THE NATURAL HISTORY OF SOUTH DEVON.

He who is disposed to view the natural objects and phenomena amidst which he lives with a mind void of preconception, will inevitably discover that while all things do indeed conspire to the fulfilment of certain *general* laws which pervade Creation, they likewise in themselves exhibit those *laws which are attached to them by the circumstances of their respective localities.*—It is only in the present day that this truth is becoming sufficiently evident, and consequently it now especially behoves each naturalist to make known the productions and phenomena of his own neighbourhood; for it is only by allowing knowledge to be drawn to one great centre that we shall be competent to decide what are *general,* and what are *local* or *partial* laws.

Men boast too commonly of their acquaintance with laws and principles, but, as these are so all-important to be acquired, it will be needful for them to determine on those which apply only *to localities* before they can arrive at those which regulate *nature as a whole.*—The earth, forming a part of the system of the universe, and governed by the general laws which regulate the revolutions of the heavenly bodies, does also perform within its own economy, movements and actions peculiar to itself; let it now further be resolved how far, and by what precise means, the different portions of our Creation in their respective situations are governed by *local ordinances,* whilst at the same time they respond harmoniously to *those decrees which preside over the world of matter.*

THE

NATURAL HISTORY

OF

SOUTH DEVON.

FIVE MAPS, EIGHTY ENGRAVINGS, AND NINE LITHOGRAPHS.

By J. C. BELLAMY, Surgeon.

ONE OF THE CURATORS TO THE DEVON AND CORNWALL NATURAL HISTORY SOCIETY.

"Vere scire, est per causas scire."

Naturam intelligere, est eam in omnibus quæ gignit operibus intelligere locis in omnibus, et formis.

PLYMOUTH:

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MDCCCXXXIX.

TO

LIEUT.-COL. C. H. SMITH,

K.H. K.W. F.R. & L.S. &c. &c. &c.

PRESIDENT OF THE DEVON AND CORNWALL NATURAL HISTORY SOCIETY.

Sir,

Whilst the world of Science and of Letters has its attention directed to the great resources of your mind for constant assistance in matters wrapped in doubt, or in the intricacies of history,—whilst men appreciate the rare and happy conjoint knowledge of those two departments of learning which in you so conspicuously shines forth, the Naturalists of South Devon feel that you are directly associated with their *researches on the more circumscribed scale.*

In laying before your accomplished criticism the labours of a humble journalist of local Nature, I desire to convey to you my individual admiration of the amazing industry with which you have so skilfully turned to account your mental powers, and for the application of which to scientific and philosophic subjects you may hold the world largely in your debt.

Sir, in framing this dedication, I labour under no self-accusation of exceeding my real sentiments, and whilst I do it on my own responsibility, I have an assurance that in connecting your name with our local Science I but speak the united feelings of all those who prosecute an acquaintance with it.

J. C. BELLAMY.

TO THE

MEMBERS OF THE NATURAL HISTORY SOCIETY OF DEVON AND CORNWALL.

In originating the Society we conjointly form, I had in view our common interests as students of the natural beauties which in these counties so abundantly surround us,—convinced, as every one must be who deliberates on the question, that combination *is the shortest and best way of attaining to* extensive knowledge, *and of securing us individually from those narrowed and selfish views which solitude in research engenders. I was not unmindful also that by promoting this union the best advantages might accrue to us as citizens of the world,—bound to cultivate the social virtues by interchange of thought, and to sow the seeds of a future harvest in the soil of things temporal.*

I cannot hesitate to believe that these prospects will gradually receive their realizations in proportion as we continue in the path which tends to the only real and useful learning, and to the promotion of our moral benefits.

Since the period of the institution of our Society, I have been occupied, so far as circumstances the most inimical to thought and judicious composition suffered me, in the compilation of the present work, which, with a distrust of myself far greater than the kindest critic will give me credit for, I yet presume—through a hope that it may be in some measure *useful—to dedicate to you, together with my best wishes for a continued appreciation of those unequalled opportunities around us, which has been already so strongly and so happily evinced.*

J. C. B.

PREFACE.

When the present race of Devonshire Naturalists looks back, as it occasionally must, into past time, it finds reason to lament over the loss which their science has sustained in the vacuities occasioned by the death of many a bright example of industry, penetration, and research:—a Montagu, a Leach, a Turton has been called away from this field of eminence and usefulness, and all have long since passed into the deep and still repose of mortals. After that reflection,—full of melancholy as it is,—the mind next enquires whether Nature, still prodigal of her charms, has been left unprovided with men of similar capacity and industry to prosecute in a connected manner the investigation of our natural riches, and to proclaim from time to time that if their *number* is indeed exhaustible, the knowledge of their varied histories is certainly infinite. If the former reflection were melancholy, this must be more so, for the memory wanders to and fro in search of substitutes and returns to us void,—none have arisen! :—we ourselves continue on in the old beaten track, departing sometimes from it for the purpose of slight improvement beyond a customary doctrine, or for some numerical discovery in the productions of Nature, sometimes also going astray from it through error or prejudice.

But so invidious has been the character of Devonshire in respect of natural productions, more particularly in the eyes of *botanists, conchologists,* and *geologists,* that we have been visited systematically by literati in these departments, resident in very distant counties or kingdoms. Amongst a large number of these worthies may be named Hooker, Buckland, De la Beche, Sedgwick, Coldstream, De Luc, and Macculloch.—These visits, I am sorry to say, shew in their results that it is high time for us to be stirred up to greater activity, lest we be subjected to the imputation of treading upon grass whilst it perceptibly grows under us. If we turn our attention to the several departments of Nature, we see equally in all these directions that the productions of *this district* with their attendant phenomena contribute by their number, their peculiarities, and their general importance, to throw the most satisfactory light on the general philosophy of our science, and to aid most sensibly a determination of the numerous questions now so commonly proposed and discussed in this enquiring age. The number and peculiarities of the genera of our birds, fish, shells, &c. their geographic ranges, the various influences on the economy and actions of our animals, above all, the number of interesting geological phenomena presented by the county,—enabling the student to deduce the laws and general conclusions which constitute the usefulness of this science,—these, and a vast number of other considerations derived from our Natural History, tend to advance our locality to a point of eminence and distinction in which other counties and spots however celebrated for the profusion and importance of their products, participate much less. The larger the number of productions coming simultaneously and connectedly under the eye of an observer, and the greater the range of associations and relative conditions under which each separate object and circumstance is viewed, the more considerable must be the amount of philosophic knowledge he acquires. On this account therefore the attention of scientific men is for ever directed to this county for the advancement of those interests they cultivate.

As for myself, as a student in this very field, the public, ever justly jealous of intrusions on its liberal feelings, are about to judge of me. Those who estimate temperately will no doubt give me as much credit for the labour I have gone through as I can rationally expect, whilst those who would judge me harshly may require to have one hint here given them ;—that the discoveries made, and points of doctrine cleared up might be reasonably allowed to weigh favorably against other parts of the book where deficiency or error may no doubt be obvious. From the supercilious critic, who is well pleased with no one but himself, I of course expect no quarter, though here I comfort myself with the persuasion that *zeal* cannot be denied me, and with the assurance that it is a most wise maxim which says "Happy are they who expect little, for they shall not be disappointed." May I also be permitted to observe, since the errors and deficiencies of this book will be the first and the easiest detected by the competent portion of readers, that there is somewhat to be allowed in extenuation as a balance in the other scale :—I have bestowed very considerable attention in collating and reducing the vast bulk of facts connected with our most interesting Natural History into inclusive theory or generalized speculative statement of its philosophy,—a task surrounded with no ordinary difficulties, considering the wide field of doubt, probability and supposition laid forth rather than contracted by progressive science. A "Natural History" of a district pretending to no more than an enumeration of its objects, or a simple statement of facts and phenomena is an undertaking totally different from one which essays to systematize those occurrences and facts in the various departments of the study, and to offer to local students, as here attempted, a theoretic statement respecting them at once consistent with itself in its own details, and with the main body of existing science. Conversations relative to local facts and the theoretic philosophy appertaining to them almost invariably shew that in the public mind the utmost discrepancy and differences exist,—every fact is recognised in its *isolated* character, seldom in its true relative position to others, seldom conceded a place in any system, or located in an original comprehensive theory,—it is placed at the mercy of the adventitious and spurious character accidentally lent it by any other circumstance happening to be simultaneously contemplated. But whereas many opposite and very erroneous, not to say trivial and peremptory conclusions are thus pointed to as belonging to one solitary fact or occurrence, it must appear on rational reflection that a circumstance or phenomenon considered in a single capacity can have but *one* place in the natural theory or system of events and existences. To what extent I have been successful in giving a locality to each of the multitudinous facts I had to encounter,—how far I have succeeded in connecting the varied sized links methodically and consistently together,—with what propriety I have added this portion of the great chain of beings and of truths to its major part as it now exists, I leave the critical reader to determine. Theoretic knowledge is the great end of science, and while a number of its followers are loud in their denunciations of "*theory and speculation*," and in their commendation of the acquisition of *facts*, they are meanwhile insensibly cultivating the former in the accustomed manner. A man cannot well regard a fact without considering it in its relative character to some other, and with respect to its influence on some theory or deduction however vague, limited, and unscientific ; theory is the pivot or centre on which the utility of all scientific knowledge, more or less revolves, it is the fruit borne on the branches of the tree formed by the aggregate of facts. Is a man actually substantially wiser because he knows the number, the names, the qualities of all the rocks which occur in our district ? Is a man really wiser if he know the names of our migrating birds, and can discriminate one from another ? I greatly question it ; the knowledge which these things convey rests in their *philosophy*, and that embraces in the one case a theoretic consideration of the origins, the ages, the order of depôsition, the probable intermixtures and chemical actions of the formations of the ancient epochs, the probable condition of the beings which resided on the earth or in its seas in those æras, and the mode in which they were destroyed and impacted in their present sites, and so forth, while in the other, its philosophy includes a whole train of enquiries equally congenial to the minds of rational creatures, and honorable to those who systematically pursue them,—such are the physical powers of birds, their contrivances to shorten their migratory routes, the reasons in the economy of Nature for such actions imposed on creatures apparently inadequate to the task, the secondary causes inducing birds to undertake their appointed flights, the means by which the extreme punctuality of these migrations is attained to, the nature and amount of the instinct by which they are impelled, the variations of that instinct or guiding agent according to locality, and so forth;—all, questions of intricacy, of deep interest separately considered, and still more so when embodied into, and made to tell in the commonwealth of science. No man really sensible of the manner in which the data and maxims of philosophy are arrived at, will for a moment doubt the importance of local facts and their concomitant theories as assistant in the construction of *general or inclusive theories,* any more than he will hesitate to admit the effect of one part or department of science on another in the attainment of truth. Theory moreover may be shewn to be useful in another way, namely that by entertaining a preconception a man is naturally induced to search for corroborative facts in a greater variety of directions and to a greater extent than he would do if not prepossessed. But still it is abundantly manifest that a theory of too inclusive a nature or what is termed a "leading theory" is a prepossession which acts most prejudicially on future investigations and discoveries.

My plan has been to avoid those departments in which I possessed trifling knowledge, namely Mineralogy and Entomology, and since the Botany of South Devon has fallen into very able hands* I thought it would amount

* Flora Devoniensis.—Banks's Flora of Plymouth and Devonport.—Dr. Jacob's West Devon and Cornwall Flora.

to arrogance if I presumed to write that much respecting it which I happened to know. I have on the same ground of objection avoided meddling with the Natural History of the south-eastern district, a work having been given to the public on the productions of that neighbourhood,† and being disinclined to an invasion of other men's territories to pilfer their properties; where however it was essential to my plan to complete the list of a series of animals, or to judge of a circumstance through the analogy of adjoining localities I have with due acknowledgment drawn my information from that source, in the same manner as I have found it expedient to consult the contents of those books which treat of the productions of neighbouring counties.‡

My further object has been, besides giving the work chiefly as the result of my own experience and research, to make the bulk of my remarks act not simply as local information but as the means of connecting local information to the great body of existing science, so that local and general science may at once be conjointly benefitted by reflecting on each other mutual lights. General science is indeed made up of scattered fragments of local knowledge, and as I have kept in view the interests of the former, it is my hope that this book will be suitable to general reading, besides interesting those who have local attachments.—It will but seldom be found, that where it was practicable to connect a fact to present systematized or

† Turton's and Kingston's Natural History of Torquay, Dawlish, and Teignmouth,—a volume of "Guide to the Watering Places."

‡ Dorset Catalogue of Birds, Shells &c. Couch's Cornish Fauna, &c.

generalized knowledge, I have omitted doing so; but in the execution of my task, surrounded and impeded by the cares, and toils, and trammels of the most irksome profession under heaven, I have laboured under difficulties to an appreciation of which I will admit none but those who have been similarly circumstanced.

To him who has no sufficient occupation or study to pass off the tedium of ennui I would most earnestly say,—take a lesson out of the great book of Nature, search our hedges or our shores for shells, gather the variety of plants which adorn our fields,—

> " —— Call the vales and bid them hither cast
> Their bells and flourets of a thousand hues."

watch the habits of our birds in their woods,—try either of these pursuits, and you will not fail to be enamoured: without such occupations, man in vain looks abroad in search of happiness—real happiness, "he goes in and out, but without the feeling that can give attachment to any one spot"; but when the mind becomes habituated to these refreshing and healthful relaxations from business it gains consolation, security, and strength, and moves a contented spirit through the illimitable fields of Nature.—Happy indeed is that man who has within him in even its unawakened form that taste and inclination for natural pursuits which he can light up and appeal to in the hour of affliction or despair, or resort to as if it were a "ministering spirit" in the intervals of tedious attention to his needful calling, at the periods of its daily, and still more at its final close. Greatly in fault also are those parents who in the education of their children fail to sow within their bosoms those seeds which shall eventually furnish the germinating scientific plants. I would but add to the individual feelings which are here expressed relatively to the study of nature, by adopting the following lines—

> "Fair Nature! thee, in all thy varied charms,
> Fain would I clasp for ever in my arms:
> Thine are the sweets which never, never sate,
> Thine still remain through all the storms of fate.
> Though not for me 'twas heaven's divine command
> To roll in acres of paternal land,
> Yet still my lot is bless'd, while I enjoy
> Thine opening beauties with a lover's eye."

But let none forget to warn themselves occasionally against an unbounded connexion with natural subjects; man has his best interests in a future existence, and we need to remind ourselves from time to time of the fleeting character of all things earthly, even the beauties of the natural world, surrounding us; this earth and its possessions form but a temporary domicile for us, to be used with discretion, and as the accompaniments of a *probationary* life, calculated also to inform us that higher considerations are befitting us, that "all that's bright must fade,"—that the best productions of the world must in the end of time be abolished, and in the course of Nature upon ourselves even the mighty though sinful fabric of the human mind.

The engravings and lithographs which accompany this work are in great measure directed to an illustration of subjects which the scientific will find *novel.* To Mr. Gosling, Mr. T. Colley, and Miss Jones of Plymstock I am greatly indebted for the assistance with which they have favored me in making certain of the requisite drawings, also to my brother Mr. P. F. B. for his etchings; but I am more especially under obligation to my sister Miss A. M. B. for her unspared exertions to delineate satisfactorily, those numerous fossils to which her name will be found attached. I ought also here to tender my acknowledgments to the subscribers to this publication, since, without that aid it could not have appeared in print ; there are several persons on that list for whose anxiety for my success I sincerely thank them.

J. C. Bellamy.

Yealmpton, December, 1838.

CONTENTS.

PART II.

PART III.

MAPS, ENGRAVINGS, AND LITHOGRAPHS.

CORRIGENDA.

The Reader will be pleased to correct with his pen as under.

At p. 6, 10th line, *for* was, *write* were.
At p. 21, 5th line, *for* of, *write* off.
At p. 32, 15th line, *for* management, *write* arrangement.
At p. 46, 11th line, *for* ærea, *write* area.
At p. 48, 10th line, *for* Cann slate quarry, *write* Mary Tavy.
At p. 54, 23rd line, *for* vein, *write* deposit.
At p. 66, 31st line, place a semicolon after slate.
At p. 75, 19th line, *for* If, *write* It.
At p. 77, 13th line, *for* affinity, *write* infinity.
At p. 79, 24th line, *for* respectfully, *write* respectively.
At p. 94, 8th line, *for mustelo, write mustela.*
At p. 126, 30th line, *for* Le Luc, *write* De Luc.
At p. 150, 7th line, *expunge the word* to.
At p. 192, 11th line, *for* Runner, *write* Ranner.
In the paragraphs preceding the lists of Mammals, Birds, and Marine Molluscs, add after the word *found*, the parenthesis thus, (as regards Britain.)
At p. 206 and 207, *for* Cliff Chaff, *write* Chiff Chaff.
At p. 273, 24th line, after the word *same*, write size.
At p. 291, 14th line, *for* loose, *write* lime.
At p. 296, last line, *for* a peat bed, *write* silt of a valley.
At p. 329, the dash in the quotation should be shorter, so as to make the two lines of nearly equal length.
At p. 358, line 30th, *for* contracting *write* contradicting.
At p. 371, expunge lines 22nd, 23rd, 24th, and 25th, as far as the semi-colon.
At p. 373, expunge from the word " toes" in the 12th line, to the semicolon in the next line:

I regret to express my belief, that, owing to want of sufficient leisure on the part of the Author, a number of errors in punctuation may meet the eye of the critic. I likewise feel obliged to apologise, however reluctantly, for two or three irregularities in the execution of the lettering of the Maps belonging to the chapter on Geography of Animals; these faults are due to the ill humour with which the Lithographer was at the time afflicted, and over which I could have no controul.

INTRODUCTION.

From the fount of science are perpetually poured forth pleasures, and advantages of the purest kind. The depraved appetite of man, glutted through a series of ages with the intoxicating draughts of depravity, fashion and adulation is at length beginning to long for that stream of knowledge which Nature in her depth of wisdom and condescension, has directed to flow by us in all our situations and abodes,—even in our most flagrant departures from that path wherein it has pleased her we should walk. Under the influence of a somewhat improved mode of education, the ameliorated condition of the public mind makes it superfluous for me here to set forth, or eulogize the immense importance of receiving at the hands of Nature those species of refreshments which our mental constitutions have been adapted to digest. But, although it may in some degree be unnecessary to insist on this in a general point of view, Naturalists may now seize the occasion to follow up the advantage gained, by exhibiting the intrinsic value, merits and characters of the several subjects embraced in this delightful study.

Amongst other things which are required in the present day to be set forth, there is one, not merely of importance, but absolutely essential to the vital interests of science—one moreover which a great number of men, passing under *the name* of naturalists, yet need to be brought to the contemplation of; this is, *that variation in the face of Nature, and those forms of difference in natural objects, and in their actions and economies, in which localities and different situations are ever rife.* Certain authors, forgetful of these truths, have too long held out to the multitude whom they guided and deceived, a vast variety of axioms applicable only to their own circumscribed knowledge. But, since nothing can be an axiom or a law, which does not apply to every subject of that class which it was intended to embrace; every one of these rules, so proved to be partial, must be condemned as utopian and worthless.

It is a most important and pleasing department of the human intellect, to employ itself in seeking out the laws and designs of nature relative to her productions, and to solace itself moreover in framing generalizations of a more or less artificial kind, relating to such portions of Creation as may from time to time be examined by it. Indeed this power of concentration and generalization is applied extensively in all kinds of human learning; the mind greatly delights in it, and it is so far a natural mental process, that our most common thoughts and speculations are oftentimes found to have been insensibly directed to this end. But in *the study of Nature* is it more especially applied, and it brings with it satisfaction of the purest and most refined description. Most happily then are we thus endowed with this noble power, and most reasonable is it that we should make our enquiries centre in this object of grand importance.

In our search however after these great truths, we speedily discover that to arrive at them we must apply ourselves to the whole range of our knowledge;—we learn that to secure these desiderata firmly in our grasp, we must first engage in inquiries both intricate and abstruse, and devote as large a portion of attention to the lower portions of Creation as to its higher members;—we find at intervals, to our astonishment, that subjects which had been but little noticed by us, or been quite neglected, suddenly contribute most influential matter to our deliberations whilst occupied in the absorbing scrutiny. Amongst this latter class of collateral aids, rank those portions of knowledge gathered from localities before imagined to yield nothing different from what had been already recognised and learnt. One circumstance alone cheers the path, and diminishes the labour of the investigators; in our examination of the structure and functions of living beings, we necessarily find the operations of several natural laws extended to each of them; by attention and careful consideration we ascertain the phenomena induced by each separate law, and note the connexions in the characters of these results; carrying these data and conclusions with us, we finally learn *to anticipate and expect* laws in any new subjects of examination from an observation of their structures and functions; the functions of living beings being themselves in great measure united, the laws under which they act must be also in greater or less unison—mutually dependant and reciprocally illustrative of each other, wherever found. In this way is it shewn how the laws of life in one series of beings, illustrate and imply those of others, and accordingly how essential is the study of every department of organic life to the perfect knowledge of the physiology of one.

With these explanations I hope it will in the first instance be seen that the knowledge of principles and laws is the legitimate aim of the philosophy of our Science; secondly, that to acquire these, we must premise a thorough acquaintance with Nature, anatomically and physiologically; thirdly, that amongst other preparatory information, an extended and extending knowledge *of the variations discoverable in localities* is absolutely essential. Let us proceed to remind the reader of the truth of this last observation, by exemplifying the way in which an acquaintance with the Natural History of our locality conduces to the development of laws.

From certain differences in the geography and physical condition of localities, the meteorological influences on living beings as to structure, function, and economy, are variable in amount and character in different situations; a county exposed as ours is to the effects of gales, must needs exhibit differences in its *Fauna* from that of a spot not so affected; a glance at the list of our pelagic birds, will place this truth before the student. A locality enjoying a tolerable equality in the temperature through the year, will needs shew differences with regard both to its plants and animals, from sites where the extremes of temperature are greater; an instance of this will appear in the tendency of some migrants to remain with us through the winter in years favourable to such an act; equality of temperature also influences the geography of some plants, and may be suspected as the cause of the occurrence of some species in Devon, or in the south-western counties of England. Geography of localities is now better appreciated than formerly in affecting the precise *habitats* of species in both kingdoms of Nature; they are found to enjoy ranges and situations very different, according to the circumstances of their positions, as will appear in cases which I shall adduce in the body of the work. The conditions of the climate, and geography of localities and districts, are now understood to influence the periods and characters of the migrations executed by their animals; many peculiarities of this kind, discovered to occur with our animals, I shall set before the reader likewise in the body of the following account of our Natural History. Constant experience enables naturalists, in proportion to the examination of districts, to add to the list of species, and, not unfrequently it happens, from the discovered animals or plants being far different from the species already known, alterations are occasioned in the genera, and ultimately in orders and other divisions, so as to affect classification generally. It will appear in the sequel that I have been able, through attention to the subject, to add to the general catalogue, from the natural productions of this district. The varying characters of climate, food, &c. in localities, conjointly produce structural differences in species exhibiting either the general amount of variation allotted to them, or those forms of alteration termed "accidental varieties," the precise causes of which however are as yet unknown. These variations serve at times to illustrate the nature of those laws which affect organization; again, the same, and all other local circumstances are apt to produce variations of habit, which tends forcibly to shew that considerable latitude has been given to animals in the exercise of what are termed their instinctive actions. I shall endeavour to shew this in the portions of the work which treat respectively of these subjects. The alterations effected in the face of a given locality by the ameliorating powers of agriculture, horticulture, planting, &c. together with the hostile operations of man on the original state of Nature, conspire to produce differences in the geography, numbers, habits and structure of plants and animals; and thus these interferences serve to derange the general polity of nature, or the mutual dependance of the three natural kingdoms, and, by shewing us the detrimental consequences to organic nature, enable us in some degree to comprehend the laws, which kept the members of the series in their just and natural connexions.

These then are a few instances taken quite at random, to prove that a knowledge of the phenomena displayed by the Natural History of localities, is essential to a due acquaintance with the laws which control the existences, the œconomies, the instincts, the structures, the geographical positions, the natural classifications, and the mutual relations, and connexions of plants, and animals.

In the last place I observe, that the geologies of localities generally present differences worthy of note, and render it highly probable that though some few general rules may obtain as regards the whole earth, each district may itself also furnish rules not applicable beyond it ; that in short there are localities to the phenomena of the deposition and characters of strata, as I shall illustrate further under the proper head.

It is necessary to remark here relatively to the MAPS which illustrate the zoology of the district, that they are assumed to have merely a limited utility. Unlike the tribes of the vegetable kingdom, nearly the whole of animals enjoy free locomotive powers, and a large proportion moreover do not limit themselves to one description of abode, but roam at will over a variety of situations. Again it must be confessed that the number of naturalists is at present so few, that in the best cases we can boast only of partial zoological knowledge of localities; and again with respect to the notice of rare animals, or visitors, the situations in which they have been observed may have been only casual and momentary. Accordingly, this novel kind of map will necessarily be of less use than those employed in the illustration of botanical geography. But, though the present maps will be of contracted service in gaining information on the laws and rules of animal distribution, they will serve to display at one view the main features in the catalogue of which we boast, and the principal residences of many species. With respect indeed to many kinds, somewhat of risk has been incurred in the situations assigned to them from the rarity of their occurrence, or the slight notice bestowed upon their range; but as above intimated, their insertion will provide a sort of mechanical assistance to enquirers. Where some fact in the geography of even a common animal, struck me as important, I have not hesitated to introduce the name in the situation considered as uncommon or interesting; and where an animal habitually occupies, or has been observed at the times of its detection to resort to opposite kinds of *habitats*, I have (if the species be rare, remarkable, or interesting in its economy,) noticed it twice or oftener in the maps. With some species this occupation of opposite kinds of residence is determined by change of season, a fact particularly noticed among the Waders, some of which, as I shall shew, remove at stated periods to temporary new abodes, and are again found after awhile, either in an intermediate situation, or in the quarter whence they had first set out. In important cases of this description, I have judged it useful to give the double, or triple insertion of the species.

NATURAL HISTORY OF SOUTH DEVON.

Part I.—Chap. I.

REMARKS ON THE GENERAL ASPECT OF THE DISTRICT.

No portion of the world has enjoyed greater celebrity for a happy union of all that delights the eye, than England, and no part of our Island has received more invidious distinction on account of this peculiar junction of every sort of scenery, than Devonshire. It is here purposed to take a hasty glance at these scenic characters of its southern districts, prior to our contemplation of its natural products and phenomena. Comprehending Dartmoor towards the centre of the county, and the coasts which occupy the southern limits, our proposed examination, extends to three opposite kinds of scenery ; the first, mountainous, bold, romantic, desolate and bald ; the second, wooded, greatly intersected by rivers, hilly, rich in pasturage, and highly fruitful ; the third, bold, but sometimes, soft and gentle, and at others, grand and terrible ; generally precipitous and barren. In consequence of considerable irregularity in the shape of the county, and a partial participation by each of these divisions in the qualities of the others, their limits are far from being accurately defined, and in this way the threefold aspect of the Shire may be enjoyed by an observer, within a range by no means considerable. By such a combination of scenic beauties,—the mountainous, the sober, the tranquil, the bold, and the maritime,—does Devon outvie Scotland, and even the more interesting and delightful of the midland English counties ; and whether therefore the lover of Nature gives preference to the one sort or the other, or whether he delight in a *conjunction* of scenic qualities, he here finds the feast on which his mind may continually be regaled.

The feeling of enjoyment derived from scenery is of course relative—it has relation to previous experience, and to prior considerations—it depends on comparison, on associations, on the production of ideas congenial to the individual mind. Dartmoor indeed, the first portion of our district, to be here glanced on "with a bird's eye,"—has in years long since numbered, had its inhabitants who felt local attachment, loved the soil that maintained them, looked with satisfaction on its mighty hills, its forests, and its fastnessess, and gloried in its remoteness from softer scenes ; but then these originals of the soil of Dartmoor were prompted in such sentiments, either by religious superstitions, the materials of which were presented to them in the majestic and fantastic "tors ;" by the friendly protection from bitter enemies afforded by these wilds ; or lastly, in a third case of which history gives record, by the "*auri sacra fames*," the victims of which desire left no spot uninvestigated from the time of their acquaintance with the localities and strata calculated to external view to be metalliferous, and might well indeed look cheerfully on the superficial unproductiveness of the Moor and regard complacently the frowning and bleak hills, out of the bowels of which the precious object of their care proceeded. How differently does civilized man view this region ! How differently do the thoughts of the Naturalist turn, as he paces considerately these barren heights ! *Contrast* is the grand prevailing sentiment as he bends his steps northward, from the beautiful South Hams, and views the immense granite hills which are his destination, and where austerity, sterility, and death-like stillness, hold their reign ! It is the especial attribute of intellect to find

"——— tongues in trees, books in the running brooks,
Sermons in stones, and good in every thing."

moreover, the well-ordered mind continually reflects that in external "Nature there is nothing melancholy,"—that every thing may conduce to a satisfactory increase of knowledge, and render the head and heart conjointly benefitted, otherwise indeed, the lines of Wordsworth might be cited as appropriately descriptive of the tract of country to which we are now supposing ourselves on a visit,

"I looked upon the scene both far and near,
More doleful place did never eye survey,
It seemed as if the spring time came not here,
Or nature here was willing to decay."

Change of scenery has one extraordinary and most usefully exciting effect upon our minds, since fresh associations and fresh ideas are at once generated on each new variation of position, and thus the mind is carried by successive steps of reason, on the road of human learning, by this occupation of external sense. The great improvement experienced by invalids, through "change of air" is not so much due to difference of atmospheric qualities, (extreme cases excepted) as to the revulsions of feelings and sentiments arising in their minds, and thence salutary alterations on their bodily systems, by the ceaseless intercourse and mutual influence of the physical and moral portions of the constitution.

As the visitor advances he finds a change in the strata or rocks, over which he is passing; the soil becomes shallow, but dark and rich; the herbage scanty, but fine-bladed and sweet; the wild plants are wholly different,—the ling and furze are spread in all directions, beneath them are thick tufts of thyme, visited by the wandering bee; in the dry open spots is the splendid foxglove; creeping between the stones, in some favored elevated spot, is seen the delicate ivy-leaved campanula; the tormentil is spread profusely; the marsh louse-wort occurs in numerous damp spots; on the margin of the stream grows the water violet; in the stream itself the lesser water plantain; on the wastes generally is spread an abundance of rushes and other similar moorish plants; on the tors above, Nature has bestowed a many-coloured mantle of lichens and other parasites, which depend for subsistence on the vapours and heavy rains which ever and anon are poured out upon them. The titlark, the stonechat, the raven, the curlew, discover themselves at intervals of the journey, and prove that even Dartmoor is not deserted by the feathered tribes. Neither have we told the tithe of its natural possessions; on the contrary, the scrutinizing search of naturalists has displayed treasures from these regions, both numerous and precious, and without question, more may still be derived from them. Yet still, *contrast* is the powerful sentiment that fills the mind, and who could pass from the well clothed land on the southern side to this naked region, and not exercise the faculty of comparison ? —not a tree tends to diversify the scene, no hedges restrain the keen blast, no rich expanse of pasturage to ease the sight, no carols to enchant the ear ; but uncouth nudity, uncompromising exposure, stern barrenness of soil, and a silence relieved merely by the breeze, the roar of some distant river, or the cry of some solitary bird. One spot indeed during summer betrays foliage ; it is where the "lonely wood of Wistman" spreads its twisted trunks between the rude blocks of granite, and derives its nourishment from unseen sources ; but then, this oasis of the unreclaimed desert merely serves to indicate the comparative fertility of gone-by times, the verdure of an ancient forest which once spread its befriending branches over the devoted land, and permitted man to lay the soil under useful contribution.

"That the moor was once cultivated is evident from the traces of furrows or ridges, and stone enclosures still remaining upon, and around it, and from the lower layer of thatch in the roofs of its old buildings, being rye straw, which probably was the grain then raised."* This is to the point, and the man of leisure, science and philanthropy, could render no greater service to his country than by proposing some plan by which this, and such-like wastes could again be rendered available to agriculture.

He who traverses the moor for the sake of mental recreation and advantage, can hardly fail to

* Burt in Notes to Carrington's Dartmoor, p. 114.

feel some touch of the sublime and grand; the hills with their awe-begetting tors, the sterile plains bestrewed with granite blocks, the mountain vallies, the ravines, the mountain torrents, the cascades, the morasses, the never-failing springs, all eminently incline the heart toward the great and good: Let the visitor ascend one of the hills amongst which his course his bent, and he will then discover that the majesty and sublimity of the scenery he had travelled to witness, was only to be *fully* attained by that labour; should he have climbed to one of the tors in the central part of the moor, he will behold around him a multiplicity of elevations assuming at their summits every curious and fantastic form; the eye is relieved by nothing but the beautiful lichens which clothe the rocks amidst which he is then situated, but the mind may be led to grand conceptions of the earth he inhabits, and to a due appreciation of himself as a moral being, peculiar in respect of his relation to the Divine Architect of all earthly scenery and productions; should he have gone to the summit of one of the hills on the border of the moor, his eye will be refreshed towards the south by scenes incomparable for loveliness,—woods, rivers, meadows, corn-fields, and even the sea are perchance presented to his view at one and the same time; at the western limit he may gain a sight of the Tamar in its tortuous course, with its green banks of quiet pasture, its bordering woods and its over-topping hills; at Dewerstone, at the south-west of the granite district, he looks down immediately on a moorland river in its tumultuous and hurried course over and amidst the intercepting rocks, an ameliorated vegetation, a dense wood, a romantic bridge and adjacent dwelling, distant hamlets and their surrounding agricultural operations; lastly, an unique and unparalleled scene may be witnessed at the southernmost hill of the tract we have been thus glancing at,—from this elevation termed the Western Beacon, or rather "from Three Barrow Tor near it, there is a most surprising view from Portland in Dorsetshire, to the Lizard in Cornwall, and from the skirts of Dartmoor, to Blackdown Hills in Somersetshire; in front, nearer the eye, the South Hams of Devon, from the Teign, to the Tamar, the estuary of the Yealm, Plymouth Sound, Mount Edgecumbe, and the British Channel." Having attempted this general description of the scenery of Dartmoor which to those unacquainted with it, may convey *some* idea of the reality, we shall for the present quit this portion of our district, bidding it farewell in the language of immortal Carrington—

> "——— Ye forms sublime,
> Adieu, that people the great Moor;—the tor,
> The hallowed cairn, the everlasting rocks,
> Moulded by time into a million shapes
> Of beauty and of grandeur;—and adieu
> Ye voices that upon the wanderer's ear
> Ever refreshing come;—the flow of rill,
> And music of the cataract, and leap
> Of mountain-stream, and sigh of mountain breeze,
> And, scared by the intruder man, the rush
> Of the wild bird."

In truth, here in the very wilds of Dartmoor, the *Philosopher* adds to his speculations new impulses and new ideas;—here the mind of the *Poet* has been invigorated and incited to new strains;—here the mind of the *Religionist* been elevated to fresh awe and a fresh spirit of devotion.

Having now examined the wild scenery of Dartmoor, it is our next design to make a transit into a district different in every way—the South Hams of Devon, styled from their beauty, and by common consent, the *Garden of England*, wherein the grand requisites of soft, and delicate scenery are nicely blended. For a short distance of a mile, or two after quitting Dartmoor, the coarseness and sterility of that tract are not entirely lost, there is yet a wildness about us, still a violence and tumult in the rivers, which indicate adjacency to an elevated and barren region.

> " ——— The Moor resigns
> Not suddenly its sternness ;———"

Soon however, the scene subsides, the hills seem nicely smoothened as if by art, they are devoid of crags, steep sides and foaming rivers in the interspaces, agriculture now predominates, and the rivers move on in comparative serenity of course, dispensing incalculable benefits on all the lower lands. The slate hills themselves are originators of springs, which deal out rivulets on their sides, and these passing by the combes toward the larger streams, form a system of connexion by water, between the hill tops and the vallies. These schist hills are disposed of most irregularly, and though vallies of tolerable length and good breadth do in some places occur, such instances are not numerous, and *in general* therefore the views are not very extensive ; in the vicinity of the coast however and elsewhere in the neighbourhood of lime-rock, the tops of the slate hills afford grand and interesting prospects. On the whole, the views occurring in the South Hams, in which the sea forms no part, may be accounted unique for the richness of the pastoral effect which the mind receives. The South Hams, also besides the qualifications of river, and pastoral scenery above named, are especially copious in wood, and though the hill tops from being usually too devoid of soil to furnish pasture, are planted much with fir and other timber ; the river sides are more especially clothed with woods;—these of course constitute a peculiar embellishment in the Devon scenery.

> "Gay spreads the prospect. From the stream-fed banks
> Loose floats the willow-foliage; alders bend
> Their leafy locks, and pliant poplars wave.
> From the brown steep, the graceful ash o'erhangs
> In quivering, light luxuriance. Wide the lime
> A massy shade expands. With silvery trunks
> Thin airy birch, and swelling maples rise.
> Coy aspers shiver all their twinkling leaves
> To every frolic wind. Fantastic oaks
> Immense, their knotty boughs entwisting, throw
> Solidity of deep, incumbent gloom."
>
> HOWARD'S BICKLEIGH VALE. p. 8.

