths of America are still represented by the small one living in the same area, and they are considered, there-

* Elements of Geology, 6th edit., p. 273.

† "Animaux Fossiles et Géologie de l'Allique." Par. M. Gaudry, Part 1. "Animaux Fossiles." 4to, Paris 1867.

fore, to belong to the present order of things. The great extinct kangaroo of Australia is represented by one of smaller size, identical in every respect save its smaller stature, and therefore it is assumed to have lived at no very remote geological epoch, and because both these animals stand in the same relation to the fauna still living in South America and Australia, they belong approximatively to the same geological epoch. In no case are the fossil mammalia found in Europe looked upon as the tests of age in the comparison of fossils from other areas. There is no reason why the classification of the Siwalik fauna should be conducted on other principles than these, because a few of the animals are common also to the miocenes of Europe. There is, indeed, this great and important difference between them, that while in India several of the Siwalik species are still alive, in Europe all have become utterly extinct. It would be as fair to term the marsupial fauna of the Australian caves liassic, because it is represented in part in the secondary formation of Europe, as to consider that of the Siwalik hills miocene because of its affinities with the miocene animals of France, Germany, and Britain. A careful analysis of of the evidence leads us to the conclusion that the Siwalik fauna began to live in the miocene, and that it lived on uninterruptedly to the present day in the same area—the true miocene forms, found also in Europe, being gradually eliminated by the competition of others better fitted for the struggle of life.

How comes it to pass that the Siwalik fauna should be locked up in the bosom of hills as high as Snowdon. In answering this question, Dr. Falconer has lighted on a most important fact for the physical geographers. The rocks of which they are composed are made up of sandstones and clays similar in character to those which are now being swept down by the rivers of the district, and they contain fluviatile shells of existing species. They are, therefore, indisputably detritus brought down by ancient rivers, and the entombed animals are merely waifs and strays swept down by the floods. The only hypothesis which will at once satisfy their enormous thickness of 2000 feet and more, and their great extent of 272 miles is, that they were deposited in the debouchment of a river. The occurrence, also, of elephants, camels, giraffes, and other large animals shews that the river passed through great plains, for none of them are dwellers in mountains. We have, therefore, a great fluviatile deposit in an estuary, which would imply that it was near the level of the sea, now elevated 3000 feet above it. The twists, faults, and contortions, point out that the cause was the exertion of subterranean force, and as the rocks abut against the Himmalayahs it would seem highly probable that the latter have been bodily lifted to that height since the Siwalik animals were buried in 2000 feet of rock. To suppose that a thin strip of country at their base could be elevated without their participation in the movement would be contrary to all analogy.

Dr Falconer cites additional testimony from another quarter to the truth of this inference. The remains of rhinoceros have been found in the Hioondès Steppe, in Central Thibet, 15,000 feet above the sea level, on the north side of the Himmalayahs. The tract is a dreary plain, shrubless, treeless, and houseless, supporting a few furze bushes and a sprinkling of the most arctic vegetation; the climate is one of polar severity. It is certain, he acutely argues, that no rhinoceros of the present day could endure such conditions of life as would result from the present climate, and that even were it fitted to endure the severity of the weather, it could not live on the short grass growing at that altitude, because the incisive teeth, or nippers, are so defective as to prevent it browsing in the same way as the horse, sheep, or ox.

"The Siberian rhinoceros' remains are found on the shores of the frozen ocean, under conditions of climate more severe than those of Thibet; and it has been shewn by Lyell how these remains might have found their way, by changes in the physical geography of Siberia, by transportation on ice-blocks, and by periodical migrations. But these conditions will not apply to the Hioondès; the rhinoceros could neither have migrated to its mountain-locked plain, from the side of Hindostan, by the passes where men and goats can scarcely find their way, save by the artificial aid of scaffoldings, nor is it apparent how the bones could have been transported to their present resting-place from a higher tract.

"The only explanation of the case that suggests itself, which appears admissible, is a depression of the plain of the Hioondès to a much lower level, and to clothe it in a vegetation resembling that of India now, which on the supposition that the rhinoceros was not a migratory visitor, but a permanent resident of Thibet, and clothed in a warm fur, is perhaps the utmost limit that could be conceded for its habitat. The plain of the Hioondès would require to have been not higher than 7000 or 8000 feet above the level of the sea. The mean level of the Hioondès, which is known at Dhapa to be 15,000 feet, and estimated to be not much less than 17,000 feet near Manasarovara, may be considered as 16,000 feet. To reduce it, therefore, to the circumstances above inferred, would involve the consequence that the northern face of the Himmalayahs, and (as elevating movements are nowhere known to be confined to narrow belts) probably a considerable portion of the chain itself, have been elevated 7000 to 8000 feet since the tract was tenanted by a species of rhinoceros."—(P. 180.)

He then proceeds to inquire whether any climatal change has been going on in the Himmalayahs within the historic period.

"Roads of communication," writes Mr Trail, "through the Himmalayahs, unite the passes from east to west, but they are passable during a few days only in each year, and are considered at all times dangerous by the Bhoteahs themselves. Roads of this description formerly used are now impracticable, owing to the increase of snow. The interior of the Himmalayah, except at the passes and paths in question, is inaccessible, and appears to be daily becoming more so, from the gradual extension of the zone of perpetual snow. The Bhoteahs bear universal testimony to the fact of such extension, and point out ridges now never free from snow, which within the memory of man were clothed with forests, and afforded periodical pasture for sheep; they even state that the avalanches detached from the lofty peaks occasionally present pieces of wood in their centre."—(P. 183.)

This evidence of Mr Trail's, as to the climatal change, is all the more valuable because it was given incidentally in a report on the regions of the Thibet passes, without reference to any scientific theory. It is corroborated also by the independent testimony of Mr Edgeworth, recorded in one of Dr Falconer's note-books:

"On the Vishnoo Gunga, between Bhadra Nath and Pundoo kesur, there is an artificial mound at a place called Kutlean Kotee, which the Puharees say is the remains of a large hill city, that became deserted in consequence of the increased cold, or descent of the snow zone. Charcoal and remains of pottery are found in it. There is a current tradition that formerly there was a straight path between Bhadra Nath and Kedar Nath, which has become impassable, so that a detour of several days is necessary. There was formerly a pass up the Bhillung river which led into Thibet. It was last crossed more than fifty years ago during the first Goorka invasion; since then an attempt was made to cross it, but the party, of whom Edgeworth's informant was one, were struck with snow blindness, and nearly lost, so that they had to return."—(P. 185.)

It is clear, therefore, that a great and appreciable change of climate is taking place, from the testimony of these two independent observers. The zone of perpetual snow is descending upon tracts in Thibet where the forests grew; for otherwise it is impossible to understand how wood could be entangled in a glacier in any other way. Passes which were open within the memory of man have been blocked up by the accumulation of snow and ice, and the inhabitants driven out of a hill city by the increase of the cold. Now, these facts admit only two interpretations; either the snow line is descending, or the mountains themselves are being gradually lifted up into the zone of everlasting snow. So far as we know the variation in the limit of perpetual snow, it merely amounts to that of the mean temperature, which in this particular region is merely a few degrees; and in the Andes also it was found by Baron Humboldt not to exceed 30 fathoms from year to year. It is, therefore, highly improbable that the descent of the snow line in the Thibetan Himmalayahs is caused by the lowering of the zone of perpetual snow, and thus we are driven to the second alternative, that the mean altitude of the plain of congelation being nearly constant, the mountains are being gradually elevated, so that portions formerly enjoying temperate climate now lie buried under an accumulation of ice and snow.

"The instance of the enveloped timber would admit of two explanations—either that it belonged to the age when the Himmalayah mountains had their elevation increased by the Siwalik and Thibet upheavements, or that the tract on which it grew had been subsequently raised up into the zone of congelation. That these mountains, before their summits attained their present elevation, were clothed with forests high upon the tract which is now covered with perpetual snow, is but consonant with the course of nature to suppose; and wood once enveloped in a snow bed would retain a freshness unimpaired for countless ages. We might, therefore, in a piece of green wood which descended from the higher peaks in an avalanche, light upon a remain which had a contemporaneous existence with the sivatherium in Hindostan, or the rhinoceros in Thibet; and it would be a matter of extreme, if not insurmountable difficulty, to determine to what period of the interval between these upheavements and the present time its envelopment in the snow should be referred."—(P. 184.)

In this way, by a chain of proof, perfect in its kind, Dr Falconer has demonstrated that the Himmalayahs have been elevated several thousand feet since the time that the Siwalik animals roamed over the plains of India, and the rhinoceros lived in Thibet; and secondly, that the elevatory force is still being exerted. He has, however, omitted to notice the evidence that the Himmalayahs were much higher in comparatively modern times than they are now. The old moraines, and other traces of glaciers far below the point at which they are now found, attracted his attention, and have subsequently been explored by Dr Hooker* and Captain Goodwin Austen.† At the time the glaciers extended much lower than they do now, the mountains must have been much higher. On the assumption that the snow line is very nearly constant, there is proof, then, that the Himmalayahs, like the mountains of Wales and Scotland, have been subject to oscillation of level in comparatively modern times.

---

* Hooker, Himalayah Journals, vol i., p. 218, vol ii., p. 273.

† Journal Geographical Society, vol. xxxiv.

One important conclusion as to the geological date as to the main elevation of the Himmalayahs flows naturally from Dr Falconer's premises. In the Siwalik fauna there were some animals that are common to the later miocenes of Europe. The Hipparion, for example, in miocene times ranged through Russia, Germany, and France, into Spain and Greece, and is found among the waifs and strays that compose the red crag of Suffolk. There could therefore in those days have been no geographical barriers to the migration of species, if India be taken as the centre northwards and westwards, if Europe to the south and east. In other words, the chain of mountains passing from the Himmalayahs through Herat and Tehran, and sweeping round the south of the Caspian to join the Caucasus, could not have presented an unbroken barrier to the migration of animals from Europe to India, or *vice versa* in the miocene epoch. According to Professor Brandt, of St Petersburg, the Steppes of Siberia were inhabited by the mammoth, woolly rhinoceros, and reindeer, while the pleiocene mammalia were living in Europe; and that as the climate of both Siberia and Europe grew colder, the Siberian fauna gradually advanced to the south and west, until the maximum of cold was reached in the glacial epoch of Europe. But whether this be accepted as true or not, there can be no doubt about the tropical animals of miocene Europe and Southern Russia having been supplanted by those belonging to a type now confined to a temperate or comparatively warm climate; or that these again were obliged to give way before the invasion of a grew of animals little fitted to endure the severity of an arctic winter. Had there been no geographical barriers, some of these animals, which without exception are confined to the Europeo-Asiatic continent, north of the Himmalayahs, would have found their way to the temperate zone on their southern flanks. There is not even one species that can be considered common to the pleio and pleistocene fauna north of the Himmalayahs and that of the Siwalik hills; and, therefore, the presumption amounts almost to a certainty that they were elevated sufficiently high at the close of the miocene epoch, to prevent the invasion of the animals coming from the north; and that they insulated the Indian mammalia as completely as the Straits of Macassar insulate the Australasian fauna.

Before we pass on to the consideration of Dr Falconer's botanical works, there is a theory which he advances respecting the date of the extinction of the great tortoise of the Siwalik hills that merits our attention.

"Are there," he asks, "any indications as to when this gigantic tortoise became extinct? or are there grounds for entertaining the opinion that it may have descended to the human period? Any *a priori* improbability that an animal so hugely disproportionate to existing species should have lived down to be a contemporary with man, is destroyed by the fact that other species of chelonians, which were coeval with the colossochelys in the same fauna, have reached to the present time, and what is true in this respect of one species in a tribe may be equally true of every other placed under the same circumstances. We have as yet no direct evidence to the point from remains dug out of recent alluvial deposits, nor is there any historical testimony confirming it, but there are traditions connected with the cosmogonic speculations of almost all eastern nations, having reference to a tortoise of such gigantic size, as to be associated in their fabulous accounts with the elephant. Was this tortoise a mere creature of the imagination? or was the idea of it drawn from a reality like the colossochelys?"—(P. 560).

In the story of Garuda, the carrier of Vishnu, the tortoise is brought very prominently forward. Garuda, while pursuing his journey,

"Met his father, Kushyupa, who directed him to appease his hunger at a certain lake where an elephant and tortoise were fighting. The body of the tortoise was eighty miles long, the elephant one hundred and sixty."—(P. 368.)

In the Pythagorean and Hindoo mythology, also, the world is supported on the back of a tortoise. Hence Dr Falconer argues that the idea of the gigantic size of the tortoise could only have been founded on some basis of fact; that is to say, that this giant form was known by tradition to the fathers of the Aryan race. In New Zealand there is evidence that the gigantic extinct moa lived during the human period, and there is every probability of the æpiornis having co-existed with man in Madagascar. Why, therefore, should not the gigantic tortoise have lived along with man in the plains below the Himmalayahs? Two crocodiles and one small tortoise have survived all the great physical changes that have taken place—why not this also? We cannot agree with Dr Falconer that there are fair grounds for this mode of argument. Could not the idea of monstrous size be derived from the discovery of the *fossil* colossochelys? In Ferishta's Indian History the bones of giants are mentioned as occurring in the hills in which the Sutlej takes its origin. It is clear, therefore, that the fossils had attracted notice at an early period. It seems most probable to us that a native living in the Siwalik area must be acquainted with the little tortoise now living in the neighbourhood, and that if he met with a gigantic carapace, such as that now in the British Museum, he could not help ascribing it to a giant individual of the same kind. In that case the mythological account would certainly spring from the occurrence of the fossil, and in no case could be taken as proof of the existence of the reptile at the time that our Aryan fathers dwelt in India. The evidence which he adduces in favour of the extinct Indian hippopotamus having lived to be a contemporary with man is of a totally different character.

"I was informed," he writes in a note by Rajah Radhakanta Dera, the eminent Indian scholar and author of the Sanscrit Encyclopedea, "that the hippopotamus of India is referred to under different names of great antiquity, significant of Jala Hasti, 'water elephants,' or living in the water. This inference is confirmed by the opinion of Henry Colebrooke, and H. H. Wilson." —(Vol. ii., p. 180.)

While Dr Falconer was making these remarkable discoveries, he did not neglect his duties as superintendent of the Botanic Garden at Suharunpoor. He undertook many scientific expeditions, and brought back enormous quantities of rare plants. But the most important service that he rendered to India was the share he took in the introduction and cultivation of tea into the Bengal Presidency. In 1834 he drew up an elaborate report for the Committee on Tea Culture, in which he stated his belief, "first, that the tea plant may be successfully planted in India; secondly, that in the Himmalayahs, near the parallel of 30, it may be cultivated with great success, and that the most favourable ground for a trial is a tract on the outer ridges, extending from 3000 feet above the sea, or the points where the cold winds cease, up to the limits of winter snow." * The merit of the original suggestion to the government, that the tea plant might be successfully cultivated in the Himmalayahs, is due to Dr Royle, who preceded Dr Falconer at Suharunpoor. He made it the subject of a special report in 1827, † and brought it before the notice of the Governor-General, Lord William Bentinck, in 1831. ‡ In 1833 he pointed out the locality in which it might be grown in the Himmalayahs. "There is considerable prospect of success in the cultivation of the tea plant, for the different elevations allow of almost every variety of climate being selected, and the geographical distribution

* Journ. As. Soc., Bengal, vol. iii., p. 178.

† Royle on the Productive Resources of India. Lond. 1840, p. 258.

‡ Journ. As. Soc., Calcutta, Feb. 1832.

of this plant is sufficiently extended, and the natural sites sufficiently varied to warrant its being beneficially cultivated.* Dr Nathaniel Wallich also, the eminent botanist, seems to have arrived at the same conclusion independently of Dr Royle, and in 1832 brought in the cultivation of tea in the Himmalayahs before a committee of the House of Commons, on the affairs of India. The recommendation of these two eminent botanists resulted in the appointment of the Tea Committee by the Bengal government, to whom Dr Falconer gave his report, and by whose express direction he conducted the first experiments; and thus while the merit of the original suggestion was owing to Drs Royle and Wallich, that of practically carrying out the idea was due to Dr Falconer. Subsequently, in the years 1849-50, Mr Fortune brought over large numbers of tea plants in Wardian cases from China, which reached their destination in the Himmalayahs in good condition.

This seems to us the share that each had in laying the foundation of a vast and important branch of industry in Northern India.

Dr Falconer also gave his attention to botanical notices in Greek and Latin works. In 1840 he wrote an elaborate paper † on the Costus of Dioscorides, in which he proved that it was the root of a new plant, Aucklandia, belonging to the compositae growing on the mountains which surround Cashmere. He advocated its introduction into the Himmalayahs, within the British dominions, where it would form a valuable adjunct to the wealth of the hill people.

In 1842 he returned to Europe, with his health shattered by incessant exposure in a tropical climate, and began the classification and arrangement of the Siwalik fossils, presented by himself and Captain Cautley to the British Museum, and that of the Hon. East India Company. After spending two years in the arrangement of his material, he undertook his great work, the "Fauna Antiqua Sivalensis," with every facility given him that could ensure his success. The Court of Directors gave him full pay, and the government made a grant of £1000, for the preparation of the fossils for exhibition in the Palæontological gallery of the British Museum. He estimated the time necessary for the completion of his work to be six years, and within three had made

* Productive Resources of India, p. 259.

† Trans. Linnean Soc., vol. xix., p. 23.

such progress, that the plates belonging to nine parts out of the twelve were published. There was, however, no letterpress, with the exception of a short introduction. In this respect he made a fatal mistake. Instead of concentrating his energies on his subject, he entered upon collateral questions, which had no direct bearing upon it. He worked from a centre to a circumference. For example, he did not set before his eves the description of the elephants and mastodons of the Siwalik hills, but those of the whole world—a task that was almost endless. His materials consequently increased so rapidly that he was quite overwhelmed. Problems were continually arising which he felt bound to solve, and pilgrimages had to be made to different museums in Europe, that accuracy might be ensured; and thus it happened that in 1847, when he was compelled to resume his duties in India, he had not written one line of his letterpress.

On the retirement of the late Dr Nathaniel Wallich, Dr Falconer was appointed superintendent of the Botanic Garden in Calcutta, and Professor of Botany in the Medical College in 1847. His new duties necessitated his surrender of the pursuit of Palæontology. The development of the vegetable productions of Bengal received his undivided attention. In 1848 he published a valuable memorandum,* on the necessity of preserving timber trees, and on the supply of firewood, and in the following year made a formal report to the government on the Tenasserim teak forests. He shewed that the growing scarcity of teak, which was more than doubled in price between 1815 and 1840, was caused by the absence of forest laws, and neglect in planting young trees. The forests had been let out to contractors, who were intent on present gain, and careless of the needs of the future. He advocated the adoption of rigorous forest laws, and the appointment of a conservator with considerable powers, and insisted that a certain number of young trees should be planted for every old tree cut down. This report was acted upon, and has borne fruit in the preservation of the teak forests. His services also in the introduction of fruit trees from America were most valuable. In 1850 † the Government of Bengal, acting on ,his recommendation, purchased a number of young trees from America, that had been preserved in ice, consisting of pears, apples, cherries, peaches, plums, cur-

* Journ. Agric. Hort., Soc. of India. vol. vi., p. 163.

† Journ. Agric. and Hort., Soc. of India, vol. vii. p. 172.

rants, and gooseberries. They were naturalised in the Himmalayahs, and formed a most valuable addition to the fruit trees which he had obtained in his journeys in Cashmere.

The cultivation of cinchona in India is a matter almost of national importance, for in the year 1857 the annual cost of quinine to the Government was £12,000, and, according to an estimate made by Mr Markham, the expenditure on this medicine by the Government druggists amounted in 1857 to £54,520, and to £40,696 in 1858-9.* On the question of the share that Dr Falconer had in the successful introduction of this most valuable plant into India, we are at issue with his biographer. Dr Falconer, he writes, was instrumental in introducing the cultivation of the cinchona bark into our Indian Empire,† and he quotes in proof a paper on the quinine—yielding cinchonas, and their introduction into India, written by Dr Falconer in February 1852, and the fact that he had himself seen plants of Cinchona calisaya in the Botanic Garden at Calcutta in 1853.

"Dr Falconer was not at the time cognisant of Weddell's accurate determination of the species of cinchona, but he recommended a trial of them in India, and indicated the hilly regions in Bengal and the Neilgherries in Southern India as the most promising situations for experimental nurseries. The subject was taken up some years afterwards, the bark-yielding cinchonas were then introduced from South America, and they are now thriving and promising to be a new source of wealth in India."‡

This claim to the merit of Dr Falconer's having been instrumental in the cultivation of so valuable a tree in India cannot be entertained for a moment. It is undoubtedly true that in 1853 there were cinchona plants in the garden at Calcutta, but all mention of their subsequent fate and of the way by which they arrived in India is omitted, and the reader is left to infer that the present flourishing state of the cinchona plantations is due to Dr Falconer. The six plants in question "were contributed by the Horticultural Societies of Edinburgh and London, raised by seeds sent home by Dr Weddell from Bolivia, were taken to Calcutta by Mr Fortune; they arrived in good order, but all died through gross carelessness in their removal to Darjeeling."‖ So far, then, from being instrumental in introducing them, Dr Falconer is responsible only for their neglect. Nor, indeed, did the idea that they might be suc-

* Markhan, Travels in Peru and India, p.64.

† Biographical Sketch, xl. ‡ *Ibid.*, xxxix.

‖ Markham's Travels in Peru and India, p. 63.

cessfully cultivated in India originate with him, but with Dr Royle. The latter advocated their introduction in 1839. The first official proposal was made in a despatch from the Governor-General, dated the 27th March 1852, or a month after Dr Falconer's paper was read in Calcutta. It was referred to Dr Royle, who recommended that the attempt should be made by the government. This resulted in the Foreign Office being requested to obtain seeds and plants through the Consuls in South America in October 1852. In obedience to his instructions, Mr Cope, the Consul-General at Quito, sent a box of seeds and plants from Cuenca and Loxa to England, all of which died. Dr Royle was not disheartened by this failure. In 1853 he drew up a second report, and in 1856 he made a final attempt to induce the East India Company to obtain plants and seeds from South America. In 1859 Mr Markham was appointed by the Government to proceed to South America, and under his untiring zeal the cinchona plants were selected and transported to India in Wardian cases, and finally naturalized in their new home on the slopes of the Himmalayahs.*

Dr Royle died without seeing his efforts, which extended over more than fifteen years, crowned with complete success. The idea originated with him, and by his perseverance assumed a practical form, and would have been carried out under his auspices had he been alive. The only merit that can, therefore, with any fairness be ascribed to Dr Falconer is, that he read a paper on the subject in India, which, most probably, was brought before the notice of the Governor-General. To ascribe to the latter a greater share in the naturalization of so important a tree in Northern India is to detract from the merit of Dr Royle, whose energy laid the foundation of the present successful cultivation in the Indian Empire of several of the more valuable articles of commerce.

In this outline of Dr Falconer's labour in two very distinct branches of investigation, we cannot fail to notice the width and versatility of his mind, which, in some respects, resembled that of the great author of Kosmos. In the power of grappling with the problems offered by the then very obscure fossils of India he has not yet been surpassed. In the share that he took in developing the vegetable resources of the Indian Empire he has earned a place by the side of Dr Wallich and Dr Royle among our national benefactors.

---

* Markham, op. cit.

EXCURSIONS IN THE SOUTH OF CHINA.

BY LIEUT. OLIVER, ROYAL ARTILLERY.

NO. I.—A VISIT TO SHAO-K'ING-FU AND THE MARBLE ROCKS.

ON December the 5th, 1860, Baron Gros, the French plenipotentiary arrived at Canton from the North, with the copy of the treaty of Tientsin in his portmanteau, and the next morning peace was proclaimed to the city in all due form. How glad the European garrison on the heights were to learn the news need not be said, for they had been long cooped up within a small compass, with few amusements and sickness rife in the cantonments; so that it was a great relief to every one to hear that now all restriction to excursions into the country was removed; and shortly after a small party, of which I formed one, determined to pay a long contemplated visit to Shao-K'ing-(Fu), the antient capital of the two Kwangs, distant from Canton about 80 miles up the Si-Kiang or West River.