Such especial endowments in this highly favoured district, could hardly be devoid of those very necessary concomitants of all scenery, an attractive Botany and Ornithology,—and such indeed are we in the actual possession of;—in these two respects the neighbourhoods of Kingsbridge and Yealmpton are peculiarly rich, though, the county altogether enjoys celebrity for all that is beautiful and interesting in Nature, and our native Poet celebrates this fact in his opening line

> "Lovely Devonia! land of flowers and songs!"

But the pastoral and soft scenery of South Devon, involves one more important qualification, namely cultivation, so that nature may receive embellishment from art. Exclusively *natural scenery* is one thing, nature and art interwoven, constitute another, the one we found in the granitic tract of Dartmoor, here, in the South Hams we have the other. Here, the beauties of Nature are thrown into relief, and receive aid in their pleasing effects upon the mind, by the operations of agriculture and horticulture; not indeed that these arts are pursued cleverly, or with much reference to science amongst us, but that the natural powers of the soil and climate are so great, that *luxuriance* seems the almost inevitable result of these proceedings however conducted. Certain it is, that our hills derive additional beauty by being crowned with waving corn crops; our vallies derive additional sweetness, by the vivid green of their pastures nourished by artificial water courses; our fields have a relief afforded them by their tall, green, bushy hedges; beyond all, our noble rivers acquire a ten-fold interest by being diversified in their passage through the county, by orchards, plantations, copses, parks, gardens and various other minor proceedings of man, whose history from the first ages attests a natural inclination to adopt residences by the sides of rivers, and pursue his natural peaceable occupations on the soil, in the neighbourhood of waters. The Dart, the Exe, the Tamar and the Yealm are severally famous for the splendour and beauty of their sceneries. The Dart is principally a mountain river, but it gradually expands in bulk, passes through the scenery just spoken of, and ultimately becomes navigable. The Exe is unsurpassed for the quietude and softness of its banks after leaving its parent hills. The Tamar is unequalled for the variety of scenery it embraces, and in particular for the height of its sides towards its weir. The Yealm, which Carrington sings as the "pride of our austral vales" is the "cedo nulli" in respect of the choiceness of the scenes which it visits, in the course of its meanderings through the cultivated parts.

In 1810, it was computed that the whole county included 1,200,000 acres of cultivated land, and 400,000 acres of waste land, waters, &c.* this

* Vancouver's Survey of Devon.

latter proportion has in the interval become greatly reduced.

The scenery of the South Devon coasts, comes next to be spoken of, and that briefly. Taken generally, it is bold and much exposed, because the land slopes very suddenly and abruptly to the sea. In some spots however long runs of beach, or sand form the approach. The land itself, is most commonly devoid of the characteristic pasturage of the county, being thin and poor; the perpetual beat of the sea wind likewise prevents the growth of timber, so that the immediate coast wears a barren and dry aspect, and no foliage, or pasture of any richness appears, till we pass the barrier of one range of hills, which offers as it were a befriending shelter against these blasts, and even there, symptoms of enervation are betrayed in vegetation generally, making it manifest how necessary distance from maritime localities is, to the full development of most trees and plants. The coasts therefore, must not be sought, for any satisfaction they will render in respect of vegetation: on the contrary, the admirer of scenery will here feast on the wild and the majestic, more especially during seasons of great disturbance of the ocean, on which occasions the mind is more particularly engaged in reflecting on the incalculable power of the elements, and on the imbecility of every thing connected with this earth when submitted to their influence.* But still, there are times and spots in which different ideas are generated: our estuaries,

* Unless we question ourselves narrowly as to the springs of our thoughts on various opportunities, we are apt to entirely overlook the chief and prevailing sentiment from which those thoughts emanate. Few perhaps have discovered that sea views induce on them a feeling of depression and the sentiment of melancholic ideality.

more especially in summer are quiet, and interesting scenes; grand woods, green fields, and even the bleak moor itself may here be viewed connectedly with the vast ocean, and the sight of some islet off the shore may lead some to indulge in romantic visions too pleasurable to last long. The sober thinking admirer of scenery, however may look down on the little harbour of Dartmouth, or sail up the entrance of the Exe, and find realities of beauty too remarkable, to be placed collaterally with fairy regions, but rather fit to be stored up, together with the impressions, and associations then awakened, and made to assume a place in the useful portion of his mind. The intellect of man is perpetually engaged on good or evil; the admiration of scenery need not be vacant, or empty, but far from it, whatever contemplation leads us to a regard of external nature, or of the springs of action which lie hidden in the deep recesses, of the intricate mechanisms of our hearts, must of necessity be useful, since, as responsible agents, these mental pursuits are especially suited to our case, and are found to be in strict accordance with what is good.

Chapter II.

ANCIENT GEOLOGY.

It is to be understood that the basis, or internal structure of that portion of the earth about to be described in a geological point of view, consists of that "primitive" rock called *Granite* with a modification thereof in two situations called *Gneiss*, and with *Porphyritic* characters in other spots, the whole passing ordinarily in the county under the term *Moorstone*, from its principal locality. Several geological reasons which I shall not be called upon to state here, induce the idea of this rock being almost universally the nucleus of our globe, though we derive our chief acquaintance with it, from those elevations termed "primitive mountains," in which class rank the heights of Dartmoor, situated near the centre of our county, and constituting the included northern limit of the district, concerning which this work treats. But, not staying to adduce the variety of reasons for thinking that it exists generally beneath us in this county, I may, for the sake of perspicuity observe, that Dartmoor is not the only spot exhibiting granitic rock, or its modifications, but that on the contrary, it betrays itself to us in the Channel, as the Eddystone and at the Bolt Head,* in an opposite direction re-appears in the hills near the northern coast, while, to the westward of the moor, granite has been found under the schist rock on the eastern bank of the Tamar, and in Cornwall formally exhibits itself in the character of hills, traversing the county to its south. Besides

* The Channel Isles likewise, are in great measure granitic.

which, *Porphyry*, and some other rocks probably equally entitled to be viewed as modifications of granite, have been detected in their appearances at the surface, at several points southward of the great granitic tract.

Around Dartmoor then, or rather between it and the other points of its appearance, repose various strata, or deposits occupying a lap, or hollow, designed as it were for their reception, and from even this one circumstance of its several re-appearances, it seems easy to gather the idea of granite constituting the inferior member of our rocks, whereon the other kinds are received.

Viewing the county therefore as a whole, its granitic district is its most elevated portion, and as geologists have already remarked, may be regarded in some respects as a "table land," different however from those properly so named, in being composed of a vast assemblage of hills, or "undulations gradually overtopping each other." This undulating appearance of its surface, geologists of experience have also pronounced to be the characteristic of "primitive chains" throughout the world. Added to this one geological evidence, the appearance of its surface bestrewed with granite blocks, the number, impetuosity and sudden risings of its currents, its springs, issuing often on the very summits of the highest hills, the character of its *Fauna* and its alpine botany, conspire to place this portion of Devonshire in the same light as other mountainous tracts of country of which granite is the base.

Notwithstanding however its generally elevated position, one inconsiderable space is *below the sea level;* this is at Bovey Heathfield, in the eastern quarter, where a sort of hollow occurs between an irregular circle of granite hills, and occupied by a deposit of a peculiar and anomalous description—

concerning the character of which indeed, the most accomplished geologists are at variance of opinion. One thing however, it seems rational to conclude, both from the relative elevation and direction of one part of this curious formation, or deposit, and which it may not be amiss to introduce here merely by the way (as the precise description of the "Bovey coal and clay formation" will form no part of the present work,) namely, that the basin thus occurring amid the granite hills, was filled at *some* time, or epoch, by the waters of the neighbouring Channel, or by a lake, whose contents were continually being supplied to it, from the adjoining elevated country. Perhaps the former supposition is the more consistent, involving likewise the conclusion, that the retreat of the sea consequent on the presumed geological disturbance, overwhelmed some forest of dicotyledonous trees, and drew them bodily to the occupancy of the said basin, conjointly with other matters, which apparently give evidence to this species of catastrophe.

The region of *Dartmoor* is considered to extend in length about twenty miles from north to south, and in breadth to an average of ten miles. The chain of hills stretches from east north east to west south west in order to join its continuation as seen in Cornwall. Its centre may be said to be distant about twenty miles from the southern limits of the county. The hills rise to a considerable height, those on the borders being highest, the elevation of these above the sea reaching to nearly 2000 feet. The summits of these hills present irregular, massive accumulations assuming extraordinary and fantastic forms, and called "tors," the blocks composing which are found to be arranged with some appearance of stratification ; the dip however is various. This assemblage of granite hills is almost generally bald, the rock exhibiting itself to view, and being strewed over with an immense assemblage of blocks of varying size. The stone itself, assumes every shade and combination of colour which it is ever known to put on; it varies also much by a change in the component parts; again, it differs much in density, some spots being considerably softened, probably through some chemical alteration proceeding in it, and porcelain earth occurs abundantly in some sites where the decomposition has proceeded to its greatest limit. The granite of the two south-west counties however is far famed for durability, and supports a part of our commerce. A certain proportion of the white Cornish stone also, is shipped for the porcelain manufactories, it being convertible into a fine enamel.

The climate of the moor is proverbially bleak and chilly, and highly conducive to health and longevity.* Its bleak winds however, can only be accounted *agreeable*, during the great heats of summer, when, *in this tract of country*, a fire becomes a pleasant companion towards evening. Hay and corn harvests are considerably later than in the South Hams, and snow invariably clothes the moor hills † long before the cultivated districts receive its visits; it also continues on Cosson Hill, its highest part, after it has left all other spots. The close texture of the rock causes rain, and the va-

* A woman who resided at the foot of Brent Tor, attained to more than one hundred years.

† As examples, I may instance the beginning of the winter, 1838; on October 10th the moor was coated with snow, frosts occurred with us soon after, but we had no decidedly cold weather or snow, till the end of January succeeding. Again snow appeared on the moor about February 12th, 1839, and lay for several days, but we had neither frost or snow in the South Hams, only a cold, bleak air. On April 4th snow again appeared on the moor, but in the South Hams, the weather was not particularly cold.

pours which the hills attract, to run over their sides, and these sources of moisture, together with the abundant springs which rise through the seams of the granite, keep the scanty herbage of the country well watered, whilst, the low temperature originating in the bleak winds, helps likewise to keep this vegetation from the scorching, to which that in the cultivated lands is most usually subjected in the height of summer. The moorland *grass* therefore, wherever it occurs in tolerable plenty, feeds quantities of cattle at that season. Extensive beds of *sedge* are also produced in some spots, and are annually gathered for making mattrasses, while lastly, vast and valuable accumulations of *peat* are found in various parts where perpetual moisture encourages the constant growth of the aquatic plants from which it is derived. This substance, besides obtaining a sale as fuel, is used by the gardeners in Plymouth and elsewhere, for the rearing of peculiar shrubs requiring a highly nutritious earth, such as this substance extensively assumes the character of throughout the moor. One other beautiful, but inferior subject of commerce afforded by the moor is the common *heath or ling* covering the commons surrounding this tract; it is used for the purpose of making brooms, which are really neat and pretty objects.

From the circumstances of the accumulation of so much vapour by the Dartmoor hills, and of their originating such abundance of subterranean, and superficial springs, bogs and morasses are numerous, as also small streams, which soon unite and constitute the splendid and romantic rivers for which our county is so celebrated.

This granitic tract of Dartmoor, has been computed to contain 130,000 acres, but the quantity of sterile land is yearly diminishing by the grants of inclosures in various directions. From the exposure of the county, the violence of its winds and the bleakness of its air, great difficulties are encountered in raising timber in any but sheltered situations; but, though the climate is thus unfriendly in its present state, and seemingly refuses to give support to vegetable life, it is to be considered whether there be any plausible objection to the proposition, of Dartmoor, having in a former period supported a very different aspect, and been under the influence of a different kind of climate—an atmosphere, not deteriorated by great barrenness and useless humidity. If the climate of a district depended simply on its situation, geographically and altitudinally, there could be no room left for this surmise, but it being notorious that its condition in respect of cultivation and wood, has considerable influence, and it being further ascertained, that the remnants of a forest are from time to time disclosed within the precincts of the moor, sunk deep in its bogs and peat; it being also shewn, that beasts of chace once held dominion in this tract, and must in consequence, have had woods to shelter them; there being in the centre of the moor, a small patch of oaks called "Wistman's Wood;" lastly, there being no *primâ facie* obstacle in the soil, or rather rock of Dartmoor, and nothing to render the lowness of the temperature insuperable to modification when once the operation of planting has been fairly begun, the principles of the above proposition may be considered established on the ground of extreme probability. It may be added, that as the Druids formerly inhabited Dartmoor, it is hardly possible to conceive that the country was devoid of timber, and of vegetation for the purpose of building, and for the support of cattle.* So far from any objection

* Diodorus Siculus describes the dwellings of the ancient Britons of his time as "poor cottages constructed of wood, and

against granite as a soil for trees, resting on the mind, it cannot be overlooked how many tracts of country of the same kind, are now overspread by fine forests, (the Alps, Norway, &c.) ; young trees are known to spring up yearly on the moor, and, if the compactness of the rock be thought an hindrance to the maintenance of roots, it may be answered that oaks of superior size have nevertheless been grown, and in some spots are still growing on this very tract, and that on greenstone, equally dense as granite, trees of splendid growth may be noticed; witness the beeches at Lyneham and elsewhere.

With regard to superstratum it is probable that Dartmoor never boasted of much, the hardness of the stone and its upland situation being unfavorable to the accumulation of loose soil. Some have supposed that the moor is a denuded district, a tract washed of its clay or other earth, at the period of the Deluge ; the clay however seems to be limited to the schistlands, and those in its direct neighbourhood, and if ever it had existed on Dartmoor it would certainly have left some slight traces there, to attest the event of a denudation, and which have not, so far as I know, been detected. As to the soil induced from the presence of a forest, this would assuredly diminish, when by the removal of the trees, the rock generally acquired a perpetual moisture, and a continued draining towards the vallies, took place over its whole surface.

It is to be understood that the wooded, watered, and cultivated state of a country, act largely on its climate, while a climate being thus formed, *it* re-acts back again on those very conditions to which

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covered with straw," and Strabo mentions them as "wooden houses, circular in form with lofty conical roofs." *From Trans. of Plymouth Inst. p.* 193.

it is indebted. Now, the former character of Dartmoor as a tract of country being subtracted, it assumed the climate before alluded to, and it is consequently presumable, that if its original character could be restored to it, an amelioration in the latter circumstance would be effected. But, it is manifest that *partial* proceedings of agriculture and planting will always be marked either by limited success, or by discouraging failures, because the surrounding atmosphere and unqualified sterility, preponderate against it. The marked success of these undertakings so ardently wished for, will probably follow only on measures pursued *generally* and *simultaneously* on this tract. *

Picturing to ourselves Dartmoor in its former garb of wood and verdure, it will immediately occur, that its elevated site would then be equally productive of cold, as now, and that the greater amount of moisture, which the trees would naturally accumulate, might even render the cold greater, did not

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* The Duke of Athol has been most successful in his plantations of Larch in the Highlands of Scotland. Timber of unusual size, and quality has been grown in vast abundance on tracts of ground previously of extremely slight profit, and quite as exposed, barren and rocky as Dartmoor, the reputed "Nazareth."

I understand that the very rich pasturage of Guernsey is situated on granitic sand, or debris.

It is always desirable that plantations of timber should be protected during the first few years of growth by an interspersion of fir trees, which help greatly TO SHELTER and protect the rest from the beating and blighting influences of wind. These should not be suffered to remain after the trees principally designed to be grown have acquired some height, for then the firs by the closeness of the plantation will assist in accumulating wet, so injurious when abundant, to the qualities of most trees. Larch certainly does not prosper in the South Hams, and probably from this very cause, but on the plan recommended in the text I should conclude it might answer well on Dartmoor.

one other circumstance, that of *shelter*, powerfully act on the climate, and restrain the other influences, which would tend to depression of the average heat. Again the foliage and wood of a forest, naturally keep off much of the sun's rays, and so allow the atmosphere within and about it, to remain uninfluenced by its power; but, in opposition to that, the presence of a soil connected with a wooded state of a country, serves as a reservoir of solar heat, to be furnished to the air, in seasons when the sun's power is lessened or withdrawn. Climate being deteriorated by moisture, that is to say, by the power of moisture in diminishing atmospheric heat, it cannot be surprising that the presence of much vegetation, is a powerful auxiliary in the amelioration of the thermometric heat of a district, since this kind of carpet has the effect of appropriating a large proportion of water for continued sustenance.

Impinging almost generally on the Dartmoor granite, and often closely joined to it,—and in one case (Black Aller Tor,) lying on it as a thin bed, or covering,—is *Schist* of different kinds, a proportion of which puts on the *micaceous* character, and retains it for a short distance from the former rock, though *mica slate* is to be met with in one other spot, namely at the Bolt-head. This *mica schist* has favorable qualities for agriculture, especially grain crops.

A *Serpentinous Rock* has been noticed by Mr. Prideaux, extending through slate in the immediate vicinity of Dartmoor.

Shorl Rock in varying characters occurs also abundantly in contact with granite. *Syenite* near the Race House above Ivy Bridge. *Trapp Rock* in its several varieties pervades the county in the form of dykes, chiefly in connexion with lime, slate and sandstone, and conforming much to the direction of their respective runs, where occurring. It is however not a plentiful rock, but forms in a few instances, high hills. Mr. Prideaux has noticed a most interesting connexion of greenstone with slate, in the case of the trapp constituting Rock and Estover estates, and the slate surrounding it. The slate takes on the colour and partial qualities of the greenstone for some extent.* Prior to noticing this in Mr. P's. paper, I had observed that a portion of lime-rock in my neighbourhood, where coming into contact with the trapp, had a fine green tinge, and though, I then hesitated to believe it to have been due to the intrusion and action of this latter rock, I now feel emboldened to class the two circumstances, as of similar character. I also believe that some other phenomena in this county, may hereafter be allowed to be ascribable to similar causes, of the action of one stratum on another chemically, or mechanically, or both.

From the fact of the great connexion of trapp with our fossiliferous strata, it has by some been thought entitled to a rank among "transition rocks"; of late however Mr. de la Beche and others, contend that this with granite and its modifications—porphyry and gneiss, as also serpentine, are collectively to be considered as of subsequent date to all other formations so far as respects their superficial appearance amongst the perceptible portions of other strata,—in short, that certain subterranean agencies of the igneous class have upheaved these rocks into their present positions among more recent deposits. This rule however, probably does not hold good universally, for, as we are not bound to compress these igneous irruptions into one œra of such disturbance, some portions of these Plutonic rocks, may have existed in their present forms, anteriorly to the

* Geological account of the neighbourhood of Plymouth, by J. Prideaux, Esq. in Trans. of Plymouth Inst.

deposition of the other series, and moreover as Mr. de la Beche observes, the detrital matter of such *primitive* rocks, may be found blended into the composition of those strata which happened to repose on them, and which, during their precipitation, would acquire this foreign material, just as if the former had been upheaved and affected the latter in the more usual manner.

That a part at least, of those rocks which until lately had by common consent been accounted *primitive*, are really entitled to that primœval rank, we are fortunately enabled to demonstrate. Be the period of " granitic intrusion" what it may, it can be shewn that granite had priority of existence to those strata which suffered at some time from its upheaving, and that even some trivial difference probably existed between the characters of those two granite rocks, in regard of the size of the component chrystals. In this district and in the neighbourhood of the granite range, enclosed or rather impacted in slate, a few feet below the surface, was found an oblong and highly rolled granitic pebble, fine grained, and of the size of two fists. Now, the knowledge of this circumstance (for the relation of which I am indebted to Capt. Blanckley, who witnessed its removal and presented it to the Natural History Society) is doubly valuable, because, it proves not only the primitive character of granite as a rock, or at least its priority to schist, but also, that at the period of slate being called into ostensibility as a rock, the operative element acted most forcibly, both in its production and in its casual effects on the previously existing stratum. From the locality above named, there is reason to suppose that this *boulder* occurred in what geologists are pleased to term " primitive slate," and if so, it will be requisite to remind them, that, coevality of occurrence can no longer be claimed for these two strata, but that on the contrary, there was an interval between the granite formation, and the precipitation of the slate rock, here assumed to be, of the reputed *primitive* kind.

The great difficulty involved by the occurrence of rolled pebbles or *boulders* in a district, is that of assigning them to that æra in geological events, to which they really belong, and though, in the preceding case of the granite boulder in slate-rock it is most easy to assume priority of occurrence to granite as a rock, relatively to slate as a deposit, there are instances in which doubts will occur, whether boulders of the same kind of rock *might not* be ascribed to a later revolution, or aqueous disturbance. Mr. Prideaux recognised *Porphyritic boulders* on Roborough Down, and *quartz boulders* on the slate tract between the rivers Tamar and Tavy. Now, the origin of these with respect to time must for the present at least, be doubtful. At the foot of St. Anne's beacon, Cornwall, (granite, ironstone, &c.) occur vast numbers of rolled pebbles, clay and sand in distinct beds, and, from the difference in the phenomena of these deposits to those which we recognize as "diluvium," there is ground to believe, that they are of the same age as the granite pebble before spoken of,—referrible indeed, to what was probably the primitive flood or revolution, of which the earth as a solid body, presents us with any testimony. Certain it is, that in the south-west counties, instances occur of the granitic localities contributing rolled blocks of that substance to the districts immediately below and around them, but, the determination of the age of these is involved in doubt, from an equal possibility of their being due to the above-named primitive disturbance, and of their belonging to the flood more popularly alluded to. There is an exception however, to this species of hesitation, in favour of those pebbles found in caverns, and under certain peculiar circumstances, both *in* these caves and *without*, hereafter to be described.

One kind of boulder may here be more especially named, as involving doubt and theory as to its origin. In the slate of the coast, certain spots attract notice, from containing knobs of harder material, and seemingly of the description of sandstone (which moreover, is abundantly joined in every variety of way to our slate); these knobs are rounded, and in some measure, placed in parallel lines, thereby inducing the conclusion of their being rounded, and involved in the substance of the slate during its deposit.

The truth of these new ideas of the modern elevation, or intrusion of granite, trapp, &c. seems to be continually borne out by every fresh examination of primary rocks in all the modifications and relations they assume, and the convenience of the theory for reconciling facts of a seemingly opposed character, is strongly manifested by attention to the very interesting and instructive geology of this county. It is contended then, by the new theorists, that a great many of our rocks, of which it will suffice here to name those principally meant,—granite, trapp, porphyry, schorl, serpentine and gneiss, are so far as respects their superficial appearance, of posterior date to all our others; they have, through the agency of fire, been reduced to a softened state and then forced up, and disseminated in some measure, around and between the beds of those rocks against which they happened to impinge, and whether in their fluid form, or in their cooled and hardened state, have been forcibly driven up, and have extensively dislocated those strata, under which they were situated. Occasionally indeed, no particular disturbance can be detected; trapp for instance, lies parallel with limestone, and sandstone in some situations, without any appearance of displacement in the latter, or at most with the occurrence of a *fault*, or slight disturbance at their brinks; but, on the other hand, there are cases where mechanical and chemical combination of connected rocks, *igneous* on the one hand, and *transition* on the other, sufficiently points out, if not disturbance, an extensive igneous action occurring at the period of elevation, and probably indeed, while at some depth below the surface. Our *mica-slate* and *ribbon jasper* are instances of these effects, the former *may* originally have been ordinary schist reposing on granite at some depth, and thrust up at the time of the granitic elevation, and converted simultaneously into its present structure; ribbon jasper again, may have, in its former state, been ordinary slate, and converted during the rising of the trappean mass into the substance now spoken of. Mr. Prideaux observes that several hills round the moor, are constituted of schorl, quartz and slate in a state of aggregation.* Where granite runs in narrow veins through slate, it is reasonable to infer that this combination took place in a subterranean situation, and that the whole was then upheaved, but, it does not *necessarily* involve the conclusion that both rocks are of one age with regard to original formation, on the contrary, I have elsewhere stated my conviction, from the evident connexion of all our varieties of slate, that they (the slates) are of contemporaneous deposition.

But, if slates, and other rocks, never supposed to have been subjected to igneous action, are among themselves conjoined, and reciprocally blended, it might be enquired, whether the cause of mechanical and chemical blending on the one hand, were not the same as on the other. The method by which a

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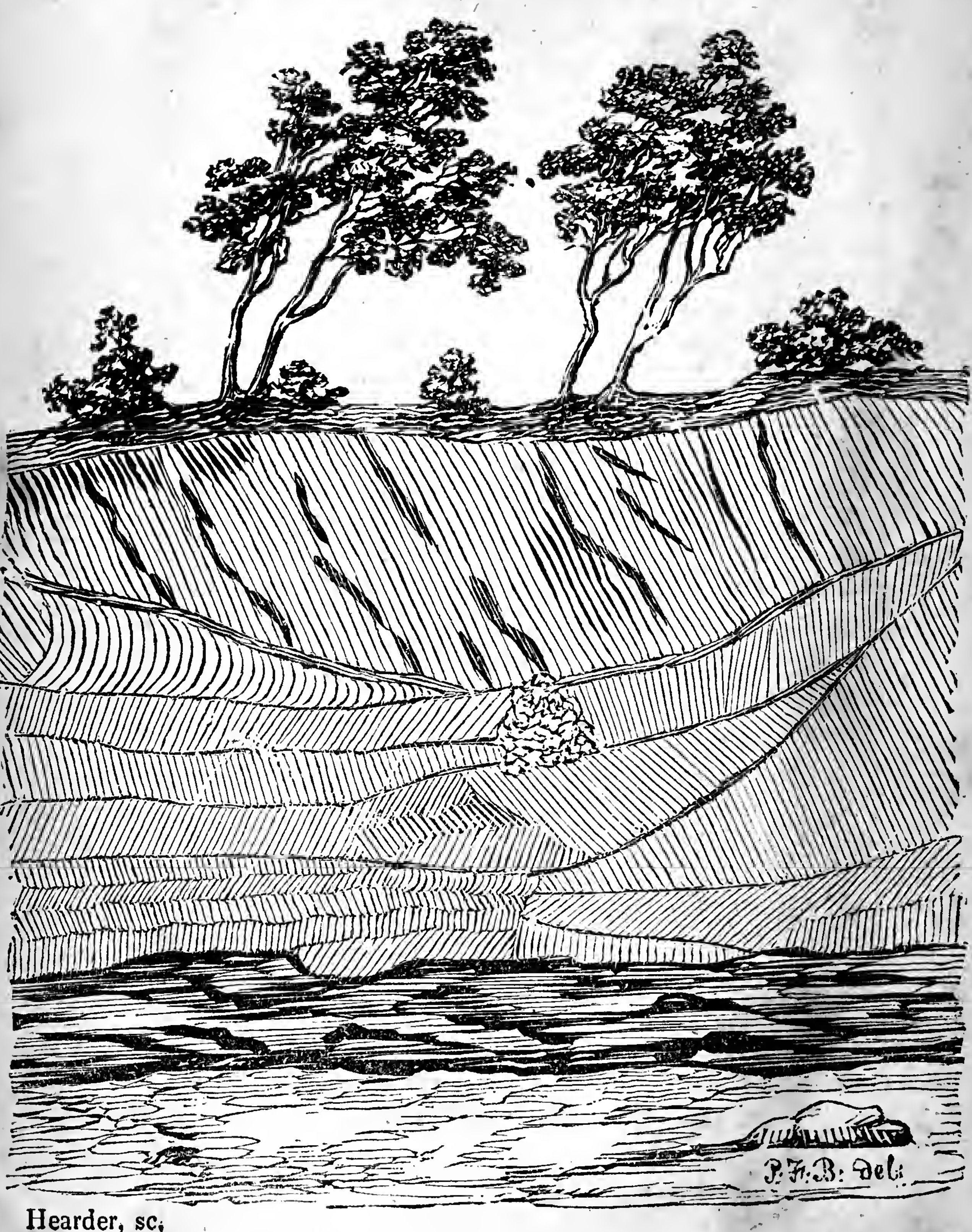
* Geological Survey of the country round Plymouth, by John Prideaux, Esq.—*Trans. Plymouth Inst.*



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discrimination of those rocks of igneous origin, (speaking of their superficial appearance) from those which are *not* igneous, and of those connexions dependent on the application of fire, from those *not* so derived, would depend on evidences of rupture, or upheaving, or tilting, apparent in the vicinity;—on analogy of the structures and appearances to those of igneous derivation in the present day;—on the absence of organic relics, and on any traces of former volcanic condition. If our granitic tract be visited, it will be seen that oftentimes slate is attached to granite with considerable irregularity, it does not merely repose on it, but is even connected to it on its slopes by firm cementation, as if indeed, the slate, in its original position underground, had been blended into the spongy substance of the granite during its liquefaction, and then, when the latter rose into its mountain forms, it conveyed the slate so cemented with it, beyond the level of the bed through which it had been projected. Throughout the South of Devon, instances may be repeatedly seen, where slate has been contorted, and disturbed into repeated angles, where its texture was sufficiently loose to admit of ready and extensive fracture; towards the top, good solid slate often becomes looser, and bent off at an angle, and possibly these facts are dependent on some upheaving force of the volcanic order. The accompanying engraving represents a remarkable case of this kind occurring in my neighbourhood.

Appearances of the same kind seem to occur in sandstone quarries. There are likewise reasons to believe, from phenomena presented by some localities, that trapp has upheaved and dislocated lime beds, and lime and slate connectedly, and in some places it has even gained a superior position to them. Prior to my belief in the Plutonic theory, I had concluded that some upheaving force had caused these disturbances in our rocks.

The new theory respecting granite, &c. I may observe, if a correct one, serves to explain the contrariety of circumstances, under which that rock makes its appearance,—sometimes near, or connected to fossiliferous slate,—sometimes in connection with non-fossiliferous slate, or other rocks of that order. It may explain, why on Morweldown (and perhaps in other spots also) a lode of copper, passes from schist to granite in an uninterrupted manner.* It may perhaps originate a reasonable inference, that during the elevation of this mass, it had dislocated certain upper beds of slate, &c. and altered, or reversed their dip. During a visit to the Eddystone, (gneiss, with granite near it) I was astonished to observe that a bed of slate at the nearest point of land in Cornwall, (Penlee Point) had a vertical position, and even partly dipped northwardly, contrary to every other instance I had witnessed. At the Start it dips northerly. Near Turnchapel it dips northeast, and at Mount Batten the limestone is nearly vertical, the whole country in that direction south of Plymouth, seeming to have been dislocated by an upheaving force. At Deadman's Bay, the lime is nearly horizontal in one spot.

Some varieties of our trapp bear singular resemblance to substances which have been submitted to the action of fierce fire, being cellular, spongy, and variously coloured; one sort, is prone to turn out in oblong, rounded, scaly nodules, and it is worthy of note, (because possibly the two facts are similarly derived) that greenstone likewise assumes at some spots, large reniform, or ovoid forms, and being sometimes superficial, these blocks are seen to have escaped (whether by mere gravity, or during the

* See Risdon's Survey of Devon, Preface.

action of the deluge, cannot be determined) into the adjacent beds of diluvial clay. It will perhaps astonish many, to be informed that greenstone resembles greatly, certain kinds of lava, poured forth in volcanic countries in modern times, and, as that substance, while fluid, would naturally insert itself between masses of adjacent strata, or being driven up bodily from below, would be impacted into the very structure of incumbent rocks, so here, instances are not deficient, where greenstone occupies crevices in other beds, and has evidently effected, at the period of its introduction, considerable alteration in the aspect and character of the stone into which it has been thus insinuated. I observe lastly, that in so far as this county is concerned, this theory may possibly after mature examination be supported by the palpable resemblance to extinct volcanoes, afforded by many of the "tors" of Dartmoor, particularly North Brent Tor.

On the whole however, the application of this, like all other geological theories, involves considerable risk and doubt, and it ought at least to be remembered, that we are by no means called on to compress all the circumstances consistently referrible to igneous origin, into one occurrence of volcanic action, but on the contrary it will not only be convenient, but even consistent, to refer the various phenomena of this order to *consecutive* Plutonic disturbances.

But still, it may with reason be inferred from the phenomena of igneous action, being so universally of the same order, that these events were not scattered through a *series of epochs*, but confined to one; and in the midst of our anxiety as geologists, to throw together as many events as possible, that might be deemed due to one cause, it may be questioned, whether at the times of these eruptions, the entire surface of the country were not convulsed, and thrown into those undulations presented by the hills of our "transition series" of rocks; it might also at the same moment be asked, whether the same intrusions did not induce a bodily sinking of the land, and thereby, those evidences of oceanic ingress exhibited by our coast. Now, we are enabled by mere reference to the granitic and trappean pebbles which occur amidst the osseous reliques of our caves, to show at once that the granite and trapp had been upheaved, prior to that great convulsion (whether the Mosaic flood, or any subsequent deluge) which annihilated the creation of animals and vegetables as they then existed with us; and, if so many ages have elapsed, and subsequent catastrophes occurred to us, there will not only be a great difficulty in tracing what were the precise results of this igneous disturbance, but even, a probability amounting to indirect proof, that those appearances of raised beaches and submerged land on the coast, were produced by *later* events. Having thus paved the way to a more consistent theory, I may remark, that I have devoted a separate portion of this work to an ample consideration of the æra to which these phenomena are to be ascribed, and confining my attention here, to the igneous class of rocks, I must confess that notwithstanding the reasonableness of the conjecture of general superficial disturbance, there is no evidence of such, beyond the limits of these presumed agents, or beyond that, of which I have given an illustration in our slate deposit. If therefore, we are to measure consequences by actual phenomena I may entertain a suspicion that the granite confined its dislocating influences to those regions or spots where it appeared, and, that the other Plutonic agents conformed on their part, to the sweep of those hills of which they were to become component portions.

It may here be noted with regard to the primitive series of rocks, that they are nearly all observed to amalgamate with, or pass into one another, as well as into rocks of a more recent date, thus granite and slate are found sometimes blended, gneiss and granite, mica-slate (allowing it to be primitive) and clay slate, mica-slate and gneiss, trapp and slate, while porphyry is seen imbedded in slate, or in sandstone in some situations.

Again, prior to entering on the subject of the next series, it may be as well to note, that the same kind of admixture prevails there also,—the various varieties of slate graduate one into another, as well as into the true greywackè rock, slate also, passes into lime, lime into dolomite, and sandstone into slate.

But, it must be observed that while igneous causes might induce some of those amalgamations in the first class, contemporaneous precipitation, most probably induced the reciprocal series of admixtures in the second, as I shall endeavour to shew in the sequel. Setting however all theory aside, the practical geologist will bear in mind, that, tracing the series of our rocks from the coast onwards to the moor, he will encounter a consecutive admixture of various collateral strata in his course: thus,—slate and sandstone, slate and greywackè, greywackè and sandstone, porphyry and sandstone, lime and sandstone, lime and dolomite, lime and slate, trapp and slate, porphyry and slate, clay-slate and mica-slate, granite and slate, besides some other combinations of minor consequence. In the rocks surrounding the Eddystone, a combination of granite and gneiss occurs. The Eddystone itself, is gneiss.

I desire to be understood, as speaking provisionally on the general question of classification and æras, and as leaving it open at all points for matured consideration. With respect indeed to the trappean rocks, notwithstanding I might have found authority and arguments, (as will subsequently be seen) for giving them a place among the transition series, and although their identity with these might be thought fixed, by even the solitary fact of that form of junction with slate called "ribbon jasper" occurring here, yet, it happens that porphyry also, does itself in some places, run in veins through slate, or exhibit itself imbedded in fossiliferous sandstone; mica-slate (by some ranked in the "primitive" order) joins itself to the common mass of schistose rock, and even granite, as just said, has been seen much blended with slate in some situations. Order therefore, and systematic ~~management~~ arrangement in the positions and connexions of rocks, seem to be set at defiance, and perhaps geological theories will witness many more revolutions before such discrepancies will be reconciled. Continued accumulation of facts, with *provisional* theoretic statements seem to be the more eligible occupation of the geologist whilst surrounded with such perplexing phenomena. The kind of facts principally required are those affecting the natural connexions of strata in respect of mechanical union and chemical similarity, and the provisional theories in which it may be allowable to indulge, should invariably regard these data as their sole rational supports. With respect to chemistry applied to geological speculations however, it is but recently introduced as a means of investigation, and it is hardly known how far it may be carried into the detail of our science. In the perusal of the following remarks on the geology of our district, I trust the reader will perceive that though I have not called chemistry to my aid, I have framed my theories on such *facts* only, as I had it in my power to adduce.