As this was to be an expedition by water, the first thing was to hire a boat in which we could travel comfortably, and we soon arranged for the hire of a faitan or fast boat, for an eight days' journey to Shao-K'ing-(Fu) and back. As trade and communication are chiefly carried on throughout China by means of water, all sorts of travelling boats are built for the purpose. The one hired on this occasion was called the Old Dragon (an appropriate name as far as the adjective went), which was a fine flat-bottomed barge, 70 feet in length, and with great beam in proportion, with one mast stepped well forward, and the customary high stern, with its accompanying huge sweep used for both sculling and steering. All our preparations having been completed we were towed across the river, here called Starling Reach, to the Fatee creek, one of those numerous tidal streams that permeate the vast delta of Kwangtung (Canton), through which the local mariners know various short cuts, and our faitan slowly threaded its way through the narrow water-way barely left open between the innumerable crafts, junks, faitans, sampans, and rafts, which frequent the populous suburbs on either bank. It was about noon, under a blazing sun, that we passed Houequa's garden on Gough Island, one of the noted show places about Canton. All about here is a waterside population, mostly occupied in junk building and boat making, and very good boats they can build, too—if they only have a copy they can equal it in every respect.*

Passing the suburbs, the houses gradually became less numerous, and soon paddy fields and lychee trees (Euphorbia litchi) intervened. A good towing path led along the entire route on each side, and our crew, who had hitherto been poling the faitan along, now stripped naked, passed broad belts across their shoulders, attached to a towing rope of twisted rattan, which was made fast to our mast, and, jumping ashore, they pulled us along at a considerable pace. The whole of the country is here quite flat, and at this time of the year, before the rice is planted, quite dry. Here and there were a few bushes at the water's edge, and a clump of bamboos. The rustic natives were mostly employed in ploughing up the ground, using the uncouth water buffalo (Bubalus buffelus) for draught. Here and there a sampan appeared, with its occupants fishing or collecting the spawn for sale in the Fatshan market. It was a hot lazy spring afternoon, and after the bustle and noise of the western suburbs, the quiet rural scenery presented a pleasant contrast. In the distance were two or three little white villages, peeping from their overshadowing banyans, nearly all of them marked by small pagodas or towers. On turning a sudden corner to the south, we saw a collection of vessels at anchor between two villages, Ng-Kai-How and Yun-kin-Chung. The waving of numerous flaunting banners, and the show of gaily-painted wicker shields and long pikes or spears, together with the clanging of the brazen gongs and the rattle of tom-toms, gave sufficient notice to us that this was a fleet of braves on their way west to subdue the Tæpings, who were devastating the country above Shao-K'ing. On account of the presence of these noisy swashbucklers, our crew would not land as they had intended, but, afraid of "squeeze pigeon," if not of downright robbery, from the military mandarins, made all haste to pass by such unscrupulous neighbours. The Mongol soldiery appeared to be closely packed on board the junks, but if one judged rightly, the amount of flags displayed was greatly in excess of the number of combatant warriors. There were twenty vessels in the fleet, each holding from sixty to seventy braves—in all, they were about twelve hundred men of all ranks, besides

---

* We had a capital four-oared "funny" built for us by one of these builders on an English model, equal to one of Searle's best.

officers. They crowded the sides of their junks to see the foreign white-faced devils pass them, and saluted us with rough jests and remarks upon our personal appearance, the reverse of complimentary. As the setting sun was nearing the horizon, a pleasant breeze sprang up, and it was most pleasant to sit on the deck watching the river-banks and looking out for fresh novelties, as each bend of the river was turned, whilst, our sail being hoisted, we glided onward with easy and almost imperceptible motion. Some conspicuous red mandarin poles soon denoted the neighbourhood of a populous town, and we then passed Upper and Lower Kup-Kow, an aristocratic locality, at some distance from the south river bank, whilst in front of us lay the great manufacturing commercial entrepôt, the city of Fatshan. Although the breeze was favourable, we did not reach the canal which traverses this busy town until after sunset. Business hours were over, and most of the upper and middle-class citizens were sitting enjoying the evening air with their wives and children in open summer houses and verandahs overlooking the water. As long as it was light, the quays, windows, and terraces were crowded with eager spectators, who quickly assembled to see the unusual sight of European travellers passing through their town.

It soon grew dark, lights began to illumine the windows, glazed with their oyster-shells, and quaint lanterns were shewn at the various hongs. The clang of gongs and drums was heard from a neighbouring joss-house, and from the flower-boats resounded the high notes of the singing girls, accompanied by lutes, clarionets, and other stringed and reed instruments ; the universally popular "Jasmine flower" melody being often distinguishable. At seven P.M. we came to anchor in mid-stream, just beyond the city, the boatmen not being at all sure of what treatment we might receive at the hands of the patriotic citizens of Fatshan. Next morning we were on the move at 3 A.M., and we landed with our guns about six o'clock at a place called Tsz-Tŏng. Here was a fine broad-towing path, on an elevated solid bund or dyke, running alongside the river as a defence against inundations. The course of the stream is very tortuous, and the country still flat and dry, with large patches of sugar cane, dry paddy fields, and acres for miles together of mulberry bushes and cotton. A considerable quantity of silk is produced in this neighbourhood and further south. Several miles to the north of us were sandstone hills of no great height, evidently friable, as they were much scarped by water action. We were not idle with our guns, and bagged some common snipe (Gallinago stenura) and quail (Coturnix communis), with pigeons; by the water were plenty of egrets (Ardea egrettoides), divers (Podiceps minor), and various kingfishers (Halcyon fuscus, H. pileata, and Ceryle rudis). All this time our boat was rapidly going ahead of us, aided by light breezes, and we had to put on the steam in order to come up with her, especially as our morning walk suggested breakfast. We passed through the village of Kee-Shek, and saw nearly opposite another called Shay-ung-Kow, and a large island covered with wheat fields. We did not catch the boat until it came into the shore at Seong-Tung, where we halted and bought fish and eggs for a ridiculously small amount of cash (small copper coin with a square hole in centre). Food, indeed, is remarkably abundant throughout this part of China; our usual fare was chicken, curry, and rice, with fish. The rising tide warned us not to delay, and taking advantage of it we let the boat proceed, following ourselves on foot this time on the southern bank. The soil here is of a red and yellow tenacious clay, and numerous brick-kilns were conspicuous. Mulberry bushes still abounded; across the river we could see a remarkable peak called the Lion's head. Before noon we passed close to a village called Ma-shâ embossomed in bamboo, litchi, and banyan trees, with fields of mustard and sugar-cane. The villagers here turned out and seemed disposed to give us some trouble, but they did not proceed to take any active hostile measures beyond making use of menacing gestures and insulting cries, which fell harmless on our barbarian ears. On our way we visited some primitive sugar-mills, the roller being worked round a pivot in a wooden shallow saucer by the ubiquitous buffalo; the juice when cooked is turned out in flat cakes, with an appearance not unlike cakes of toffy. When the sun was at its highest we retreated from its glare into the shelter of our faitan, and were nearly all dozing when our approach to the large commercial town of Sy-nam was announced, and we went on deck to see this important mart, famed for its iron-ware and other manufactured goods. Its population is estimated at 20,000 inhabitants. On the west of the town, on some friable sandstone cliffs, undermined and caverned by the river, were some strong batteries with brass guns in the embrasures commanding the river approach to the town. These same crumbling sand cliffs were extensively honeycombed by numerous crowded burrows of sand-martins (Cotyle sinensis and C. riparia), which seems to breed here. The river was covered with small ferry boats and sampans, whilst numerous trading junks were loading at the wharfs for the North river trade, and large rafts were floating down stream from the upper districts about Wu-chu-fu, where timber is plentiful. On some of these large timber rafts are whole villages of the lumber-men, and the rafts are so constructed as to be divisible, in order to pass narrow creeks or sharp bends on their passage.

We could see in front of us, about three miles distant, the tall white pagoda of San-shui, and within an hour and a-half after leaving Sy-nam we reached the landing-place for San-shui, the town itself lying inland about two miles. San means three and shui water, the name being caused by the junction of the North and West rivers, forming the Canton River, taking place here. Our distance from Canton was now forty-five miles. The town is walled, and is the chief town of the district.

On Wednesday the 13th March, by 7 A.M., we were passing Tsing-Kee, with its large square tower, denoting a government pawnbroking establishment. As soon as we had cleared this place, we had our usual matutinal swim, and then a walk along the paddy-fields. Far a-head were now to be seen distant ranges of hills and mountains, whilst the country about us grew more undulating, shewing that we had reached the antient coast-line, having left the rich alluvial districts which mark the Cantonese delta.

Villages are frequent on both banks, and thickly populated, nearly all having good schools attached to them, and every child above tender years was able to read, and most to write. Ni-Tawng and Poo-e-Shui were the next villages of importance; the latter remarkable for its large modern college, founded in the first year of the reign of the late Emperor Hien-Fung. On the north bank and opposite are large examination halls, marked by a forest of mandarin poles; also, a large depot for salt. In the background were the Nam-wan-Shan, or "hills of the southern bay," averaging some fifteen hundred feet elevation. On the shores here were noble specimens of the shady banyan tree (Ficus Indicus) and in the sun on the banks were numerous lizards, among them the Tachydromus sexlineatus and others. We examined some large fish-tanks at Sha-Wan, in which were preserved the Li-in,* a fish far superior to our carp, and growing over ten pounds weight.

* The Li-in = The Gouramier (Osphronemus olfax).

In the middle of the river here is the large flat island of Kwang-li, forming a triangle, with its two sides to the north. The channel on the south side is the shallowest, but gave 3½ fathoms. The mountains now frowned close above us, and in vain the eye sought for a gap through which the broad volume of the Si-Kiang could pass. However, the river narrowed rapidly as we ascended it, and when we had left the white fort sixteen miles behind us, we could perceive a magnificent but narrow gorge gradually opening to our admiring gaze. The river here, narrowed suddenly from 1000 to 200 or 300 yards, winds swiftly through a vast rent in the

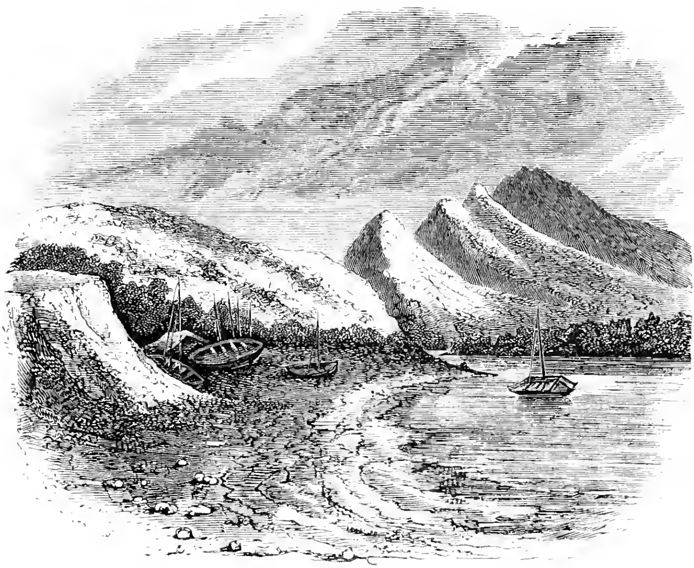


Fig. 1.—Entrance to River, &c.

mountain chain, whose dark precipices rise perpendicularly on either side several hundred feet above us. The wooded summits culminate on the south side in a peak 2800 feet elevation, and on the north in one of 1800 feet. We entered this pass at 1.45 P.M., barely able to stem the current, whilst above us hovered some large kites (Milvus melanotis) that frequent this locality. The mountain pass is called the Antelope Pass or Hibiscus Gap, sometimes the Shiu-Hing-Hup. At its eastern entrance is the village and custom-house of How-li. In the pass itself we sounded, and repeatedly found no bottom at 12½ fathoms, even close to the edge of the beetling rocks. The naked sides of the cliffs were caverned and hollowed by the waters many feet above us, testifying to the effects of the furious summer freshets, known and dreaded even at Canton under the name of the "Western floods."

There are narrow paths cut along ledges on the face of the cliffs to enable the crews to tow their vessels against the strong eddies and currents in the pass. Along them are here and there little shrines placed to record the loss by wreck or flood of some hapless mariner. The place is romantic in the extreme, and naturally the imaginative Chinese people it with fabulous monsters as well as with piratical bandits, who are, perhaps, not so fabulous. It took us two hours to pass through this rocky chasm, four miles in length. The western extremity is here marked by a small pagoda, on a conical peak 300 feet above the sea.

The sun seemed to shine brighter when we had left this dismal pass of Shiu-Hing-Hup, and at our exit was disclosed a cheerful view of the extensive valley of Shao-K'ing, bounded by a fine amphitheatre of mountains, with no less than seven pagodas of various sizes in sight at once.

What the origin or meaning of these many-storeyed monuments may be no one seems to know. They are sometimes accounted for by the Chinese as symbolical of the all-pervading Fung-Shuei, a superstitious genius which animates the cardinal points, hills, water, and weather, including the general prosperity of the neighbourhood.

A lofty pagoda on a high hill is supposed to bring good luck and advancement to all who dwell within its sight and influence. Although Shao-K'ing boasts of so many of them, I am afraid their influence has greatly diminished. When a merchant has completed a great speculation with success, or when his argosies have returned laden with wealth, he sometimes erects one of these follies to commemorate the event.

Below the suburbs of Shao-K'ing extensive fisheries were passed, with large dip nets, bag and stake nets. These nets are in the river close to the banks. Beyond these, about six miles above the Antelope Pass, begin the suburbs of the town, which we reached at five in the evening. These suburbs are built on tall piles similar to those at Sy-nam, and boast of two remarkably handsome and antient pagodas, both of which have numerous shrubs and creepers growing out of them, and are generally moss- and grass-grown. The town itself lies at a little distance back, and is protected by a high solid embankment against all fear of inundation. Irrigation is provided for by means of well-constructed culverts and sluices.

Like all district towns, Shao-K'ing is tolerably defended by stout brick walls and bastioned gates, now in a slightly ruinous condition. It was six o'clock or more before we made fast to the shore, but the sun had set and the town gates were closed, so that entrance to the town was denied. However, we were permitted to send in our cards and letters of introduction to the Mandarin.

The extremity of our journey by water was now attained, and we had travelled 75 geographical miles in all from Canton. Of course, we could have come up much quicker, but we preferred seeing the country by daylight, and walking along the shore for observation and sporting, to travelling by night. The regular passage boats take only from thirty to forty hours to do this distance in, according as the wind and tide are favourable or not.

Thursday the 14th March, whilst dressing for a state visit to the chief magistrate of Shao-K'ing, we sent to hire some palanquins and bearers, who arrived when we were at breakfast; their price having been suddenly raised, we learnt on inquiry that some officials had been extorting "squeeze money" from them. We had prearranged the hour for our reception, and started at half-past nine in eight palanquins, along the bund, and through the suburbs, entering the city walls by the south gate. The city seemed in a ruinous condition, but there were remains of antient grandeur in the moss-covered ruins of many antique yamuns, temples, and ancestral halls, the finest being those on the site of the Viceroy's Palace in olden days, all well shaded by long-lived banyans. The principal streets alone seemed to be thickly populated, and in them crowds of curious citizens assembled to see us pass by, being kept back from pressing on us by an escort of Mongol braves, sent to meet us for that purpose. Besides numerous silk shops, chow-chow houses, and opium divans, were armourers and bow-makers. The yamun which we entered was similar to most of the third-rate yamuns of Canton. Various retainers ushered us through detatched open halls, where official business is transacted, into a more comfortably furnished apartment, where we were most courteously received by the venerable magistrate, who, after the endless chin-chinning, an indispensable preliminary, begged us to be seated, and regaled us with tea, accompanied by melon pips, whilst a tray, not unlike a large Pope Joan board, was brought, the various partitions being filled with sweetmeats and preserves. He had heard that peace had been proclaimed, but it had not been published publicly yet to the townspeople. On hearing that some of his subordinates had been squeezing our bearers, he assured us that they should be bastinadoed with split bamboos. He begged us to excuse any impertinent conduct from the ignorant townspeople, and warned us that we might be pelted or maltreated unless he sent an escort of soldiers to guard us. He insisted very kindly on our accepting the guard, who would also act as guides to us about the vicinity, and we found them very useful in carrying our sketch-books, shot belts, &c.

On leaving the yamun we made our exit from the city by the north gate, and crossing a stone bridge over the moat found the narrow path leading into the country, bordered by some smaller suburban villas and cottages, with well cared for gardens around them, with clusters of lychees, plantains, papayes (Carica papaya),

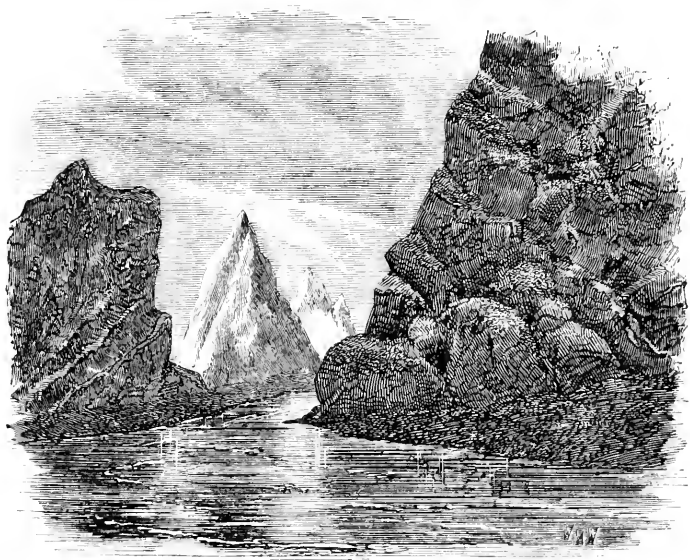


Fig. 2.—Marble Mountains.

plum and guavas (Psidium sinense), water-melons (Cucumis citrullus), &c. Beyond, in the open country, were fields of cotton, the ground-nut (Arachis hypogea), from which they express a valuable oil, with indigo, Cassia, castor-oil, and various peas, as dhol, (Cajanus florus) gram (Cicer arietum), yams, and sweet potatoes, cocos, and a large portion preparing for rice planting—the whole of this extensive plain around Shao-K'ing being as highly cultivated as a market garden. The villagers were employed in harrowing, the harrows being drawn by the ubiquitous buffalo, and mostly tended by women. The plain is bounded by a high range of mountains, mostly wooded, and any slight undulating eminences are covered with innumerable horse-shoe or omega-shaped graves, the cemeteries of departed generations. In the midst of this alluvial deposit, at about three miles from Shao-K'ing, rise seven abrupt and detached rocks of red-veined marble, with remarkable peaked summits, averaging about 200 feet above the level of the plain, their distant outline reminding one irresistibly of the Needle Rocks intensely exaggerated. They present features of more than ordinary interest, not only to the geologist, but also to the antiquarian, and are famous throughout the two Kwangs, for their wonderful caverns, whilst the monastic retreats, perched in seemingly inaccessible hollows and ledges on their precipitous sides, are objects of pilgrimage and veneration for many miles away; and various superstitious legends are related in connexion with the far-famed Marble Rocks of the seven stars (Sam-Seen-Koon).

We ascended by a laborious climb up narrow paths to the summit of the easternmost rock, which is the highest and largest of them all, and obtained an extensive view for our trouble, the fantastic peaks of the neighbouring rocks forming a picturesque foreground. There are two Budhist chapels on this rock, besides some residences for the monks. In the lowest chapel was an elaborate image of Budha, representing that deity with forty-eight arms. The faces of the rocks are overgrown with bushes and small trees with creepers and ferns growing in the crevices. Every here and there are seats and benches, with colossal inscriptions cut in the solid stone, dating from the dynasties of Yong-Ching, Kang-Kee, and Keen-lung. The trees and rocks were full of the feathered tribes, such as titmice (Parus minor), plenty of the Chinese starlings (Acridotheres siamensis), chattering with great noise, rollers (Eurystomus orientalis), and others. We now descended, and walked along the foot of the rocks, where are some large ponds in which the art of pisciculture is carried on by the Budhist monks with great economy and success. They buy the fish spawn in jars at the market, and hatch the ova in the shallow paddy fields, which are arranged in terraces connecting one with another, so that the young fry can be shifted as may seem necessary. They fatten up their fish in stews, producing magnificent specimens of carp. Throughout the whole of China fish is remarkably cheap. We now examined the great cave and temple of Kon-Yum-Ngam.

This cave has evidently been formed by the action of a subterranean river, which has thoroughly undermined the whole rock. There are two entrances, one through a low fissure on the south side, and the principal one on the north side, leading through an upper grotto, in which the stalactites have been tastefully left to form a natural canopy, whilst the stalagmites have been carved into quaint figures of warriors, altars, figures of Budha, immense candelabra, and vases forming a crystal joss-house, ornamented with the customary banners, votive tablets, burning joss-stick, and other accessories.

From the grotto, at the entrance, a descent of forty well-paved steps brought us into the great cavern, which was but dimly illumined by our torches of twisted bamboo, and the vast vaulted roof remained in mysterious darkness until we fired some Chinese rockets up vertically, which lighted up the lofty roofs and crystallized stalactites 120 feet above our heads. In every direction were branching caverns, one of which we explored, but were stopped soon by deep pools in the bed of a former torrent. Most of the others were quite full of water. By lighting bonfires of dried grass behind some of the screens of transparent rock, where pillars of stalagmite and stalactite were joined in one, marvellously charming effects were produced.

The whole rock seemed hollow; when we discharged our guns with some blank ammunition the reports reverberated like thunder, the echoes dying away in hoarse murmurs in the distant bowels of the mountain. Very grand certainly, and heightened by some crystals from above becoming detached by the vibration, and tumbling about our ears, scattering, as they struck any rocky projections, with a myriad of scintillations. Our attention was now drawn to a hollow rock, forming a natural stone drum. In shape it was something like a mushroom. On being struck smartly, it vibrated with a hollow sound—a very Chinese Memnon, and to which superstition has attached many supernatural abilities. We put a large bundle of Chinese crackers underneath it, which, being. ignited, gave us a startling volley of cracks and bangs, which severely tested the vibratory powers of the marble drum. The noise was indeed deafening, frightening numerous bats from their hidden retreats. The figures of the monks in their long robes, our half naked coolies, and the braves in their picturesque attire, lighted up by the glare of the torchlight, with the savage depths of the cavern as a background, formed a subject for the brush of a Rembrandt.

In the cool of the evening we retraced our steps to Shao-K'ing, and by sunset left the landing-place of Shao-K'ing on our homeward voyage, reaching the Pass of Shin-Hing-Hup at dusk. The entrance to the gorge looked most dismal and uninviting, so that our boatmen were anxious to anchor outside the narrow passage until daylight, but we insisted on their proceeding in spite of their hideous tales of Lally Lus and other horrors. So we went on through the dreary pass, all being still and quiet as the grave, only disturbed by the occasional flight of the night-herons (Nycticorax griseus) and the distant cry of the short-eared owls (Otus brachyotus), which frequent these rocks. We were soon fast asleep, and were about half-way through the defile, when we were suddenly awakened by a collision with another boat, and the cry of Lally Lus from our boatmen, who came tumbling below in extreme terror. We jumped up on deck, and soon saw that the crew of the other boat, against which we had bumped, was as frightened of us as our men were of them, and had also rushed below, and were busy getting out their long pikes, so we had only to shove the boats apart, and retire to our slumbers, after a hearty laugh at our disturbance. By midnight we had arrived at the custom-house of How-li, and made fast to some salt junks lying close to the shore here.

On the 15th of March, on arising in the morning we found ourselves the objects of interest to all the crews of the various craft lying off the custom-house (established for levying the war tax). The vessels bound up the river formed a convoy loaded with salt, and those from the upper waters, bound downwards with indigo, oil, paddy, firewood, silk and tea. There is only a small village at How-li, where necessaries can be procured for victualling the passage boats, and we here hired a guide to take a few of our party up to the wooded mountains of Ting-Hu-Shan to visit the famous monastery which reposes under its shadows. The remainder of our party crossed over to To-Ki to shoot snipe, which abound in that locality. Our guide, by name Teen-Tuk, with two boys, Ayow and Asam, led us inland to the north-west, about five miles across flat open fields, in which the skylarks (Alauda cœlivox) were carolling under the sunshine. The country is diversified by small hamlets, ponds, and marshes, full of waterfowl, gallinules, &c. We followed the course of a shallow stream tumbling over its rocky bed, tracing it up a long valley, on each side of which arose lofty hills, here and there scarped perpendicularly with huge boulders and moraines, lying scattered on the slopes at their base. Above were dense woods rising high among the mists that hung about the summits. The atmosphere turned chilly, and we soon lost sight of the sun, the Scotch mist turning into rain as we ascended, and we entered a ravine in which a well-repaired paved pathway of rather steep gradient led through "the groves of the pleasant mists" on "the mountain of the golden lake," the said lake being a mysteriously deep tarn among these hills. The blending of the sub-tropical vegetation with the foliage of trees, due to increased elevation, presented us with varied yet exquisite forest scenery. Among the trees flitted the Ying-Ko or ring parroquets (Palæornis Rosa), the sole Chinese representative of this tribe, whilst little stripped squirrels (Sciurus tristriatus) leapt nimbly from bough to bough, whilst the call of the pheasant and the tapping of the woodpecker (Picus chloris) would frequently be heard mingled with the song of the Hwa-mei (Leucodioptron sinense), which the Chinamen are so fond of domesticating for fighting purposes as well as song. The timber trees were loaded and entangled with numerous vines, bauhinias and other lianas, whilst various orchids, ferns, lycopodiums, and pendent lichens ornamented the stems of fallen timber.