SLATE,

in its varied appearances, occupies the generality of South Devon, southward of Dartmoor, being as it were diffused in all directions; the other strata, lime, trapp, &c. being intruded between its courses and hills. Under the term slate, I here include every kind of rock popularly so called, and in consequence, for the sake of convenience confound together, rocks considered by some both "primitive" and "transition." However perfect, systems and tables as set forth in books may seem to be, and however desirable it might be, for me to present definite terms and divisions of the strata under examination, I am so clearly satisfied of the immatured condition of this science, simply from the fact, that local phenomena have not yet been narrowly investigated and compared, that I think it highly probable a few years will once more remodify existing opinions and classifications, and that, consequently, it can be no great outrage, to consider provisionally all our rocks of a slaty nature under one head, though, I do not mean to exclude conjecture and classification altogether. Thus, while under the term slate, I comprise mica-slate,* clay-slate, roofing slate, grey dunstone, greywackè-slate, flinty-slate, and greywackè, with perhaps some other minor kinds, I believe it would be unphilosophical, to disregard the principle of arrangement, derived from the occasional alternation and intimate blendings of certain strata, together with the truly natural association of deposits, by the occurrence of the same description of animal remains and other structures in their substance.

* I have endeavoured to justify myself in considering mica-slate as a portion of the general body of slate rock, altered in character by its connexion with granite; but, I incline to think, that some kinds of mica-slate are indisputably of the same order as igneous strata.

But who, in the midst of conflicting statements of authors, will undertake to explain what is clay-slate, and what is not, particularly as, this is generally ranked amongst the primitive (non-fossiliferous) rocks, and with us contains indubitable proofs of *being* fossiliferous, besides being apparently in union with a mass of other slate containing no such demonstrations? In a popular work now before me, (Weekly Visitor) giving a succinct statement of strata, primitive formations are described as being destitute of petrifactions; then, the rocks so classed under this head are briefly described, and amongst them stands "clay-slate." It is added, "the clay-slates of Switzerland are celebrated for their impressions of fishes. Mont Pilot consists of thin lamiœ, and in almost every plate is impressed a fish"! Thus, it would be gratuitous and presumptuous in me, to draw a line of demarcation between the clay-slate and the other kinds of slate, (supposing a natural distinction to exist, which I am not sure is the case) for, as respects a distinction founded on the occurrence of fossils, the "grey dunstone" and greywackè contain no fossils, and are, it is well known, in immediate connection with patches of fossiliferous slate, and consequently, the hills of slate connected with the fossiliferous slate above named, may, for aught I see, be equally regarded as coeval in their deposition. If therefore, it were demanded of me to state what I regarded as clay-slate, and to draw a line of demarcation between it and other kinds, I should say, either that the separation must be dependent on the presence or absence of organic relics, presuming on the possibility of making a separation by that means, or, that the entire mass of our slate not evincing the characters of mica-slate on the one hand, and betraying none of the characters of flinty-slate or of greywackè-slate on the other—in short, all that rock which amongst amateurs and persons loosely informed on the matter is termed clay-slate, and which I have above recognised in a general way as being fossiliferous, must receive this appellation.

From what I have just stated, it might be gathered that the interruptions to the courses of the different varieties of slate are not sudden, but rather the reverse. This circumstance indeed, is remarkable amongst the features of this rock considered as a whole. Mica-slate, clay-slate, (used in a limited sense) roofing-slate, grey-dunstone and greywackè slate, are observed to pass gradually into one another, and to reciprocate each other's qualities. Again, greywackè-slate, flinty-slate and greywackè graduate into one another. Roofing-slate is found sparingly, and in small patches. It obviously passes into the general mass of clay-slate, of which, notwithstanding its containing organic remains, I have above surmised that it may in propriety be ranked a part. The general body of clay-slate assumes a great variety of aspects, which are manifestly graduated, sometimes approximating the typical roofing slate and sometimes degenerating into a loose, brown rubble, or becoming indurated or closely impacted constituting "grey dunstone;" not unfrequently also running into decided greywackè, either in small patches or even in extensive beds. Altogether, these last named rocks form the generality of our hills, which are round-backed. In situations where the slate is in tolerable sized fragments, fossils are found in plenty. Although I have mentioned certain kinds of slate as being fossiliferous, I believe that no fixed rule can be laid down on this subject, for the same kind of slate will in one place exhibit these remains, and in another be destitute of them. Greywackè-slate is most constant in this respect. The rubbly and loose kinds of clay-slate, and the best kinds of roofing-slate, but seldom contain them. The generality of our slate, that namely, to which I

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presume the term clay-slate may be applied, is found assuming for the most part the appearance of small and loosely joined fragments of a light grey colour, sometimes blueish-grey, much tinged with iron, and frequently intersected by seams of quartz, also brown, whitish yellow, red, greenish, &c. At intervals, these hills of clay-slate give good quarries of roofing material, of a bright lead colour, in which, fossils are distributed. These quarries are in general soon worked out, the stone soon becoming coarse, or degenerating into a rubbly state, or a "grey dunstone" which is an indurated form of clay-slate. The course and dip of our slate vary greatly, even at times within a small space. I have understood, that near Exeter is a bed of slate horizontal in its course. This, it was thought was a rare circumstance, but in this neighbourhood it is far from being an uncommon appearance, though only observed in small patches. From a level, it varies to a close approximation to verticality. It faces usually from about south-west to about south-east, but likewise, at times, looks southwardly, eastwardly, and westwardly or thereabouts; but, though it is thus prone to variation, even repeatedly within a small distance, I am not aware that it ever faces northwardly of east and west, save through intrusion of other rocks. Its solidity varies sometimes within very confined limits, and this often depends on the sudden presence of quartz, which is seen to pervade the slate with great freedom in some spots. At times, there is reason to believe that access of air determines the decomposition of slate, though, in some cases where this is supposed to have happened, I should consider from its brown and powdery appearance that some peculiarity of chemical composition had existed previously. Generally in fact, the loose, rubbly condition in which we observe a deal of our slate to exist, cannot have been owing, at least in the first instance and principally, to atmospheric influences; for, in some places, as at the slate quarries, this presumed decomposition shews itself throughout the whole depth to which the rock has been worked—at one spot, the rubbly and loose state of the rock gradually disappearing, and the substance by degrees getting closer, until it is fairly of the character of "dunstone," or at the least of ordinary slate. Indeed, this transition from loose to indurated slate is exemplified most freely in this neighbourhood, and seems to be inconsistent with a supposition of decay from the agency of air. The oxide of iron occasionally stains our slate in fantastic shapes. It seems also, to occur in greatest plenty in the immediate neighbourhood of fossils, and in their composition. I occasionally find fragments of slate in the quarries on which are marked, dark, broad, concentric lines, in the manner of the layers of wood in the boles of trees, of which appearances I can offer no explanation.

There is one fact in the history of our slate worthy of notice, and worthy of being further investigated with a view to some explanation. This is the bendings or reflections in the slope of the rock, observed in very many places. In one spot in particular, I have observed it to be bent four times in the depth of as many feet, so as to assume a perfectly zig-zag appearance. It must be recollected, that this occurrence is not limited to loose and disconnected kinds of slate, but may be seen on larger scales in good solid sorts also, though the repeated reflexions may not be here so remarkable or perfect.* At Crabtree, near Plymouth, there is a

* At a spot called Meadow-foot, at the mouth of the Erme however, this convoluted and zig-zag condition of slate is assumed in good solid rock on a very extensive scale, the whole shore being composed of arenaceous schist, putting on the same undulated

hill of slate, which, towards its summit turns off at an obtuse angle, which gives this rock a peculiar aspect. Mr. Hennah records an instance, where the slate seems as if thrust up by some violent impulse from below, between two beds of lime. I am of opinion that several similar instances as regards this appearance of the deposit of the rock, can be

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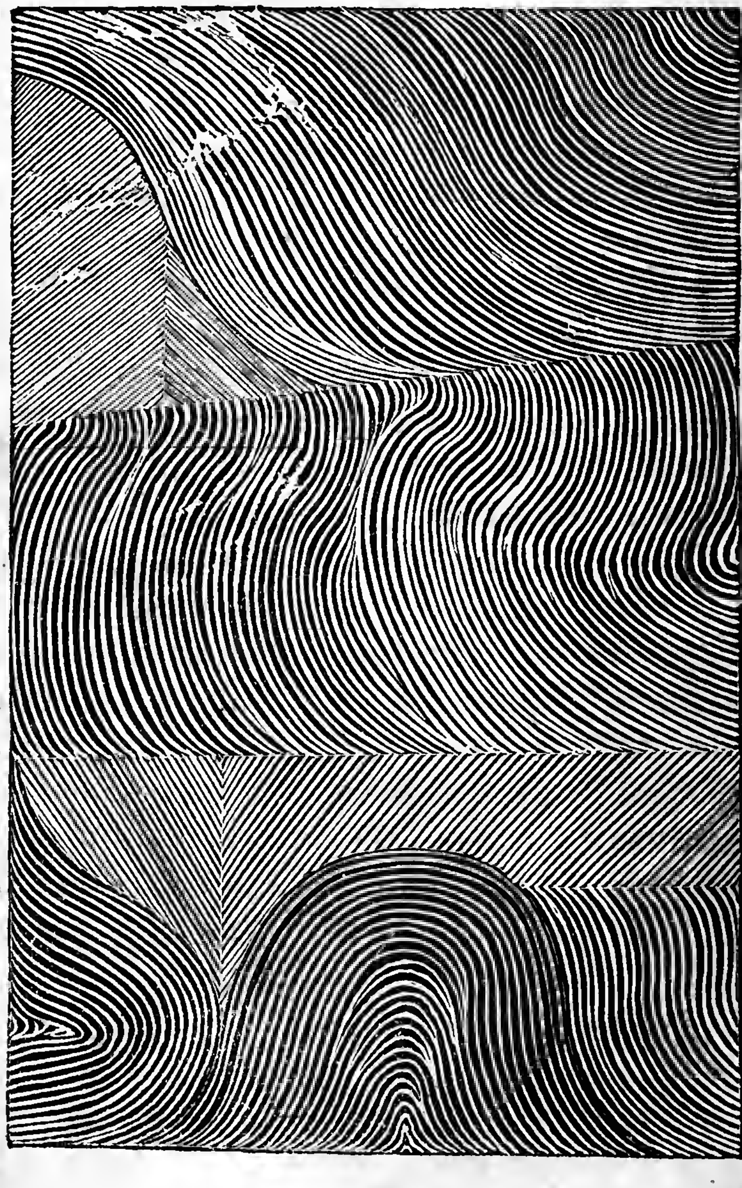
appearance as is displayed by sand on a very flat beach, on the retreat of the tide. This condition indeed, must have been taken on during the precipitation of the rock, and not by any force exerted from below.



shewn in our neighbourhood, though, as to the exact cause of this, as well as of the reflections above specified, I can offer no satisfactory notion further than I have elsewhere mentioned.

Greywackè-slate assumes a very different appearance from all others. It is harder, and not so extensively tabular, is of a dark lead colour, and passes very freely and very suddenly into greywackè at numerous points. Viewing it as it appears on the coasts, it displays itself in large flat cakes having thin and rounded edges, between which, other cakes are in their turns inserted. In the greywackè slate, are found the *turbinolias* elsewhere alluded to. Beneath the water, these are dislodged by the action of that element from their bed, and thrown up in more or less perfection of form on the beach, a fact corroborative of the general rule, of fossils exceeding in density the matrices in which they occur. Dr. Leach reports that at Buckfastleigh in this county, the lime is seen covering the indurated slate, and that, they both at this spot contain a quantity of flinty matter. Now, it is singular, that close to the place where I reside, there is seen a small quantity of lime overlaid by the slate, and both containing flinty matter ! *—a fact, seemingly confirming, amongst others to be named, the contemporaneous deposition of these strata, or at least their close relationship with respect to the convulsions which have disturbed the crust of our globe. The circumstance, of strata at their points of junction being more

* It is very worthy of remark, that flint is by no means limited to what is termed the "cretaceous epoch," but was prone to form even at the early period of slate and limestone deposits. Mr. Bartlett noticed at Berry Head, masses of flint imbedded in the latter rock, and some lying on its surface, having been separated by the action of the atmosphere. Are their origins due to the remains of animals ?

or less cemented, blended together and intermixed, appears to me to have attracted too little notice, for though, in some cases their admixture seems rationally accounted for, by the previous well-founded conjecture, that their deposition was coeval, there are other instances, in which we have no ground for imagining that their depositions *were* coetaneous. Lime and slate are most freely intermixed at their points of junction, and we see the same thing occurring between the slate and sandstone in spots where these meet, the latter frequently being wedged into the other; in some places also, there being alternations and union of qualities (arenaceous schist) for a considerable area, there are other reasons for imagining the contemporaneousness in the deposit of these strata. On the other hand, where slate abuts against granite or trapp, we find, that in some spots the former is cemented freely to the latter. This is seen in numerous blocks scattered profusely through the valley at Ivybridge, and I am sensible of cases where there is as thorough intermixture, as between slate and limestone.

Amongst the varied relations assumed by slate in its beforenamed general diffusion, there is one which seems to indicate, that even the oldest (allowing for argument that they *are* of different ages) kinds were not contemporary with granite, for this rock not only extends into contact with granite at our north, but even spreads between the hills of that primitive formation, assuming perhaps in its run, a lengthened three-sided figure. Whatever be the actual relations between lime and slate, (or at least certain sorts of the latter,) and whatever may be the depth to which the lime as a whole, or in some parts descends, I must not omit to furnish an additional proof of the intimate connexion subsisting between these two strata, namely, that " Lime appears in masses on the north, south, and west sides of the Dart, insulated in schistus," (Carrington's Dartmoor, Preface) also at Boveysand, side of the Yealm, &c. just as, schistus may be seen, placed similarly in lime, independently of any suspicions of these insulated patches having been thrust up in the manner supposed by Mr. Hennah, or occurring thus through Plutonic agencies. This kind of insulation of slate may be noticed on the hill leading from Stonehouse to Devonport. Striking alternations of these strata are also not uncommonly observed, as at Prince Rock and Kitley Hill, both near Plymouth, east bank of the Tamar (where greywackè, slate, and lime are found to alternate), and in several instances also, I have observed lime and slate at their point of junction, forming an intermediate kind of stone, a fact likewise noticed in the case of the lime and slate of Westmoreland, where lime mostly rests on slate, and in approaching it, gradually gets slaty. Schistose lime occurs at St. Mary Tavy, close to Dartmoor.

The greywackè slate of the coast, besides the ordinary lead colour, presents several others, some particularly pleasing to the eye—green (with minute fossils,) drab, purple, purplish drab, golden yellow in small patches, olive, and silvery drab. A deal of this schist is employed for coarse flooring in cottages, and some for mantel pieces. Its fracture being conchoidal, it is used with great facility in the formation of very strong and solid masonries.* Argillaceous schist not unfrequently exists in small beds, the fracture of which is prismatic, this may

* The generality of slate forms a remarkably durable building stone. Its appearance is greatly against a belief of such a fact, and if laid horizontally it would probably endure but a very limited time; when laid vertically however, so as to allow water to run off, its durability is astonishing;—a piece of the "old wall of Plymouth," now nearly two hundred years old, which I have seen, and is built of common grey slate, seems to have suffered little from the action of time.

be seen on the road to Goosewell near Plymstock, and in other spots. Occasionally also, ordinary slate assumes a very indurated aspect, without altering its colour or general qualities, this may be observed on the Exeter road just beyond Elburton.

Iron is found in some parts of our slate in loads, and also is scattered in mere traces, through the substance of nearly all our rocks of this formation, appearing in slight indications in the schist adjoining those few beds of this metal which occur in limestone; it occasionally betrays itself in small insignificant masses of sulphuret. *Quartz* pervades it most freely in some places, and these narrow veins seem invariably to end in points. At Compton is a pretty large vein of *jasper*, much mixed with ordinary quartz; I have seen many small blocks from thence. Jasper is also often found on Roborough Down, among heaps of ordinary stone used for repair of roads.

The prejudices and prepossessions of geologists, appear far more hastily formed and more deeply rooted than those of any other kind of philosophers, and because involving so long a train of consequences, far more prejudicial, and far more inexcusable. Until the recent set of geologists turned their attention to the science, it consisted of *theory*, *now* it mostly consists of *facts*. The slate of South Devon had all along been condemned as non-fossiliferous, and though the limestone has for some time been admitted to contain reliques, it is only lately, that slate has been characterised by a lecturer at the Plymouth Institution, as destitute of animal remains.*

* See Mr. Walker's "Lecture on Geology." Also Mr. Prideaux on "Geology of South Devon," who considers the Cann slate "*primitive*." Also "Guide to the Watering Places," by Turton and Kingston, where the slate of that district is said to be devoid of fossils, though at Brixham they are found in vast abundance—Turbinoliæ, Encrinites, &c.

Notwithstanding the irreconcileableness of the fact to preconceived views, and the hesitation and chagrin with which many men receive it, our slate formation *is* fossiliferous, and even abundantly so in some places. Without doubt, a vast quantity of our slate—the loose and highly separable material of a large number of our hills, is devoid of fossils, but, in a deal also, of the same kind of rock where it would not be expected to exist, fossils are sparingly distributed. In nearly all the quarries of roofing slate they are readily distinguishable, and in the greywackè slate of the coast, a variety of interesting specimens attract notice. It may be argued, that there is evidence of a gradual increase of organic life, of gradual passage from the period when the earth was devoid of living beings, to that time when they were tolerably numerous, as exhibited in the formation of our limestone. This gradual kind of change is allowed to be a maxim in our science ; but, whatever partial symptoms of this rule are to be detected or fancied in the present case, I am clearly of opinion, that the decided *connexions* of the whole body of our fossiliferous rocks, will far outweigh any considerations gatherered from the remains themselves calculated to engender a persuasion that intervals occurred between their depositions. Whether the arrangement which is perceptible, occurred through mere accident, or by some law of nature during the process of the nearly simultaneous deposit of these rocks, must for the present be matter of speculation.

If we were to calculate the probable amount of those relics which are with difficulty recognised, or of those appearances *probably* referrible to former beings, it is possible that it would surpass the quantity of other remains in this rock. These obscure indications of animal (and vegetable ?) life, are seemingly the remains of soft gelatinous bodies, such as are the *Actiniæ* of the present day, and many like creatures. Some of these fossils I have had represented for their better identification by the collector, but, many through obscurity of character would defy the efforts of the graphic art in exhibiting their actual appearance. But, so far from the fossils of the slate being limited to these kinds of animals, we discover the remains of *conchifers*, and perhaps of *fish* in it, and, should doubt exist on this important point—important, if only identifying the slate rock as of equal consequence in its contents, with the limestone,—it may be here mentioned, that slate in other parts contains fish and shells. The Tintagel and Snowdon slates for instance, contain the latter fossils. (see De la Beche's Manual.)

It is usual, to find fossils much accumulated together in certain spots, as is the case also in lime and sandstone, and this rule even extends to each kind of fossil, to a limited extent. Thus, I have found a kind of zoophyte very numerous within a small compass of about a foot square, and occurring but rarely elsewhere; in general also, each fossil seems to have its own special locality, whether numerous or sparing in quantity. Greywackè slate may be known from roofing slate by its fossils, and roofing slate, from ordinary clay-slate by the same means, though less decidedly.

Excluding the consideration of indistinct fossils before spoken of, *encrinital* remains are most common, and there seem to be several species, all different from those in limestone. Remains of a zoophyte, or something similar in growth to a *coralline*, are perhaps next in the order of frequency. *Turbinolias*, of which there are apparently three, or more kinds, rank next; one sort is plentiful in a hard slate on the shore at Boveysand. The *calamopores* in slate, seem almost always to occur at the line of junction with lime, and are probably of the same species as occurs in the latter rock so profusely. The same circumstance of identity in the fossils of the two rocks, seems to occur with respect to some other kinds. Between Elburton and Brixton in particular. I have observed that at the junction of lime and slate the two strata intermix, and alternate in narrow layers of two, or three inches thick, the encrinites here, being common to both kinds of matrix. *Ferns* are reported to have been found in our slate, but I think the fact questionable.

It has been laid down as an axiom, that the fossils of laminated rocks, such as slate, are situated parallel to those laminæ; this however is not invariably the case; I have a fossil from my neighbourhod, a representation of which appears among the engravings, which was found to be placed in the stratum, without regard to its lamination, and the same observation may apply to the *cyathophylla*, and some other relics of the slate.

There is yet one other remark belonging to this portion of the subject, and which requires to be taken into account, by those who would advance our present acquaintance with the slate fossils to a higher standing than it now assumes. A large proportion of these remains consist in their present form, of lines arranged in a parallel manner, being in fact the impressions of animals, whose organizations like those in the same class now living, involved that parallelism of their component parts. This fact is important, because it prepares us to admit specific, and even generic (perhaps I might be safe in adding *ordinal)* differences between the specimens, which otherwise the mind through overcaution, might reject. Certain it is, that a great variety of our specimens, from assuming this almost universal aspect of parallel lines, might seem to have had one common specific origin, whilst, on more deliberate inspection, they may more correctly be referred to several species, belonging even to more than one genus.

GRAUWACKE ROCK.

The true greywackè rock, or compact greywackè, ("blue dun" of quarrymen) from which our fossiliferous series of rocks has in later times been named, is found in intimate connexion with sandstones, slates, and limestone. It consists in almost every case, of inconsiderable accumulations of, for the most part, dense material, used for building and repair of roads, is of a light blue colour, and very fine grained ; its hills are usually low, and with one or two exceptions, its tracts small in ærea. It passes freely into slates and sandstones, and the intermediate kinds of rock are of difficult determination ; saving however these cases, greywackè may be distinguished from sandstone by its melting before the blowpipe. So manifestly is it a component of our fossiliferous series, that in one spot I have found it reposing in a lap of limestone, and connected on one hand to slate, and on the other to a fine grained sandstone ; both of which strata are themselves also closely joined to the lime, the former indeed being like the grauwackè rock a superficial bed, and resting on and running into the limestone. Grauwackè is also found to run in veins through slate, and graduating with it at the same time. It is thought probable, that its highly comminuted texture obviated the display of the same animal remains which its collateral strata are often found to envelope, and yet, this rule is hardly worthy of regard, for, the slate rocks themselves, considered by some as formed of a highly comminuted detritus of other strata, includes fossils in a perfect state, and the sandstone of South Devon, obviously constituted of aggregated particles, incloses perfect specimens of alcyonia, turbinoliæ, corals, &c. which in all probability were in existence, at the time the turbid mass consolidated around them.

The soil of the greywackè rock, is highly fertile, perhaps as much so as slate and sandstone, for the productiveness of which, there would seemingly be so good a reason, in their far looser texture, and fissility, giving transit to evaporations during the droughts of the summer months. The depth of a superstratum ought never to be lost sight of however, in searching for the causes of the fertility of a given rock. Many farmers complain that slate lands scorch sooner than limestone tracts, a complaint contrary to all rule, as well as to reason, and will be found dependent on, the soil of *their* estates being shallower even than that, usually known to cover lime-rock. It is perfectly astonishing to observe, that though soil gives a manifest advantage to the growth of all timber by its accumulation of carbon, water, &c. for their support, yet, that the nature of the rock below, interferes but in a trifling way with their development, so far as respects their taking root and fixation. Most wonderfully do trees contrive to bore and insinuate their roots into even such strata as the grauwackè and greenstone; on examining attentively where their roots happen to be exposed in such rocks, a sort of mouldering and decay of the stone appears, and the conclusion thence drawn, is that though by their contortions, these members were probably long resisted in their efforts to descend, a slow, but continued erosion and dissolution of the components of the dense material was effected, and thus, greater and greater scope given by this extraordinary operation of vitality, for the enlargement of these portions of the tree, and the introduction of soil and other supplies from above.

LIMESTONE.

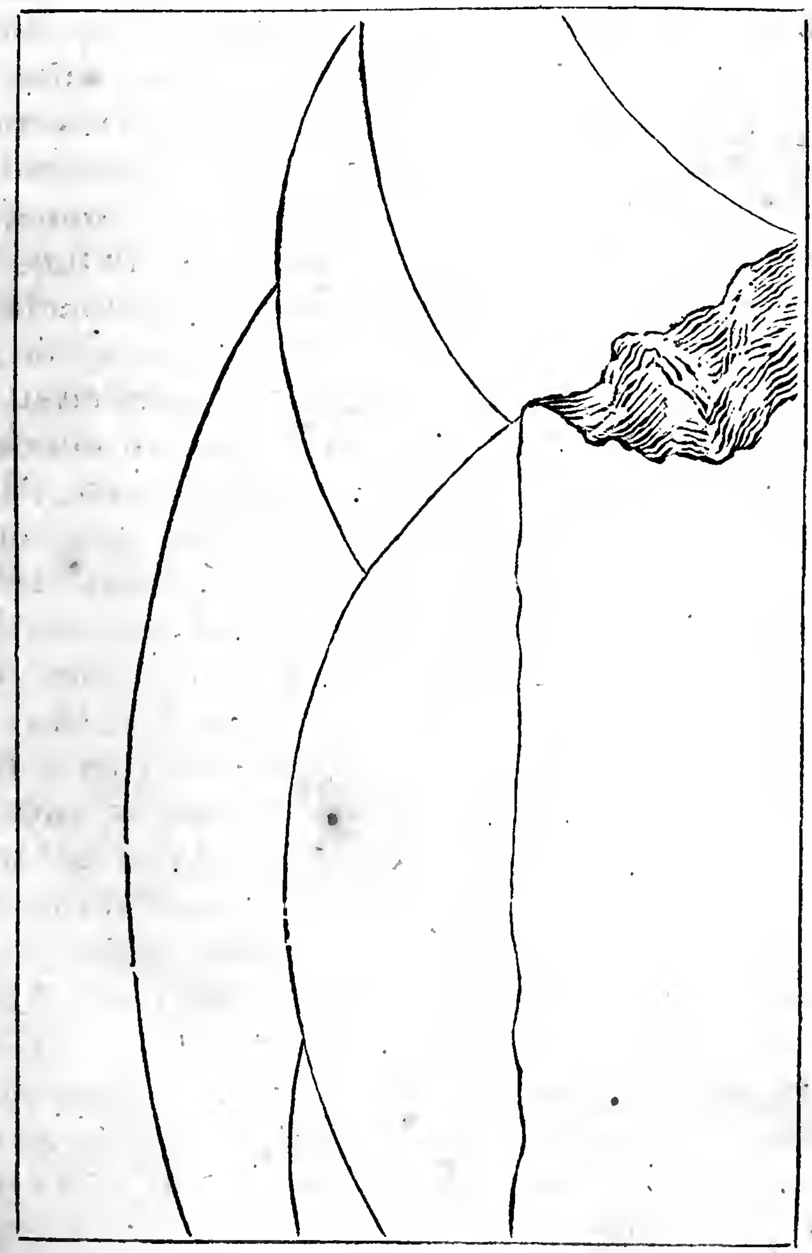
Guided by prevalence in quantity, limestone comes next under consideration after slate and those rocks which are its modifications. The principal locality of the South Devon limestone is at the coast, where it appears in connexion with slate and sandstone in varying manners, but, it also occurs in several other spots, likewise much in union with other strata, as at Ashburton and Buckfastleigh which are considerably removed from the coast; and further, it appears in small and inconsiderable quantities at less distances from the main line, such as at Cann slate quarry, and at some other sites between that and the neighbourhood of Plymouth, closely connected to the slate rock. According to general belief, it passes from the south-western extremity of Devon without much interruption eastwardly; there divaricating; but, after proceeding about nine miles eastwardly from the Dock Yard at Devonport, its western point, it is temporarily hidden from view if not discontinued, and is traced subsequently, rather by glimpses and indications than by direct continuity. Its course, even for the above-named distance is occasionally lost, and it seems certainly throughout, to have a decided disposition to occur in isolated forms, both in that immediate course, and at small distances therefrom, thus, while it is traced in the neighbourhoods of Plymstock, Brixton, and Yealmpton passing eastwardly, an indication betrays itself at Boveysand, and a small patch is detected bordering the river below Coffleet, a narrow seam of lime may also be seen in the slate of Bigbury Bay, which possibly may pass to a more considerable body of that rock in a subaqueous position,—all these isolations being invariably intimately joined to the body of adjacent schist. But, though it is thus so greatly connected to the slate rock, it is likewise very much blended with sandstone in some few situations, as at the Devil's Point, and Mount Wise, and, while an intermediate kind of rock between the lime and slate is far from uncommon, the sandstone does also as I have reason to think, form with it an anomalous or bastard compound in one or two cases, besides alternating together distinctly.

Although the general or prevailing order of occurrence of our " transition rocks," counting from the granite and other igneous formations towards the coast, be such, that the limestone tract is intermediate to the slate northwards, and the sandstone on the south, yet, this rule laid down by many experienced geologists, is reduced to an unscientific dogma by examination of the relations assumed by limestone, in its progress eastward, in which it will appear that this order is oftentimes reversed, and that limestone may have both other rocks northwards, and both southwards of it; that in short this stratum considered in the mass, is to be regarded as mingled up in every possible way, with its associated formations.

The *direction* assumed by the limerock about Plymouth, and so far as Yealmbridge, is east and west, or rather, as observed by Mr. Hennah, it points a little towards north-west and south-east.* As regards its *dip*, it is about south-west, but this differs much, and in some spots, but little of this characteristic of stratified rocks, can be discerned; oftentimes it is very steep, while at others, the rock is nearly horizontal in its bed, some of the lime at Deadman's Bay, near Plymouth for instance. In general however, where uncertainty exists as to a block of limestone being artificially or naturally placed in the ground, the conjunction of these two characteristics in it, will for the most part enable a person to decide. The *colours* of the South Devon limestone are numerous, and though it is very generally grey with certain admixtures, it occurs often

*" Account of the Limerocks of Plymouth" by Rev. R. Hennah, F.G.S.

black, white, and pink, often also veined and blotched with these conjointly, and in one solitary instance I have found it green. It is suspected greatly that to a large amount, these colours may be due to organic remains imbedded in the stone, but though, these forms are abundantly coloured in this manner as if painted artificially, the very same colours are spread profusely through certain localities of the limestone seemingly devoid of fossils. The ordinary *breadth* of the limestone tract from Devonport, onwards to Yealm Bridge may be estimated at about a half mile, and its *height* does not often exceed one hundred feet, hereby offering a contrast to the elevation of the slate hills, which is perhaps on an average three or four hundred feet. In connexion however with this latter circumstance, it must be noted, that saving the slate and sandstone hills directly bordering the coast at some parts, the land of South Devon apparently rises from the limestone to a low range of slate hills at its immediate back, and thence by gradual steps to the schist hills bordering the moor, which are often seven, eight, or nine hundred feet high, and lastly to the moor itself, whose prevailing elevation is still greater. In respect of *depth*, nothing decisive is of course known, save where it overlies other strata, and where it is prone to put on a very tabular condition ; it may with great propriety be inferred, that this rock passes to a very great depth, and rests ultimately on the general supporting bed of our grauwackè strata, namely granite. The top of the limestone range is for the most part quite level, but in some places, the rock assumes the "round-back" form. If a geologist stand on an elvated part of of our limestone in the immediate vicinity of Plymouth, he can distinctly see, that this rock joins itself by a gradual rise to the slate hills, which back it in every direction ; he will see also, that with slight deviations, the whole body of this stratum is flat and horizontal, scooped out however, in some spots, to afford passage and space to rivers and creeks, but still generally presenting to the view a horizontal plane, or plateau about a half mile in breadth, including the spaces overspread by water The accompanying cut shews a cluster of slate hills rising gradually in the back ground, and joining in the fore ground to a lime ridge, distinguished at once by its horizontality.



The *fossils* of the limerock, which are subsequently to be spoken of generically, are distributed pretty generally through out; many spots however, exhibit them very sparingly, if at all, while others on the contrary, are richly bedecked with these forms. The most ordinary sort which the collector encounters, is the *zoophytic*, to which in fact, many spots are altogether limited in respect of animal reliques, whilst again some sites abound in shells, *beyond which they are not noticed*, and again, in regard of these shells, univalves are limited to some spots, and bivalves to others. Certain other places, abound so greatly with *crinoidal* relics, as to cause the rock containing them, to be as it were encrinital limestone, that beyond Millbay towards Stonehouse, being an example. The looser kinds of stone, are usually the most fossiliferous, and both in lime and slate those parts of the rock which approach the surface.*

At Yealmpton the limestone is surmounted in one direction by *dolomite*, or limestone impregnated with magnesia; it forms on the surface, crags, (there termed "tors") which are extensively subject to erosion by weather; it is thicker towards the centres of the small hills which it covers, than towards their borders; at the centre also, it mixes greatly with the common body of the marble, rendering the rock *partly* dolomitic, while, towards the borders, it is pure, highly crystalline, and so beautifully coloured as to have been used by statuaries. So far as I have yet experienced it is not fossiliferous. It appears in small patches in some few other spots of the neighbourhood, also at one part of the rock at Cat-

* It is presumable, that prior to the solidification of our rocks, the animals occupying the fluids, accumulated greatly towards the surfaces, and thence, are now found as fossils in the loose rubbly head-stone.

down near Deadman's Bay, and in one instance in the vicinity of Torquay, besides which limestone has magnesian qualities in a less degree in many other places.* Although, it is most usually confounded with the substance of the lime which it joins, yet, it likewise is found connected at an absolute line of junction perfectly distinct; is rarely slaty. The South Devon limestone is greatly pervaded by seams of *calcareous spar* in numerous situations, and this substance (used much for garden paths) is likewise found much in the narrow fissures of the rock, adhering firmly to the surfaces where the beds are approximating. It is also rarely discovered in masses of several tons weight towards the surface. *Caverns and fissures*† are common in this rock, and are most generally lined on their roofs and floors respectively by stalactitic and stalagmitic concretions. *Jasper* is found sparingly in small patches and veins in the limestone. *Calaminaris* is also a reputed production of the Yealmpton rock.

Although, from defective knowledge of mineralogy, I am not able to say any thing generally on the subject, I must yet beg to introduce a trivial notice of an irregular *vein of iron*, lately discovered in the lime of Yealm Bridge. It consists of disconnected blocks of ore lying loose in clay, or joined to the bed of lime; the fissure wherein they are found, is lined with soft slaty matter, and pursues a course nearly due east and west, but as yet has not been much examined; the largest block taken out weighs about 30lbs. Several proofs of the contemporaneousness of this metallic deposit with the lime bed, here presented themselves; 1st. a block

* See "Guide to the Watering Places." Part II.

† With regard to the origin of these caves,—may they possibly have been due to the escape of gaseous matter at the period of deposition of the rock?

was found projecting from the substance of lime, and perfectly and originally joined to it; 2nd. some of the blocks of ore, loose in clay, contain a proportion of lime; 3rd. the lime generally close to the fissure (and in other spots about this neighbourhood, as I can testify) contains small portions of iron ore; 4th. a block of ore was found having at one part, a mark passing all round it, indicating a former division into two parts, but subsequent consolidation, and, on inspecting a block of lime projecting into the fissure, and under which, the block of iron lay, it was seen that the same kind of mark existed also here, and passed around it, precisely opposite to that in the iron ore; 5th. the blocks generally lie loosely imbedded in clay, the whole of which as well above as below them contains particles, and is stained abundantly with the metal. This notice will I trust be deemed satisfactory by those interested in the question of the age of these deposits. A few solitary masses of iron have at times been seen in the lime at Hooe, also lying loose on the surface near Langdon, and near Brixham in Torbay a considerable vein lies in connexion with the same rock. Again, at Mount Batten another vein has lately been brought to light in working the lime rock, and probably it might yet be found still further metalliferous in many directions, contrary to original expectation. This bed of metal at Mount Batten has impressions of fossils on many parts of it, shewing clearly the connexion of it with the deposit of the rock, I believe however these impressions belong exclusively to the surfaces in direct contact with the stone. Although, the metal is stated to be in limerock, and certainly does in some measure mingle with it, yet the substance of the lode, which consists of irregular blocks, is actually situated in the body of a vein of shale, (or deposit intermediate between slate and clay) impacted between certain masses of lime at the junction of that rock with slate in the hill behind, and it is suspected the lode may stretch into its interior. Should the result be so, it will open a somewhat new fact in mining affairs, and may encourage the owner of the lime quarry at Yealm Bridge, to ascertain if the vein there observes a similar rule and direction.

FOSSILS OF THE GRAUWACKE SERIES IN SOUTH DEVON.

The following are some of the genera found in the LIMESTONE of South Devon—those which are most generally recognised, and most important.

Sertularia
Flustra (Brixton, J. C. B.)
Spongia
Fungia
Cyathophyllum
Turbinolia (Catdown, &c. J. C. B.)
Caryophyllea (Brixton, J. C. B.) see woodcut
Alcyonium
Anthophyllum
Favosites
Porites
Gorgonia
Astrea
Rhodocrinites
Encrinus
Pentacrinus
Stromotopora
Syringopora ? (Yealmpton and Catdown, J. C. B.)
Madrepora
Retepora (Mr. Hennah)
Calamopora
Ananchytes (Plymouth and Oreston, J. C. B.) (see lithograph)
Spatangus (Ashburton, Mr. Bartlett,) see lithograph

Serpula (Brixton, &c. J. C. B.)
Trilobus*
Amplexus (Yealmpton, J. C. B.)
Scyphia
Spirifer
Cerithium
Pileopsis
Natica
Cirrus
Pleurotomaria
Euomphalus (Ordnance Quarries, Mr. T. Colley.)
Turbo
Turritella
Pleurotoma
Murex
Buccinum
Bellerophon (Stonehouse, Mr. Hennah)
Orthocera
Terebra
Nautilus
Terebratula
Pecten
Megalodon
Cardium
Anomia
Mytilus
Mya
Ostrea

The following are the genera chiefly recognised in the SLATE,—those which can with tolerable certainty be named.