Through occasional breaks in the dense foliage of the trees we could see hanging woods and rocks towering far above us, with here and there a summer-house or shrine, to which neat zig-zag paths led in various directions. After reaching a level of about 1200 feet above the river, we found the monastery of Tek-Chime, with its fine new temple and hospitable brotherhood. The superior of the establishment received us with flowery Chinese compliments and played the part of host most graciously. It appears that the old temple had been burnt down by the rebels in 1859, so that they had been obliged to build a new one, the Hing-Wun-Tz, and now they heard that the rebels were again approaching. They shewed us an immense bell, just new from the foundry, of some 2000 catties weight; they must have had great trouble to convey it up these heights. The monks here are not allowed to eat flesh, but are restricted to fish and vegetable food; they gave us some capital rice and mushrooms, the latter being novelties to us; they had many handsome and rare plants, cultivated with great care, roses and chrysanthemums, of which the owners were very proud, besides dwarfed trees, fantastically trained shrubs, with odd sports and grafts, which Chinese amateurs take such pleasure in.

We returned to our boat in the afternoon, and later in the evening pulled across the river to examine the mines on the southern side of the Shin-Hing-Hup. These mines or quarries consist of pits eight hundred feet deep, from which a valuable black stone (cannel coal ?) is produced. It is a black stone almost like jet, takes a considerable polish, and is used for inkstands and palettes; the surrounding rock appeared to be coarse grit rock and beds of solid dark slate. The echoes here were very amusing, high notes being repeated distinctly several times in succession. The quarries were not being worked, as the mandarins had demanded an excessive royalty on the produce. Late in the evening we dropped down stream with the tide to Lo-un-Chun, a village opposite to Kwangli island, and nearer to the Teng-fu mountain than How-li.

On Saturday, 16th March, we started at 7 A.M., and took the same route to the Tek-Chime monastery, reaching it in two hours and a half. Here we provided ourselves with some stout poles to climb the upper heights, and procured a guide. After three hours' hard climbing, during which the woods became gradually thinner, and, finally, disappeared, we halted at a spot, beyond which our guide declared that he had never been. However, we pushed on until we reached the summit, but the thick clouds breaking for a few minutes disclosed a much higher peak than that on which we were at (4000 feet), and separated from us by a vast chasm, at the bottom of which lay far below us the Enchanted Golden Lake. We were much disappointed at not having reached the highest summit, but there was nothing for it but to descend *via* the charming deep tarn, the spare waters of which were carried off by a series of cascades and waterfalls, by following which we arrived in due time at the foot of the mountain under torrents of rain, and were heartily glad to regain the shelter of our boat.

The next day (Sunday) we passed Sy-nam and reached Fatshan, where we spent all Monday morning returning to the monotonous duty at Canton the same evening.

*THE RECENT EARTHQUAKE AT HAWAII.**

HAVING had an opportunity of seeing the effects of the late volcanic concussions and eruptions in South Hawaii, I send you a short description of what I observed. Unfortunately I arrived too late on the spot to see the eruption itself which only lasted four days; but I had good opportunities to investigate the effects produced.

Kilanea had been occasionally active ever since October of last year. Instead of one or two there were seven lakes in constant ebullition, and volumes of steam and gases were thrown off constantly. The lava would often overflow the banks of the lakes, and cover a great portion of the area of the large crater.

On the 27th of March the first shock was felt over all Southern Hawaii, the region of Mowna Roa. On the 28th one hundred and fifty shocks were counted. On the early morning of the 29th lava was seen flowing on the summit of Mowna Roa, according to native report, and also on the night following, but not at any time after. The earthquakes continued, many very severe, to the number of two hundred in twenty-four hours, up to April 2, while the fire in Kilanea seemed to rest.

On April 2, at 4 P.M., a most terrific shock occurred, which was felt here in Honolulu, and laid prostrate, or threw off their foundation, all walls and most houses in Kau. All the fissures described in my report were produced then, amongst which that most extraordinary one which split the side of the mountain, and sent down to the level plain an enormous mass of dirt and water, the mud flow of Kapapala.

The great stellated fissures in Kataka, through which, five days later, the lava broke, must also have been first opened by this shock. Immediately after it the sea receded, and soon returned in an enormous wave, forty to fifty feet high, which ran over the tops of the cocoanut palms, and swept away every village on the southern coast, destroying about sixty lives, and disabling many a poor fellow. Fifteen or twenty times the sea receded, and returned again before it resumed its equilibrium. As we learn from Cali-

---

* Letter from Dr Hildebrande, Honolulu, Sandwich Islands, to Dr Hooker, F.R.S.

fornia papers, the great wave reached California and Oregon five hours later; but, strange to say, here at Honolulu it was hardly noticed; nay, even in the northern part of Hawaii it has been quite insignificant. During the four days following this great shock, more than two thousand were counted in Kau; in Kapapala the ground was in incessant motion, swaying to and fro like the sea, so that people became sea-sick. On the night between the 3d and 4th three shocks occurred between 12 and 2 A.M., which were distinctly perceived by me at Honolulu, and which about Kilauea are said to have nearly equalled that of the 2d. Thus matters continued until the 7th, when at 6 P.M. the lava burst out of the great star-shaped fissures in Kahaka, reached the sea in three hours, and continued to run until the 11th, when it suddenly ceased. The earthquakes became less in intensity and frequency at once, but they continued to be felt until the middle of June.

When I was at Kapapala we counted nineteen in twenty-four hours, and a very severe one I experienced when near the great fissure which had caused the mud-flow. Most interesting is the relation of the activity and subsidence of the lava in Kilauea to the whole series of volcanic phenomena, as you find it described in my report to the *Gazette*. Undoubtedly the great reservoir of lava, which comes to light in Kilauea, had been filling up to its utmost, and large quanties of steam and gases had accumulated in it, which found a fitful vent in one of the lava lakes, "the blow hole." This ceased to blow about two weeks before the first earthquake, in consequence of which the confined gases were brought to an extreme degree of tension, which first produced the simple vibrations, and at last, on April 2, the enormous fissures of the superincumbent crust. It is remarkable that the fissures then caused belong to two systems, two of the principal ones tending from Kilauea westward, and two from the summit of Mowna Roa crater of Mokuaweoweo, south and seaward. The two systems intersected each other within the length of the Kahaka lava stream to that of the mud-flow, at the place of the eruption in Kahaka, elevated about 3590 feet above the sea. I presume that the great shock of April 2 established a communication between the lava reservoirs of Kilauea and Mowna Roa, and that in consequence of it the lava of Kilauea emptied itself in that of Mowna Roa, and was ejected through the fissure belonging to the latter. The lava resembles in many respects that of the eruption of 1840, which came from Kilauea; is as rich in olivin, and as light and porous. The lavas of Mowna

Roa are all heavy and compact, and some as much so as true basalt. Most remarkable in the present eruption was the enormous mass of an exceedingly light brownish friable pumice, ejected before and during the same.

The incandescent matter of it filled the air like so many stars, and came down so slowly and leisurely, cooling in the descent, that people did not know what to make of it, and were hardly aware of them when they fell down on their bodies.

Another peculiarity was the amount of steam and gas thrown off. On Hawaii, people could not see objects at forty paces distant, and the gas (sulphurous acid) was so irritating to the lungs that it caused universal cough and dyspnoea. On the 9th, and for five days after, the sky in Honolulu was so hazy that the sun appeared like a blood-red round disk, and the hills, five miles off, were invisible. Ships that were a thousand miles off at sea, to the south and north-east, had the foggy haze for a day or two.

The extraordinary liquidity of the lava was another remarkable phenomena. It was over a distance of fifteen miles, down a slope of not more than six degrees, in less than four hours. Captain Brown, on whose estate the eruption broke out, and who, with his family, had to fly for dear life, says that it ran at the rate of ten miles an hour. His residence was buried under the lava.

*COLLINGWOOD'S RAMBLES IN THE CHINA SEA.**

DR COLLINGWOOD is what is popularly called "a sea-beast man." Although a botanist and a zoologist and possessed of a good knowledge of most branches of Natural History, his peculiar passion is Marine Zoology. In all the wonderful and *outré* creations, which render the aquarium so attractive, he is specially at home. It is not to be wondered at, therefore, that he should have eagerly availed himself of an opportunity to visit the shores and waters of the China Seas, nor that in his account of his voyage the denizens of the waters should occupy a larger portion of its natural history than the inhabitants of their shores.

We can hardly imagine anything more attractive to a student of Marine Zoology than such an expedition. The China Sea has been less explored scientifically than most other parts of the tropical seas, and there was not only the prospect of new discoveries but the certainty of an ample harvest of rare, beautiful, and little known species. Dr Collingwood thus glowingly describes one out of many of his experiences of this kind :—

"On the 1st of August we anchored at the edge of an extensive coral reef marked on the charts as Fiery-Cross Reef from the circumstance of the ship 'Fiery-Cross' having been wrecked thereon. The surface of the sea was perfectly smooth and glass-like, so that at the depth of 60 or 70 feet we could see the anchor lying at the bottom, among blocks of coal, as distinctly as if it had been but 6 feet from the surface. Never to be forgotten is my first ramble over this coral reef on such an afternoon. Taking a boat with a couple of rowers I left the ship and steered in search of the shallowest portions of the coral-strewn sea. A short row brought us upon a two-fathom patch, over which I allowed the boat to drift slowly, and leaning over the side and looking down into the mirror-like sea I could admire at leisure the wonderful sight, undisturbed as it was by the slightest ripple. Glorious masses of living coral strewed the bottom ; immense globular madrepores ; vast overhanging mushroom-shaped expansions ; complicated ramifications of interweaving branches, mingled with smaller and more delicate species ; round finger-shaped horn-like and umbrella-form lay in wondrous confusion—and these painted with every shade of delicate and brilliant colouring—grass green, deep blue, bright yellow, pure white, rich buff, and more sober brown, altogether forming a kaleidoscopic

---

* Rambles of a Naturalist on the Shores and Waters of the China Sea. By Cuthbert Collingwood, M.A. London 1868.

effect of form and colour unequalled by anything I had ever beheld. Here and there was a large clam shell—chama—wedged in between masses of coral, the gaping zigzag mouth covered with the projecting mantle of the deepest Prussian blue; beds of dark purple long-spined Echini, and the thick black bodies of sea cucumbers—Holothareæ—varied the aspect of the sea bottom. In and out of these coral groves, like gorgeous birds in a forest of trees, swarmed the most beautifully coloured and grotesque fishes, some of them intense blue, others bright red, others yellow, black, salmon coloured, and every colour of the rainbow, curiously barred and banded and bearded, swarming everywhere in little shoals which usually included the same species, though every moment new species more striking than the last came into view. Some, like the little yellow Chætodons, roamed about singly; others in large shoals; some were of considerable size and seemed to suck in the little ones like motes in the water; and, in an interval a small shark about 10 feet long, swam leisurely along.

On this reef he made a curious observation, which seems to us to indicate that some sea-anemones have the power of paralyzing or fascinating fishes without actual contact. Dr Collingwood thinks otherwise, and that it is a case of parasitism, that the fish lives and takes refuge in the stomach of the sea-anemone; but his own account of the incident seems opposed to this. In any view the observation is curious:

"By far the most remarkable circumstance I met with on the Fiery Cross Reef was the discovery of some actineæ of enormous size, and of habits no less novel than striking. I observed in a shallow spot a large and beautiful convoluted mass of a light blue colour, which, situated as it was in the midst of coloured corals, I at first supposed to be also a coral. Its singular appearance, however, induced me to feel it, when the peculiar tenaceous touch of a sea anemone made me rapidly withdraw my hand, to which adhered some shreds of its blue tentacles. I then perceived that it was an immense actinea, which, when expanded, measured fully two feet in diameter. The tentacles were small, simple, very numerous, and of a deep blue colour; and the margin of the tentacular ridge was broad, and rounded, and folded in thick convolutions, which concealed the entrance to the digestive cavity.

"While standing in the water breast-high admiring the splendid zoophyte, I noticed a very pretty little fish which hovered in the water close by, and nearly over the anemone. This fish was six inches long, the head bright orange, and the body vertically banded with broad rings of opaque white and orange alternately, three bands of each. As the fish remained stationary and did not appear to be alarmed at my movements, I made several attempts to catch it, but it always eluded my efforts. Not darting away, however, as might be expected, but always returning presently to the same spot. Wandering about in search of shells and animals, I visited from time to time the place where the anemone was fixed, and each time, in spite of all my disturbance of it, I found the little fish there also. This singular persistence of the fish to the same spot and to the close vicinity of the great anemone, aroused in me strong suspicions of the existence of some connexion between them.

'These suspicions were subsequently verified; for on the reefs of Pulo Pappan, near the island of Labuan, in company with Mr Low, we met with more than one specimen of this gigantic sea anemone, and the fish, so unmistakeable in its appearance when once seen, again in its neighbourhood.' Raking about with a stick in the body of the anemone no less than six fishes of the same species and of various sizes were by degrees dislodged from the cavity of the zoophyte, not swimming away and escaping immediately but easily secured on their exit by means of a small hand-net. Thus the connexion existing between this fish and the anemone was demonstrated, though what is the nature and object of that connexion yet remains to be proved.

"There are at least two species of these anemone-inhabiting fish, and a second species of the same genus differs from that just described in having black and cream-coloured vertical bands instead of orange and white. Such a fish I have seen; evidently related to the first-mentioned, living in a tub which did duty for an aquarium, in the possession of Mr Low at Labuan, which had been obtained from what was probably a second species of fish-sheltering anemone. This fish was remarkably lively and amusing, and of a disposition I can only describe as knowing, and lived in good health in this tub for several months—a proof that the connexion between these animals, whatever its nature, is not absolutely essential for the fish at least"—(p. 152).

Greatly to its detriment we do not doubt—as surely as the residence of an oyster in the stomach of a gastronome would be to it. This is not a case of parasitism on the exterior of the body, nor of a parasite specially framed to spend its life in its interior, nor of an animal taking occasional refuge under the wing of another like the Pinnotheres pisum within the valves of the horse mussel. A Holothuria, from the same seas, of which a figure is given in the "Voyage of the Astrolabe" (Holothuria ananas), is said to shelter a fish in this manner, and we doubt not for a similar purpose. The notodelphs and other small crustaceans, which are said to take refuge in the sac of some Ascidians is another parallel case. Some years since* we argued that these small animals were not guests taking refuge with a host, but victims to its appetite. We found in the sac of Ascidea virginea that although many of the notodelphs were swimming about quite lively, others were lying dead against its walls, and others were half digested, and we accounted for the circumstance of any being alive by the large size of the sac and the small size of the notodelphs. It might be some time before they were seized or entangled in the ciliated meshes of its walls. We think the case of Dr Collingwood's sea-anemone and banded fish quite parallel to the ascidians and the notodelphs. The fish were being devoured by the anemone, and the proof of

---

Murray in *Proc. Royal Soc., Edin.* 1858.

it is that those fishes which he routed out from the interior of its gape were languid and easily caught. The process of digestion had begun upon them, but they had not yet been deprived of life. This is our explanation of the circumstance; but there remains the curious fact of the fish hovering like a fascinated bird over the mouth of its devourer, and returning to the spot again and again after being driven off by Dr Collingwood. The distance at which Dr Collingwood describes the fish to have been from the tentacles of the anemone, independent of the fish swimming away and returning, would seem conclusive against its having been touched by the acontia or cnidæ of the zoophyte, which might otherwise have accounted for the stupefaction of the fish. Mr Gosse, in one of his books, mentions an instance in which a little fish swimming about in health and vigour died in a few minutes in great agony through the momentary contact of its lip with one of the emitted acontia of Sagartia parasitica; and the effects of the acontiæ of different species may be different, and more especially may be more powerful in larger species from tropical seas.

Dr M'Donnell at one time thought electricity might have something to do with producing the stinging effects of these acontia; he no doubt subsequently abandoned that hypothesis; but the probability of that agency being concerned in the matter should still be kept in view.

Apropos to animal electricity we observe that Dr Collingwood quotes an instance reported to him of the occurrence of electricity in a snake.

"A circumstance was told me by the colonial chaplain, Rev. J. Moreton, which, although it may seem apocryphal, I am unwilling to pass over altogether in silence. He found on one occasion, outside the verandah, a snake about five feet long, of a reddish colour, but not mottled like a boa. It had had its head crushed, that being the usual way in which the natives destroy snakes, though it is not always immediately fatal to them, for they will crawl after such an injury. Mr Moreton told me that he took the snake in question by the tail by his thumb and finger, and instantly felt a strong electric shock, which ran up his arms to both his shoulders, so that he dropped the snake in alarm. Although much surprised at the circumstance, not being a naturalist, he neglected to take any means to preserve the reptile." (p. 173).

The nudibranchs of these seas, like the sea anemones, startle the beholder with their gorgeous and bizarre colouring. The annexed plate (fig. 1.) shews the form of some of the most striking of these; but it is unnecessary to say that their beauty is entirely lost for want of colour. The upper one on the left, marked as from Kelung, is cream-coloured, edged with orange, and marbled with

Fig. 1.—See page 360.

vermilion markings. That below it, from Haitan Straits, has a chrome margin, and is spotted with deep crimson. The next to the right, from Makung Harbour, is deep blue, spotted with yellow, and with the tentacles and branchiæ of bright vermilion. The next from Labuan is striated with delicate alternate hues of brown and yellow. The long, smooth one from Labuan is reddish, passing into a brilliant amethystine head, and edged with opaque white, the tentacles and dorsal branchiæ orange. The last on the right, from Fiery Cross Reef, is described as reaching nearly eight inches in length, of an olive-green colour, and covered with slimy bosses and tubercules, which rendered it a most unsightly object. Most, if not all of these, are undescribed.

It would require more space than we can give to follow Dr Collingwood through the numerous other marine animals touched on by him—crabs, molluscs, fishes, star-fishes, annelides, hydrozoa, forminifera, &c. The marine zoologist will find much to interest him. A valuable paper, which had been already published in one of our scientific periodicals, on the luminosity of the sea, is incorporated with the narrative. In it the various kinds of phosphorescence are defined and traced to their origin, the number of divisions being five, viz.:—1. Sparks or points of light; 2. a soft liquid, general and wide spread effulgence; 3. moon-shaped patches of steady light; 4. instantaneous recurrent flashes; 5. milky sea. All these are traced to animal life of some kind or other, and his explanation of the phenomena is as follows:—

"Ever since, many years ago, I became acquainted with Mr Groves' 'Researches upon the Corelation of Physical Forces,' I have looked upon that ingenious theory as the rational explanation of animal luminosity. Light, heat, electricity, magnetism, motion, and chemical force, are all interchangeable, and each may manifest itself in the form of the other; but although these are called the *physical* forces, who can say that they are not *organic* forces also? One of them, which long since would have been regarded as eminently inorganic, is now fully recognised as an organic force produced by vital organs, and regulated by the will of the animal exhibiting it. I allude of course to electricity, an agent which is possessed by several fishes, and we know not by what other animals, a force which is produced directly through the agency of nervous power, for the regulation of which a special cerebral lobe is recognised. If this nerve force or vitality can display iiself in the form of electricity, why should it not do so also in the form of light? In the more highly organised luminous animals, as in Lampyris (the glow-worm), in which nervous centres exist, there is a special organ for the development of light, doubtless regulated by some part of the nervous system. Kölliker, in his examination of the luminous property of that insect, came to the conclusion that there was neither combustion nor phosphorus in the case, but that it was the product of a nervous apparatus, and dependent upon the will of the animal. In others the contractility of muscular tissue or of sarcode substance, which contractility is itself a vital act, seems sufficient to produce the phenomena in question." (pp. 407, 408.)

The nature of the phenomenon treated by Dr Collingwood is a very difficult one, and we should have liked to have had the views of such an intelligent naturalist a little more developed as to the modus operandi by which the luminous result is attained. No one will dispute the position he has entrenched himself in, that if all forces producing physical phenomena are corelated and convertible, it may be due to any of them. But what we should have liked to know his opinion upon is, which of them is in operation in any particular case. They may all or any of them be mixed up with it, but taking the phenomenon at a particular stage, what is its then nature. When we see the ocean apparently on fire, is the light real fire or is it not? Are the animals which give it out burning or not? Is it slow combustion by chemical action, or is it a phenomenon of electricity? It comes very much to this—Is there more than one source of light? Fire-light used to be thought different from sun-light. We now know that they are the same. Our own opinion is that there is only one source of light, and that is chemical action—in other words combustion. Combustion, indeed, is usually understood to be only another word for oxydization. Hence, where there is no oxygen, it would follow that there can be no combustion, and some examples of phosphorescent and fluorescent light seem to exist under combustions where there can be no oxydization. The light in such instances may nevertheless be due to the presence of oxygen in such small quantities as to escape our detection, or that light may be produced by some analogous phase of chemical action where something else takes the part and performs the duty of oxygen; and it seems not unreasonable to ascribe the phenomenon to one or other of them until we have better data on which to go.

Leaving such recondite physiological questions, let us turn to some of the other more palpable and material subjects noticed by Dr Collingwood. The woodcut, fig. 2, is a representation which he gives of the curious forms produced by the degradation of sandstone rocks, on the south side of Kelung harbour, in Formosa. We should have been disposed to refer the appearance to the action of the weather, but Dr Collingwood ascribes it to aqueous action. He says:—

"The effect of aqueous action upon the sandstone rocks are very conspicuous in some parts of Kelung harbour. Near the cave before mentioned, and immediately upon the verge of high water, is a tall isolated sandstone rock, having precisely the appearance of an old ruined castle, and appropriately named Ruin Rock, which forms an excellent land-mark by which to anchor a ship. The harder layers of sandstone having defied the effects of weather, and the spray which is dashed up during the north-east monsoon, to which the harbour is exposed, the softer portions have at the same time been more or less excavated, leaving a mimic resemblance of the ruined chambers of a three-storied building.

Fig. 2.

But the most curious and extensive effects of the direct action of the sea are to be found at the entrance of the harbour on either side. That on the north side is called Image Point on the chart, but the south side is even more remarkable, and no less deserves this name, while the effects are on a larger scale." (p. 89.)

To what formation these sandstone rocks belong Dr Collingwood could not determine, but they are part of a carboniferous series, which he thinks is probably of recent origin. Over them lies a bed of coal, which is worked for economic purposes, and which would be of immense value were it all equal to our British coal. But although tolerably good for domestic purposes, it does not answer for steam vessels. In fact, it would appear that it is almost as cheap to take out coal from England as to buy this coal on the spot, the quantity required to produce the same heat being so much greater of this Formosan coal.

Dr Collingwood visited another bed of coal in Borneo, which cropped out from beneath a thick layer of vegetable mould. He speaks of it as indifferent looking, and it would rather appear that although plenty of coal is to be found in that region, it is probably all tertiary, and although useful for domestic purposes not likely to be of much value to our shipping.

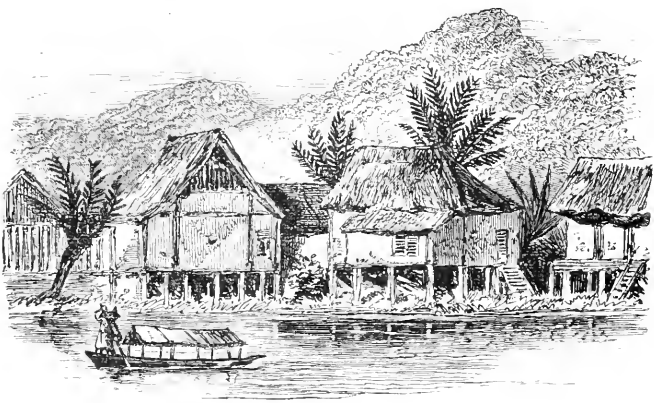


Fig. 3.