Astrea (Yealmpton and Elburton, J. C. B.)
(see woodcut)
Spongia (J. C. B.) see woodcut

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* Trilobites are found in the limestone of the South of Ireland. The genus is among the earliest of articulated animals, and is at the same time characteristic of the grauwacké series of rocks.

Sertularia, or some allied genus (J. C. B.)
Flustra (Coffleet, J. C. B.) see woodcut
Cyathophyllum (J. C. B.) see woodcut
Strombodes ? (see woodcuts)
Calamopora
Turbinolia (see lithographs and woodcuts)
Encrinus (see woodcuts)
Pentacrinus (see woodcuts)
Trilobus (Crabtree, P. F. Bellamy—Boveysand, Miss Hook)
Turbo, (Boveysand, Miss Hook) see lithograph
Orthocera (Boveysand, Miss Hook)
Fish, entrails of ? (see woodcut)
Two doubtful species of shells (Mount Batten, J.C.B.) (see woodcuts)

The following are those genera found in SANDSTONE—those which can be distinctly recognised.

Spongia
Alcyonium (Whitsand, Rev. Mr. Hore) see woodcuts
Turbinolia (see woodcuts)
Calamopora, (or some solid coral) Whitsand, Rev. Mr. Hore, Mount Wise, Mr. Hennah (see woodcut)
Encrinus, (Boveysand and Holbeton, J. C. B.) (see woodcuts)
Shells, (bivalve) Mount Wise, Mr. Hennah

The extent of this list of fossils,—which, owing to their highly impacted manner of inclusion, their altered shapes, their frequent dissimilarity to known species, the great resemblance of the lower animals to the class of vegetables, their occurrence frequently in fragments, and so forth, is not near so ample, as it may at a future day be rendered,—ought to be considered as remarkable, more because of the low situation of the grauwackè series in the scale of rocks, than because of the contrast it presents to the doctrine of those, who could see *no* animal remains in it. But, surprising as its amplitude may seem, this fact is of trifling interest when compared to the much more astonishing circumstance, that it contains genera preserved through all the changes of the earth, up to the present period. Indeed, a mere glance at it will shew, that the type of structure has been preserved nine cases in ten, and, though many species are peculiar to these rocks, very few of the genera (save of course certain modern names adopted for the classification of fossils) are so,—they are continued into more recent groups.* That some of those kinds which from their obscurity cannot as yet be spoken of with confidence, *are* peculiar genera in the grauwackè rocks, is indeed far from improbable. Some of these anomalous fossils I have had represented; they occur principally in the slate rock, but in all likelihood, many of those unintelligible forms observed in the lime, are likewise the remains or fragments of beings equally strange and peculiar. There are some also in the sandstone to which the same remarks apply.

The limestone obviously includes the largest amount and variety of fossils, and the sandstone, a much less quantity than the slate, but, though the general prevalence of some genera, (and same species probably in some cases) through these three incongruous depositions cannot be overlooked, it is to be apprehended as above said, that the slate and sandstone, and more especially the former, contain animal remains, not discoverable in the lime,—some which are ipso facto characteristic of those strata.

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* The fossils which I collected in Oxfordshire from a soil totally different in age from our rocks, are yet in great measure, similar to those in the limestone of South Devon.—Many fossils of the chalk are also very similar to those of our limestone.

I have in another place expressed my conviction of the impropriety, if not impossibility of making geological separations between our three fossiliferous rocks. How far this view is supported by the similarity of their fossil contents in general appearance, and in some cases by absolute identity, I have there shewn, and it remains for those of a contrary persuasion, to say if a gradual increase, and improved development do really exist in this series,—whether, progressing from the slate, prototypes can be detected.* Meanwhile however, till more accurate information regarding these reliques

* An experienced collector at Plymouth, besides many other persons, are of opinion, that the fossils of the slate and sandstone,—those at least in the immediate neighbourhood of the limestone, are properly speaking fossils of the latter rock, escaped as it were into adjoining strata from their own beds, but, this is admitting a statement fatal to their own doctrine of the separate ages of these rocks, since, the whole must have been fluid at one time to have allowed of this escape. It has appeared to me that, though the contemporiety of these three rocks is not supported by an universal identity of their fossils, it is far better in regard of their illustration to act as if separate investigations were altogether needed, since, nearly the whole may possibly be distinct from the others in each case.—That some few of those in slate and sandstone, in close connexion however to the lime, may be identical with the species occurring in the latter stratum, might I think be most safely allowed, and should geologists see no objection to the coeval existence of three distinct fluids, and these separately inhabited by beings different in each case, then, the escape of some few sorts from the lime into the slate and sandstone at the time of solidification, may in fact be a rational conclusion. The calamopores in slate might perhaps belong to the lime by this mode of reasoning.

While however in addition to the fact, of fossils accumulating much towards the surfaces of beds and strata, it seems with us to be in great measure a rule that fossils of the slate and sandstone occur most abundantly where lime happens to be in the neighbe attained to, I would caution myself and all others against prepossession, and endeavour to keep the question alive, rather than hurry it to a fancied settlement. Our ignorance as to the occurrence of piscine remains, &c. in the lime, whilst they occur probably in the other rocks, is sufficient proof of our present incapacity to decide this point.

Taking the catalogue in the mass, there is as might be imagined, a preponderance as to quantity, in favour of the radiated animals, and especially the *crinoideæ* and *solid zoophytes or corals*, but there is a much greater variety of forms to be found among the *conchifera* and *mollusca*. *Zoophytes* predominate largely in the lime, *crinoideæ* in the slate, and probably in the sandstone also.

SANDSTONE.

Notwithstanding that the prevailing rock of our district is so generally found to belong to the class of slates, there are a few other kinds of strata constituting a part of the general mass, and of these, the "old red sandstone" occupies a considerable bulk taken aggregately. Its masses are usually seen to exist as beds and hills of inconsiderable area and magnitude, and found I believe to extend to no great distance from the coast. They present a variety of aspects in consequence of difference in colour, and manner in which the fragments are conjoined. A common colour of our sandstones is a pink, or flesh colour, a great deal also is grey, or bluish grey, so as to wear the appearance of common limestone in

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bourhood, the species themselves do not in such cases appear much affected by the proximity, but are in nearly all cases distinct. Those in the slate at Berry Head seem all of distinct kinds from the species found in limestone, which is just at hand. Those in the slate at Sandy Cove, perhaps are *not all* separate from the limestone fossils.

the quarry when viewed hastily; some are of a very light blue, or lavender colour, whilst others are of a dark aspect, being different shades of drab, and even ash; lastly, at some spots, we have what is generally termed red sandstone, which varies indeed from pale, to dark brick-colour. Our sandstones are most generally of a fissile and sectile character, the mass consisting of flat plates placed like the laminæ of slate, and wearing on this account when superficially viewed, very much the appearance of a quarry of that substance, whilst, other sorts consist of flattened oblong blocks, placed slantingly, or horizontally, and some, of indeterminate shaped blocks variously connected, and difficulty separated. On examining the intimate structure of these several kinds, further variations are discoverable; such as exist in the form of slabs of tolerable thickness, are usually of a close texture, and are advantageously used for flooring kitchens, &c. being regarded as little inferior to Purbeck stone in durability; the generality of the quarries supply the means for general building purposes, the refuse serving for repairs of roads; such as is of a fine grain, and free from admixture of quartz, &c. is often employed when cut into proper shape, for sharpening scythes and other instruments; the hardest and closest grained, and which is accumulated in squared and other shaped masses is worked into the blocks used for paving the carriage part of streets, and it is employed thus on account of its great density and resistance. It is cut likewise into mullars. It is but rarely that this rock presents a really *sandy* structure. Where sandstone protrudes to the sea, it suffers disintegration readily. Very often, sandstone exhibits in its fracture scales which wear the appearance of mica. Occasionally, blocks are seen which have in the direction of their grain, dark lines quite parallel to each other, like pencil marks on white paper; the same colour occurs in fanciful marks at different parts of the same light-coloured stone. Thin seams of quartz traverse these rocks in some situations plentifully. Their dip is various, seeming to depend on the general course of the hills and elevations they form, but as in the slate, they usually look southernly, or with an inclination to the east or west.

The connexions of the sandstones form of course the more important features of their history. When investigated in their course, we cannot fail to notice their strict conjunction with the fossiliferous strata, for, besides being insulated in distinct patches among the slates and lime rocks, alternating with them, and presenting hills of similar height, they are in themselves slightly fossiliferous in some parts, and so far as I have seen, only where they approach or are connected to, those fossiliferous rocks,—the fossils themselves too, being of the same class, and perhaps sometimes indentically the same in each instance. Moreover, the sandstones may be traced into intimate connection and union with slates, the diverging blocks and masses of sandstone hills, and plains passing freely into the substance of the other rock, and this, in its turn by reason of its foliated and more subtle nature occupies the crevices, and fissures of the sandstones at their points of junction in beds. Occasionally, where sandstone protrudes into slate an appearance of alternation is observable, as occurs also, where lime protrudes into slate, and many blocks are composed of united sandstone, slate and quartz; while finally, it not infrequently occurs, that some fragments at these spots where the strata are intermixed wear a doubtful or intermediate character, an opinion of their nature being as it were arbitrary. Precisely the same thing I have noticed as occurring to the lime and slate, their qualities are apt to become blended, the fragments putting on a decided slaty texture and feel, but still displaying the presence of lime on application of the test—these facts conjointly pointing out the coeval deposition of the whole. It is however requisite to state, that sandstone is not only blended with fossiliferous slate, but also at times with blue dunstone, (indurated slate) which is *not* fossiliferous, and I have seen fossiliferous lime situated between beds of "grey dunstone" also; so that, it will be necessary in theorizing on the question of the deposit of these several strata, to admit that dunstones are coeval with the other rocks notwithstanding their deficiency of organic remains,* or, for the sake of apparent consistency towards the doctrine of separation of fossiliferous from non-fossiliferous rocks, to admit the perplexing and inconsistent idea of different ages of dunstones, according to the positions they assume with respect to other rocks, as also, to allow similar separations of other non-fossiliferous slates from such as *do* contain fossils. In fact, if we are to apply this classification of rocks according as they contain petrifactions or not, some sandstones will be classed with the fossiliferous slates and lime, and some with non-fossiliferous slates, trappean rocks, &c.; the true greywackè rock will be separated from the greywackè slates; some beds of lime must be separated from others, and even some parts of a given bed from the rest; the dolomite blended as it is with true limestone will not be coeval with that formation; in some instances, the general mass of a hill, or bed of slate must be ranked differently from that part which is fossiliferous though seem-

* I have lately found, that there is an exception to the rule of grey dunstone being devoid of fossils, in the case of a portion on the shore at Mount Batten apparently connected to the metaliferous shale before spoken of.

ingly a mere continuation or portion of the same,—and this arrangement made too in defiance of manifest and great obstacles.

When we take a general and connected survey of the facts presented by the geology of this district with the view to frame a systematic notion of the respective ages of our rocks, and of their mode of deposition, the mind is inevitably perplexed by contending problems suggested by the want of uniformity in the phenomena they exhibit. To select that theory most congenial to our apprehensions and judgments, we must draw that picture the parts of which are the most consistent together, and the most in unison with the results attained by examination of the phenomena of other localities; and if the statements of this sketch shall be found capable of supporting, or at least not in contradiction to the popular views of the *general geology of the globe*, no useless opposition, or multiplication of theories will be committed.

We are first to remember, that the principal basis of the whole fabric is in all probability granite; it is elevated by igneous agency into hills of vast size in the region of Dartmoor, and sweeping as I conceive southwardly passes to a submarine position, appearing however in the channel as the Eddystone and at the Bolt Head. Besides the granite, our gneiss, and the porphyritic and serpentinous formations and some other rocks belong to the same series. We are to consider, that the mountainous nature of the granite is in all probability preserved throughout its whole extent, and that this chraacter would in some degree at least, influence the appearance as regards elevation, of the strata reposing on it. Reflecting on the number and variety of the remaining rocks, and still more on the partial symptoms of gradation of animal forms observed in the fossiliferous part of these, we might be tempted to indulge in the notion of repeated catastrophes, but, as I have previously intimated, the facts related in support of the absolute connexion of the lime and slate,—lime and sandstone,—sandstone and slate, &c. together with the absolute inclusion of small patches of these deposits in their beds, forbid this supposition. We must then regard these rocks as one series, as coeval deposits—the results of one agency. But, though consecutive epochs have not been employed for their deposition, it is highly probable that the action was not altogether simultaneous ; non-fossiliferous slate or schist may have been first precipitated, partly filling the interspaces of the granite, and connectedly therewith the fossiliferous greywackè, siliceous and clay-slates; portions of schistose dunstone and compact greywackè also would occur ; while these were yet in a somewhat fluid state, and had not as yet assumed their final position, sandstones and limestones would be deposited at intervals amidst these rocks, and their approximating fragments become blended, diffused and projected respectively one sort into another ; the sandstones might now acquire animal forms from their neighbours at the points of junction, and the limestone precipitate or fluid already charged with the forms of primæval creation nearly through its whole course would impart certain of those animals to the slates, and thus account for the similarity of these remains in the members of this series of rocks. Those who consider trapp a "transition rock" might say, that together with the sandstones and limestones, our trapp rocks (never however containing fossils) would assume their place in the general mass, and though the usual character of this formation and its freedom from organic remains are facts unfavorable to that arrangement, we might indeed remember its position among these, and, that its immunity from fossils is nearly as reconcileable with such a classification, as the non-fossiliferous portions of sandstone, lime and slate, or the greywackè rock itself. In regarding this formula of deposition, it must be recollected that lime and sandstone are accumulated mostly on the coast, and that among the irregularities which occurred, slate is often superior to them both.

I feel perfectly sensible of the want of perspicuity in the present theory, but console myself by reflecting that with our *present means* of theorizing, it would be difficult to frame one more consistent than that which supposes the simultaneous existence of several distinct kinds of fluid occupying separate limits in one common sea,—each also *for the most part* containing its own peculiar beings, and these turbid fluids precipitating their solid particles and contents so nearly at the same time as to be in some degree blended.

It may now be useful at this stage of our inquiry, to present a succinct and connected statement of those facts which seemingly point out the propriety of regarding our fossiliferous rocks and their modifications as coeval,—deposited with small intervals of time, insufficient to render their separation perfect. To commence with that rock constituting the bulk of the series, and in some measure the basis as it were of the fabric—

1. Slate—its various kinds are decidedly in connexion, graduating into each other, and apparently forming one mass. Greywackè rock is much connected with them, and even runs through them in veins, at the same time graduating on either side.

2. Further, it is joined intimately to, and graduates most conspicuously into sandstone and lime, forming therewith intermediate rocks, such as

calcareous slate and arenaceous schist. Numerous blendings and alternations of the three deposits also attesting the reciprocal junctions of each kind with the others.

3. The changeableness of the relative positions of the three rocks likewise greatly favours the idea. Lime is often received in small beds into the lap of the slate, and vice versâ slate occurs resting on the lap of the lime in large or in very small patches, or even running through it in narrow veins. The respective relations of sandstone and lime, are prone to vary; and the slate intermixes greatly with the sandstone; I have also even seen the former resting on the latter as a mere shallow bed.

4. The course and dip of the three strata may in some measure be said to be similar.

5. Lime and slate are both traversed by veins of jasper, and slate and sandstone are greatly loaded by veins of ordinary quartz.

6. Lime and slate at points of approximation have been found impregnated by flinty matter. At one spot the lime assumes a siliceous character derived from the adjoining sandstone which contains a great proportion of that matter.

7. The contained fossils are often generically and specificially identical. They are also congregated greatly at the points of union of the strata.

8. There is no *tenable* indication of progressive improvement from a presumed lowest member of the series of animals (or beings generally) upwards.

9. The strata appear to have been connectedly simultaneously and similarly affected by Plutonic disturbances; the lime (except when very solid) and slate are both often bent towards their surfaces and margins where the consequences of igneous irruption might be looked for. They are both also (rarely) found bent in their very interiors.

10. Not only do the strata occur often in disconnected beds, but these beds themselves in the instance of each of the three rocks, are also compounded of assembled smaller ones aggregated without *palpable* separation.

11. The surface of the country altogether presents an uniform rule in respect of the arrangement of the hills, and in general of their heights,—the slopes and curvatures of these whatever their compositions are not abrupt or broken; towards the lime tract also the slate hills become lower, as if to accommodate themselves to the elevation of the former rock, and are gradually interwoven with it in the general surface of the country.

A lecturer at the Plymouth Institution, as also a writer in the Geolog. Trans. have endeavoured to shew that our limestones are the formation of coral insects residing in a supposed ancient sea or basin, having the slates and sandstones for its bottom.* Now, allowing the above statements to act as negative proofs against this notion, the following may be here introduced as *positive proofs* of its fallacy. Coral rocks such as are now forming, are of a loose and cavernous texture, of an uniform colour, exhibit clearly the habitations of the architects, are without stratification, dip, or absolute course. Our lime rocks are dense in structure, variable in colour, rarely present the traces of *polypifers*, have generally decided stratification, dip, and course, conform

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* This idea was not *novel*, for even Buffon argued against the supposition—adducing the fact of stratification as decisive on the point. (see De Luc's Travels in England) So far as respects the identity of the deposit of lime and slate, my own notion of coeval precipitation is not new, (see Moore's Devon) but I am not sensible that any one has hitherto conceived the probable coeval deposit of the *three* fossiliferous rocks.

able indeed for the most part in these respects to connected rocks, they are remarkably uniform in height, they contain also veins of jasper, veins of iron, and patches or veins of slate, they have large cavities with generally smooth sides, they include shells and other animal remains (quite solid throughout) not found in the other rocks, they are blended much with the substance of the other rocks, and, those isolated beds in slate, or grey dunstone are in nearly every case so affected by that circumstance as to be of a bastard or intermediate nature.*

We are now to picture to ourselves a new condition of the earth after this deposit of "transition" strata, and destruction of primæval creatures and vegetables ; the surface now produced for the present in the district now being considered, none of those demonstrations of creative power which had just passed into the mineral condition but of which nevertheless, brighter and more complex instances were at a future period to appear. But, though the passage from simple to complicated creation was here abrupt, the interspace of time was filled up by a gradual and consecutive development of intermediate forms in other situations. Sandstones and conglomerates† referrible it is supposed to some following convulsion or convulsions, are found towards the south-eastern portion of the county, and the Bovey coal field in the eastern quarter is

* At Brixham blocks of lime occur in the body of the slate rock.

† *Conglomerate pebbles* have indeed been found here, generally lying on the shore, or in the shingle of estuaries, (Yealm, Mount Edgecumbe, Bigbury Bay, Boveysand, &c.) but, I am far from convinced of their having been originally formed in this district, though I confess they have great resemblance to our own sandstones. Have they not been loosely transported hither ? Beds of conglomerate occur however as above said to our north-east, and likewise in Cornwall. See de la Beche's Manual, and Boase's Primary Geology.

in itself a proof with some geologists, that an interval fraught with a creation more advanced in physical endowments had succeeded to that evinced by the contents of our own rocks.*

The limestone, sandstone, and slaty precipitates, which we traced as the coeval (though not precisely simultaneous) deposits of one flood or aqueous catastrophe, were not imposed on the granitic bed with reference to equality of surface or method of arrangement; no farther rules can be detected than such as I have pointed out; with the few exceptions related, no order of occurrence is observable, and

* A late writer of eminence opposes the doctrine of *progressive development*, in the various "zoological epochs" because, contrary to supposed rule remains of a quadruped have been found in slate which is low in the scale of rocks geognostically, and because in some solitary instance the order of progression is reversed, and so forth. I had never understood that the rule was more than *generally* preserved,—that it excluded sparing productions of the higher classes of animals from the original æras of the world, or that it prevented the superaddition of the lower tribes during the more advanced epochs. Can the facts of a *generally preserved* scale of advancement, and very often of a decided numerical predominance of the fresh addition in the scale of improvement during each succeeding creation,—or in short, a general rule of advancement among those animals and tribes respectively peculiar par excellence, to each geological epoch, be denied? That *every* geological change, disturbance, or revolution was attended by some change, or advancement in the order of being as has been hitherto taught, may however be greatly questioned. Many of these appearances are much *too local or circumscribed* to admit of such a theory, independently of the positive evidence of *facts*, which are decidedly averse to the belief in numerous cases. In the present instance of conglomerates and sandstones to our east, no proof whatever is furnished by them or by any concomitant circumstances, that a coincident improvement of creation attended the formation, on the contrary, I believe they are even said to be devoid of fossils, but whether fossiliferous or not, the influence of local Plutonic action must never be lost sight of, as an agency of very general, as well as irregular occurrence.

in lieu of a level surface the greatest irregularities occur, and the utmost latitude of variation from equality is universally presented. The heights however of the tallest hills, whether slate, sandstone, trapp, or other rock, are tolerably uniform, and the predominating stratum—slate, seems to accommodate in a remarkable manner, the other rocks ; for, though the hills and ridges of the schistose formation are so irregular in size and devious in course, insulated depositions of the others seem nicely blended with it in the construction of sweeps, vallies, ridges and simple elevations,—the outline never appears abrupt or broken, however complex the arrangement or numerous the component parts. The main line of limestone pursues its eastward direction unbroken for a great space, and throughout this course but little appears of interrupted surfaces, broken outline, or interference by other strata.

All this is at variance with what might be expected from the nonconformity on the part of the slate hills to regularity or rule of course, and therefore strongly evinces the contemporaneous origin of the series.

That these hills existed anteriorly to the Mosaic deluge there is the strongest evidence ; no deluge I apprehend would leave such a multiplicity of simple ranges and elevations, and these having (speaking of course independently of soil since deposited) such well rounded sides, protruding ends, and intervening vallies ; no flood I conceive would excavate a valley such as I have here seen, where, at one spot, limestone rises into a hill on one side and sweeping across the vale, reappears opposite, lying in connexion with slate ; nothing but original deposition is equal to an explanation of the tortuosity of the slate hills, in the arrangement of the component fragments of which, there is found such an evident tendency to turn, or round off in order to pursue some other direction after passing the angles they so abundantly form,—a circumstance quite irreconcileable with the notions of an original general level, the laminæ and fibres of the slate having had an uniformly disposed course, and the unlimited capacity of the deluge to excavate vallies from the hardest as well as from the more readily disintegrated rocks.

These roundings, contortions, and sudden projections of our slate hills may be the sufficient reason why the dip of this stratum varies somewhat as before mentioned. They are also the selfevident causes of the many horse-shoe vallies or "combes" with which Devonshire abounds. Hills of slate are usually formed by an uniformly directed series of laminæ, or at least by laminæ varying but little in their dip; some few hills however are formed by laminæ dipping in opposite directions and gradually getting vertical towards the centre. In such cases, one of the halves will dip as do the slate hills of the South Hams generally.

Having admitted the succession of certain geological epochs, after that wherein the lowest tribes of beings found imbedded in the fossiliferous portions of our strata existed, we once more find our district contributing animal remains to attest the visit of some great revolution and catastrophe to this immediate spot. Looking to the subjects of this demonstrative deposit we are instantly informed through inductive argument, that the æra in which these creatures lived must have presented complications of economy, or in other words, series of plants and animals the former subservient to the latter, and more than this, we gather also that the agents in this economy must have been resident in the very district where their exuviæ are now found.

Again, through the knowledge of geology in general, and through the inference set forth by the principle of gradation of beings from primæval creation up to existing tribes, we are informed that the means of destruction employed in the present case was the Mosaic Flood.* In the epoch then antecedent to the Great Deluge, our district was peopled by tribes of animals and plants having a close affinity in organization to existing races, and these, a portion of which are hereafter to be named, were, as we shall now proceed to shew, destroyed and swept away by the waters of this stupendous and destructive engine.

The origin of the various structures constituting the crust and superstrata of the globe is well known to be wrapped in obscurity, each new deposit counting from below, is thought to have been the absolute formation of each succeeding flood, or destructive agent; I find however, that the clay termed *diluvial*, or at least some kind of clay, was in exist-

* I have here and in other places used or implied the expression *Mosaic* flood, but without a full conviction of its propriety. That a flood of some date occurred here in a remote epoch of the world, and wrought the effects about to be described, I cannot however doubt. It may be that the Mosaic flood was partial—limited to that part inhabited by man, and that the other portions of the earth were consecutively submitted to the same circumstance. This question is of so great subtlety that it cannot be said to be decided in the works of those who have had the most extensive opportunities of inference, and therefore for me to pretend to decide the point by mere local geology, would amount to a kind of arrogance, of which I should be sorry to be found guilty. For the sake of method, I have however chosen to adopt a name with which none but the new theorists can find fault, and let no one suppose that in the present caveat, I detract in any way from Scripture.—To question the general authority of the Bible, is to deduct from the authority of God, but, to question the signification given to certain words of Scripture by mere men, is to deduct from their anthority alone.

ence before this destroying element wrought its effects upon us, since, clay of a dark red colour, and even another sort,—white, with intervening river gravel, and at one spot an addition of sand, from a bed on which the "diluvium" and its animal contents repose, in the Yealm Bridge cave, besides other kinds existing in many crevices of lime rock apparently inaccessible to diluvial matter, but in probable connexion with the shale existing in the rock.

There can be no necessity for searching out evidences of extravagantly stupendous force exerted by the Flood, when its actual character and extent of power appear in the following indications. It swept over the lands and carried with it the diluvial clay, which it eventually deposited on a great proportion of the surface as for the most part a shallow stratum. Although it appears on the generality of hills and elevations, it necessarily subsided and accumulated in the vallies and lower portions of the country, and, since the vallies are deepest, and the ground altogether lowest towards the coast, the clay and debris driven by this flood chiefly occur at these parts. We are to bear in mind, that this flood was not a mere inundation, or simple power of mixing the fluid element with the softer and finer particles it would encounter, but, that it was in a highly agitated state, and capable of acting on the grosser and larger bodies lying in a free condition on the earth; accordingly, it rolled trappean, dolomitic, granitic, and other blocks, after dislocating them from their more or less trivial connexion with their parent beds down into vallies, and in some instances, even in contrary directions to their gravitation. There are spots, where large masses of these rocks appear imbedded in sand or diluvial clay, separated as it seems from their original site at a higher elevation.

It removed the pebbles constituting beaches, and the beds of rivers, and conveyed them even to elevated spots; besides the occurrence of these in caves nearly on a level with the general subjacent soil, they are discovered not infrequently in the smaller cavities towards the top of limerocks, and usually in the substance of a clay deposit. It removed loosened fragments of limestone, and scattered them in the vicinity of, and on the bed to which they belonged, as seen plentifully in the vicinity of Plymouth, especially in the caves and fissures of the limestone, whither the substances whirled by the fluid would naturally tend; it is not uncommon to find consolidated masses of bone, clay, pebbles, stalagmite, and irregular pieces of limestone in these hollows; and I lately saw a mass of firmly united rough fragments of limestone of several tons weight which had fallen from the brink of a lime quarry, where it had rested in a natural excavation of the rock. If acted on, and lossened the smaller and superficial fragments of slate and sandstone, carrying them with the general body of clay, in all the irregularities of its course. This mass of commixed clay, schist, sand, pebbles, and other uncertain fragments proceeded to fill up caves, fissures, and all the small crevices in the several kinds of strata; some caves however are filled exclusively by sand, and some solely by clay, whilst the ordinary mixture is noticed in the spaces between certain parts of strata, as between trapp and slate, trapp and lime, &c. This mixed diluvial deposition is moreover seen in various places where natural hollows and pits had originally existed, and sometimes distinct stratification and alternation of the substances may be noticed. With respect also to the clay separately, it in some measure so acted on its harder portions as to roll it into balls like small boulders; specimens of which occur in some of the caves of limestone.

It carried bones of animals, with clay, stones, &c. into caves, or conducted those already there, deeper into their recesses. It conveyed quantities of sand towards the mouths of caves, and there left it to close up their apertures as now seen. Finally, though it did not disintegrate and excavate rocks into the form of vallies, it unquestionably swept before it the substances already spoken of, and therewith would generally round off and smoothen the inequalities presented by the rocks by choking up the hollows of a smaller kind, and depositing debris as a covering to projecting asperities ; while in its retreat it would by its tide-like undulations effectually heighten the circularity of the sides of the hills, by depositing matter in all the slight pits and excavations ; and, evacuating these abodes for the last time, would draw within its power the various loose bodies deforming the evenness of the sweeps, and fix them in more requiring situations. A great deal also would no doubt be carried onward to the subsequent marine beds ; and the vallies just left by this devastating though in one respect ameliorating flood constitute a kind of *vallies of denudation*, a term, which though it chiefly expresses the act of carrying away the looser fragments of the rocks constituting their sides and bottoms, must be understood to imply also, the act of depositing in lieu a covering of diluvium, by which the surfaces were rendered smooth and fruitful.

It is a very common circumstance to find in the neighbourhood of our sea, and estuaries, large deposits of diluvium accumulated in the small natural hollows and depressions of the rocks, where, secure from demolition by the elements, or by agricultural proceedings it has lain as originally deposited through the long series of post-diluvial years. These accumulations consist most generally of clay, with impacted pebbles of sandstone, quartz, granite, schorl, and several sorts of trapp. Diluvium is seen to the greatest advantage on our cliffs, where, through the ceaseless destruction committed by the waves, sections both of the rocks, and superincumbent soil are exhibited to the geologist. At Bovey-sand, in addition to the diluvial bodies just named, pebbles of calcedony, chalk flints, and agates (the two last having occasional impressions of *polypifers*, and being no doubt similar to those in the direction of Haldon) are far from uncommon; these were no doubt carried by the waters from their native beds at some distance. The general body however is composed of clay, with an affinity of minute fragments of schist crammed or compressed together with wonderful consolidation as the effect of its own gravity through a long period; here and there scattered through the mass, appears a pebble of flint, trapp, schorl, or granite, similar to those accumulated in other spots with a less quantity of clay. In one part, this diluvium is composed only of sand, and a few pebbles firmly consolidated. In another spot the clay is wanting, having perhaps in the lapse of time escaped from between the large pebbles by their weight and by its own tendency to be dislodged from impending positions. To some, this last kind of accumulation might wear the appearance of an ancient beach, but, its connexion with the whole range of diluvium just spoken of should be borne in mind, and the following are sufficient reasons for considering the entire mass as of that nature, and not the remnants of an ancient beach—the presence of clay in abundance,—the presence of the transported pebbles, (not only agates and flints, but, such as granite, &c.) above named,—the commixture of the various components,—the situation of the mass in small hollows of the rock,—the presence of a preponderance of small bits of schist,—the existence of exactly the same accumulations in-land, and lastly, their *various elevations*.

I have said that a strict classification of rocks according as they contain animal remains or not, is inadmissible, and, that to recognise this principle in drawing out a theory of the deposition and age of our own strata we must lose sight of plain indications of a contrary tendency. I am not however saying that "zoological epochs" as set forth on the large scale are factitious or arbitrary, and I here revert to this opinion in order to state with candour that if one were inclined to favour the idea of consecutive depositions of our strata, it would receive support from these facts : 1st—some of our strata, or parts of strata are devoid of fossils ; 2nd—some parts of the strata contain a very sparing quantity of the lowest tribes of animals ; 3rd—some parts of the slate contain a profusion of fossils, some of which are of a higher grade than those sparingly scattered in other parts of it ; 4th—the limestone contains petrifactions of far greater variety and generally higher order than those found in the slate; 5th—the slate contains some organic remains not found in the lime; 6th—I must add also, that though the rule is far from being universally observed, lime and sandstone which contain the highest organised remains, for the most part preserve the highest or most superficial position in the series of our rocks. Our lime is said to repose between slate on the north, and sandstone south, but, as I have elsewhere shewn, this rule is valueless.

Whatever may have caused this curious arrangement, I am of opinion that the equally curious classification of bivalves, univalves, zoophytes, &c. one sort apart from another, as observed by the Rev. Mr. Hennah in the limerocks, belongs to the same series of phœnomena ; besides which, I am now enabled to add, that a partial order of this same nature may be noticed in our slate fossils, though, through ignorance of their specific names, I cannot here venture on an accurate account in proof.

Upon the whole, I think I may with confidence refer the reader to various observations I have been able to introduce in refutation of the plausibility of this separation of our rocks in respect of the fossils they contain, or on the other hand, in respect of their fossiliferous and non-fossiliferous condition. I entreat the naturalist to dismiss the speciousness of this doctrine from his mind in favour of more solid and convincing arguments, and, in concluding this part of the subject, I wish to draw his attention to one other fact illustrating as I conceive the novel conception here indulged in, of a complicated and gradual, though coetaneous deposition ; this is, that in numerous quarries of the three fossiliferous strata, but more especially in lime, it is seen that distinct and separate beds of the substance have been laid, so that, while on sure data we have contended for consecutive steps in the nearly simultaneous precipitation of the several materials, as also for a deficiency of precision in their mode of occurrence and for their intermixture, there is here ground for supposing that the same rule of quickly-succeeding precipitations extended even to the separate kinds of rocks respectfully, and it is worthy of being considered, whether this fact may offer any explanation of the local occurrence of the majority of our fossil specimens.

Table of the more important Igneous Rocks, Strata, and other Deposits of South Devon.

GRANITE, SERPENTINE, SCHORL ROCK, HORNBLENDE, AND OTHER TRAPP ROCKS.	*Igneous Rocks*, upheaved at different periods. They existed probably in a somewhat similar form in the interior of the earth prior to their elevation, and it is also rational to think, that some portion of them or their modifications, have had their present elevation from some more ancient æra, or even ab initio. This class of rocks is termed by many geologists " *Primitive Formations.*"
LIME, SLATE, SANDSTONE.	Rocks of the *Transition* or *Greywackè group*, and so far as the south-west of Devon is concerned, apparently coevally deposited. The source of the substances of which they are constituted is very problematical, but, though the immediate derivation from prior existing rocks is questionable in respect of the lime and slate, it is hardly so in regard of the sandstones.
CLAY. ACCUMULATIONS OF FRAGMENTS OF ROCK, PEBBLES, SAND, &C.	Substances formed or removed to their present sites apparently by the passage of a vast current of water over the land, but, having no solidifying power on the disintegrated particles, or severed and transported portions of rock. The clay may possibly have been derived from the argillaceous formations previously existing. Aggregately these substances are called " *Diluvium.*"

I have omitted the mention of gneiss, porphyry, greywackè rock, and various other modifications of the above characteristic or typical strata, these being considered elsewhere. In the above table also, I have not included the sandstones and conglomerates of the south-east of Devon, respecting the formation of which, there appears some peculiarity, and to which perhaps the above remarks do not apply.

We pass on to notice the other series of animal remains afforded by this district, with a view to positive discrimination of species. We said that our district must at one period have presented complications of economy among living beings, that, series of plants and animals had their existence here anteriorly to the "Deluge" which we imagine overspread the ground and annihilated them. It is surprising however, that of this chain of beings some only of the connected links are now found. There are four spots where relics of this æra now spoken of have been recognised, and they consist so far as I have learned and experienced, of the highest tribes of animals alone.* It is still more curious, that even these have been found solely in caves,—they have not been met with in the diluvium *of this district* external to these cavernous depositories. But, that the stratum in which they repose is diluvial matter no one can doubt, since it is so thoroughly analogous to the same deposit without, in its several characteristics before recited.

The caves wherein these antediluvian reliques are deposited being in each case of limestone, stalagmitic incrustations are formed on their floors, and on the substances from time to time introduced; accordingly, confused collections of clay (of antediluvian date, as I suppose) and stalagmite, occur

* Very lately however, Mr. T. Colley found a *nerita* in soil just over a bed of lime, many feet below the surface, and it may probably be a question, whether the Bovey coal formation may not be hereafter classed with diluvial deposits. It has hitherto been ranked among later depositions, and its circumscribed occurrence is indeed somewhat unfavorable to its arrangement among depositions so general as are those attributable to the diluvial epoch. Besides consisting of the remains of *trees* and *grasses*, a few *shells* have been found in this coal. Fine specimens of *jet* have occurred there, as I am informed.

over their stalagmitic floors, and after the diluvial clay and its contained exuviæ were superposed, we naturally see a fresh deposition of the same calcareous mass, and again, on any new substances overlaying this, *they* also will receive a similar envelope. In consideration of this continued filtering from the rock, it will be possible generally to determine the relative ages of the contained bodies. It must however be recollected, that the capacity of furnishing these limy particles varies in different portions of the rock, and in some spots no percolation whatever takes place, so that, bodies lately introduced may be invested by a large amount of stalagmite, and vice versâ, substances deposited for a very considerable space of time may be covered by a shallow envelope of the same. Instances to this effect may be noticed around Plymouth.