While in Borneo he passed some time at Sarawak. The accompanying cut (fig. 3) shews the picturesque character of the Malay houses there. He also took a trip up one of the rivers among the Dyaks, and visited one of the stalactitic caverns which are known to exist there. It is known that some of these caves are ossiferous, and probably in no part of the world is there a more interesting field for palæontological discovery than in them. It might help to clear up the curious problem, why such an extensive country as Borneo should be almost entirely destitute of larger mammals. Dr Collingwood puts it thus :—

"It has been remarked that large quadrupeds bear no proportion to the luxuriance of vegetation of the tropics, and the greatest herbivorous animals abound most where the soil and climatal conditions do not encourage the greatest development of vegetation. Thus it is in Borneo, where, although the country is a vast forest under an equatorial sun, large animals are rarely met with."—(p. 216.)

The fact, as regards Borneo, certainly is as here stated; but we cannot agree with the generalization as to some connexion or relation existing or being to be expected between the amount of vegetation and the presence or absence of larger mammals in any land. The two things have nothing whatever to do with each other, and the presence or absence of every kind of animal solely depends upon whether the land in question at its appearance above the sea was in connexion with or near to some other land where such animals existed, so as to allow of its being peopled by emigration or dispersal from it. The special puzzle with regard to Borneo is, that while it is abundantly peopled with arboreal and aquatic mammals, such as bats, monkeys, squirrels, otters, and tapirs, there is an almost entire absence of animals which require solid ground for the sole of their foot to rest on. A semi-arboreal tree cat or leopard, and a small light-footed deer is the nearest approach to a truly terrestrial animal. With these exceptions, and even these, perhaps, can scarcely be truly called exceptions, there is nothing mammalian on Borneo which could not live on a half-drowned land. If we suppose Borneo formerly entirely flat, as the greater part of it still is, and united to Java, and then sunk until it became level with the sea, like some parts of New Guinea at this moment, where there are groves of mangroves growing on the flat muddy beaches, extending backwards for several miles into the interior, before the solid land is reached, we should have a land covered with timber, in which all the arboreal and semi-aquatic species might live for long ages, but in which the larger animals of Java, such as the elephant and rhinoceros, could not possibly survive. The elephant no doubt now occurs in Borneo, but, as is rightly said by Dr Collingwood, it is not aboriginal but introduced. The date and history of the introduction is perfectly well known. It was by the Sultan of Sooloo, who received some elephants as a present from our own East India Company, and finding them troublesome and expensive to keep, turned them loose in Borneo, where they have bred and multiplied. From time to time it has been said that the rhinoceros also occurs in Borneo, but no well-authenticated instance of it has ever been recorded, and the belief among naturalists is almost unanimous that it does not exist in Borneo. Dr John Edward Gray indeed has, during the last season, given Borneo as the habitat of a new species of rhinoceros, which he has described in a paper read to the Zoological Society. But neither the species nor the locality will stand much scrutiny. It would appear that Dr Gray has lately had occasion to examine in detail some of the skulls of larger mammals which are stored in the British Museum, and on comparing the series, he has found some which do not quite correspond with the rest, and instead of considering these, as has hitherto been the custom, as abnormal specimens or variations from the type, he has arrived at the conclusion that they are distinct species. Thus in comparing the skulls of the tapirs, he found one marked "Tapirus Americanus, from South America," in which he thinks the "position of the internal nostril on the palate," is so different from that of the common South American tapirs, as at once to separate it from them, and he has consequently described it as a new species "not yet observed in the living state," and given it the name of Tapirus Laurillardei.

Next, dealing with the rhinoceroses in the same way, and increase of appetite apparently growing by what it feeds on, he has doubled the dose this time. He gives us two new species of rhinoceros also "not yet observed in the living state," which he has described under the names of Rhinoceros Floweri and Rhinoceros nasalis from skulls in the British Museum—the former from Sumatra and the other from Borneo. As to the value of these new species this is not the place to give an opinion. When we mention that Professor Owen considers Dr Gray's characters as merely individual variations, we imagine that few of our readers will require one; but as to the locality of Borneo it is of importance to the present question, and, being a matter of fact and not of opinion, there can be little difficulty in settling it. The locality is given by Dr Gray broadly and distinctly in his diagnosis simply as "Borneo" without query or qualification; but on looking to the particulars of where it came from and how it came (which it is but justice to Dr Gray to say he always gives with scrupulous fidelity so far as they appear to him to be relevant), we find to our surprise that he has no warrant at all for saying that the species is from Borneo. No one has told him that the skull belonged to a Bornean animal. It turns out to be a mere inference on his part.—"The skull was purchased of a dealer, who said that he received it direct from Borneo." Even the dealer does not say it is a Bornean specimen. We all know how a collector gathers from all quarters as he moves along, and when his store is large enough, ships them home from the last port he comes to. Are all that have been so accumulated to be held as having been natives of the port of shipment? Because this skull was shipped from Borneo does it follow that it was killed in Borneo? In these seas the communication is so frequent and easy between the different islands, that special caution in ascribing a locality is necessary; and as if to warn Dr Gray from the blunder he was falling into, he found another skull in the British Museum collection, marked from Java, possessing exactly the same abnormalities as he gives as the characters of his supposed Bornean species.

Dr Gray gets over this difficulty by the conjecture that the locality Java may possibly be a mistake for Borneo. "It was purchased of a dealer, and has been marked R. Sondaicus Cuvier Java, by some previous possessor. The habitat may depend on the person having decided it to be R. Sondaicus."

Had the facts been reversed, and the skull been labelled "Borneo," we might have accepted the conjecture that Java was meant, seeing that that would only be reconciling the facts to all that we previously knew on the subject. But Dr Gray's proposition asks us to run counter to all our previous knowledge, merely for the sake of supporting his new quasi Bornean species—one of whose chief titles to confidence depends on its being a native of the new locality. We have no desire to prejudge the question. The rhinoceros *may* be a native of Borneo—the skull said to have been received direct from Borneo *may* have been so received, and the animal that bore it *may* have been killed in Borneo, and it *may* have been by omission that it was not stated to have been killed there—the skull labelled Java *may* have been so labelled by mistake, and *may* have come from Borneo—Dr Gray's new species, Rhinoceros nasalis, *may* be a good species "not yet observed in the living state"—and variations in the nasal bones *may* furnish sufficient characters by which to discriminate species; but we think until some or all of these possibilities shall have been proved to be facts, it would be rash to conclude that the rhinoceros is a native of Borneo.

Leaving the larger species out of view, Borneo possesses many remarkable mammals. One of the most interesting of these is the

Galeopithecus Philippensis, which although not confined to Borneo is abundant there. It is particularly interesting, from the mixed affinities which seem to be combined in it. It may be described as a mixture of the monkey and the squirrel, and its habits bear out the suspicion of the affinities which its form suggests. Although placed by systematists next to or among the quadrumana, it has in many of what may be called its minor characters, strong sciurine elements. We shall contrast its mode of flying from tree to tree, as narrated by Dr Collingwood, with a short account of a similar propensity of the flying squirrel in North America given by Sir Charles Lyell in his tour through America; and we think the reader will feel disposed after reading them to allow a greater share of the squirrel element to be present in the Galeopithecus than he had perhaps previously been disposed to admit.

First hear Dr Collingwood :—

"Sitting in the verandah of Mr Martin's house about sunset, I had an opportunity of observing the habits of the flying squirrel (Galeopithecus) the Kerbong of the Malays. The animal came streaming through the air from a distant clump of trees, its flank membranes extended, and its long tail stretched out behind, and with a graceful sailing motion at length arrived at a tall tree trunk which had been left in the midst of the cleared jungle, on the lower part of which it alighted. The animal then began to ascend the trunk in a spiral direction, running a little way at a time and then stopping. Having reached the branches it selected one, along which it crept until it had reached the extremity, when it suddenly launched itself into the air, and glided away on outstretched wings in the direction of another tall tree, about 150 yards distant, gradually descending as it proceeded, and finally alighting upon the lower third of the trunk. Again it crept up the branches, and again it cast itself off, making this time for a more distant tree, when it was lost to view in the jungle. At the same moment another Galeopithecus arrived at the first-mentioned tree, which standing alone, offered a good mark and a convenient resting place for these singular animals. This one repeated the same process, only going in the opposite direction. Every evening at the same hour, these animals, probably the same individuals, might be seen making use of the same trees in their flight so that it was easy to say when they had alighted anywhere what would be their next flight. Having reached the highest part of the tree, they sailed steadily away to the next, with grace and swiftness, in a gradually falling line, with no apparent movement of their flank membranes, but with the evident power of accurately guiding their flight to the next stage in their progress, which may thus be described as a vertical zigzag." (p. 211.)

The notice of the habits of the North American squirrel, by Sir Charles Lyell, to which we refer, is as follows :—

"After travelling so much in the woods, I had never got sight of more than three or four species, owing, I am informed, to their nocturnal habits. I regretted that I had not yet seen the flying squirrel in motion, and was surprised to hear that Dr Buchanan had observed about a hundred of them every evening for several weeks, near Philadelphia, on two tall oaks, in the autumn when acorns and chestnuts were abundant, and when they had spare time to play. They were amusing themselves by passing from one tree to another, throwing themselves off from the top of one of the oaks and descending at a considerable angle to near the base of the other; then inclining the head upwards just before reaching the ground, so as to turn and alight on the trunk, which they immediately climb up to repeat the same manœuvre. In this way there was an almost continuous flight of them crossing each other in the air between the two trees."—(*A Second Visit to the United States*, by Sir Charles Lyell, p. 303.)

Before leaving the zoology of Dr Collingwood's book, we shall just quote one suggestion for the obtaining of small birds :—

"The Klings" (a race from the Coromandel Coast of India, of whom considerable numbers are settled about Singapore) "here have a mode of obtaining small birds which might prove useful to the practical ornithologist. I have more than once seen one of them beneath a Banyah, armed with a straight tube or sumpitan about six feet long, and a piece of soft clay, from which having broken off a morsel, he rolled it into a little ball between his hands, then placing it in the tube and taking aim at a small bird singing in the branches above, he noiselessly blew the pellet, and down fell the bird to the ground, stunned, or it might be killed. A little practice, one would imagine, would enable a performer to play upon this instrument, not wantonly, we would hope, but for the purpose of procuring small birds when they are required for preservation without injuring the plumage." (p. 267.)

We can endorse Dr Collingwood's suggestion, and say, from personal trial of the South American blow-pipe, that a moderate degree of skill is not difficult to attain.

Dr Collingwood saw the diamond mines, or rather diamond washings, in Borneo. For the most part diamonds are of small size, but of a brilliant water, although large ones have been occasionally met with. The largest Bornean diamond belongs to the Sultan of Matan, and is valued at £269,738, weighing as uncut 367 carats. In the sand and gravel of the river bed, at depths averaging from 6 to 18 feet below the surface, and in strata sometimes several feet thick, the diamonds are sought for with varying success by a large number of Malays, who sinks shafts at a distance of 20 feet apart in the shallow parts of the river. They construct huge pyramidal frames of large and strong bamboos, about three yards square at the base, and by means of heavy stones they sink them upon their claims, so that they may not be carried away by the stream, and at the same time shall point out clearly the working place of each party. Their next important stock in trade consists of a number of large shallow round wooden bowls. Filling a bowl with gravel from the river bed, they (standing in the water) hold the bowl, just skimming the surface, and give the contents a rotatory motion, cautiously and skilfully allowing the muddy and lighter sandy particles to flow over with the water, until nothing is left at the bottom of the dish but the larger and heavier sandy and gravelly substances, which are then carefully examined for the diamonds.

We have left ourselves scarcely any space to speak of Dr Collingwood's observations on the vegetable products of the countries

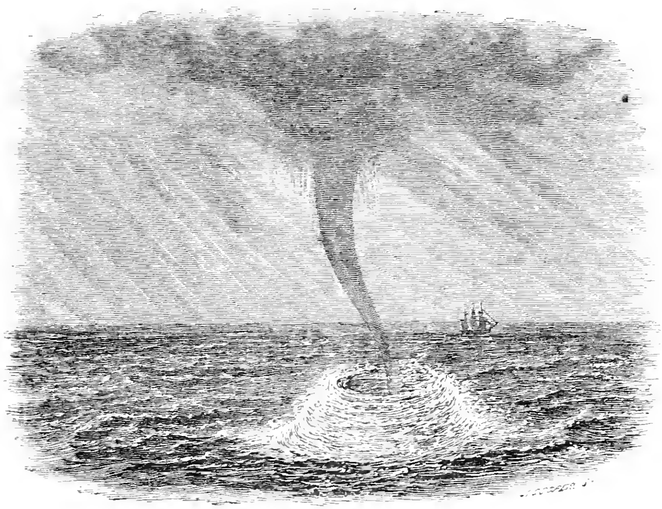


Fig. 4.—Water Spout in China Seas.

he visited. The most important part of these is perhaps his notices of what is doing commercially in the cultivation of the different useful plants, such as coffee, cotton, cocoa-nut, sago palm, pepper, sugar, nutmeg, gamboge, gambir, &c. He has noted the advance making in the cultivation of these with an observant eye—and those interested in them will find some useful incidental information. Of purely botanical information there is not a great deal. The following observation on the behaviour of the sensitive plant, although not new any way, may interest the general reader:

"One of the commonest roadside plants of Singapore is the sensitive plant (Mimosa sensitiva), which grows in profusion in waste places, and on banks by the wayside. It is a very low spreading plant, of suffruticose habit, seldom rising higher than the grass among which it grows, or more than six inches from the ground, but covering large spots, which are distinguished from the rough herbage by its neat regular foliage. It seems to be almost constantly in flower, for in October, November, and May, I noticed numbers of the little round tufts characteristic of this acacia (mimosa), and of a pale flesh colour. The manner in which the aspect of such a little bush is altered by a touch is very remarkable. Brush your foot over the luxuriant little plant as you pass by, and the whole bush seems to disappear, and you look back for it almost in vain; the leaves have all closed up, and the stems become depressed, and nothing is left but a few withered sticks on the grass. Try to pluck a sprig and it fades between your fingers; so that it is very difficult to gather and examine it in an expanded condition. But if you will carefully take between the finger and thumb the pulvinus or swelled base of the leaf stalk where the little thorns are situated, without touching any other part, and pinch it hard before attempting to break off the sprig, the pinnae will remain expanded relax your hold, however, and they will immediately begin to close up."—(P. 257.)

The natural physical phenomena of the world were not overlooked by Dr Collingwood, and we cannot better indicate his attention to them than by closing our views with an engraving of a waterspout (see p. 377), copied from a sketch carefully taken by himself, and which tells its own tale better than any words could do.

*A FORTNIGHT'S STAY ON LOS FARALLONES.**

IN the month of May 1851, when California was still in its infancy as a state of the American Union, I was a resident of San Francisco. One morning the captain of a British ship, then in the harbour, with whom I had some acquaintance, came to me with an excited face, and said he wished to propose a speculation.

"Well, Captain, you know we are all ready for anything that will pay; let us hear what it is."

"Yes; but first you must promise that if you do not *go in* yourself, you will not say anything about it."

Having given the required assurance, he said, "You know what a price eggs are."

I laughed, and admitted that I knew what I had to pay for a boiled egg for breakfast.

The captain nodded, and looked wise, then drew from his pocket a large green egg, beautifully spotted, streaked, and speckled with black.

"Look at that. I know where we can get a shipload of them for the picking up, and if you will provide a small vessel, I will take her to the spot, and with the assistance of my brother and one or two others, load her in a week."

"That is all very well, Captain, but when we have got the eggs to San Francisco, what can we do with them—who will buy that kind of egg?"

"Oh," laughed the Captain, rubbing his hands in great glee, "never fear but we shall sell them fast enough. I got the information from a townsman of my own, who owns a whaleboat here. He has already tried the spec himself, and sold his cargo to the restaurant folks for omelette eggs at a dollar a dozen."

Omelette eggs were already pretty well known in San Francisco, for, owing to the great scarcity of poultry, eggs had been imported from the coast of Mexico, Peru, and Chili—aye, and even from Boston, packed in various ingenious manners, but, nevertheless,

* The Farallones are a group of rocks near the mouth of the Bay of San Francisco.

arriving in such a condition that they could hardly be called fresh eggs, yet still, when disguised with onions and "fines herbes," were available to the restaurateur for omelettes.

My friend the Captain, then informed me that the egg he shewed me was a murr's egg, and that these birds were then laying in thousands upon thousands on the "Farallones," a small group of islands rising abruptly out of the sea, some twenty-five miles west from San Francisco.

In those early days of San Francisco, we were all full of life and energy and love of adventure, and the prospect of a week's bird's nesting on this gigantic scale promised amusement as well as profit, so I first had the egg boiled to ascertain its merits, and on finding that it was as good as a fresh duck's egg, and infinitely preferable to the "omelette eggs" already mentioned, agreed to provide a small schooner for the expedition, and determined to form one of the party myself.

The Egg Company was *limited* to the Captain, his brother, another sea captain, a young friend of mine, and myself, and the crew consisted of the captain's cabin boy.

We took some provisions and a keg of fresh water on board, and sailed with the evening's tide. There was but little wind, and we did not sight the "Farallones" until the next morning.

Leaving the eggs out of the question, the rocks were worth coming to see for themselves alone. From the midst of the waters, a mass of rock rising in the centre, like a gigantic steeple or lighthouse. On the shelving rocks, sloping towards the sea, thousands of birds, their white breasts looking like a large bed of flowers; to the right of the principal island, and only separated from it by a very narrow strait, another huge, hump-backed rock, literally covered with birds, while the air was filled with shrieking sea-gulls. We had difficulty in finding a safe landing-place, but finally discovered a little narrow sandy cove, with a whaleboat in it—the whaleboat of our captain's friend. Here, then, we anchored; and landing in the ship's boat, each provided with a basket, commenced operations. We were soon busily employed amongst the eggs, and found them in such profusion, that it was clear we should easily load the little schooner. But the interest of the trip did not end there. We had the island to explore, and make acquaintance with its population.

We found that there were three men on the island, all on the same errand as ourselves, one of whom was our captain's friend of the whaleboat. There were three or four rude huts built of rough stone, by Russian whalers, who formerly frequented the island for the sake of the seals and sea lions, which were said to have been at one time abundant there. These huts must have been long abandoned, for the floor was overgrown with grass, and of the roof there was very little left. During our stay one of our party shot a seal, the skin of which must have been of considerable value, as the fur was beautiful, but that was the only one we saw. The sea lions, however, were plentiful enough, and were fond of reposing on some flat ledges of rock, and basking in the sun with their young calves. I am aware that the sea lion is only a local name for these animals, but I do not know the correct name. They are in shape like a seal, but are destitute of fur. They are clothed with coarse yellow hair, not unlike pig's bristles, and their length is ten to twelve feet. One of the whaling party killed one of these sea lions, and, wishing to present the skin to the infant Museum in California, I got permission to appropriate it, and began to skin it with the assistance of one or two others of our party. We quickly had the uppermost side laid bare, but an unforeseen difficulty prevented our completing the task. The united strength of our whole party was insufficient to turn the beast over, so we were obliged to abandon the skin. We captured, however, two little calves, and put them alive on board the schooner; pretty little creatures, with fawn-like eyes.

We had been nearly a week on the island, and the hold of the vessel was more than half full of eggs, when a gale of wind arose, and the captain fearing a storm, thought we should pass the night more comfortably in one of the huts, instead of sleeping on board, as we had always hitherto done. We cast the other anchor, and moored the vessel as securely as we could. We then brought our keg of water and a day's provisions on shore, and made ourselves as comfortable as circumstances would allow.

The next morning the captain went out early, and in about a quarter of an hour returned with a very dismal countenance, saying,

"Well, here's a pretty go."

"What's the matter, Captain?"

"Why, she's gone!"

"Who's gone?"

"Why, the schooner to be sure, eggs and all."

There was a dead silence for a minute, and we looked at each other with bewildered countenances, until our position struck one of us from the ridiculous point of view, and he burst into a loud laugh, which was infectious, and became general. There was not much to laugh at, however, for we were really castaways on a desert island. True, there was plenty to eat for the gathering, although not much variety, but our supply of water was very small, and we had not yet discovered any spring on the island. What was to be done was the next question. The whaleboat was our only means of escape, so the two seafaring men volunteered to row to San Francisco, as soon as the storm abated, and bring another vessel, whilst, in the meantime, we who remained were to gather a fresh cargo. There was no difficulty in getting the loan of the whaleboat, and our captains took their departure.

We did not find our solitude at all unpleasant, and became every day more pleased with the place and its inhabitants. I watched with interest the habits and peculiarities of the different birds.

The murr (as our captain called it) is the foolish guillemot. It lays its solitary egg on the bare rock, without any attempt at building a nest, not even a stick or a straw, but is not the less careful and attached to them, of which we saw plenty of instances. The sea gulls were flying round in great numbers, and the moment they saw an egg without the protection of the mother they pounced upon it, flew off with it to a little distance, dropped it on the rocks to break the shell, and immediately gobbled up the contents..

One day I was watching this little game, when I saw a gull hovering round a guillemot who was sitting on her egg. The gull emboldened by success thought to take the egg from under her. She drew back her neck, watched her opportuuity, and with a sudden dart of her sharp bill, stabbed her enemy to the heart. I took up the dead bird, and found it had been pierced just under the wing. We cooked the gull as we were getting tired of nothing but eggs, eggs, eggs, for breakfast, dinner, and supper, and very good eating it was, entirely free from the strong fishy taste that almost invariably attaches to these birds, affording a curious exemplification of the influence food has on the taste of the animals we eat. *Mem.*—Egg-fed gulls are not fishy.

As another variety to our bill of fare, we found a bed of large mussels on the rocks, poor stuff, but acceptable as a change.

Unfortunately our keg of water gave out ere long, and we could only discover a very small spring of water, so thoroughly impregnated with guano, that even after being boiled and allowed to settle, it was very strong, although I conclude not unhealthy, as none of us suffered any bad effects from its use. Besides the guillemot, there were other birds laying on the island. First there were the gulls, but they do not lay in the profuse and promiscuous manner of the guillemot. We had to search for their nests. They were generally to be found in little cozy nooks, where the detrition of the rocks had formed miniature valleys. The nests were neatly constructed of dry grass, and usually contained three eggs, sometimes two, rarely four. These eggs were very different from the others. Smaller than a hen's egg, of nearly the same shape, of a light olive-brown colour, sprinkled profusely with streaks of a darker shade, and with a very thin shell. As an article of food we soon discovered their superiority, and during our sojourn on the island used none but them.

Next, there were the puffins, or sea parrots, as our sailors called them. They build their nests, or rather I should say they lay their egg (they lay but one) in crevices, or holes in the rocks, sometimes so far in as to be beyond reach. These puffins very much resemble those which come to breed on the small islands off the coast of Wales and Scotland (in which latter country they are called coulternebs or Tammie Norries), but are more beautiful, inasmuch as they are adorned by a long silky tuft of a golden yellow, on each side of their head. The egg is white, and nearly round. On one occasion I ventured to put my hand into a hole, when the bird was on its nest, and got a terrible bite for my pains. Their beak is very strong indeed, designed, I believe, for cracking mussel shells, and admirably adapted for the purpose.

Then there were the shags, but they built their nests on the very summit of the highest pinnacle in the island. This abode looked inaccessible from below, but I scaled it without much difficulty, and found on the top a platform, on which there were several nests of these birds. The nests were very large, and shabbily constructed of sticks and sea-weeds. In one there was a brood of young ones, fledged, and nearly ready for flight, or I might perhaps better say, ready for sea. In the others there were eggs, varying in number from five to seven, white, and not much larger than a pigeon's egg: this struck me as strange, for the bird is much bigger than the guillemot, whose egg is larger than a duck's.

I only took a specimen of the eggs, as they did not seem to be worth much, but I thought one of the young birds might do for supper, so after a fight, in which he defended himself bravely, I got one by the neck, and carried him home, if I may be allowed to call our temporary refuge by that sacred name. The bird was tender enough, being young, but I am afraid his parents had reared him on fish.

There was another bird that we frequently saw on the island, but we never discovered its nest, if indeed it had any at that time. The captains called it a sea pigeon: it somewhat resembled a common pigeon in colour and shape, and in its red legs, but it was more slender and web-footed.

We found several skeletons of the pelican, but saw none of the living birds. I suspect they must be migratory, as I have often seen the live birds in the bay of San Francisco. They are smaller than the pelicans we used to see in Wombwell's Menagerie, and grey instead of yellow or white.

I think I have enumerated all the live stock we saw on the island, with the exception of the common domestic cat, of which there were dozens existing in a wild state, their ancestors having no doubt been left by some whaling vessel.

A fortnight after our first arrival our captains returned with another small vessel, in which we quickly stowed what cargo we had collected, and immediately returned to San Francisco. We counted out a little over 1000 dozen, and sold them all to one man at a dollar a dozen.

W. MURRAY.

INDEX.

EDINBURGH: PRINTED BY EDWARD RAVENSCROFT.

Date Due