The four stations at which our fossiliferous caverns occur, are Oreston, Yealmpton, Berry Head and Torquay. The Oreston caves investigated by Mr. Whidby who published their description in the Philosophical Transactions, are thought by Dr. Buckland to contain the remains of antediluvial animals which had perished by falling over the precipice of the caverns, whilst hunted in the case of the ox, horse, &c. and whilst hunting, as in the instance of the tiger, or hyæna ; he thinks their carcasses were deposited on the projecting ledges of rock, and were afterwards carried by the Flood, together with various diluvial matters, deeper into the recesses. Dr. Buckland and Mr. Hennah in their respective works affirm or imply that no bones of the larger mammals occurred in these caves. They are however both in error, as I have bones of the elephant, rhinoceros, and hippopotamus from this locality, in my possession. I conceive these fragments were washed down amidst the diluvial matters. De la Beche observed that the remains were always collected at the bottom, and beneath large accumulations of fragments of rock. As I had no opportunity of examining the Oreston caves, I can offer no decisive judgment on the somewhat contrasted opinions of Buckland and De la Beche, in respect of the phenomena they presented.

I have lately received from Oreston a curious tooth, which I am not able to assign to any species of animal; it was taken out of a small fissure of the rock, unconnected with those caves in which the great assemblage of bones just alluded to was found. This tooth is represented in a woodcut. The animals to which the bones in these caves at Oreston, as also those in the cave at Torquay belonged, being the same as those found at Yealm Bridge of which particular notice is taken, I have not thought it requisite to repeat the names.

The second spot where this class of remains occurs is Yealmpton, my own residence. Here a series of caves has at various times been brought to light; one very similar to that at Yealm Bridge (of which I shall presently give a precise account) was found by the quarrymen a few years since, and its contents thoroughly destroyed; near this, a small cave has since the discovery at Yealm Bridge, been investigated by a gentleman on whose property it occurs; its contents were quite similar, save in variety and quantity, and the bones of the hyæna and deer were those principally noticed; again, among the pebbles and rubbish of Kitley cave which adjoins the village, I found an hyæna's tooth, and a fragment of the head of a hare, or rabbit, there is also a bone of some quadruped firmly fixed among the diluvial pebbles in that part of the cavern which seems to have been choked up with those bodies:—facts which are at variance with the account of this subject given by Colonel Mudge in his paper read before the Geological Society, though I am not prepared to say any more than he, that this cave had been employed like that at Yealm Bridge as an hyæna's den, on the contrary, I conclude that these solitary specimens were washed in with the diluvial matters ; near Yealm Bridge is a cavity of small dimensions, and here, among the pebbles, brecciæ and mould, I found after a long search, a single tooth of a pig cemented to a portion of indurated clay ; the chief instance however, is the cave at Yealm Bridge* which I found to contain a set of relics not inferior as to number of species to that examined by Professor Buckland at Kirkdale, the cavity itself also presented superior accommodation, in regard of height, though its length was much less. Before proceeding to the precise description of this, it must here be understood, that among the several species of animals inhabiting our lands in the antediluvian æra, there were some which had the habit of appropriating caves and fissures of rocks as dens, to which they habitually resorted to repose, or to devour their

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* On September 1st, 1835, I published the account of this cavern in the "South Devon Monthly Museum," with a *feigned signature,* and on March 23rd, 1836, Colonel Mudge, who had in the interim heard of, and examined into the facts, read a memoir on the subject before the Geological Society, in which however, the discovery is ascribed to me. In the Penny Cyclopædia, Colonel M. is implied as the discoverer ! This circumstance should serve as a caution to persons who fortunately possess any information worthy of public record, not to sacrifice the sole reward of scientific research which is to be reaped in this country, by choosing *a work and a method of publication* which necessarily prevent the world from placing credit in the right quarter. By reference to Nos. 23 and 37 of the "Edinburgh Journal of Natural History" it will be seen that I have acknowledged two extracts from the Colonel's account in a new report of my discovery, and have in return, set Colonel Mudge right on some important particulars which I had superior opportunities of becoming aware of.

prey, and of these, there was one remarkable for ferocity and strength,—the hyæna. Hyænas of the present day are known to be unsparing in their habits, their physical powers are prodigious, they drag huge carcasses to their dens, attack successfully the largest quadrupeds, and even at times sacrifice the aged and young of their own species. The acuteness of Dr. Buckland has opened to the world a new and most interesting view of the generality of fossiliferous caverns,—he discovered convincing evidence that they were employed by hyænas as their domiciles, and that the majority of exuviæ found in them had been submitted to the action of their terrific jaws after being dragged to these abodes. In the Kirkdale cave he discovered proofs that their predatory powers had not been limited moreover to the destruction of herbivorous creatures, but, that like hyænas of our own times, they had not spared their own kind. I have found it a most interesting circumstance to trace the resemblance of the facts displayed by my newly discovered cave, to those offered by the cave of Kirkdale, and must here observe, that they are strangely correspondent. Perhaps however one difference should be noted, namely, the probability that more than one predatory animal appropriated our cave as a place of habitual resort. The circumstance of a double or triple entrance leaves room to admit this, and, as one proof of the employment of the cave as an hyæna's den is gathered from the vast quantity of their bones and teeth which was collected there, (as though a generation of the tribe had in process of time been consigned to a common grave) there is a similar indication in respect of the fox, since the remains of this beast are next in abundance to those of the hyæna, and were congregated in one chamber of the cavern.

As therefore I have once before said, Southern Devonshire in the immediately preceding epoch to the "Great Deluge," harboured a race of ravenous quadrupeds which preyed on another race of the harmless or herbivorous kind. Besides which, there existed with these, other creatures of a somewhat intermediate character, or less decidedly predaceous, and again, others whose exact relation to the series cannot be determined; these however, were mingled with the general mass, and there occurred in the last place, solitary teeth of the large mammals, which I rather conclude were driven in amidst the diluvial clay, &c. at the time of the deluge, than conveyed thither by the hyænas whilst connected with the carcasses.

OSSIFEROUS CAVERN AT YEALM BRIDGE.

In the summer of 1835, having casually heard of certain bones, met with in the progress of working a limestone quarry at Yealm Bridge, I undertook to investigate their value, and the circumstances under which they occurred, the present account regarding only the bare facts which obtruded themselves to view.

Lime-rock abounds at Yealm Bridge, and caverns and fissures are not unfrequently disclosed to view during its removal for economical purposes. That, on the southern side of the river at this spot, rises to a great height; and before its consumption commenced, its bed projected to the banks of the river. It was in the upright surface of the rock, that the opening or openings of the cave probably formerly existed; but the memory of man can render no account concerning these original entrances. I say entrances, for as there were certain chambers to the cave, each pursuing different directions to the surface, it is reasonable to suppose there were an equal number of apertures ; besides which, the fact of the remains of the predatory beasts here discovered being disposed so that each kind was generally speaking separate from the others, seems to point out independent and unconnected movements of these creatures.

A great part of the cavern had been destroyed, and a large quantity of the bones removed, and irrecoverable, at the time we commenced the investigation. The relative positions, directions, and measurements of the remaining cavities, are stated by Colonel Mudge as follows :—"Portions of only the eastern and western chambers remained. The former consisted of a descending shaft to the depth of ten feet, which turned at right angles, and again ascended to the surface, both the descent and ascent being at an angle of 45°. Of the western chamber, a portion remained uninjured. From the present opening, it takes a northerly direction for forty-three feet, the height varying from five to six feet, and the breadth from four to five. It then turns westerly for twenty-five feet, the height varying from five to twelve feet, and the breadth from three and a half, to five."

Several deposits arranged as superimposed strata, occurred in this cavern. The lowest stratum consisted of compact red clay, three feet six inches deep. Above this was found a layer of argillaceous sand in the eastern chamber, and of coarse gravel in the western chamber, the former varying in depth from six to eighteen inches, and becoming broader towards its limit ; the latter not exceeding six inches in depth. Over these respectively, a bed of stiff white clay (since become red) presented itself, being in depth about two feet six inches. Lastly, above the whole was an accumulation of diluvial clay, three feet six inches deep, containing pebbles, and the osseous remains. A stalagmitic crust of variable thickness formed an almost general covering to these strata and animal remains. Such were the appearances, and number of deposits, where the space was sufficient and circumstances favorable.

In one direction, where the cave had communication with the surface by means of numerous, small, circular, lengthened apertures, an alternation of thin beds of clay and stalagmite was observable; and, contained in the substance of this stalagmite, we discovered the bones of three or four species of *mus*, which however, we have not been able to identify as the remains of existing kinds. One of them is certainly allied to the water-rat, and another to the common field-mouse. Besides these, there were some recent exuviæ found in connection with the diluvial clay, namely, certain snail shells, and the bones of a bat, both of which creatures are known to hybernate, and not unfrequently to experience death in such places. There were likewise other relics, of the antiquity of which we are not clearly satisfied, since it is the habit of very many animals to appropriate such cavities for dwellings, to betake themselves during night, during sickness, during winter, or as a resource when pursued, to the hollows and crevices of rocks; and since, by a variety of causes, their bodies after death are liable to be found blended with such as are the genuine productions of a former epoch.

The pebbles found in the uppermost stratum are certainly granitic and trappean, derived in all likelihood from Dartmoor, or the adjoining river, which continually washes fragments of those substances from their beds, in the course of its passage from its source, to this place. Brecciæ, (or conglomerates of clay, fragments of rock, bones, pebbles, and stalagmite,) coprolitic masses, bodies resembling indurated adipocere, portions of rich spongy fibrous clay, and patches of black mould, were also distributed through the same bed. No hair was found. The bones were in great number and variety, and for the most part it appeared, that besides the separate occurrence of those species which are predaceous, such as the fox and hyena, there was moreover, a separation of the herbivorous from the other kinds ; but this may have been accidental, and it must be recollected that this account refers only to such portions of the cavern as remained for our examination. It is for the same reason difficult, or impossible to state the proportions borne by the different kinds to each other ; but, if the facts presented by these remaining portions of the cave could be allowed to furnish such a statement, it would be, that the rapacious exceeded in number the other creatures. Very many dozens of hyenas' teeth were collected ; and in one small spot having an area not greater than four feet, I extracted seven dozens of canine teeth of this animal. Next in frequency of occurrence to the bones of the *hyæna* and *fox* were those of the *horse*, *ox*, *deer*, *sheep*, and *rabbit*. After these, ranks the *rhinoceros*, whilst the bones of the *elephant*, *wolf*, *pig*, *glutton*, *bear*, and *duck*, were extremely rare. Phalangeal bones and a very few others were all that I found perfect, the rest being in a broken state. The long bones had generally lost their epiphyses, and very many, not excepting those of the hyæna, were marked by teeth of some predatory beast, and evidently show that they had been chipped and gnawed. One or two fragments display on their surfaces, scratches resembling those made by the teeth of a *weasel*, or animal of that kind. Teeth of very aged animals were found, and there were also bones of young individuals belonging, with the exception of a few of the hyæna, to the herbivorous kinds. The remains of the elephant are indeed confined to two teeth of a young animal. Some of the bones have been attacked by inflammatory disease, and this occurs among the larger kinds of teeth which also in some instances are fractured, as if they had been submitted to great violence. Some pieces of bone are on one side highly polished, as if they had been subjected to great friction; and Colonel Mudge observed a part of the roof of the cavern which is lower than usual, perfectly smooth and glossy, as though it had been rendered so by the frequent transits of the tenants of the cave.

It is very difficult to determine on the precise number of species of animals found in this cave, since, besides that a very great quantity of the bones had been originally destroyed, our knowledge of fossil osteology is as yet very imperfect, and the broken condition they were found in, precludes the possibility of identifying a great many of them, even with the greatest facilities of comparison with other specimens. Add to this also, that not unfrequently fragments, and even teeth, are met with, which baffle the keenest discrimination, that a degree of uncertainty with respect to date often attaches to some of the animal remains deposited in ossiferous caverns, and that sometimes from a disparity in size, conjoined with a similarity in shape and figure of some series of teeth, a doubt arises whether there may not have existed several analogous species of such animals. This kind of doubt has unavoidably arisen in the present investigation; but it seems most reasonable to conclude, that there were two or even three species both of deer and horse, since there are series of teeth of these genera greatly differing in size.

Notwithstanding that the bones from this cave I so fortunately discovered, betrayed no symptoms of altered character so far as external aspect and superficial examination go, being to appearance in no way different from bones which have been exhumed after a few years' interment, it is natural to inquire whether in their intimate composition, alterations cannot be detected, whereby some information may be added to the chemistry of bone, and to the inquiry concerning the operation of those circumstances under which these bodies were so placed, as well as concerning the period during which they have lain entombed. So far as respects the hard earthy portion of bones, it seems that when excluded from the action of air, they will remain for ages unaltered; though when I exposed some of my specimens for two or three days and nights to the action of the weather in a rainy season, they soon split and cracked, showing proofs of incipient disintegration. Even without this exposure to the weather, the whole of my specimens suffered so much from contact of the air, as to oblige me to use a kind of varnish* for their protection. But, this decomposition must be regarded as the effect of unusually lengthened age; for in general we see that bones of ancient date do not suffer in this way on being brought to light. Besides the durability of their external figure, these bones had lost much of their moisture, and had imbibed in lieu the droppings from the cavern, which convey much of the calcareous matter of the rock, this latter circumstance in particular, determining their very absorbient quality. If the lips be applied to them they are found to adhere tenaciously. With respect to the animal part of their composition, I shall have

* Gum arabic and brown sugar dissolved in water, and diluted to the consistence of very thin gruel.

to offer a modified opinion. That it is somewhat lessened in quantity in all bones of this class and date, I have no doubt; but, I also think that there are differences dependent on the bone selected for examination, on its being entire or fractured, on its situation in the cave, and so forth. If you experiment on a small fragment, the result will seem to be very different from what it is when experimenting on an entire bone, at least so far as regards the ordinary method of employing muriatic acid to dissolve the earths and exhibit the remaining animal portion. Thus, when by experiment I endeavoured to determine the comparative difference between these, and bones of ordinary occurrence, I found that after selecting a fragment of fossil bone and a piece that had lain exposed on the high-road for some months, each weighing a half drachm, and putting them in maceration in glass vessels, violent and rapid escape of carbonic acid gas, due no doubt to the imbibed calcareous matter, proceeded directly on the fossil piece being immersed; gradual corrosion, or rather gradual removal of the earthy portions was soon evident, and in the space of seven hours, nothing remained of the original fragment but a small spongy, flocculent mass, or pellicle, weighing eleven grains. On the contrary, the other fragment gave off slowly and deliberately gaseous matter; the process of removal of the earths was not finished for a very long time, and in the end, the original form of the immersed piece was retained; it was soft, fibrous, flexible, and elastic, and weighed eighteen grains. But again, my brother finds that in exhibiting the animal form of bones, no external difference is observable between specimens of this kind, derived on the one hand from a phalangeal bone of the fossil hyæna, and on the other from any common bone. The first *seems* to exhibit the fact as well as the other; but I decidedly think there is a diminished quantity of the albuminous substance, though it may not appear so. Mr. Martyn, in his "Treatise on Fossils," speaks cautiously on the subject of the chemistry of fossil bones by saying, through Professor Playfair, that they *often* contain a portion of gelatin (or rather, by recent examination, albumen) in their composition, particularly in their interior, the surface only having undergone a change. In other instances, he adds, the gelatin (albumen) is *wholly* displaced, while a greater proportion of carbonic acid than that which existed in it originally is found united with the calcareous matter. Those in the Rock of Gibraltar seem to have been so circumstanced. It seems from Professor Buckland, that the bones at Oreston contained less of albumen than those at Kirkdale. The question, therefore, respecting the composition of fossil bones must be answered in a cautious and qualified manner, and with reference to the conditions of each particular case.

The occurrence of the *bones of mice* in the substance of some of the stalagmite, is a circumstance to which too much attention cannot be directed in framing a theoretic statement of the age of the contents of this cavern, because, as before mentioned, they are not identically the same species with those now in existence, and from their peculiar position might seem not to have been contemporary with the other animals. Yet, in consideration that other specimens of these remains were discovered in the diluvial clay, it may not be unfair to suppose that these found in stalagmite were so impacted previously to the catastrophe which effaced the whole series of antediluvian creatures, during indeed that period in which the hyænas and other predatory beasts employed this cavern, or its compartments, as their dens. There is the same analogy or resemblance of these mice to the present kinds, as subsists between the other antediluvian creatures and their representatives of this day,—the same remarkable affinity. Looking also to the wise provisions of Nature in regard of food, we see that these small creatures would hold a decided relation to the predaceous habits of the animal I have ventured to designate glutton, from its evident similarity to our *mustelo gulo.*

Very recently, a set of bones similar to those met with in our other caverns, have been found in a cavity of the limerock at Berry Head, on the south-west side of Torbay, by the Rev. F. Lyte, but no particulars have as yet been received. I am informed however, that over the fossil accumulation, there occurred human remains, and works of human art. Still more recently, another deposit has been found near by, the bones of the *elephant* predominating.

Near Torquay is a considerable cavern called Kent's Hole, which has in its day drawn great attention from the novelty of certain facts in connexion with it, and which were laid forth to the public by the Rev. J. Mc. Enery. The fossil bones there discovered, were of the same class and character with those before enumerated, but it seems also, that in this cave were found the remains of man, and a variety of articles of chace and warfare, referrible to an ancient race of people.

In that long period of the occupancy of this Island by its primitive tribes, preceding its invasion by foreign nations, and before indeed, history recited anything concerning it, caves were adopted as human abodes, as places of shelter from enemies, and moreover, for the purpose of the burial of the dead; and hence, though in the immediate neighbourhood of which I have a more particular knowledge, no instance of this adopted residence has occurred to me by which I might speak on the subject from personal investigation, I am here enabled to afford the reader some information on this curious inquiry, illustrated by the contents of the above named cavern at Torquay.

A dispute has been long in vogue, and still lingers among the learned in antiquity, as to the equality or disparity in age, of the ordinary fossil bones of caverns, and of the human remains and works of art occasionally found in the same spots, and more or less *associated* with the former. For my own part, I am wholly unable to judge in this matter by the aid of history or antiquarian knowledge, but, after a perusal of the "Reliquiæ Diluvianæ," I came to the persuasion, that no theory could be more rational than Dr. Buckland's, or would at all bear comparison therewith. Subsequent and frequent consideration of the question has always tended to confirm me in my first impression, save that I am not *thoroughly* convinced that our fossil bones belong to the period preceding the Mosaic Flood, or that this deluge was universal. Not long since, I was informed by a very celebrated and learned antiquary, who himself supports the idea of the coevality of the animal and human remains, that Mr. Mc. Enery willing and anxious to support Dr. Buckland's ideas, when asked—"Did you, or did you not find human bones in this cave?" reluctantly and hesitatingly replied in the affirmative. In Natural History, not only is the mode of argument in great measure peculiar by its rigidity, but the autoptical examination of subjects is, (or ought to be,) by its extreme scrutiny and discrimination, peculiar also. The present case is one decidedly illustrative of this assertion, and will serve to shew the necessity of a *full* inquiry into facts before conclusions are deduced. It was imagined from Mr. Mc. Enery's mode of answering, that his theory had been shaken by the evidence afforded by his own eyesight, whereas, in point of fact the question had been put without reference to circumstantial detail, and the *perfect* answer to it which I shall here furnish out of a letter from that gentleman to me on the subject, will rather shew, that a blow has been levelled against the opponents of the Buckland doctrine, which they will find it difficult to parry. To Mr. Mc. Enery, I am under great obligation for the kindness and unreservedness of the communication which here follows, and I doubt not, that the public will duly estimate its scientific import.

"I have found human bones, and works of art, "such as pottery and articles of flint, such as "arrows, knives, and axes, fabricated of silex, "*beneath* the stalagmitic crust, and in association "with the relics of fossil mammalia, but decidedly "under such circumstances as left no doubt on my "mind of their having been introduced *subsequently* "to the fossil bones. My opinion is, that the ground "or crust, has been in several places broken up for "the admission of human bodies belonging to the "aborigines, who made this cavern their dwelling, "(in the absence of better accommodation) or "hiding place from which they sallied forth with "the rude weapons in their hands (that they had "fabricated there, of flint, stone, and bone, the "great laboratory of which was near the principal "mouth) in pursuit of game. In some cases, their "dead were covered up with the materials thrown "up from the pit, (namely, red loam charged with "fossil bones, rounded and angular stones, &c.) "mixed with fragments of a rude pottery, and their "primitive weapons. In other places the bodies "had been burnt and the ashes enclosed in urns, "into which were thrown minute arrow-heads, and "slender pins of bone. The cinerary urns were in "course of time crushed, and overlaid by masses "that loosened by changes of temperature, separated "from the vault. Both descriptions of sepulture "were slowly glazed over, and in many places "deeply encrusted by the calcareous matter which "unceasingly distils from the roof and sides. An "artificial covering was thus formed over the recent "as well as ancient deposits, which were thus as "if confounded by a common seal. Hence all the "mistakes of superficial observers respecting the "presence of human relics in the same bed with "fossil."

To say that the bones of men and their works occurred in the cave, is to say nothing more than that some ancient race of people had at some period used this cavity as their domicile, or sepulchral ground. To say even that their bones, &c. lay under a considerable coating of stalagmite, separated moreover from the antediluvian reliques by a less considerable layer of this crust, would be to express nothing more than that the filtering from the rock had continued subsequently to the period when the bodies or bones of these men had been consigned to, or laid in this grave, as I have before shewn when alluding especially to *stalagmite;* and if the separate beds of this crust *should* exist in a ratio of thickness of the inverse order, it might simply indicate that the power of transmitting calcareous particles varied at different periods, though I only insist on this as a possibility. But, waving this kind of argument, it seems that in respect of the present case, the mode of occurrence of human bones and works of art is explained very differently.

In the same way, I have had the question put to me, "Did you not find human bones, or any relics of ancient human art?" I answer,—not the least trace of one or the other shewed itself.

I have a letter by me from the pen of Dr. Buckland, wherein he warns me I had perhaps been hasty in ascribing certain of the bones of the Yealm Bridge cave, to the *sheep*. A careful comparison however of these with bones of our present existing species, and due reflection on their actual position in the cave, is sufficient to warrant the name assigned to them, and Messrs. Clift and Owen, of the Royal College of Surgeons have on examination confirmed my opinion. Dr. Buckland imagined their absence from the ossiferous caves with which he was acquainted, tended to prove that no tribe of men were contemporaneous inhabitants of our island with the hyænas, elephants, rhinoceroses, &c. &c. whose remains occurred in the caves of Kirkdale, Oreston, Hatton-Hill, Torquay, &c. But, I must be allowed to remark, that nothing can forbid our allowing the existence of *a* species of sheep in the epoch now alluded to, though the absence of ovine remains would indeed strengthen Dr. Buckland's position. It is quite as likely that a kind of sheep existed, as the species of ox or horse. Ovine bones occurred under the stalagmite in the cavern at Berry Head.*

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* In a subsequent letter, the learned and obliging Professor shews how a fallacy similar to that mentioned by Mr. Mc. Enery might occur, relative to the age of ovine bones found in caverns, though, his remarks which I here give, do not apply in either of the above named cases. "Nothing is more common than to find "the remains of sheep and lambs in the same cave with bones of "hyænas laid irregularly over the surface of the floor, and the "accumulation of these is due to foxes that in modern times "have frequented these caves, and dragged into them their prey, "*as they sometimes also, dig deep holes in the diluvium within the* "*cave, which holes, in the course of time get filled up again ; it is* "*very possible that a sheep's bone falling into one of these holes whilst* "*open, may subsequently be found at a great depth in the diluvial clay* "*thus disturbed, and may seem to be of the same age with the bones of* "*extinct species by the side of which they lie buried.*" In the cavern

It is now very much the fashion to adopt the notions of Mr. Lyell and others, in considering present agencies as the powers which have in lapse of time caused the several stratified deposits of the earth, and brought fossilized animals into their impacted or other positions. Again, Dr. Fleming expresses his opinion that our cave-animals were not destroyed by the *(a)* Flood, but, were exterminated by the influence of man their cotemporary. With regard to the first idea, I think it the most untenable of all modern doctrines, and with respect to the latter, it has its refutation in the absence of all remains of human bodies and human art, from the same stratum and same condition wherein the bones of the animals themselves are laid. To which, and the other proofs usually adduced against this fallacious argument I will here add, that if the sheep, ox, and horse were at this said æra subjected to man, a large portion of what would constitute the quarry of the hyænas, wolves, and foxes is withdrawn, and the series which seems so perfect in regard of proportion between the rapacious and the herbivorous tribes, is broken up. It seems also very unlikely, that these aboriginals unversed in the arts of altering through domestication the sizes of their retained animals, should have had horses of such varying stature as the teeth from the Yealm Bridge cave indicate there existed as distinct species at the period of the occupation of our country by this series of quadrupeds.

Whenever it can be shewn that human bones are actually at times *fairly* associated with animal

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adjoining Yealmpton Village, a bone seemingly of an ox is fixed partly in the stalagmite, and is no doubt due, as Dr. Buckland above says, to the habit of foxes which habitually convey their food to the recesses of caves (where such are conveniently situated) for the purpose of secret consumption.

remains of the tribe found in our caves, I acknowledge that the ideas I have here advanced must as a consequence be relinquished; but I firmly believe it *never will* be shewn, and so far as the doctrine of the identity of the cave-animals with the animals of the same names now in existence may derive support from the apparent great similarity generally found, those who side with me need be under no apprehension, for besides that in some instances great differences in size can be detected, minor disagreements (superior however to those betwen existing individuals of a species) may be found in the majority of the remaining cases.

The naturalist, versed in an actual knowledge of the law of affinities and disagreements as exhibited amongst living tribes of creatures, is prepared to understand and argue that the very considerable affinity which subsists between these antediluvian and existing animals is not greater, or rather it is generally speaking less than is exhibited between nearly related species of the genera now resident on the earth. And, if the rule of gradual elevation of living beings through the various epochs up to the typical perfection of the present æra be accredited as sound, we have in the history of these cave-animals evidence of their age, and relation to the postdiluvial epoch by the point of perfection displayed in the organization to which they reached, while, in their similarities to the creatures which they prototyped, we trace trivial though positive lines of demarcation, pointing to the natural separation between the creatures of the respective periods.

The assumption that the large mammals of this antediluvian race were inferior in size to those of the present day of the same names, in consequence of difference of climate from that experienced by the latter, is not worthy of credit until this difference be further shewn as probable, and it is to be observed, that other animals obey a contrary rule ; some teeth of a species of horse are gigantic as compared to the generality of living instances, the fragment of hare's skull which I found at Kitley cavern must have belonged to a much larger animal than our *lepus timidus*, and the parts of the hyæna's skull contrasted with a cast of our Cape hyæna's impresses the mind with the terrific force the former species must have possessed in its masticatory apparatus beyond that of the latter,* so that altogether the rule of diminutives is far from being inviolate.

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* M. Cuvier, says the *hyæna fossilis* was one third larger than our present species allied to it, but so far as my own comparison of these species goes, I should imagine the difference had been rather over-estimated by him.—The elephantine teeth from the Yealm Bridge Cave on the other hand, due perhaps to nearly full-grown animals, are absolutely diminutive in comparison with those of recent species. (see woodcuts.)

CATALOGUE

Of those animals whose remains have been discovered in caves of limestone in South Devon, shewing at one view the proportions which subsisted between the different kinds of these original occupants of the country.

Tiger Hyæna Wolf Bear Fox Glutton Weasel	"Carnivora." Animals subsisting on living quarry
Pig Horse, (2 or 3 species of) Elephant Rhinoceros Hippopotamus	"Pachydermata." Animals living on plants, branches of trees, &c.
Ox Sheep Deer, (2 or 3 species of)	"Ruminantia." Animals living almost wholly on grass.
Water Rat Mouse, (perhaps 2 species of) Hare, or Rabbit	"Rodentia." Animals subsisting on plants, grain, fruits, &c.
Duck	probably herbivorous and insectivorous, conjointly.

The whole of these remains except the tiger and hippopotamus, were found in the cavern at Yealm Bridge, but *only a part* in the other caves of the district. Their perfect similarity to those of other caves in different parts of England, and the Continent, establishes their identification with the series,—a series exhibiting a probability that at the period when these animals inhabited Europe, circumstances were in great measure different to those now present, since they seem to have been unsuited to the existence of a vast variety of beings now constituting the natural products of the continent of Europe and its Islands. Regarding the foregoing catalogue only so far as the mammals are concerned, the series may appear tolerably perfect, because the rapacious creatures hold a strict relationship to the herbivorous, but then insectivorous quadrupeds are deficient, such as the mole, shrews, and hedgehog; and though there are a few granivorous animals, and such as subsist on wild fruits and the bark of trees, we have no positive data for affirming that remains of trees and plants have as yet been found, which can undeniably be stated as belonging to the same æra, and as having furnished the provender which the greater part of the above named creatures naturally required, and doubtlessly had provided them.—It may indeed hereafter be ascertained, that the Bovey coal and clay deposit represents as to its own extent, the remains of that vast abundance of forest and other productions belonging to the period we are now speaking of; but at all events we are certain, that a condition of the country different from that now seen, was essential to the maintenance of the creatures which then possessed it. The elephants would need forest tracts, inasmuch as they seek shelter, and feed principally on the branches of trees; the rhinoceroses would require marshy lands of some extent; and the hippopotami large lakes, or deep and capacious rivers;—morasses, jungles, and extensive shelter would be required for the accommodation of tigers, hyænas, boars, wolves, &c.—plains for the horse, and peaceful ruminants. Whether this condition of the land were antediluvian, and whether the *climate* to which these animals were subjected, were different from the present, are questions still sub judice, but there can be no rational doubt that the state of the country was greatly, though perhaps not *essentially* different from what might now obtain independently of cultivation.

As in the examination of an animal or plant, the mind inevitably traces out its connexions to others, its internal economy, or its uses in the scheme of creation, or to ourselves; so here, when by the examination of petrifactions and fossil bones, we are enabled to look back to former ages of the world, and to call up to our view by the magic aid of science the former aspect and condition of this portion of the earth, we find the subject blended with and inseparable from the theories and arguments concerning the epochs of the globe, the changes which it and its inhabitants have undergone, and the immutability of the laws of nature.

In quitting this subject I cannot forbear from one remark on the theory of geological deposits, that, since different situations afford such varying phenomena and features of connexion and deposition, and such differences in their fossils, we might hence gather an important lesson on the propriety of allowing peculiarities to local geology,—that, although some few general rules may be arrived at in a review of the general geology of the globe, especial rules may be detected in the geology of an island or continent and again others in the geological appearances of mere localities, and that, notwithstanding authors have been industrious in the framing of such rules it will most likely become more and more obvious that they have been set down hastily, and under the guidance of only partial knowledge, that, in short, certain of these presumed laws of deposition and connexion are not unfrequently reversed by unqualified evidence in local investigations. To carry with us preconceptions in investigating the geology of districts, implies error of the worst kind and greatest amount as their consequence. There can be no difficulty in admitting that Nature may have chosen to vary the detail of her plan of action in an infinity of ways during the gradual process of the construction of our earth in its different parts, and it should ever be remembered, that in proportion to existing complications of arrangement and number of substances in the first instance, will be the ratio of *multiplied* complications induced by succeeding revolutions. Experience of every passing day clearly shews us how greatly naturalists have been, and still are stupified by preconceptions, and prepossessions of book learning.

Chapter III.

ALLUVIAL GEOLOGY OF, & RECENT GEOLOGICAL ALTERATIONS IN SOUTH DEVON.

It comes within the province of Geology, to examine next in order those deposits, and those alterations that have taken place on the surface of our land since the time it was visited by the flood last referred to, and though this inquiry involves somewhat of antiquarian research, it is included more especially under the present head and is elucidated by internal evidences, just as fossils dug from an ancient deposit in the interior of the earth bespeak its characters, history and age.

It might be imagined that as the subjects and events to be examined, occurred nearer to our own times, and some perhaps, even under the eye, or during the time of the ancient inhabitants of the Island, they would admit of clearer demonstration and less equivocal language than have been employed in the foregoing consideration of diluvial and antediluvial strata and remains. But, unfortunately our anticipations of perspicuous evidence in these matters receive disappointment at the very outset of our speculations, and the main features of our collected thoughts and aggregated accounts consist of unresolved questions relative to the diluvial or postdiluvial origin of certain soils, and certain remains of organized creation,*—undetermined queries as to the powers of existing agencies,—unsatisfactory acquaintance with the more abstruse departments of physical science as applied to the condition of the earth's nucleus, the motions and powers of the tides, &c.,—uncertainties as to the change of river courses as one of the results of the Deluge, besides various other doubts of minor importance.

In pursuing this enquiry, I shall as in the examination of our more ancient geology contrive to enumerate circumstances consecutively in the order of their occurrence, commencing with the æra immediately following the Flood whose devastations and effects I have been endeavouring to depict. That the waters of the Deluge on their subsidence retreated to an elevation not far different from that now presented by our sea, we have proof in the circumstance of "diluvium" occurring not much above the present tide on the cliffs round Plymouth. Such accumulations of travelled pebbles, and debris, would, I apprehend, appear chiefly where the power of the waves was finally exhausted and their action spent. There is also proof which I

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* Polwhele records the remains of the *moose deer* as having been found in Devonshire (bogs of Bovey Heathfield I believe); also the "*debris of numerous hogs.*" Borlase mentions the discovery of "part of a *fossil horn*" in slate rock, in Cornwall. Vancouver says that in the parish of Cruwys Mortchard was discovered the celebrated "*fossil bacon,*" (p. 24.) It is necessary to ask, what were the particulars of these discoveries, and how far they are authenticated, before bestowing confidence on such reports, or assigning them to any æra. There may be some doubt as to the age of the *nerita* before alluded to. The Rev. Mr. Hennah obtained from the Oreston caves, bodies having all appearance of *snake's eggs*; they were imbedded in stalagmite, and are therefore probably modern. I procured from the Yealm Bridge cave, some bits of a root of a tree in a small crevice, in a *semi-fossil* state.

shall presently adduce, shewing that at some remote period, the level of the sea was even far below what it now is, but it is not material to decide whether that state was assumed immediately on the retreating of the diluvial waters, or by gradual or sudden subsidence in some period afterwards.

Subsequently to the occurrence of the Deluge, animal and vegetable existence again attained to its ordained condition in the prescribed series of improved developments of organic forms, and in additions to the catalogue of species. Not only the present race of animals, but many also now exterminated by human means, had undisputed dominion on our lands. Forests of wonderful extent afforded them the needful shelter; these extended to the very limits of the land seawards, and not only sheltered the wild creatures of that period, but gave protection to the aboriginal occupants of the soil. Around the entire coast of Great Britain, submerged forests have been detected in the sand and shingle immediately within the limits of the water on the full ebb of spring tides,—attesting that at an ancient period the Island had a greater elevation than now, above the sea. These relics, consisting of species now growing with us,—the *oak*, *beech*, *hazel*, *&c.* have been noticed in a variety of situations on the northern, eastern, and western coasts, but still more so on the southern; they have been found on the shores of the Isle of Wight, on the shores of several southern counties, on the shores of the Channel Isles, and with us have been noticed in Mount's Bay, in Torbay, at Polperro, at Boveysand, at Sandy-cove adjoining Plymouth, in the bed of the Lara, and in some other spots. Neither are there deficient evidences of a like kind inland;—the roots, branches, and even leaves of trees (*fir*, *beech*, *oak*, *hazel*, and *alder*) have been exposed to light at considerable depths in the peat and marshes of Dartmoor, and it is probable from the occurrence of the marks of the axe on some specimens, and the discovery of ancient weapons in soils and beds of the same age with these reliques, that the remnants of these original woods,—those portions not engulphed by the ocean, or occurring more decidedly in-land, were felled and in great measure obliterated during the strife for supremacy between those tribes who occupied the Island at the commencement of the first period of history.* Again, additional proof presents itself to a like purpose at Mount's Bay, and at the Land's End in Cornwall, where, setting aside probable exaggerations, remains of buildings have been discovered of very ancient construction, and at great depths beyond the shore. (Carew's Survey of Cornwall.) The geological connection of the strata of the Scilly Isles and Land's End, the occurrence of clay on the former, (?) and the inconsiderable depth of the intervening sea, give great reason to apprehend an original junction by an intervening tract of country. Moreover, ancient historians (characterized indeed by want of accuracy, deficiency in solid proof, and a singular disposition to perpetuate mere tradition, equalled by a credulity in popular reports and falsehoods) are in every instance agreed in a general assertion as to former connections of the islets off the coasts of Great Britain, with the main land; there are likewise among them a number of coincident remarks constituting in a general way historical evidence of a considerable invasion of the

* A roman *cuirass* was dug up at East Brent a few years ago. A Roman implement of warfare or chace has been found deeply imbedded in the Dartmoor peat. Another of the same class was discovered in shallow soil at Yealm Bridge. Some *celts* were discovered at Ingsdon some few years ago. (Jones' Guide to Scenery of Ashburton, p. 22.)

ocean either just prior to the possession of this country by man, or during the first æra of his residence.* Warner in his "Cornish Tour" places implicit belief in the assertion of William of Worcester, that St. Michael's Mount was situated six miles from the sea previously to the *tenth century.*

But however this may be, the connected evidence of geological enquiry on the one hand, which points out not only vegetable remains of existing species at present within the grasp and territory of the ocean, but even the remains of an ancient beach still further out within its precincts, and of historical record (in great measure vague and equivocal, yet coincident as to general report) on the other, fully attest that *at one time* our sea stood much further out than now, and suffered communication over dry land, between certain elevated points at this day severed by intervening ocean.

Torbay undoubtedly presented at one period,—namely, contemporaneously with Mount's Bay and the tract of land above spoken of,—a low, swampy, forest tract. Submerged trees of the kinds before named have been recognised on its shores, and the alder an accompaniment of rivers, has been drawn up, as I am informed, from the very centre of this bay, the depth of which is inconsiderable, and which is

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* Nennius, who wrote twelve centuries ago, reports that there subsisted then, a tradition of the Isle of Wight having formerly been united to the British Coast, he adds, that the name of the Isle is derived from an old British word signifying a rent or separation. Still however, the disjunction could have been but partial, as appears from this last fact, and the report of Diodorus in the first century, that the Romans at the ebb of the sea, conveyed their tin in carts from Hampshire to the "Isle of Vectis" or Isle of Wight. It would appear that in the time of Ptolemy the great Geographer, namely shortly after Diodorus, the number of small Isles was much greater than at present.

furnished at its entrance with an imperfect bar, or bridge of rocks formerly perhaps protecting this area of country from the sea. Had the ocean tenanted this basin a greater number of years, no doubt this barrier would ere this time have disappeared.

It might be conceived, that since the Bovey Heathfield formations consist of dicotyledonous trees, &c. in an imperfectly mineralized state, and associated with clay, gravel, &c. they were contemporaneous with the submerged forests of the coast, which are moreover, *likewise* accompanied by clay. There are however no indications of a beach so far removed from the present sea-mark as is the site above mentioned; the elevations of the sea subsequently to the last great geological catastrophe do not seem to have devastated the land so extensively as to have reached that far. Had the ocean risen to such an extent, and continued long enough in that position to have partially mineralized vegetation, unequivocal proofs would have been bequeathed to us in regard of the exact line of its innovation. Besides which, the relative positions of the trees and clay are in the two cases opposite;—in the one, the clay was carried over the country by the powerful undulations of the devastating and outspread element, and finally deposited *upon* the vegetation which had been sacrificed by its ravages; in the other, the sudden and *limited* rise of the sea overwhelmed the forests of the coast, whose *foundation* consisted of clay the proceeds of the very flood which had preceded. Could it be shewn, that besides the mineral state of the trees of the Bovey basin, specific differences exist between them and those submerged on the coast, the question would be settled beyond doubt.

What that period was in which the sea rose upon the land (or land sunk into the sea) to such an extent we must ever remain ignorant. Warner indeed, gathering his notions from William of Worcester would make it appear that the irruption happened in the tenth century, but unfortunately, this latter author is not content to speak of forests and wild beasts on the land occurring between St. Michael's Mount and the sea, but adds that there were 140 parish churches* in the tract of country which had intervened between the Mount and the Scilly Isles, an assertion so remarkably wild as to deduct at once from the importance of his evidence.† It would rather appear, that this elevation (sinking) had occurred prior to the visit of the Romans, for it is well established that the small vessels used by these people in the exportation of their metal from the mines of Dartmoor, came up the Plym as far as Plympton Castle, at the foot of which was situated the Roman camp. Now, if so remarkable an elevation of the sea (sinking of the land) had happened during the Roman settlement, there can be little reason to suppose it would have escaped the notice of their historians, and had it occurred after their time, it would surely have received still more decisive record. Pytheas of Marseilles, whose narrative dates back before the time of the Roman invasion,

* Churches were not *generally* built till the time of restoration of peace after William the Conqueror was crowned, say about the year 1070.

† A passage in Virgil refers to a similar oceanic irruption affecting the Italian coast,—severing a portion of land and so forming the Isle of Sicily and the Straits of Messina.

" Hæc loca vi quondam, et vastâ convulsa ruinâ
(Tantum ævi longinqua valet mutare vetustas);
Dissiluisse ferunt cum protinus utiaque tellus
Una foret; venit medio vi pontus, et undis
Hesperium Siculo latus absidit, arvaque et urbes
Litore diductos angusto interluit æstu.

Æneid 3rd, line 414 etc.

mentions the sea around Britain rising eighty cubits on the land. In a question however of this kind which involves so much obscurity, the object must necessarily be, to assort together as many geological phenomena as can be consistently made referrible to, and accordant with some acknowledged points of history, or historical epochs, where these seem to lend assistance in the investigation.

It certainly appears that this primitive disturbance of the ocean after the period of the Flood was not of a violent description, for it has been ascertained that the submerged trees at Mount's Bay, as also those discovered by Dr. Fleming in Scotland, and in other situations by other observers, are in an erect posture, a circumstance incompatible with the exertion of great force.

In this idea of a gradual though in great measure quiet mode of ingress to the sea, I am supported by the fact of the absence of marine remains from these deposits, proving, that during the event no forcible irruption of the ocean, such as would transfer and mix its own contents with the productions of the adjoining land, took place. It has been found also, that the fresh water plants and shells, such as were the products of the swamps and low lands wherein these forests were situated, are in some instances still preserved, and the leaves of the trees have, in I believe all cases, been found to have accumulated among and over the timber of these submarine beds, shewing clearly, how little the sea interfered with them at the time the usurpation was effected. The clay moreover, or soil in which the trees grew, is in many cases still found around their roots and the fallen trunks and limbs, and the occurrence of this stratum certainly gives these submarine deposits a relative age with regard to what are termed our "diluvial reliques."

From evidences afforded by this neighbourhood, or rather by the elevated beaches (which contain specimens of shells of existing species) presented to view in the cliffs of both south-western counties, it would seem that the rise must have been considerable and temporarily fixed.* The usual height

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* The height of raised beaches referrible to a modern epoch varies greatly; at Coquimbo they are said to be raised above the sea 400 or 500 feet: recent shells were found by Mr. Lyell from 30 to 90 feet above the Baltic. The average elevation in Devon, Cornwall, and Somerset, is found by De la Beche to be 40 feet.

Ancient beach on Plymouth Hoe. Owing to the recent alterations on the Plymouth Hoe this object of curiosity has been nearly removed. Going however lately (May, 1839) to look for any remnants, I found that at the "Western Hoe" at an elevation of *about fifty feet above the present sea*, the quarrymen had laid open to view a most interesting section of a remaining portion about *twenty feet in depth*; the circumstances I noted to be as follows:—the entire body of the beach rested on *smoothened rock*; it *sloped* very gently seawards, that is to say southwards, and had *no inclination to dip east or west*, as if the upheaving force had tilted it to one of those points; the mass consisted of *thin beds or layers*, from one to four or five inches thick, *regularly superposed or stratified*, and varying most systematically *from extremely fine sand to tolerable-sized pebbles*, the several sorts *never appearing to exchange position*, but keeping uniformly to those beds to which they belonged in regard of size; each layer formed a *solid* cake, increasing in compactness towards the centre of its depth; the *layers also were greatly cemented together*, but not so firmly as were the components of each distinctive stratum; the *top differed from the rest* in being several feet thick, and in being composed of sand of uniform size, and in great measure loose or incoherent. My idea is, that such phenomena different as they are from those of present beaches, imply a *gradual elevation* of the sea—(sinking of the land)—a continued series of *trifling impulses*, whereby fresh and varying deposits were with *short intervals* superposed; that *no tilting* to the east or west occurred during this upheaving as supposed by some, but that *all the elevations* betrayed along the Hoe east and west, are *consistently referrible either to one* of the ancient beach on Plymouth Hoe (now nearly destroyed) is about 30 feet above present high water mark. The rock on which it rests is often smoothened, and specimens of *pholas dactylus* are

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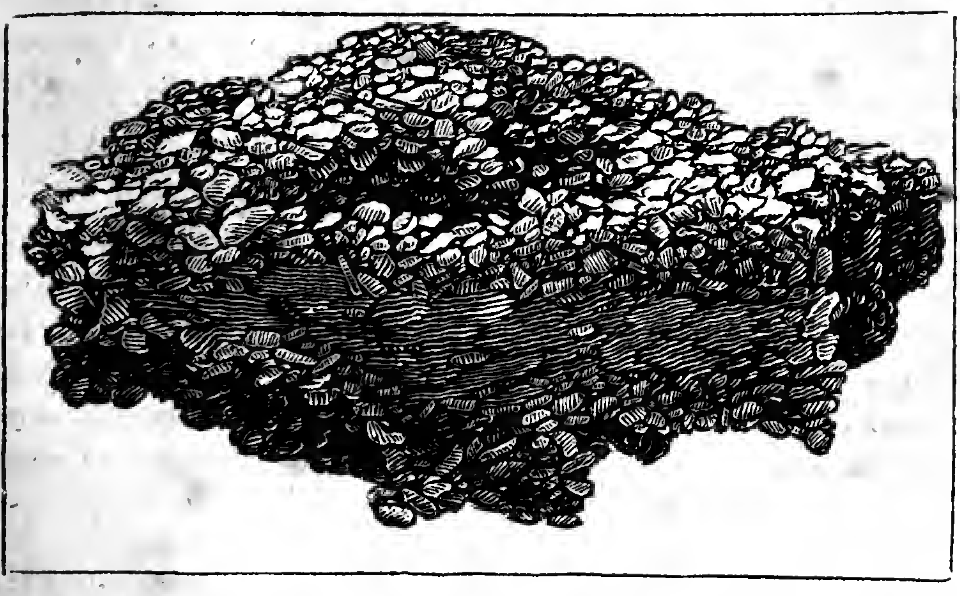
slope of beach, (as some may think, though I incline to think *not*) or to the *graduated mode of elevation*, so especially indicated in that one spot just particularized.

With regard to the accurate assortment of the pebbles constituting the various laminæ of this ancient beach, it appears to be occasioned by the different power which the sea employs at the times of its agitation, since, the degree of force which it has will occasion a difference in the size of the bodies which it throws up,—when the momentum is considerable, the rush of fluid disdains the smaller substances, but selects those presenting more considerable surfaces, and vice versâ. Where extensive areas of beach occur, this fact is apparent in the different sizes of the pebbles found assorted as it were over its whole extent. Near Portland in Dorset is a beach of this kind, and so regularly are the pebbles disposed over it, that at night, fishermen or those frequenting it, by merely examining with the hand the size of the pebbles on which they are standing, can tell with tolerable accuracy on what part of this extensive line of shingle they are situated.



Piece of the ancient beach, shewing the consolidation of its strata towards their interiors.

found in it; and the roundness of the pebbles, and existence of these shells in the smoothened rock, sufficiently shew that the sea rested there awhile, ere it again sank towards its future bed. A few years ago a portion of a *Roman Galley* was brought to light in excavating at Newnham Park, which again shews how high the sea was situated at that time on our coasts, *or at least* to what extent the river was there navigable on occasion of high tides, and throws some light also of a negative description on the period of the elevation.*

That its action was not violent may also be further gathered from the very partial dislodgment effected on the "Diluvium" of our neighbourhood. It indeed may have washed away from their beds a vast number of pebbles, and scattered them on what would subsequently be, the shingles and beaches of the present day, but it had not sufficient power to *obliterate* what we may now rank as the *traces* of diluvial accumulations.

Mr. De la Beche has as I think on too trivial grounds endeavoured to shew, that the beach on the Hoe was raised prior to the time of the encroachment of the sea above mentioned, and during the residence of the hyænas, rhinoceroses &c. whose bones are found deposited in caves of limerock, and of which I have already made record. Now, I submit to the readers of that extremely useful book the "Geological Manual," that the circumstance of the occurrence of "angular fragments of limestone" on the old beach is not sufficient evidence that it was raised during the period of those creatures above whose remains at Oreston ever so large a quantity of these fragments have been heaped, I see

* See an account tending to a similar conclusion in respect of Scotland, in Lyell, vol iii. p. 267. A Roman Galley has also been dug out in Romney Marsh very lately.

no reason why these pieces could not have been derived from the cliff at the time the sea rested there, or why in *very modern days* they could not slip " by the force of gravity, assisted by meteoric causes" over the ancient beach. But, allowing even that this circumstance occurred at the time of the " great weathering," or that it affords a relative date for the origin of the beach, which it certainly does *not*, I feel emboldened to observe that according to Mr. De la Beche's own most cautious method of induction, the vast assemblage of fragments of limerock at Oreston caves, on the Hoe, and elsewhere, could not have received those positions by a cause less considerable than a body of agitated water, such indeed as would annihilate existing tribes of beings, and per force hurl them, *together with* fragments of rock which the element had severed or dislodged, into caves and hollows of the earth. I therefore entirely differ from this learned author in his inference " that the beach was raised during (he should have added by mere logic—*or prior to*) the existence of these animals—hyænas, rhinoceroses, &c."—and there is not only in this portion of his work deficient proof of his own shewing, to this effect, but likewise deficient probability from other reasonings,—for, if he would wish to connect together the elevation of this beach with the existence of the above named animals on our land, I remind those who have faith implicit on the entire contents of his book, that while the shells in this said beach are admitted to be identically the same species as those now in our sea, the cave animals of our district are not (neither does Mr. De la Beche think they are) related to existing species further than through analogy ; and it is well known, that this difference alone would be sufficient with many geologists to excite a strong suspicion, if not a confirmed opinion of the latter animals being referrible to an æra more ancient than that to which the former can be ascribed; and in short, it leaves with other reasons, grounds for consigning the beach to the same epoch as that wherein the forests now submerged and containing proofs (as Mr. De la Beche acknowledges) of belonging to the present æra, flourished. In truth, admirable as is the "Geological Manual" as a book devoted to a consideration of *facts*, and the more valuable as being destitute of a *leading theory*, its author has overlooked the necessity of making *local facts accord together in respect of time, and making them harmonize so far as possible and to the needful extent with the general geology both of this country and of the whole world.* Accordingly, superior as Mr. De la Beche's reasonings are to the generality of mens', he appears to me from this anxiety to provide a special theory for every case and to the exclusion of general considerations to have departed occasionally from his rule of careful induction.

It must be confessed however, that the discrimination of ancient beach from those deposits referrible to sudden oceanic ingress, or to the action of waters overspreading and devastating the land, is far from easy,—their characters so often approximate, they are so often situated near together without presenting defined characteristics, they would both for instance be accumulated greatly in hollows, clay *might* perchance escape into the substance of the former structure, and as previously intimated, not only would diluvium occur at a variety of elevations, but likewise ancient beach might in the progressive rise of the tide to which it is ascribable, be accumulated at a variety of heights above the present sea-mark. So complex are Nature's operations in the department of geology, so approximating and interchangeably associated the features of the various substances and phenomena she presents.

Yet notwithstanding these difficulties it certainly seems that the appearances of the ancient beach of Plymouth Hoe, and the identity of the animals connected with it with those now existing, provide for it a relative date,—an age separate from, and indeed posterior to, that of the cave-animals.

To resume :—With respect to the retreat of this tide, I conceive that if it had been *by successive steps*, these beaches around the cliffs of Devon and Cornwall would certainly be traceable downwards to the present ones, which they can*not*; and it is accordingly probable, that as the movement of the land in its retreat must have been dependent on a similar cause to that which produced its ingress, both actions were accomplished in one manner, namely by quiet, continuous subsidence, and quiet and continuous elevation.

To trace this retreating tide to its ultimate level is a matter of no small difficulty, because it appears that during the last centuries, the sea throughout the whole of the northern countries has been continuedly falling from the land, besides which, an effect of no mean magnitude is exerted on the bulk of our neighbouring sea by the great diminution in the size of our estuaries and inlets, and a third power of an opposite character to the two former consists in the vast bulk of the Atlantic waves which are perpetually driven towards the south-western parts of England,—tending to increase somewhat the proportion of sea by which they are encompassed. So that, whilst the accumulations of alluvial matters in our estuaries, and the diminished bulk of our rivers as compared to their ancient condition, and the gradual sinking of the ocean from the coasts of northern countries, would inevitably tend to reduce the height of our tide very greatly, a partial counterpose to this reduction is afforded by the pressure of the Atlantic wave which especially in more modern times has committed devastations and encroachments to no small amount. In consideration of these contending circumstances, I repeat it is impossible to say whether the sea subsequently to the great elevation above referred to, retreated to an intermediate position, or to a level very near that at which it now stands: to decide such a point, it would be requisite to ascertain the comparative power of the above circumstances throughout the intervening time.

Before going further, it is requisitc to observe that we are not of necessity limited to the supposition of only one marine elevation and depression. In modern centuries—it is well ascertained from chroniclers,—this country has been visited by numerous floods and earthquakes, which are indeed synonimous expressions for convulsions or movements conducted in the interior of the globe. The "Saxon Chronicle" records a flood of great extent occurring in 1099, and affecting the southern counties in a remarkable degree. There is a tradition among the inhabitants of the parish, that the Church of Revelstoke, now situated on the very cliff, was originally three miles inland, and as the Churches generally around the coast of South Devon are considered by antiquarians as among the oldest of the kind, and as it is particularly unlikely that a fabric of this description should have been built in such a precarious position, I think we may infer, that it together with some other of our Churches in similar localities, were reduced to their littoral situations during the flood above named, when also it has been conjectured, a part of the estate of Earl Godwyn (now "Godwyn Sands") was swallowed up. Certain it is, that in Bigbury Bay off the spot where Revelstoke Church occurs, no anchorage can be obtained, the ground being shallow and rocky. It is a coincidence, that the second Church of

Perranzabuloe, now in *its* turn enveloped by sand through the violence of the Atlantic exerted on a low and exposed coast, is considered to have been built about the year 1100. Still further, I would observe that the occurrence of this flood so destructive in its consequences in other spots,—and as I have shewn, probably here likewise,—may have originated the idea among some, that it was in this comparatively modern epoch the sea enveloped the land between St. Michael's Mount and the Land's End, and overwhelmed the forests before spoken of. But, surely an invasion so remarkable in effect would have been preserved to us in circumstantial record had it happened in that æra. It would appear, that prior to the latest centuries the Church of Plympton St. Mary built in low ground, suffered very greatly by encroachment of the water of the neighbouring marshes, so much so indeed as to cause the erection of an elevated aisle on that side chiefly affected. For the same reason, the ancient Church of St. Budeaux on the banks of the Tamar was removed, and the present one built in its lieu. On the whole therefore it may be allowable to infer, that conjointly the flood above recorded, and the perpetual violence of the Atlantic, have succeeded in the more modern æras in restraining somewhat the tendency of the ocean to recede, and in effecting invasions on our coasts which have been preserved with some exaggeration in the hereditary traditions of succeeding ages.

With regard indeed to the invasions committed on our coast, the appearance of our cliffs will at once testify to their amount. When it is considered, that, consistently with geology and even with common reason, we are bound to admit that the hills and land generally on the shore originally presented the same smooth outline, and perfect and continued slopes and curvatures offered to the view by the land more northwardly or in the South Hams,—in short, that the land was formerly continued outwards to the sea in the manner of a gradual descent, (considered in the mass)—we see at once, how great an usurpation has been effected. In surveying the coast, it seems often as if as much as half of a hill had thus been gradually sacrificed to the domains of the ocean. The whole coast presents a continued series of small coves, and isolated, irregular rocks, produced by the constant ferment of the sea. We see also, instances of points of land being severed and becoming insulated masses, the structure of these being denser and more resisting than the removed material, such is the Shag Rock in Plymouth Sound. In another spot, the yielding of the rock has left a more considerable islet called the Mewstone, between which and the land adjacent, a very trifling depth of water remains at low tides, and perhaps not 100 years since, it might have been accessible on the retreat of the sea. A similar remark applies to St. Michael's Mount in Cornwall, though here, the marine action has occasioned but a narrow intervening strait.* Burrow Island seems to come but partially under the same rule with the two last cases, it appears originally to have been a hill belonging to the adjacent series, and slopes immediately to the land side, the wear therefore occasioned by the sea must have been but little in the intermediate space. The invasions of the sea are evinced differently on the northern coast of Cornwall, where, on some of the low grounds between the hills, vast hillocks of sand have been deposited, and are gradually being augmented, whereby, considerable tracts of pasturage have been lost to the agriculturist.

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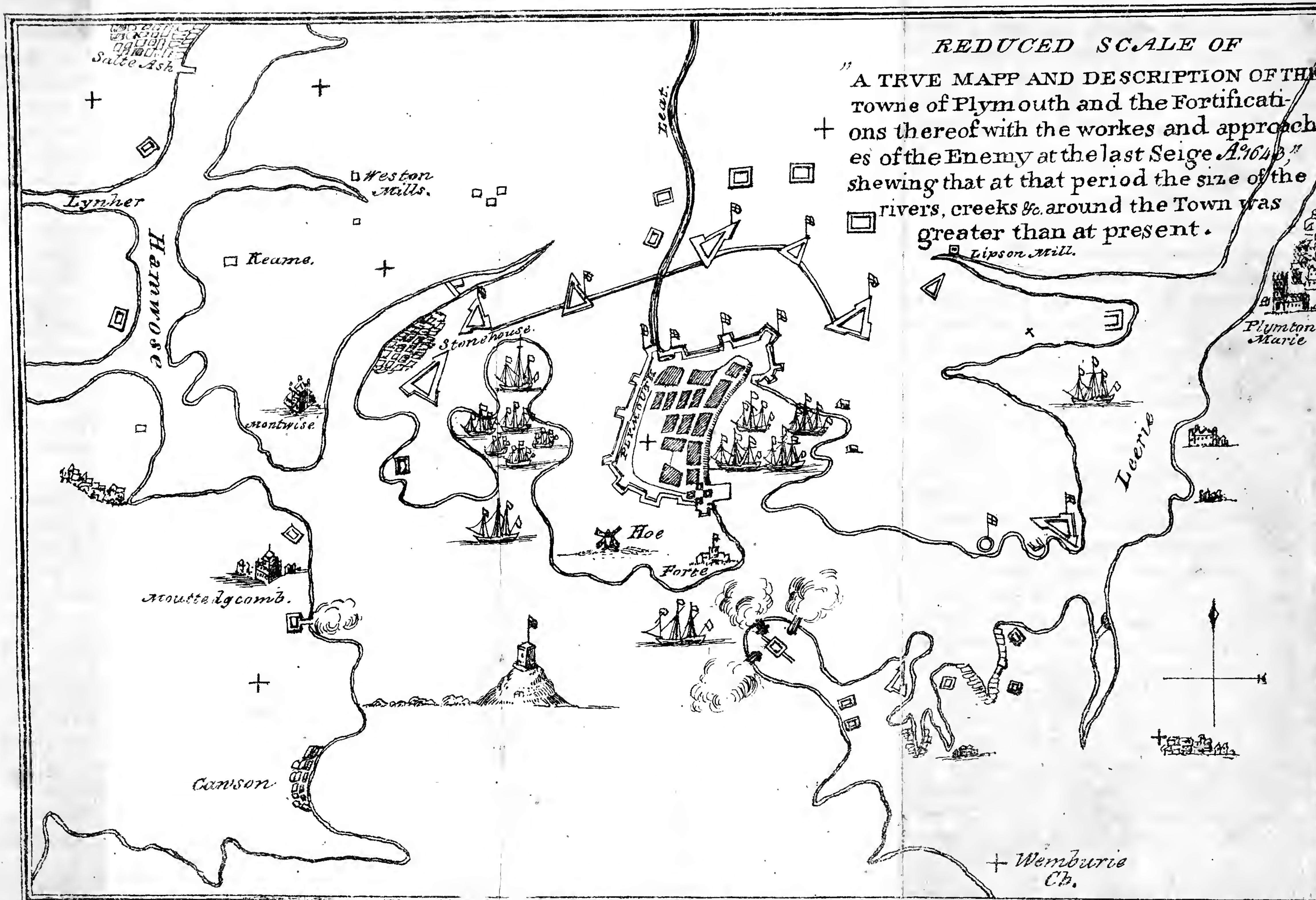
*Roman Coins have been found at the base of St. Michael's Mount.

We see within our own time, devastations and ravages of considerable amount committed on the occurrence of even minor floods originating in all likelihood merely in the force of a sea wind exerted during the menacing elevation of a spring tide. Altogether indeed, our exposed position relatively to the sea causes disintegration to be conducted on our cliffs with great rapidity, and there can be no doubt, the destruction would be still greater if it did not fortunately happen that our slate dips so generally towards the channel, and thereby lessens the battering influence of the waves.

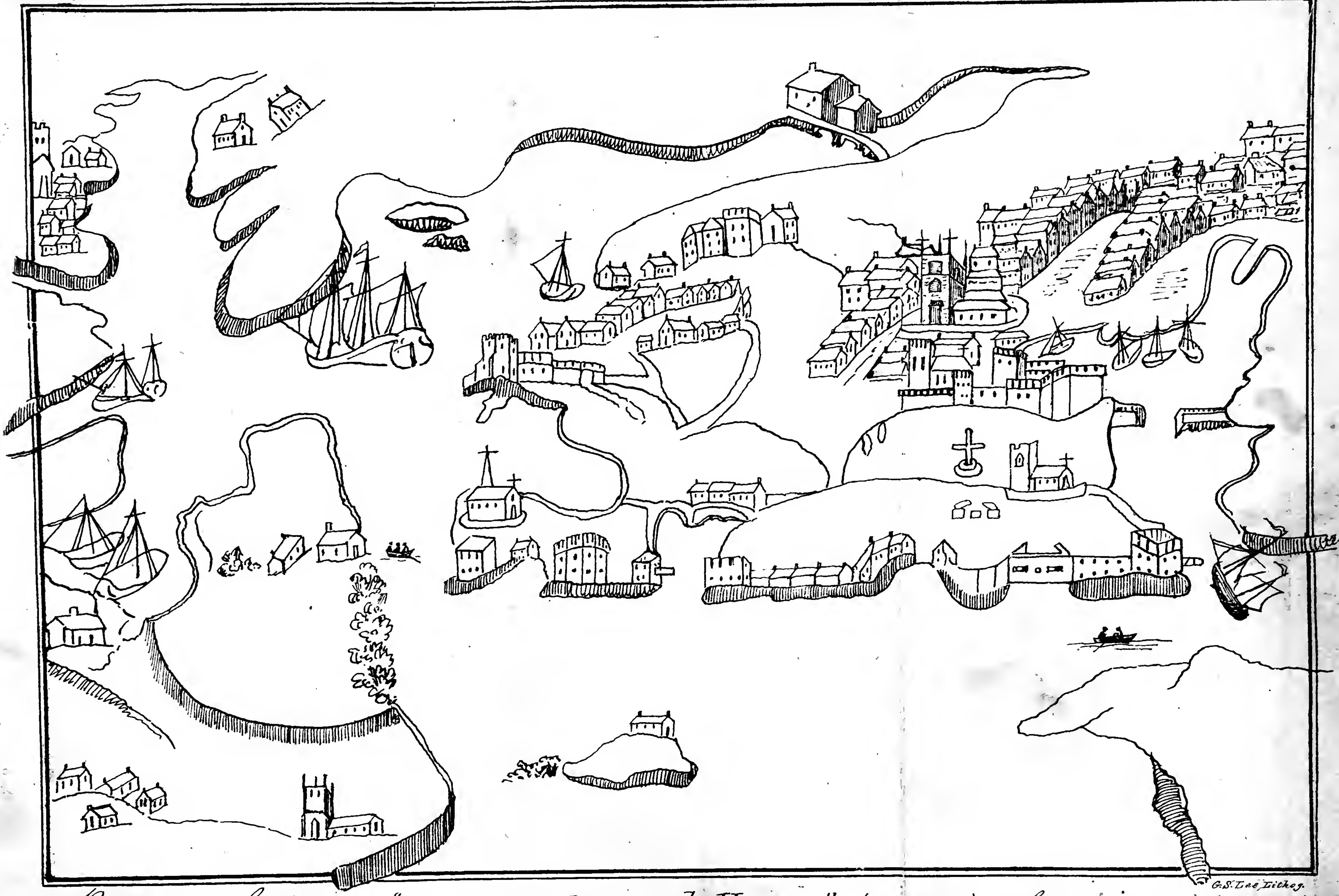
Modern authors with great propriety agree in attributing considerable geological effects to the discontinuanee of river courses, the filling up of estuaries, and still more, to the general subsidence of the ocean in the northern portions of the world; they have traced the results of these proceedings in the occurrence of marine matter inland, and in the gain of considerable tracts of land, especially of course, where the country is generally flat. I purpose now to examine how far these natural causes have extended themselves into operation in this immediate neighbourhood. At the time when the sea stood so far out as to admit of forests growing where now is deep water, the rivers were naturally continued outwards considerably beyond their present terminations; that spot now occupied by the Lara or estuary of the Plym may therefore have originally been the site of a sylvan district, with the river or its yet parent branches passing towards its ultimate abode, and flowing probably over the very surface of the slate rock which it has been found constitutes the substratum of this river bed at a great depth. On the rise of the sea in the manner which I have recorded, these woods would be overwhelmed, and deposited amid the shingle and debris naturally conveyed there by the ocean on the one hand, and by the rivers on the other. During this period it should be remembered, Dartmoor boasted of its forest, and since, the size or number of rivers materially depends on the quantity of wood in their vicinity, it is reasonable to conclude, that at that date, it yielded to the sea a far greater bulk of water than it now contributes. Old river courses are not unfrequently met with on the moor, and, in meadows through which our rivers in the South of Devon pass, an abundance of gravel and pebbles can be discovered for the depth of two or three feet;—proving, that at one time the size of the currents was far greater. I may add also to these last statements, that a large number of our vallies excite by their appearance strong suspicions that in the place of the little brooks which now traverse them, they were at the time above named, occupied by branches of those large rivers which Devonshire then contributed to the sea.

Still however, the quantity of matter deposited in our estuaries and inlets is wonderfully great,* and this circumstance, connectedly with the bodily retreating of the sea, has produced changes in the immediate vicinity of Plymouth very worthy of remark. On referring to the map here given, it will be seen that at the date of 1643, the proportion of water around the town was perhaps double what it now is,—and again further back about one hundred years, namely in the reign of Henry VIII. the proportion was still greater, as the reader will perceive by reference to the second map accompanying this description (which though it serves our present purpose, is from its age less satisfactory in outline than could be desired); so that, independently of

* A piece of oak *bearing marks of the axe* was taken up some years ago in sinking a shaft in the bed of the Lara, at a considerable depth. It may be seen in my brother's Museum, Plymouth.



REDUCED SCALE OF
"A TRVE MAPP AND DESCRIPTION OF THE
Towne of Plymouth and the Fortificati-
ons thereof with the workes and approach-
es of the Enemy at the last Seige Aº 1643,"
shewing that at that period the size of the
rivers, creeks &c. around the Town was
greater than at present.
Salte Ash
Lynher
Hamwose
Weston Mills
Keame
Leat
Lipson Mill
Stonehouse
Montwise
Plymouth
Hoe
Forte
Plymton Marie
Leerie
Mouttedgcomb
Cawson
Wemburie Ch.



Reduced Scale of a "Chart of Plymouth Haven," drawn in the reign of Henry VIII; shewing, in connexion with the other map, that the size of the rivers, inlets &c. around the Town has, since that period been continually diminishing.

the fall of the ocean after its very great elevation, there seems in modern centuries to have been a gradual retreat occasioned by the two causes above named.

One instance deserves especial record; by turning to the map of Charles 1st's time, the distance to which the Lara extends up, is seen to be considerable. The Church of Plympton St. Mary is there shewn to be on its south-eastern side, and perhaps at the distance of less then a mile from it. The Lara *now* extends up no further than Long Bridge, (or would reach that far if not restrained by an embankment) which is situated to the west of the Church at the distance of more than a mile and half. The stream from thence onward to the Church is very small, but the ground generally in the neighbourhood is swampy, and it is not a little strange that such a site should have been selected for such a fabric. The intervening streets between Plymouth and Stonehouse were a space in former years occupied by an ample creek, wherein vessels rode at anchor as our maps shew, and in fact, very lately in excavating, anchors have been dug up from that spot, and the original debris or mud of the creek encountered. The creek it is said was still employed in this way no longer than 100 years ago.*

I here quote from a judicious compiler, certain additional facts corroborative of my own argument. "From ancient records (Palkian MSS.) it appears "that an arm of the sea extended to the very walls "of Exeter; and the place where vessels lay at "anchor for the loading and unloading of all kinds "of merchandize, is still called the *Water Gate.*

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* There are certain small spots of the Town and its vicinity not included in the *Borough*, and not rateable, which is explained by the fact of the Borough having been defined prior to the retreat or exclusion of the sea towards its present site and boundaries.

"The best lands in the valley beneath the city "appear to have been once overflowed, and the "ancient boundaries of the stream may even now "be traced up and down the river."*

The following passage points to similar geological proceedings in another neighbourhood. "At Tiver- "ton, the alterations in the bed and course of the "river Exe are remarkable. In 1771, St. Peter's "Church and Tower were declared to be in danger "from the encroachments of this river, and that it "was navigable much higher than at present, there "is no doubt. Anchors have been found at Cowley "Bridge, far above the present navigation. Formerly, "mills were at work on the banks of the river a "little under the road towards this bridge, from "which spot, the water has now retired to a con- "siderable distance. In the suburbs of Exeter, "some of the lands now dry were once overflowed. "Half a century ago, a man digging for a well in "his garden in the parish of St. Thomas, found "first a stratum of sand, after this, several other "strata of different kinds; and under the whole "about fifteen feet deep, a bed of hazel leaves five "or six inches thick, on the removal of which, nuts "swam about on the surface of the water. Hither "therefore it should seem they must have been "drifted, and afterwards covered."† Did not other causes conspire, the mere "filling up of estuaries" would tend greatly to a retreat of the sea from those spots, and accordingly, De Luc‡ on this sole account argues that our estuaries were at one time much larger. Many centuries ago, there was a harbour at Seaton of considerable importance. Leland who wrote about the year 1538, takes notice of this fact in the following terms. "Ther hath

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* Moore's "Devon," p. 37. † Ibid. p. 29.
‡ Travels in England.

"been a very notable haven at Seton, but now ther "lyith between the two pointes of the whole haven, "a mighty rigge and barre of pible stones in the "mouth of it, and the river of Ax is driven to the "very est point of the haven caullid Whitcliff, and "there at a very smaul gut, goith into the sea. The "town of Seton is now but a meane thing inhabited "by fisharmen. It hath been far larger when the "haven was good."* "Less than an hundred" *(now nearly five hundred)* "yeres since, shippes "usid the haven of Budleigh or Ottermouth, but "it is now clene barrid"† De Luc affirms that the valley of the Otter has every appearance of having originally been a gulph. There are strong suspicions, that Bovey Heathfield has within comparatively recent times, been accessible to the sea,—the mineralized vegetation and clay formations constituting the bed of the estuary. Recent trees &c. have been exposed to view in the bogs, conveyed as it is supposed during storms and heavy rains. I have further been informed, that in late years, anchors have been taken up, a circumstance, which if true would at once put the question at rest. It is generally believed, that the Dart in former years was of considerably greater bulk beyond Totnes Bridge,—the tide reaching far up the valley, and constituting according to tradition, a large expanse of water immediately under Berry Castle. The meadows are now traversed by only a small stream in the spot so supposed to have been overflowed.

It would be natural to ask, whether similar remarkable changes are not evident in the other rivers of the neighbourhood. I am not aware of any other cases which *so strongly* evidence the change I have been endeavouring to depict, but the natural

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* Leland Itin. vol. iii. p. 38—47, quoted in Moore's "Devon" p. 36.

† Ibid. vol. iii. p. 46.

lowness of the ground from Catwater onwards to the bottom in which the above named Church occurs, is the very manifest reason why so large a volume of water reposed there in former years. St. Germains was a cotemporary small emporium of the Romans together with Plympton, and their vessels were enabled to penetrate as far up as the Castle;—this circumstance is consistent with the flatness of the country from Hamoaze upwards to the town, and at this day, like the former case of the Lara, the river St. Germains is reduced to a much less considerable size. In other directions however where no such extensive flats occur, evidences are yet found of retreat on the part of estuaries passing up between closely approximating hills. The Rev. J. Yonge has kindly written me the information that he bored close to his house in Puslinch meadow to the depth of 40 feet, "and brought up black mud an evident deposit." This meadow is some little way from the limits of the estuary as it now stands, (or would stand if not restrained by an embankment) and the circumstance brought to light by Mr. Y. marks the retreat which has been progressively taking place in modern times.

Alluvial lands indeed, are altogether greatly on the increase, and the Erme river seems to me to indicate this fact conspicuously both by accumulation of mud in the smaller branches, and by the bulk of sand cast up by the sea towards its mouth. Its possession of a "*bar*" or bridge of rocks at the entrance greatly favors this collection, since, the quantity which the tide in ordinary cases conveys with it on its retreat, is here at once retained after its first introduction. The Exe furnishes an example of the same kind, owing to the existence of a "*bar*" there also, while the Dart having none, is enabled to cleanse its bottom on each egress of the tide, and the river altogether affords excellent ground for anchorage even of the largest vessels. On the other hand, the Avon offers a decided case of contracted dimensions by the accumulation principally of sand-banks, which are here of large size. To all appearance, this river in former years was of considerable breadth, but owing to general oceanic retreat, deposit of mud, and the occurrence of a partial ridge of rock at his mouth, it has now given place to a broad expanse of sand overspread with maritime vegetation. On the short but very high bar of rock which stretches into it, there is a large and in some spots very deep deposit of fine sand, accumulated either at the period of the general elevation of the sea before spoken of, or during some violent storm and tidal elevation; once only in the memory of man has it been covered, viz. in the great storm of November, 1824, when also, the sea had free access to Slapton Ley.

The observer of such matters affecting the question of oceanic usurpation and retreat need to be particularly careful to frame his conclusions upon the *aggregate* of collected evidence, since it not uncommonly occurs, that *partial* evidence indicates opposite results to that which might accrue from a consideration of conjoint facts. In the promotion of a general result Nature may effect circumstances which if separately considered would point to a conclusion exactly opposite to that which is going forward on the larger scale, thus, the successful attacks made by the ocean on the coast in exposed positions furnishes no argument against general oceanic retrocession and the filling up of estuaries &c. by alluvium, and so likewise, the information which the traveller obtains at the mouth of the Avon of the encroachments which the sea is now effectuating on the sand-banks, proves nothing against the general deduction that the sea is in the mass retiring and heaving up more and more of this very material, whilst in the back ground also, the river gains every facility for alluvial deposition.

When the lowness of the slate tract which passes to a junction with the limerock of the coast from the higher hills of the South Hams, and which constitutes the chief site of Plymouth is considered, it must naturally be inferred, that not only was that spot submitted to submersion at those periods of sudden ingress of the ocean which I have before spoken of,—the sea occupying the bays and creeks of the slate hills at our back,—but that even in very modern times anterior to the building of the town, and before the filling up of estuaries and the general retreat of the northern seas had sufficient influence to keep the tide to somewhere near its present boundary, it has been gradually retiring from this tract, and at the first building of any settlement had retreated towards the space between Plymouth and Stonehouse, and which as above said, constituted for some time and no longer than a century ago (?) a creek for anchorage of small vessels; according to which supposition, the lime hills or ridge between the sea and the town would have been insulated, as also perhaps that range fronting Stonehouse and Devonport, and the sea moreover occupying as just said the deep and graceful sinuosities and defiles between the slate hills, would stretch up behind the land directly north of Plymouth at Lipson on the one hand and at Stonehouse Mills on the other, and these two creeks approximating towards the rather low tract (Mutley Plain) intervening between those points, would occasion a near insulation of a small series of elevations whose actual separation from the surrounding districts by vallies nearly on a level with the estuaries, and by portions of water still existent, remains also particularly apparent in our own day.

But in connexion with a presumed generally greater size of our rivers in former years, and the conclusion more particularly of a bodily rising of the tide at one period, we are brought to the necessary inference that the vallies and *combes* opening to the sea and having their floors but little above its present level, were once parts of its domains, or at least the victims of its occasional intrusions; the romantic combes on the coast between the rivers Erme and Avon seem to me good cases in point, though I feel bound to say that in these and all such instances there is a lack of decisive evidence in the accumulation of "Alluvium."

I conclude therefore in regard of the foregoing contents of this chapter, that in the lapse of recent centuries the sea around us has been gradually diminishing in bulk, and that it still continues to retreat. And with respect to the main question here discussed, I am of opinion that at the termination or soon after the occurrence of the great Deluge the sea stood much further out;—that forests of great extent existed in former years where now are estuaries and the sea itself;—that by some inward convulsion of the earth, the sea rose and usurped the lower lands, and imbedded the forest tracts in alluvial detritus and soil;—that when by some recurring inward movement of the globe this elevation ceased, the waters retired towards their present abode, somewhere intermediate indeed between the post-diluvial sea-level and the height attained to during that disturbance which dislodged them and heaved them to their transient exaltation.

Very much in connexion with the present subject of alluvial occurrences and substances, is the enumeration of the pebbles which are so abundantly accumulated in our rivers and on the sea coasts, because, although circumstances were in operation anterior to the Deluge which would occasion the formation of the same pebbles as we now find, yet, they are unequivocally illustrative of the power exerted on stone by the violence of river water in its rapid descent over mountainous tracts, and of the still greater violence with which the waves smoothen the masses of rock which through them have been severed from the beds to which they respectively belong. No kind of rock seems proof against the disintergating agency of propelled water; the beds of our rivers and the beaches of our neighbouring sea are strewed with a profusion of rounded fragments of every species of stratum of which the county boasts. Pebbles of granite, schorl, and various sorts of trapp are carried from the central districts of the county onwards by slow movements to the estuaries, huge granitic blocks are slowly undermined as they repose in their beds, and are eventually during some winter flood conducted into the body of the stream, where they serve greatly to restrain the impetuosity of the current, and in consequence its devastating influences on exposed land. During those periods when such extraordinary elevations of our rivers occur from heavy falls of rain or overflowing of springs in the moorland districts, the pebbles may be heard striking against each other in their progress with the torrent, the larger blocks of moorstone, limestone, and trapp are also gradually hurled forwards, and in the hurry of the streams on these occasions they not unfrequently force new passages in soils readily removed. In the moor itself, the stones and blocks lying in the beds of the streams are greatly rounded, proving the rapidity and violence of the descent of their waters during heavy rains and sudden risings of the springs.* A large assortment of various kinds of slate, lime, and sandstone may be collected from the beds of our rivers at those spots where in consequence of an eddy, accumulations of their products are heaped up. On the shores in some spots are found numerous pebbles fallen from the "diluvium" on the incumbent cliffs, to which I have before alluded, but in addition to these, fragments are washed up from the depths far out and lodged amid the immediate products of the shore;—*red sandstone* of various degrees of hardness, *greywackè slate*, *clay-iron stone*, *basalt*, *trapp*, occasional blocks of *conglomerate*, *porphyry*, *limestone*, &c. are therefore the pebbles most commonly met with on the strands, and besides those masses coming under the denomination of pebbles, there are in some spots a number of blocks of considerable bulk piled up as it were in rude aggregation, the consequence of storms of a power and violence incalculable. The mere accumulation of these is not however so remarkable as the fact of their being usually so jamed in and locked together as to be quite fixed, and it is well known that where they are thus confined, it would be requisite to break them

* In respect of the force of rivers at their junctions with the sea, few perhaps are aware of the immense power which they exercise throughout their entire depth and even more at the bottom than at the surface; the swiftness and force are also augmented when the passage is narrow. The power of the tide at "Cremill Passage" is well known, and owing to the constant scouring which it effects, there is greater depth of water there, than in any part of Hamoaze or of the Sound. The matter however which the tide was wont to bear outwards to the body of the sea is now by the erection of the Breakwater intercepted, and whereas Plymouth Sound had once a gravelly and sandy bottom in all directions, the channel is now gradually being choked up towards the middle by a bank of mud corresponding to the breadth of the structure which now crosses it.

with a sledge hammer in order to remove them. A very similar illustration of the same kind of *peculiar force* which the sea thus exerts may be derived from the most diminutive sea shells situated in "shell sand." In these we continually notice grains of matter blocking up their mouths much to the obscurity of their characters about that part, and on application of a penknife or pin to the intruding body it is found to be so impacted as to resist the greatest exertions at dislodgement short of fracture of their peristomes.

In a valley not far from my residence, among the pebbles which had accumulated there in the course of time when the river which traverses it was of greater size, were found some few years ago, "*tin pebbles*" or small rounded blocks of tin ore tolerably pure, and it is further reported that the men occupied in the discovery of these, occasionally detected bits of *gold*. The remains of ancient *stream-works* occur at several spots along the course of the Yealm, two of them near the village of Yealmpton.

Those geologists who are proselytes to the new doctrine of Lyell, will doubtlessly look for illustrations in our district of the supposed power of rivers to cut extensive gorges in rocks, and will perhaps point to the passage of the river Lyd at Lydford Bridge as a beautiful instance of the force of river currents. I feel persuaded that our county can produce but very limited proofs of the cutting power of streams even where the land would apparently suffer it without great opposition, and certainly, we can shew no instances indicative of the ability of rivers to effect *important* geological alterations—in short none but *secondary* geological results. With regard to the passage of the Lyd, I have no question but that the force of the torrent more especially of course in winter, has produced some erosion of the rock, and a deepening of that most romantic and beautiful chasm across which the bridge is thrown, but I can by no means admit as some have, and will, that the entire gorge is the production of the river, for besides being opposed to my conception of the utmost power of a mountain torrent, such an idea involves the anomalous conclusion of the stream having undergone a general sinking from its source onwards, an idea indeed which likewise involves the conclusion of a general alteration, or sinking in the surrounding tract of country, since, the depth of the river's bed in its course, save at this one spot, is not unusually great. In my own mind I entertain no doubt that this fearful cleft is a disruption of the schistose stratum produced during some subterranean igneous action on the "primitive" and internal rocks.

With greater success however, will the inquirers after the influences of modern causes of geological change on the very surface of rock appeal to our district for corroborative proof. Like the effects which the sea produces on every sort of rock, but more especially on the schistose strata, there is a testimony set up in all directions of the superficial destruction of rock which time in his unwearied efforts at devastation has *ever* committed through the medium of the disintegrating properties of air and water. This lessening or "*degradation of land*" may be apparent to a close observer every where, but to those who desire decisive evidence on the large scale, must be shewn those denuded or as it were insulated masses of quartz rock appearing through the midst of slate in certain spots towards the coast; these doubtlessly were once concealed by the same material as they are now supported by, but owing to the loosening qualities of the elements, bit by bit, atom by atom of the softer rock has in the lapse of ages been abstracted, and disclosed the denser substance to view.

Not to dispute the efficacy of existing physical operations on the superficial portions of the globe, one axiom with me is—in direct difference from the new theory of the identity of ancient and modern causes of change—to draw the line of demarcation between the two, feeling satisfied of their perfect incongruity, and of the absence of those superior agencies which apparently operated in the former. Doubtlessly, the commoner properties attached to matter and motion have ever been the same from the first ages, but, to account for the introduction of new principles, new combinations, and new and stupendous influences, we need allow the introduction also of a power which in latter æras has not interfered. Can the chemical affinity and cohesion of particles as they exist in our ancient strata,—can the combinations of heterogeneous rocks, as evinced among a great number of formations,—can the appearance of new materials on the earth, carbonate of lime for instance,—can the uplifting of our ancient rocks,—can these, and other original changes of the earth be really ranged as collateral actions with those now witnessed? If however we *disregard* the modern changes of our globe we assuredly shut our eyes on phenomena intrinsically important, and may probably confound with primeval conditions, modern circumstances and substances incongruous therewith, so far at least as system and theory are concerned. It has accordingly been my endeavour to give due weight to those recent changes discoverable with us, during the preceding pages devoted to the second part of the geological department of this work. To theorize consistently with respect to our grauwackè rocks, I found it requisite to withdraw all confidence in the system which forces present agencies to play a part in causing their production and the phenomena of their deposit; I view the matter in connexion with a supernatural cause acting on the earth and infused into the materials employed.*

Amongst alluvial deposits is reckoned *peat*, a substance composed of decayed plants peculiar to damp soils. Of this alluvium we have an abundance on Dartmoor and its vicinity; where it has attained to some considerable thickness it is cut into turf, which when dried is used in the parishes of, and

* In Mantell's "Wonders of Geology" a plate is given of some ancient coins imbedded in iron-stone, shewing of course the action of causes now existing, equal in that instance to what has also occurred in very ancient periods. A case of the same kind though far less decisive has come under my notice, and may be here introduced as illustrative of the geological changes actually proceeding in our own day. A mass of stone of curious shape was picked up on one of our beaches, and it being uncertain in character was afterwards broken in order to view the interior. Its centre was a horse-shoe greatly eroded, around which had gradually congregated the sand of the shore to a considerable thickness, and with so great solidity and compactness as to wear the appearance of the commoner and less dense sandstones of the Devon coast. This fact therefore even alone will justify a belief in the limited geological operations now proceeding, though they are *for the most part* different even in quality and character, not to say amount, from those which were conducted under especial auspices in ages past.

If the reader will refer to p. 58 of the above work, he will find what I was unaware of till after I had written the preceding paragraph, namely, that a *precisely* analogous specimen was in possession of the author, and that he attributes the consolidation to the ferruginous matter distributed through the mass,—it is termed indeed "ferruginous conglomerate." I may here also add, that in the sister county of Cornwall a most remarkable proof is afforded of recent operations in nature, by which a rock is at the present time in an actual state of formation, and similar in its composition around the moor for fuel. Where this peat, or the old soil of furze-brakes constitutes the land of enclosures, a free admixture of lime seems not only advisable but requisite for the procurance of crops, as I have noticed elsewhere. These peat beds when cut or disturbed are reported to vegetate anew.

In this class of formations, also may be ranked the soils and deposits formed from the solution, disintegration, decomposition and separation of the looser fragments of rocks by existing causes, chiefly atmospheric. The granite of Dartmoor where it contains a superabundance of felspar, gradually decomposes, and varies in softness down to "*porcelain earth*" which may be cut with a spade. Many parts of the moor present extensive beds of this substance, and one found of late years near Shaugh employs at present a great number of men in the process of casking it for exportation.

Dolomite is susceptible of a similar description of decomposition or softening, as I have noticed at Yealmpton both in large quantities and in mere superficial alteration of the stone by the action I believe of the water of the soil and air.

The variegated sort of *trapp* is from its comparatively loose texture liable to disintegration from the

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to the above mass which has a horse-shoe for its nucleus. On the northern coast of Cornwall so greatly exposed to the fury of the winds, vast quantities of calcareous sand are continually carried to the land, and form districts of hillocks of this material. In some spots it becomes consolidated by the infiltration of ferruginous particles derived it is presumed from the adjacent ancient rocks, and so great is its density as to be even used as a building stone. "The infiltration of water thus impregnated, Dr. Paris "observes, is a common and extensive cause of lapidification; at "Pendean Cove, granitic sand is gradually hardening into a breccia "by this process; and in the Island of St. Mary, Dr. Boase has "noticed granitic sand becoming indurated by the slow action of "water impregnated with iron." see p. 71, Mantell ut supra.

air, and is readily broken at its surface into small fragments by implements of husbandry coming into collision with it. These fragments are peculiar in being of a somewhat rounded figure, and on striking them, they are found to consist of continued coatings like an onion; these concave pieces gradually moulder down into soil, and the remaining nuclei or centres not broken down into the same hollow fragments remain in the ground, and by atmospheric influences as well as by the blows received in the operations of husbandry soon acquire a very rounded figure, and may excite surprise and speculations of various kinds in the minds of persons who have not proved the great susceptibility of this rock to decomposition and rounding. The soil it constitutes must be of very indifferent quality.

The *schistose rocks* are especially liable to disintegration, decomposition, and fracture, or loosening of parts at their surfaces. Compact slate or grey dunstone, loosens most readily at its surface on every fresh exposure, or disturbance by the plough or pick, and falls into dust, or small pieces in proportion as it is moved about and exposed to the action of the elements, forming eventually a good soil for general purposes, called "Dun-soil" or "Dunland." Several varieties of slate also are prone to dissolution and softening; some of it, where exposed to continued damp, gets as soft as cheese, and if decayed wood be at hand, the rock moreover acquires a black colour by infiltration of carbonaceous particles. A great deal at the surface becomes light brown and hoary, through removal of original colour by exposure to the sun and air, and there is one coincidence with this worthy of note, that as fossils are ordinarily found towards the exterior of our rocks, or the surfaces of their beds, so they are not uncommonly seen in the substance of decomposing or decomposed slate. The generality of slate rock suffers disintegration, and especially such as consists of conjoined small pieces, and the whole of the soil thus formed is of considerable value in general agricultural affairs ; the practice however of mixing lime with it, must not be understood to have any useful chemical effect, though in the first instance of this soil being brought into use for for farming purposes, a small admixture of that substance may be accounted necessary to supply that proportion required by all plants, but especially corn and vegetable crops.

A little while ago, a flattened oblong stone was handed to me for examination, which had been dug out of clay with many fragments of limestone, the whole resting on a bed of limerock in the parish of Plymstock. From its great weight, its having a crust or envelope, and from bearing a strange impression in one part of it, I hoped I had found a meteorolite, and took it accordingly to be examined by Mr. Prideaux of Plymouth ; though at first disposed to favor my idea, he at length, after due investigation, decided on its being "*magnetic iron stone*," and the only curious portions of its history were its having the impression or regular shaped pit, and its being found in such a situation far removed from any bed of this kind. I named to Mr. Prideaux at the same time, that near the spot where this stone was discovered, another, equally curious in appearance, had been taken up from a depth of several feet in the clay some few years ago, and upon giving him the following account of it, he pronounced his opinion that it cercertainly was a *meteorolite*. Unfortunately the description was afforded from memory, the specimen having been most provokingly lost; it was of the size of the head of a child a year old, and might have weighed eight or ten pounds, the surface was cavernous, or excavated into pits of irregular shape and size, a powdery, though somewhat unctuous, substance covered the exterior, it had I believe, an external coating, and the general mass was dark grey colour within, but not shining. Allowing this to have been a meteorolite, it is the first that has been found in our neighbourhood, or perhaps in the the county, and though there is a want of *natural* evidence of a decisive kind to support Polwhele's assertion, that *volcanoes* have been numerous in Devon, and that there have "been a few (though not very destructive) *earthquakes* in former years, this meteorolite certainly takes its station as an indication of one of the more terrific agencies of Nature with which our county has been visited.

There is yet one other illustration of recent geological operations to be included in this chapter, this consists of a *petrifying spring* at Hooe near Plymouth. Calcareous matter is so abundantly deposited from the water of this stream as to incrust most liberally substances which fall into it; they acquire after a short time a beautiful white crystalline envelope, and eventually become dense and stony. A great proportion of our springs appear to contain a large amount of calcareous matter, which thus renders the water "hard" as it is termed, and which accumulates as every one knows, on the sides and bottoms of tea-kettles. Although these springs are so often found to rise in slate rock, as indeed happens with that at Hooe, the water probably in its rise encounters lime-rock, from whence these limy particles are derived.

Throughout the whole series of epochs of the earth, atmospheric and other natural agencies have uninterruptedly exercised their powers in decomposing and converting into fragments the exposed surfaces of every description of rock. This has been called the "*weathering of strata*," and there are examples of it very evident to the most casual view throughout our district. In several of these strata however, and more especially in limestone, a vast aggregation of small blocks (not seldom fossiliferous) rests on the main body of the rock in so regularly disposed a manner as to lead to the presumption that they were originally so placed, and that the rock has not been "weathered" into this condition. In some spots, limerock at its surface appears cracked into numberless small rhomboidal fragments, owing I believe to the access of damp, air, and heat, and perhaps owing also to a less degree of density than belongs to the interior of the stratum. At the period when our strata were disturbed by subterranean Plutonic convulsions, these fragments originally deposited on the solid beds or severed by disintegrating causes, were further removed, and perhaps launched into lower situations. Again, at the period when a body of waters overspread and swept through the country, many of these fragments were carried from the beds to which they belonged, and lodged together with clay in other positions. Among the fragments which surmount lime hills, may be discerned portions of rock totally different, so that to some extent these accumulations are not distinct from those collections of debris termed "Diluvium." But in modern and in present times, the original and previous amount of dissolution of rocks at their superficies is continually being augmented, and in some parts of a bed it is carried on much more speedily than in others.

Chapter IV.

RIVERS, SPRINGS, AND LAKES.

"In Britain's matchless Isle
Unnumbered floods meander, and she wears
A verdurous robe that seldom cheers the lawns
Of softer, brighter climes. But Albion rich
In rivers sweetly gliding o'er her map,
Nor streams so fresh—so fair,—nor fields so gay,
May boast, as thine Devonia. Ever falls
Upon the well pleased ear the melody
Of thy soft-flowing waters,"————

CARRINGTON.

The South of Devon is remarkable for the great number of *rivers and streams* by which it is intersected, nearly the whole of which take rise in the central and highest part of the county.* This central district is Dartmoor, a wild, and for the most part granitic tract, a vast assemblage of primitive hills gradually sloping away to the South Hams, where this nucleus disappears beneath the schists, limestones, and other rocks, but again rises to view in the Channel as the Eddystone, &c. so

* For some other remarks on this head, see chapter on "Geography of Animals."

that it forms a sort of basin or cavity wherein our other strata are contained. Whatever be the nature and extent of the connexion maintained between the sea and rivers at the sources of the latter, we see most evident proofs of the influence of rain, dews, snow, &c. on their currents ; in the protracted droughts of June and July their fountains are no longer productive of due supplies to many of them, the fish resort to the few shallow pools that remain here and there in the beds of the streams, nearly all our springs are exhausted, vegetation altogether languishes, and is seemingly alone sustained by the dews of night ; in the fine dry weather of May when our rivers are at a medium of size, they will in the space of two or three hours swell prodigiously with foul water, rain having then fallen to great extent somewhere near their sources ; the size and number of tributary streams controuling of course the volume and rapidity of these torrents ; the dark brown colour given to the rivers on these occasions (due in part to carbon held in solution, and derived from decomposed vegetable matter,—the result of previous hot weather, and in part to the vast abundance of dirt, which the increased volume and power of the rivers hurries forward with them) is by their great rapidity then acquired, often conveyed out to the very mouths a considerable distance into the salt water ; in October and November, which may be termed rainy months, we are again inundated, springs overflow, and fresh ones discover themselves in various directions, even breaking forth in hard turnpikes ; in frosty weather the rivers are low, exhalations being in great measure suspended, and the hardened ground at the sources of the parent streamlets not suffering the vapours and snow to penetrate and commit themselves to the currents. Mountains and hills are known to be great attractors of clouds and vapour,* and the more so in proportion to their size and height, so that we reasonably regard our central, primitive, rocky district as the great source of the river water which descends to us, independently of the connexion which may subsist sub terrâ between it and the ocean.

Springs are very abundant with us, except in limestone tracts; in slate they break forth with great freedom on account of the frequency of river currents, and the ease with which water traverses the substance of this rock, but limestone being cavernous, the water penetrates by the cracks and separations of its beds to the caves as far down as the level of any adjacent river, where it meets in all probability some spring of water from the stream, or to some other hollow which by its freedom from joints may act as a natural reservoir. In this way, the inhabitants of limestone districts not near any river, are greatly distressed for water, but should a mass of slate project into this tract as is extremely common, water may in all cases be readily obtained at a slight depth, particularly if a stream be adjacent. The contrast between lime and slate with regard to the power of retaining moisture near the surface of the earth is readily seen in our lengthened droughts of summer, the limestone lands speedily displaying a burnt herbage, and the slate lands retaining a great proportion of their fresh green, a clear proof of the extent and utility of terrestrial exhalations.

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* Tavistock is situated at the foot of the junction of two ranges of hills, and is accounted one of the most rainy places in the kingdom. The moor altogether is under the baneful influence of a very humid air through all the months but the hottest.

At intervals we have springs of superior and unvaried temperature, and which from their exposed surfaces in summer being cooler than our skins when applied, and in winter being never frozen and never so cold as we expect to find water on applying the skin to it at that season, have acquired the name of "*hot and cold springs,*" but the surface is not the part to judge by with respect to their temperatures, for by the natural process, their superior heat is soon parted with to the air, and in favorable states of the atmosphere, as in clear, frosty, moonlight nights, if we look steadily against the stream proceeding from one of these fountains, or over a well of such water, we see evidence that the heat of the fluid as it escaped from the ground must have been pretty great, for there is a continued emission of very subtle steam, quickly borne off into the dense air and re-deposited. Some of these springs are in evident connexion with rivers, and to have attained their elevated temperature, must have descended through some passages of the river-bed to a great depth of the earth before reappearing at the surface. One near my residence rises and falls with the river close to which it is, and pours forth muddy water at the time of our summer floods. Very often however in rainy periods this spring yields but little, shewing, that its source is far up beyond the reach of the immediate maritime climate of the South Hams. Fice's well on the moor is a spring of the above named kind.

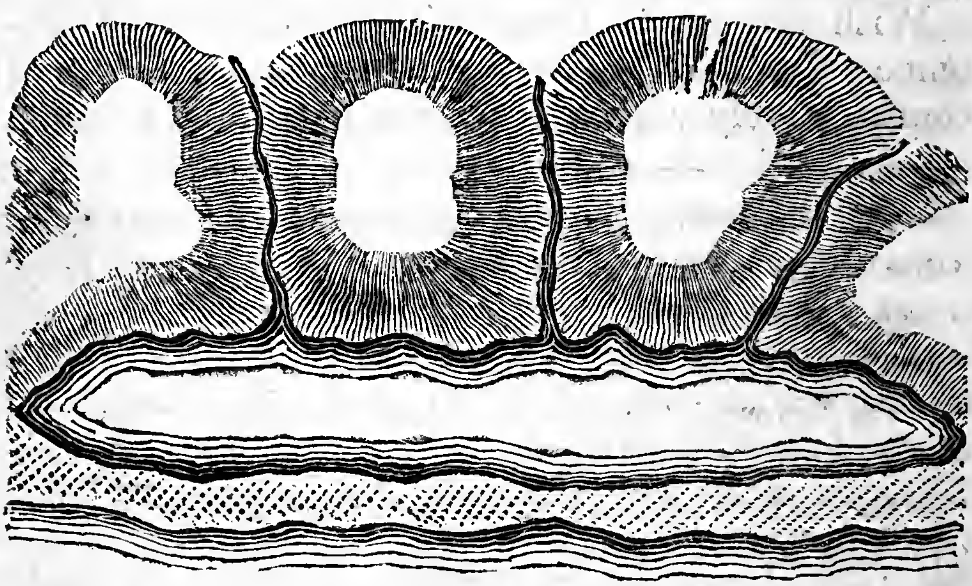
With respect to *lakes*, those of which the South of Devon boasts are but few, and very inconsiderable in dimensions. In the forest of Dartmoor the streams occasionally expand in width and constitute shallow sedgy pools, hardly deserving the epithet of lakes ; certain spots also where springs originate, give place to expanses of water which fall rather under the denomination of *morasses* or *bogs* in the generality of cases. Craumere Pool the largest of these collections of water, is the celebrated fount whence many of the Devonshire rivers are derived, but still offers to the view more the character of a swamp or bog than that of a lake.*

The schist tracts broken as they are into numberless hills, and presenting numerous specimens of *upland vallies,* are yet so disposed as to afford no sites for the accumulation of stationary waters by broad expanses of hollowed land between the elevations. On the contrary, the eminences closely approximate, and furnish steep and narrowed passages for the rivulets.

With respect to *Bovey Heathfield,* some difference of opinion exists as to its actual elevation comparatively with the sea, for, according to some

* "We missed *Craumere Pool,* and it is not to be wondered at "that we did so; the precise situation is found with difficulty "even by those who are well acquainted with the topography of "*Dartmoor.* We must at one time have been very near it. Several "of the Devonshire rivers are said to have their rise from this "pool;—strictly speaking, that is not however the case, the "rivers rise from various parts of the morass around the pool: "the bogs encircle it for miles. This curious pool, from its obscure situation, has been but seldom visited by travellers;—a "friend who saw it a few years ago has favoured me with the "following particulars:—'*Craumere Pool* is of an oblong form, "about 150 feet in length and 80 feet in breadth: it was not full "of water, which gushes from a bed of gravel beneath the stratum "of peat bog. I descended about ten feet to the edge of the "water. It cannot be approached with horses on account of "the quaking bogs, and although provided with a guide, I should "have missed the spot if a labourer had not pointed it out to me.'" *Jones' Obs. on Scenery, &c. of Moreton Hampstead and Dartmoor.* p. 54.

a situation *below the sea-mark* implies the existence of a lake, and it has been asserted on the best authority, that a part of this spot is so circumstanced. It would also seem however, that a position *on a level with the sea* argues some accumulation of lacustrine water, and consequently it may be inferred that the said tract of alluvial ground having the character of a bog or morass in one direction, suffers the escape of the river water from the adjacent hills by means of subterranean egress. It is asserted in Moore's Devon that the Heathfield is 50 feet above the sea!! How is this contradiction to be reconciled?



Plan of Slapton Ley.

By far the most important collection of water coming any way under the denomination of a lake, is *Slapton Ley,* and which has, as will be seen, characters in some respects peculiar. Certain inconsiderable hills overlooking the sea contribute three small streams to it. Between the points of land of two hills which stretch farthest out to the Channel, there runs a ridge or bar of rock, and on this the sea has heaped up in the lapse of years the rubbish and sand of adjacent ground, and that which was contained in its own depths. In this way, an area which in former years was undoubtedly tenanted by the sea, is now cut off from its visits excepting during storms, when a breach in this bar or breakwater of sand is necessarily occasioned. The three streams at present produce an expanse of fresh water about three miles long by a half mile broad, the surplus of which instead of passing off through a decided channel, drains through the sand during each ebb of the tide, and more especially at one spot. The lake being at about the same level as the sea, cannot effect a channel for the escape of its contents, because, the sea perpetually casting up debris from its bottom and exercising force upon the bank on its own side, prevents the formation of an hiatus by the water collecting within the basin. Near Falmouth is a lake of somewhat similar character, called Swanpool.

In addition to Slapton Ley and Craumere Pool, the lacustrine waters deserving more especial record are *Clacywell Pool* near Walkhampton, *Tutorlake* and *Redlake*.

Besides the number of very fine springs of South Devon, remarkable for their great purity, their clearness, or the quantity of water which they yield, there are many possessing decided *chalybeate* properties though but little known or employed by invalids.

An artificial spring has within a few years been obtained at Plymouth, and is in connexion with the Baths of that place. It is a mineral, or rather a saline water, procured from the astonishing depth of 365 feet, but though dignified by the title of "*Victoria Spa*" water, it in reality holds but an inconsiderable proportion of iron in its substance.

By Professor Daniel of King's College it has been reported to contain in the pint (imperial measure) as under :—

Carbonic Acid Gas	8.100 cubic inches
Dry Salts	151. 66 grains

These dry salts are found to exist in the following proportions.

	grs.
Chloride of Sodium	96.64
Muriate of Magnesia.........	18.68
Muriate of Lime	15.10
Sulphate of Soda	9.55
Sulphate of Lime	8.94
Carbonate of Lime	2.06
Carbonate of Iron	0.69
	151.66

The presence of so much saline matter seems dependent on to the adjacency of the sea to the locality on which the spring has been procured.

Chapter V.

CLIMATE AND BLIGHT.

"For surely the country is temperate, and freed from extremities of cold by the vicinity of the sea, which causeth a moderate warmth; through whose working, the frosts and snows are not here so piercing, nor of such continuance as in the inland countries. Indeed the furious gusts of wind in the winter season, rowling upon the high hills and upon the moors, make the air cold, and by their boisterous assaults, tyrannize, keeping down hedges and trees as if shorn."

RISDON'S DEVON.

It falls to the lot of naturalists resident in this maritime locality to record a *climate* of such a varying character, as to defy the formation of many rules or characteristics. It is uncertain from day to day, and uncertain as respects a given period in its annual return.

In the first place, by means of our proximity to the sea, and the prevalence of winds from that quarter particularly also in the cold season, we have a climate remarkable for humidity, and as this same wind comes from a surface varying much less than the land in point of temperature, it confers upon us a climate remarkable also for uniformity as regards the mean of the annual heat. Commonly speaking the extremes are not great, they are prevented probably from departing much from the average temperature by the cause just named; by the fact of the soil being generally stiff and hard, and so retaining its heat from the air in summer (though in winter it would for the same reason increase the cold); by the ground being pretty much overshadowed by trees, which keep off heat greatly in summer, and retain moisture; by the very frequent rains and clouds obscuring the sun in summer, whereby the atmosphere has time to cool down; by the constant occurrence of nightly vapours, which have the same effect during the heat of summer; by the humid particles continually wafted to us by the prevailing winds before named; by the number of our hills which intercepting the winds in their course obviate their asperity; and by the occasional intervention of winds from the opposite quarters (namely Dartmoor) during summer, or of unaccountable cold occurring even with the former, and not during the cold season.

South-west and west winds are then the most common, and they not only blow almost unremittingly from the end of October to Christmas and the beginning of January, but they even most commonly prevail at other seasons also.* They convey

* South-west and west winds may be said to occupy nine months of the year, the first however is the commoner of the two, since westerly winds last but for short intervals at a time, while south-wests often blow for long periods. The occurrence of winds in South Devon may be stated as follows in the order of their frequency;—south-west,—west,—north-west,—south,—south-east,—east,—north-east,—north.

During that period of the year wherein south-west winds mostly prevail, should an interval occur of north, or north-west blasts, clouds are often after awhile seen to rise from the former direction, by which it must be naturally inferred, that far outwards in the Channel the wind has again reverted to the old quarter, and gradually strengthening will soon dissipate that blowing over land; hence, the rustic on viewing these rising clouds assures us that before the lapse of twelve hours the wind will be again seaward and bring renewed wet.

to us the exhalations of the Atlantic, cause the profusion of rain we receive, and the continuedly humid state of the air, and greatly prevent our experiencing extreme heat in summer and extreme cold in winter.

The causes here named conspire to render the general character of the climate of South Devon mild and genial, interrupted only by (usually) short periods of wintry cold. However unsuitable to the human constitution for reasons elsewhere assigned, the celebrity of the Devonshire air for softness and genial effects has spread far, and causes numerous visits from restless valetudinarians confiding in the unjust comparison of a Devonshire to an Italian climate,*—a comparison indeed hardly allowable after the vicissitudes of the former have been subtracted. Still however it has a genial power, and though the moisture which ordinarily forms the accompaniment of this mildness is inimical to human vigour and muscularity, its effects on vegetation are in some manner highly favorable. In the small towns situate on the sea side, the *myrtle* developes its pleasant foliage and sweet flowers in high perfection, unimpeded by the accession of winter frosts. The *geranium* in like manner is found, though deteriorated thereby in richness, often to withstand the cold of the same season in such spots;—Babbicombe, Salcombe, (sometimes termed the English Montpelier) &c. may perhaps especially be quoted. But, more northwards in the centre of the South Hams, how often does it occur that during a severe winter some myrtle fondly and attentively watched and guarded in its growth, is in one night sacrificed, even after it had attained to considerable bulk and strength! Our county therefore can hardly be regarded as the especial

* Devon has been termed the "Italy of the West," from its climate and its scenery.

habitat of myrtles, notwithstanding that Poets have so much, so habitually insisted on it in support of the mildness of our air. In the same spirit also, they have upheld that doctrine by asserting that a kind of myrtle grew wild with us. The *Myrica gale* however, though termed in some places the Dutch or Bog myrtle, and with us Devonshire myrtle, is a plant wholly different from the garden myrtle, and so far from proving mildness or serenity of atmosphere, grows by preference in moorish elevated ground,—Holne Chace for instance. There too, not countenancing the genial air, the property of the atmosphere of the coast, it blooms and diffuses its aromatic odour under the austerities of the moorland breeze. The *aloe*, a cultivated plant, is another instance collateral with the myrtle and geranium, shewing the genial character of the air of South Devon *taken generally*. It has been a common remark with travellers passing into Devon from the more eastern counties in spring, how much forwarder our vegetation is than theirs.

A far more decisive proof of this character than those afforded by plants—so extensively liable to death from sudden frosts, is to be gained from birds. Several species of songster possessed of great hilarity, and readily acted on by stimuli, indulge us with their vernal notes at various periods of the winter,—cheering the gloom which so generally characterizes that season, and leading us momentarily to entertain the hope that "the time of the singing of birds is come," though in fact, experience teaches us directly after, that a severe and perhaps long frost might presently supervene and stop these melodies. In another place I have entered into full particulars of this phenomenon resulting from the peculiarity of our climate here mentioned. In such years (the generality) as remarkable cessations of the winter's cold occur, giving place as it were to that peculiar mildness of air derived from maritime position, we witness similar indications among insects that are noticed with birds as above shewn. On the milder of these days—those particularly when the sun diffuses an enlivening and pleasant warmth, the common fly awakes, and enjoys in some sheltered spot the few hours of that brightness which broke its hyemal slumber. So early as February 10th, 1839, several bees were noticed abroad, under the same influence of unusual heat. Not uncommonly also, beetles and a variety of other insects which I cannot presume to name, come forth from their brumal retreats at the same early period.

Dartmoor must unquestionably be considered as originating a climate of its own, and as affecting the South Hams in no inconsiderable manner. The temperature of this tract, though visited ordinarily by sea winds from south-west and south-east, is very far below that of the cultivated and more maritime districts, and it does not seem yet decided by meteorologists whether we may attribute this to its barrenness and freedom from timber, or not, some declaring, that freeing a country of timber will elevate its temperature, and others affirming that this act has an opposite result. There is certainly one reason why we may anticipate an increased heat from the clearing of a district, for if the sun's rays be intercepted by a large amount of timber and foliage, they cannot of course ameliorate the air circulating through the forest and about its neighbourhood. Without presuming to meddle further with this question, it may be sufficient for me to remark that the elevation of the Dartmoor district, its power of furnishing a deal of moisture, and its freedom from soil able to restore caloric to the air, are seemingly sufficient reasons why its temperature should be less than the surrounding lands. In periods when the heat of the air of these lower tracts has been elevated, the colder atmosphere of the Dartmoor hills rushes in either suddenly in the manner of an ordinary current, or by a gradual descent,—restraining the process of increasing heat. Towards the west and south-west, a current of wind brought over land from opposite directions inevitably conveys to us the chilly atmosphere of these central hills. During summer, when we have the largest share of easterly and north-easterly winds, it is not uncommon for this chilly stratum of air to be transmitted towards the South Hams and to check a *lower* current of wind arriving from the sea, bringing with it the customary mists and clouds so characteristic of our climate:—"the north wind driveth away rain." In winter the climate of the moor is particularly damp. On the whole it may safely be affirmed, that the moor is productive of a local climate on a small scale, affecting sensibly the lower tracts by a cooling, dry, chilly or blighting current according to the period of the year. Vancouver has ascribed its blighting power to *one particular hill*,—Cawson hill, the highest.

The common influences which induce the great alterations in the temperature of seasons do not in South Devon exhibit their full perfection of power, but are qualified and limited in force by the causes I have before recited. So remarkably is this shewn, that while it is no very uncommon thing for persons to need fires at Midsummer, they have been found subjects of indifference (though rarely I allow) at Christmas in some years. It has indeed happened to my own knowledge that cold gusts of wind, with perhaps cold rain, may render the surfaces of our bodies colder at the first period than at the latter, and certainly, remarkably warm and fine days frequently enliven the Christmas week.

The cold however which so usually sets in with bitterness in January, does at times commence in December, or even November, and it is far from uncommon to have intervals of great cold in these months. The cold which I say attacks us in January, is in the majority of years not extreme The January of 1837 however, was remarkable for *intensity* of cold, and the same month of 1838 was observable for the *duration* of extreme cold. It is thought however, that the intensity and duration of these frosts were induced through the occurrence of east winds at those periods, and that in short, this wind generally carries the cold of the season to that unusual pitch. No doubt also, the north and north-east have an equal, or but little less influence. Yet at times there is an anomaly in this respect worthy of note, namely, that winds from that quarter are *not invariably* attended with cold in winter. December 7th and 8th of 1838 were attended with north-east wind, and the former day was remarkably genial and the latter very sharp.

Although the summers are occasionally very wet and considerably below their average of temperature, they are in some years, remarkably hot and dry. The month of June moreover is itself often remarkably changeable, and exhibits in itself a direct transit from the one condition to the other. Most persons can recall instances of hail-storms happening in June, which prove of course great depressions of temperature. In the case of our wet summers, the heat of the earth being restrained, the autumns in such years have an unusually heated atmosphere, and the ground is observed to steam profusely.

Changeableness however is by no means a characteristic of the summer months though there may be occasional intervals of rain and thunder storms. Change from wet to drought, and from cold to heat in the weather from day to day, is the more particular character of the spring. Altogether, our springs are very rainy, though changeable and deceitful in regard of frosts. Storms, occasionally of severe character, occur in this quarter, but are far from being punctual to the equinox. Easterly winds are frequently observed in spring, but they continue only for short periods, are dry and cold, and thereby blighting in effects. In the two years 1837 and 1838, severe cold has come on late in the season; in 1837 snow fell on April 22nd, in 1838 snow and frosts occurred with intermissions from April 15th to 20th. In illustration of the same liability to cold in this season, it is further seen that there is a constant proneness to relapse from the genial warmth of approaching summer to pinching cold of the commencement of the vernal quarter, and these transits occur not infrequently in the lapse of twenty four hours. Causes must here be in action respecting which I have myself imperfect and unsatisfactory ideas, for, very warm days occur with wind from the east, and vice versâ, cold days with wind from the south-west or west. Probably some immediate or local conditions of the air in these cases prevent the ordinary results.

Our autumns are usually remarkable for being wet, with however an interval or so of fine mild weather. Yet there are instances of extreme drought, one of which was the autumn of 1836, when the generality of the springs in the neighbourhood were dried up. The equinoctial gales are generally very destructive. During the floods of autumn, the river Yealm below me has been known to rise in some parts more than twelve feet.

January is a dry and very cold month, with frequent easterly winds. February is a cold, wet, and uncomfortable month, with generally periods of easterly blasts. March is often showery, with unsettled cold winds. April is often cold, windy, and dry, sometimes however showery, winds often easterly and northerly. May is showery with fine intervals; it is variable in heat and wind. June is occasionally fine and warm, but generally changeable, with intervals of cold winds from south, south-west, and west. July is settled in character, but floods nearly always occur. August is also of settled character. September is generally settled, but sometimes rainy. October is cold, and rainy;—winds often from the west. November is windy, wet, and variable. December, rainy.

It is worthy of remark, that some alteration is thought to have taken place with regard to the connection subsisting between the several seasons, and certain corresponding months. On consideration however, and on enquiry among persons, I cannot find that this opinion receives further support that the actual fact of our winters having of late been considerably lengthened out into spring, or rather into months usually correspondent with the first part of that season, whereby, spring itself is not removed, but shortened by about one month, summer and the succeeding seasons commencing at their proper periods. I am not inclined to place much confidence even in *this* rule, for, though February would here appear to be the suffering month, it is sometimes tolerably fine, while severe cold attacks us so late as the end of April in some years as above noticed. I must also observe, that in two years it has appeared as though there had been a precocity in the springs, February seemed to be lost by the winds of March occurring in this period, then, March presented us with showers characteristic usually of April, and subsequently, April displayed the flowers and beauties of May.

I am disposed to think, from the few observations I have been able to make, that in investigating the causes and nature of *blights*, persons have not taken sufficiently into account the power of certain winds, particularly when conveyed in narrow streams along the course of vallies. But, since no wind is *invariably* blighting, there probably exists in some cases a peculiar quality conveyed by it, which very likely is electricity in some form, knowing as we do, how often streams of electric fluid affect vegetation destructively for great distances in narrow lines; at other times, the wind itself, void of any peculiar, contained quality, appears to act detrimentally on trees and herbs by its continued current restraining and then staying altogether the circulation of the sap and fluid, while again, some winds as accompanied by some admixture of moisture in certain proportions, or by being peculiarly drying, have the capability of calling into existence, insects which themselves are the efficient agents in the blight. Electric matter as a blight certainly exercises its effects on some trees and plants in preference to others; thus, I have seen sting-nettles and the leaves of some particular kinds of trees alone affected after the prevalence of lightning, and there is reason to suppose it may act in a manner and on a scale quite unexpected by us in its latent or unseen state when the atmosphere is surcharged with it, and conveyed in various directions by currents of air set in motion. That narrow currents of wind will by continued action on vegetation for some time, and even perhaps in some cases for short periods, produce blighting effects, is I imagine, pretty evident. It will be seen in another place how decided is the influence of the south-west wind in checking the efforts of growth in trees, and this same phenomenon may by reason be classified together with the still more evident (because quicker) effect exerted by the same wind in its production of blight on apple bud and blossom when the trees are situated in vallies and low spots towards the coast, directly exposed to these blasts. Its effects are also commonly exemplified on laurels and on other evergreens in similar spots, while those trees and shrubs situated near, but on high ground have been found exempt from this disaster. In the opinion of some persons, this blight is produced by the efficacy of saline particles carried by these winds from the ocean, but besides the freedom of salt in such small portions from the active quality here attributed to it,—causticity I presume, it is only requisite to remind the abettors of this idea that since the south-west wind prevails for probably nine months of the year, this effect ought to be remarked on a very large scale and not limited to occasional blights. Salt however is conveyed in tolerable quantity in the spray wafted inland by the sea breezes, and at the distance of a mile from the shore it has been seen collected on the windows of houses. Other persons again, talk of insects being generated by, and conveyed by these winds, and so deposited on the blossoms and fated portions of trees, &c. It is unfortunate however for this hypothesis that since south-westerly winds have their origin on the surface of the ocean they cannot by possibility be the vehicle of insect life. There are some winds and some conditions of the air peculiarly favorable to the development of insect beings, and in which only indeed they are called forth to enjoy their existence:—a brisk current of air getting up at that juncture will convey armies of this insect blight to distant spots, and so give the semblance of cause and effect being appreciably concomitant. Easterly winds are, as I have once said, blighting during the colder months by their inducing pinching frost, a very powerful and generally acknowledged agent in restraining and suppressing the vitality of vegetables, and particularly some few species, amongst which ranks the hardy spruce fir. South-east winds appear also to be occasionally attended with blight, from what immediate cause however I am as yet unacquainted.

On June 10th, 1838, I remarked that the apple trees in my garden looked unhealthy, and on closer inspection, found that a large quantity of buds and shoots were killed, the decay extending two or three inches down into the very wood of the tree; besides this, a vast proportion of the apples, then of the size of nutmegs, were seen to be eaten or eroded superficially, and in some of these little pits I found certain minute green insects (aphides ?) doubtlessly the operators. Next day, I found that these had congregated on the leaves in large companies, they had changed generally to a light brown colour, though some were still green, while some few had been metamorphosed into winged insects; those yet unchanged seemed lethargic. Some other kinds of winged insects, caterpillars, &c. pervaded the trees also, and the leaves were wrinkled and faded wherever many had got together. In a day or so, nearly the whole had disappeared, but the greater part of the fruit and leaves thus affected fell sacrifices to their assaults, and those which survived became sickly. It is observeable, that this was not the only blight sustained by this neighbourhood at the time, for the gooseberry trees suffered in a lamentable way by the ravages of a caterpillar which eat up presently all the leaves* and induced death as a consequence in the fruit. Besides this, the apple trees to the eastward of me were attacked by immense crowds of caterpillars in some situations, and of "fern-webs" (coccinella), or "oak-webs" (scarabeus) in others, which devoured speedily every leaf of the trees, and caused death in the fruit of all

* About July 1st these trees put forth fresh leaves, but not vigourously.

those parts thus visited. I believe I have understood that the neighbourhood of Kingsbridge is particularly subject to such blights. On June 5th, 1839, being four miles south-east of Kingsbridge, I saw in a field of grass, immense crowds of the brown coccinella invited out by the warmth of the morning. Soon after these occurrences of 1838, the crops of broad beans in this place were infested by multitudes of aphides of a sooty colour. Now from these two facts of the coincident death of the buds and assault of the insects on the fruit, and of the prevalence of blight generally at the period just named, I infer that a certain electric state of the air was the first cause of the disaster, for, on the one hand we naturally attribute the sudden death of the shoots to electric influence, while on the other, we recollect how intimately associated are the phenomena of life and electricity, and how plausible it seems to attribute vivifying powers on the eggs of insects to an unusual proportion of electric matter generated in the air. For three weeksbefore this event, the weather had been dry and rather close, and upon the whole, it cannot be matter of surprise that I should be so willing to attach a blighting power to electricity in its latent form, for there is no doubt, that the amount of electric matter in a country is ever proportioned to its liability to clouds and wet, as greatly happens to us in this county. Farmers calculate that the latest time at which their crops of apples may be cut off, is from June 7th to 12th, and there is no doubt, that it is this same sort of blight I have here described of which they complain in so many years. Partial blights are very frequent, both as respects the district so affected, and as regards the apple trees themselves, and again, it often happens that the blight only affects the buds, or leaves, or fruit in a partial manner and renders them respectively, or conjointly sickly. Moreover, it is found by some farmers, that in certain years some trees in particular are subjected to blighting influences, and they complain that one tree especially exhibits this effect oftener than all others,—it is, here vulgarly named "Johnny Gaud" I must remark in conclusion, that some springs and summers are observeable for presenting a somewhat sickly condition of fruit trees and other kinds, but this not sufficiently evident to common eyes to demand notice, yet again, there are some seasons in which we hear differences of opinion among farmers as to whether a blight has actually occurred or not. In this case of course the blight would either be of that withering character induced as I have said by electric fluid, or on the other hand, by some subtle and minute insect escaping their obtuse observations. Upon the whole, it may not be so very improbable, that the generality of blights are capable of acting in a limited manner, and effecting as it were a partial death in those trees and vegetables which are their victims, and thus, as countrymen affirm, a blight may be brought about by two causes, of which the first had insufficient energy to produce immediate death, but being succeeded shortly by some other noxious influence, this result became at once apparent.

The mildness usually distributed through our winters, followed as it is in frequent instances by frosts in springs, give us no such great advantages as are ordinarily and invidiously attributed to us, since, with the exception of choice spots situated in security from frost, fruit and vegetation generally when arrived at a state of considerable forwardness is forthwith sacrificed.* *Late frosts* are in South

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For the same reason of continued return of wet and cold in our springs, out-door vines rarely produce much or good fruit. The generality afford very small and insipid grapes.

Devon particularly common, occurring to us frequently in the nights and early mornings of May before the sun has risen, and even so far in the season as June, when however as elsewhere said, vicissitudes of temperature are remarkable for their suddenness and extent. In the second week of May, 1839, a rather severe frost took place on the whole of the southern coast of the county; it destroyed quantities of young apples, the shoots of all the early potatoes, the kidney beans, the sting-nettles, a large proportion of the leaves of the ash, oak, ivy, and laurel; it blighted the shoots of the laburnum when about to blossom, and in numerous cases quite prevented that process, and lastly, it killed an abundance of young gooseberries, which were strewed beneath the trees after they had turned yellow from the frost. The effects of the frost upon the young apples was not apparent till the occurrence of the long drought which succeeded, when, not encouraged by timely showers to protract a questionable sort of existence, they forthwith fell off,—sacrifices to a blight, sudden as lightning in its influences and sweeping as a pestilence in its course.

Vallies in particular suffered, and those open to the sea, more so than those removed from it; the fogs and vapours of the night resting greatly in these parts, and requiring the heat of the succeeding day to dispel them, thoroughly saturate vegetation, and by chilling its energies render it the more susceptible to penetrating frost, and keep it bathed in this obnoxious medium long after the sun has visitedthe hills with his resuscitating beams; whilst, regarding those vallies and combes directly open to the sea, they are assailed by a double disadvantage,—the sea winds themselves acting inimically on plants and trees, and of course especially so, when aided in their assaults by fogs associated with frost.

It is altogether most difficult to say what sites are the most desirable as localities for *orchards*, for though low spots, viz, combes and vallies possess, the advantage of offering shelter from unfriendly blasts, it is to be feared that insect life coming under the denomination of "*blight*," has in such spots greater opportunities for development, and as we have just seen, they have the very great disadvantage of accumulating detrimental moisture at the juncture when frosts are to be apprehended. On the whole however, the qualification of *shelter* being duly appreciated, vales and combes removed sufficiently from the tyranny of sea winds may rationally be preferred for the culture of a tree the fruit of which yields so genial a beverage to our husbandmen.

On May 15th of the same year as above spoken of, a fall of snow took place on Dartmoor, and in the town and vicinity of Plymouth great cold accompanied by a descent of sleet was experienced. But this solitary case of very late frost and cold is not to be regarded as unusual; on the contrary, such instances are far from uncommon, and thus the Poet in allusion to the disappointed hopes of this season, says

> "To day he puts forth
> The tender leaves of hope, to-morrow blossoms
> And bears his blushing honours thick upon him:
> The third day comes a frost, a killing frost!"

The sudden depressions of heat in the nights of June not unfrequently prove fatal to kidney-beans, and some other plants particularly susceptible to this species of impression, but whilst allowance may be made for great delicacy in such cases, they tend to shew the disadvantages under which many forms of vegetable life labour in a climate so prone as ours to transitions of atmospheric temperature and insidious change.

It is proverbial with us that a *dry May* destroys the generality of our crops, or renders them at least sickly and reduces them greatly in amount. We count therefore with certainty on these consequences when the above character of the month is fairly established. Grass, and corn of all kinds immediately appear sickly and stunted, and the future crops are invariably small; turnips and potatoes also suffer, being greatly diminished in size and number, and deteriorated in quality; cabbages again, are injured greatly, never arriving at much heart or good flavour. It is known also, that a dry May is favorable to the production of certain insect pests, amongst which is the "flea" that feeds on the leaves of turnips just after they have come up, and the eggs of which I may here observe lie in all likelihood in the soil, for I find on sowing turnip seed in a piece of ground that had been occupied by a grass plot for a series of years, that although the season was favorable to the production of the insect, and had actually generated it on some young turnips a few yards off, no insects of this sort appeared on the former plants. In 1786 the loss sustained in this county by this insect was estimated at £100,000. In this month (May) the vegetable world is in general occupied in making its first essays, requiring however the aid of moisture to effect its objects at this juncture, and in defect of the conjoined influences of heat and moisture, the sequel might a priori be readily conceived. In 1836 we not only had late corn and other harvests on this account, but, hay was more than doubled in value, and cabbages could not be obtained for money. Hay harvests are with us very precarious times, owing to their being nearly always deferred till the end of June and July, and that season proving in the generality of years prone to wet and change; hence this article is as frequently sour and musty, as within the limits of safe employment for an animal so readily damaged as the horse.

The most remarkable of the *insect pests* to which our gardens and fields are subject, in addition to those I have named, are the "red ant" so injurious to walled fruit trees, the caterpillar of the "cabbage butterfly" which attacks so voraciously the leaves of the vegetable after which it is named, the "aphis" which injures so many of our green house and garden plants particularly the rose, and the caterpillar known under the collective name of the "black army" among agriculturists, which makes such remarkable ravages among fields of young turnips, but which happily rarely visits us; its last visit was in September, 1836. As to the "American bug" (aphis lanata) there is reason to believe from its gradual diminution in numbers, its term of existence with us may not be long; in 1834, its numbers were greatly reduced, and now it is known but sparingly with us, and chiefly in recital of the fears it once caused, and which proved unfounded, for its injuries were at most trivial, and were perhaps generally speaking, imaginary. In 1835, when we experienced a very hot and dry summer, the turnips were greatly injured by the "wire worm," and it was further remarked that simultaneously sheep were infested by an insect in their skins which prevented the growth of the wool and proved a serious evil thereby to the farmer. Though not an insect, but a vegetable product, the "smut" in wheat deserves mention, it being such a great impediment to the procurance of good flour, and because, its occurrence may by the perseverance of every industrious farmer be readily prevented; the plan which I have understood is found to succeed, consists of washing the seed year after year carefully, using several fresh additions of water on each occasion, until the agriculturist finds in the succession of his crops a complete extirmination of the annoyance. Two years are often sufficient to rid the seed of this "smut."

The moisture of our climate betrays its injurious consequences on timber in quite as remarkable a way as blight shews *its* peculiar consequences on the smaller members of vegetation. The *oak* apparently sickens in our South Hams from this cause,—it does not exhibit that size and vigorous description of growth seen in the dryer and central counties. Near the moor however it seems better climatized, and at Buckland-in-the-Moor particularly its size is grand and its spread luxuriant. The "Meavy oak" is also a splendid instance of the same sort. *Fir* is far from suited with a locality in Devon, its nature becomes impoverished, and its size stunted. *Beech* is somewhat scarce with us, but in many spots very large old trees may be seen, and apparently unimpaired by damp. *Ash* arrives at no great size, and twists greatly in its growth. By far the commonest tree is the *elm*, which though grown so readily is apparently much deteriorated by the humid air; it does not grow on high ground; its timber is seldom dense and perfect in quality, very much suffers from that disease termed "dry rot" and a still larger proportion becomes affected with "caries" in several forms; indeed, the generality of our timber is highly susceptible of this affection, and requires the careful consideration of the woodman to prevent loss by timely felling. Parasitic vegetation luxuriates in this humid climate, it clothes apple trees in particular most abundantly.*

* Respecting the *chesnut* very little can be said of its growth; some however are thus particularized by Miss Dixon. "Lower "down the wood (*towards the Tamar*) are some very large Spanish chesnut-trees, and one may be particularly distinguished;

The lichens of Dartmoor also, are remarkable for their variety and exuberent growth.

Wet summers, such as that of 1838, are particularly unfavorable to the crops of wheat, because they give rise to an infinite quantity of minute fungous vegetable growths on all parts of the grain, its bracteas, awn, &c. and they attack the plants so early as to prevent the proper maturation of the grain. This parasite is called by farmers "*yellows*," but though it is at first of that colour, a great deal soon becomes grey and black. A small patch of Victoria wheat which I raised in my garden in 1838 was thoroughly destroyed by the "yellows," not a single grain turning so as to be available for flour.

In our present ignorance of the nature of electricity, it is hardly possible to count correctly on its probable extent of power in the production of those subtle forms of being called "blights," but it will be proper to keep alive in our minds a suspicion of its extensive operation on the latent or deficient vitality of the microscopic class, even from the few facts in our possession which seemingly point to that source as the vivifying influence; and it will be proper also to recollect the experiment recently performed of passing an electric stream through water, upon which there appeared therein multitudes of microscopic animalcules.

I subjoin here a comparative view of the mean heat of each month of the year 1806 taken at two situations in this county of those opposite kinds which in accordance with what I have already expressed, ought to (as they really do) shew the

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"its dimensions being no less than 31 feet in circumference and "rising 7 or 8 feet before it separates into 3 branches each the "size of a large tree."—*Journal of ten days excursion to northern and western borders of Dartmoor.*

very different amounts of average yearly heat in situations towards the moor and in those towards the sea, besides exhibiting the slight variation of temperature in the progress of the seasons in the latter kind of locality. These tables are extracted from Vancouver, and it should be noted that the seasons in the southern coast are said to be even milder, and the spring earlier, than on the northern coast of the county where one series of observations was registered.*

	OAKHAMPTON.	ILFRACOMBE.
	Faht.	Faht.
January	34¼°	53 °
February....	36¾	48½
March	41¼	52
April	43½	57½
May	50¾	62¼
June........	55½	64¾
July	62	65¾
August......	63¾	66
September ..	57¾	61¾
October	46¾	62¼
November ..	41	58¼
December....	39½	56¼

* I cannot help suspecting however, that the atmosphere must have been *particularly* uniform at Ilfracombe in the year 1806; the slight thermometric range from 48½° to 66° seems too remarkable to be an ordinary occurrence even on the southern side. I have not as yet paid much attention to this kind of registration, but in the winter 1838—9 generally allowed to have been particularly mild, the highest point attained by the quicksilver at Yealmpton (which however is certainly much above the sea-level) was 56° and this only for one day, Nov. 27th, (south-west gale) and though it stood at 53° on January 16th, I am persuaded the

The peculiarities of the climate of South Devon which we have been considering are not without their especial influence on the human body. Our nervous systems are ever ready to warn us by pain or other bodily inconveniences of the unsuitablenes of localities to the maintenance of healthful existence,—we feel that life does not consist in living, *but in being well.* "Non est vivere sed valere vita." Accordingly, throughout the South of Devon, or that part southward of the moor, the enjoyment of pure and vivacious health is to a great extent unknown to the inhabitants for the greater part of the year. The air being usually burthened with a deal of moisture, precludes that rarefied and oxygenated state which addresses itself so invigoratingly to the nervous system. In the same manner that our fires burn more briskly in frosty and clear weather, so does the flame of human life feel a renewed impulse under the same circumstance; and as fires burn sluggishly in hazy weather, so does the human constitution under that condition of the air, loose its elasticity and vigour,—it becomes as we ordinarily say, depressed and enervated. Let any one try the results of "walking for an appetite," first on one day through fields and woods by the side of some river, and on the next day let him

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average heat was greatly below that indicated in the above table. At 8 o'clock in the evening of January 15th the thermometer out-of-doors stood at 46°,—so mild as to render fire undesirable,—the air so loaded with moisture as in some measure to impede respiration. On 17th we had a very sharp frost, while on the 20th the mercury stood at 45°. These are data shewing at once the inconsiderable variation in the average heat of the year, the immediate source of this mildness, and the tendency to temporary change.

ascend to the atmosphere of some hill, in which aqueous matter by its weight will not remain suspended and to which indeed it is but sparingly driven, save in cloudy and moist weather.

"——————she loves—
Hygeia loves the upland ridge————" *

Another peculiarity of our climate—its continued liability to change, has also a corresponding influence upon us, and since we draw incessant supplies from the universal medium, and as that itself is endued with such great powers on our systems, surprize cannot be excited that diseases of no slight moment are called forth in those parts most decidedly exposed to it, and concerned with it. Sudden checks of perspiration inducing *colds* and *fevers;* preternatural and sudden excitement of the blood-vessels of the lungs causing various kinds and degrees of inflammatory disease in those organs; and lastly a host of other (sometimes anomalous) *inflammations* in various parts of the body seem therefore to be the particular consequences of this variable quality of the temperature and composition of the air. *Pleurisy* in particular is unusually common with us in damp seasons, and also *catarrhal ophthalmia* and *quinsey.*

To avoid this disastrous power of our climate, persons of delicate constitutions and especially of consumptive habits resort to places bordering on the sea well backed by hills intercepting the

* I have no question but that the elasticity suddenly felt by those who visit the moor, and the stimulus which the body seems to receive, depends on the quantity of oxygen contained in the air of that district. I believe I never experienced real hunger but twice, and those were the occasions on which I visited Dartmoor.

cold currents of air from opposite quarters the access of which would lessen the general mildness and uniformity of the maritime atmosphere and induce frequent transitions to opposite extremes. Hence, maritime positions not so protected by hills *immediately* at their backs are of all others the least calculated for health, and the least desirable for those who would wish *to benefit* by sea air. Penzance well protected by hills against the cold winds has long been known as the *English Montpelier* for its *continued mildness*, and is consequently the great resort of valetudinarians. There too the vegetable world feels the same benign influence, and in winter garden plants which elsewhere are the inevitable sacrifices to frost, are in that place found to remain vigorous and healthy. Many small places on our coast exhibit some measure of this same qualification. Newton Ferrers for instance in my own neighbourhood though protected by a very inconsiderable hill, is yet more forward in its gardens by several weeks at the commencement of spring than most other places near it, and myrtles and geraniums which survive the winter at that village, do not long exist in the open air on the first accession of frosts in the village immediately opposite—separated from the former only by a narrow creek.

Low situations in general however, have their disadvantages as before said, and they are not only productive of depressing consequences on the human frame in the usual mode of speech, but they are even especially conducive to a sort of *Typhus fever* having its immediate origin probably in the insufficient stimulus to the nervous system afforded by the dense aqueous atmosphere of such spots, and further its inefficiency to produce due oxygenation of the blood. Within my own experience, Typhus fever is the decided ailment of low abodes, and it has been known to extend itself exclusively to habitations situate in the course of a river or on the banks leading to it. The notator to Carrington's "Dartmoor" who does not allude to the cause of this fever, nevertheless confirms the above idea in a marked manner in the following passage. "The air "of Dartmoor being healthful and bracing, its "inhabitants commonly called moorsmen, as a "natural consequence are famed for strength and "longevity, as well as for considerable skill in the "art of wrestling, although occasionally in the deeper "vallies Typhus fever has prevailed." That so formidable a disease should obtain in the immediate vicinity of a district proverbially healthful, is a marked indication of the concomitance of this affection with depressed sites. It may however be exceeding the bounds of propriety to affect any precise knowledge of the cause of this formidable disease, and notwithstanding I have just intimated the probability of the insufficient stimulus to the nervous system and insufficient oxygenation of the vital fluid being the causes indirectly inducing it, it may be equally philosophical to regard the unfavorable influence of the atmosphere of our vallies on the due excretory function of the skin as productive both of Typhus fever and of the various descriptions of inflammatory attacks referred in ordinary parlance to that comprehensive term "colds." To understand the absolute state of the air of low situations correctly, it is only necessary to look down on some valley from an adjacent eminence on a cold day succeeding rain or fog. Directly the sun which while at his height had kept the exhalations in too subtle a form to be perceived, begins to sink towards the horizon and to withdraw his heat, the whole of this fine vapour assumes a condensed aspect, and will even at times take on the deceptive appearance of an estuary or large river winding up between the hills. This same vapour exists of course at all seasons, though in summer in a lessened form. I safely affirm that through the causes I have named, but very few good constitutions exist in those spots and places low-situated with which I have been medically acquainted.

Notwithstanding however the highly deleterious influence of such an atmosphere surcharged with water on the excreting surface of our bodies, on the secreting membrance of the lungs and even on respiration itself, not to forget also the inflammatory affections brought on in various parts by change of situation of the inflammatory attack, or through sympathy of these with the important offices of the general envelope, it must be observed that mere humidity of itself is not the general cause of those complaints which are vulgarly called "colds," but that it is the circumstance of *change* which produces this result, even that from damp hazy weather to clear and frosty, as indeed the proved susceptibility of the skin would have led one à priori to suppose.

Whatever tends to depress or deteriorate the vital energies of the constitution, tends to that affection termed *scrofula*, a disease which manifests itself under a multiplicity of forms and from which no portion of the frame can claim exemption. In conjunction with the weakening powers of the climate an unhealthful diet co-operates prejudically on the lower orders of persons in this county taken in the mass, and the two causes together produce a taint of this malady spread over this section of the population, though towards the moor it becomes less and less common.

East winds are from certain phenomena which they occasion by the sudden change or revulsion of temperature induced, somewhat worthy of especial note. In summer indeed, it is difficult to say whether there are any phenomena supervening on the peculiar cool or even *cold* which their arrival produces; but in winter, the "biting east" has some interesting consequences which we may here stay a moment to enumerate. Towards the evening of some day in January which had as yet been wet and mild, the air is suddenly observed to become gradually sharper and sharper, and on examination, the bleak gusts felt by us while walking on some elevated ground are found to arrive from the "cold quarter." Simultaneously, it is remarked also that vessels in the seaward horizon seem unusually close, and the moor hills appear distant only some half dozen miles,—we look on their bare sides as if their inclosures could all be discerned and counted. This circumstance depends on an unusual clearness of the atmosphere and its refracting powers* under

* Of this however there may be some doubt, it may not amount to an ocular deception, there may be no refraction, but only a particularly transparent condition of the atmosphere. With refracting states of the air bodies seem greatly *lifted above the horizon*, which is not very evident in the above cases, and moreover it must be remarked, that refraction does not always accompany cold, but may occur at any part of the year. The following short statements made known to me by Mr. Roberts of Lyme Regis will exemplify the nature of refraction to those who desire to understand something of it. The French Coast is not discernable from Hastings, but, one day it suddenly became evident to the inhabitants,—every little prominence of land was distinctly recognised by the fishermen and others, and great numbers came out on the heights to observe the phenomenon. No one remembered anything of the sort having ever occurred before.—The captains of two vessels agreed to meet in the course of their voyages at a certain place or certain degree of latidude. When at the distance of a hundred or more miles from this proposed rendezvous, the captain of one of the traders discerned the other and saluted repeatedly, but without answer; proceeding

the influence of frost, by which condition also, the stars twinkle and appear particularly bright. As the sun declines still further, the exhalations of the day begin to settle, and are almost frozen into icicles ere they gain the earth. In the depth of the night the frost arrives at its acmè, and at day-break a splendid hoar-frost presents itself to view, in nothing more remarkable and beautiful than in the fringe which decorates every blade of grass in the meadows. Now, the sportsman habited for an expedition through swamps and wet fields, is seen departing early, full of anticipation of success in his search for snipes and woodcocks, aware, that with an easterly wind these birds disperse over the country, and are found at every little pond and brook exempt from ice. This frosty and bleak wind also causes many species of the grallæ, &c. to frequent the shores, or at least some proportion of each kind; while, on the same principle of dispersion of animals under want, certain individuals of the thrush kind, the robin, wren, hedge-sparrow, &c. haunt the margin of rivers, and pick up aquatic

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on his voyage, he arrived in two or three days at the agreed spot, and found to his astonishment the vessel waiting according to original proposal. He found also on charging the other captain with having neglected his signals, and with having proceeded beyond the appointed spot, that the appearance was due only to refraction by which the vessel proceeding on her course towards him had actually been so elevated above the horizon, as to have appeared near him and beyond the appointed limit, whereas, in fact, she had not at that time arrived even so far as that spot.—One Sunday, the poor of a small place situated on one of the high hills above Bath, were alarmed by seeing (as they supposed,) a Regiment of Soldiers marching *on a hill* near them, and being under the influence of great terror, ran to the clergyman and informed him that a body of soldiers was coming into the place; this gentleman found that a militia man had lately died in a village in an adjacent valley, (!) and was that day being escorted to his grave by a few of his comrades.

insects stored under the pebbles. These severe frost-bringing east winds are however *generally* of short duration, and hence, the rustic assures us on finding the moor hills appear very close to him, there will be frost followed directly by a thaw or wet.

Although the most prevalent winds of the South of Devon are those from the south-west, which are according to the season of the year mild, and productive of a moist atmosphere, we yet have occasional periods in which the wind continues to blow for days together from due west, or due south, and other times in which it proceeds from different quarters for a still longer space, but most usually with occasional shiftings.* But of the whole of these, there is no one more remarkable at times in its effects than that from the west. *Westerly winds* usually assail us in spring and autumn, they are purely blighting winds. Early in the October of 1836, these blasts did extraordinary damage ; in

* Taking Europe altogether, westerly winds are said to be the most common. It often happens in South Devon, that towards autumn and winter the wind veers round from east or north-east to west or south-west in a very short space of time, the thermometer immediately rising many degrees from the mild atmosphere thus brought to us from the sea. Simultaneously with this rise of temperature, we often experience also severe gales of wind on these occasions, with partial blight of many trees and shrubs, and especially the laurel, which seems remarkably sensitive to these sea breezes. There seems altogether a law in meteorology by which extremes of temperature are avoided. After the occurrence of an atmosphere acquired either on the one hand from the sea, or on the other from the cold district of Dartmoor, there is a sudden revulsion in the air, and an atmosphere from a contrary quarter is more or less suddenly poured in to the intermediate tract or South Hams. In the same way, some author has remarked that in his neighbourhood gales of wind from a cold quarter invariably succeeded to thaws during winter. During the season in

one day were all the trees and shrubs not situated in the vallies of the south-western part of the county (where they lay secluded as it were from the currents) stripped as if by magic of their verdure. On their western sides, the leaves became quite brown, and the generality of those on the opposite sides, partially so, so that it required only a short continuance of the same power to remove them from their blighted attachment. This sudden and simultaneous check precluded the possibility of discerning the usual gradual process of casting off the leaves in the various species of trees. Winter was supposed to have set in very early, and such an occurrence was not within the memory of the oldest inhabitant of my neighbourhood. The proceedings of this day closed with a storm which prevailed through the whole succeeding night, and when we rose next morning, the country presented a woeful appearance. Notwithstanding this severe check, some trees made an imperfect effort at fresh foliation, but the storms which took place in the two succeeding months soon removed all these traces.

Storms, apparently are designed to ameliorate the state of the atmosphere, and to set the balance of temperature correct, consistently with the period of the year. It is perhaps the principle of *revulsion* (if I might so express myself) to which we are indebted for what are commonly termed "thunder storms," at least those occurring to us in summer,

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which the warm and damp, or rainy atmosphere of the sea is poured in, the sun during day often acts powerfully enough to keep up sufficient wind to carry off the clouds, and immediately on its descent, rain falls in abundance. Thus it is somewhat an axiom that the middle of the day will determine the weather. This alternation of fine shining days and rainy nights often continues for a week or more. The descent of the sun however, by suffering the accession of some opposite current of air to that prevailing in the day, does also occasionally cause fine nights to succeed to very rainy and tempestuous days.

for they are observed to be subsequent on long continued drought, and to be productive of very considerable reduction of thermometric heat, more so I believe than attends *ordinary* descents of rain in the hotter months, which tend so pleasantly to cool down the atmosphere, and so gratefully to renew the vigour of every thing which has life. But "thunder storms" with their attendant deluges of rain, act in a more decided manner and on a weightier scale,—creating a degree of cold, which only the solar influence of several succeeding days suffices to remove. From the elevation of the Dartmoor hills, thunder clouds are in the rainy season driven much towards them, and are there intercepted. Of the fury of a moorland storm, we are assured none but they who have witnessed it can entertain a just idea. More than two hundred years ago, in October, a most terrific and awful thunder cloud broke over the church of Widdecombe-in-the-Moor; the lightning did damage to the amount of several hundred pounds, besides killing or injuring many persons. It seems that something like a meteorolite (in all likelihood one of the gaseous kind) accompanied the bursting of this cloud. The circumstances drew great attention at the time, and they were on several occasions printed.* The exposure of the Channel causes it to be particularly dangerous to shipping during storms, and it is observable, that gales from the southern directions are often followed most suddenly by furious blasts from north-west, the wind rapidly veering round to that quarter, thus exposing shipping to double danger. A remote consequence and use of winter storms seems to be the clearing of forests of superfluous timber, and such as has been the subject of natural decay.

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* "Guide to Scenery of Ashburton," by J. P. Jones, p. 38, et seq.

South-west winds when long continued or conducted in narrow streams, are as I have before said blighting in their effects, and as we should anticipate, *gales* of wind from the same quarter produce most evident results of the same kind when occurring during the time that vegetation is in full or partial development; if these blasts cut off the sprouts and leaves of evergreens in winter and spring, much more should they destroy the foliage of trees and plants when duly expanded. But, whereas the cold of winter would seem to assist in the destruction of vitality, it appears beyond the depth of our philosophy to unravel the mystery of the total destruction and indeed *incineration* of the exposed parts of many kinds of trees and plants during the short duration of a storm or heavy squall from that direction. During the wet and boisterous month of July, 1839, a storm of the above kind taking place at night, we found the sides of the hawthorn, bramble, elm, ash (partially), apple, and of very many garden trees, shrubs, and small plants exposed to that quarter, completely browned on the following morning; sting-nettles, and some other wild plants, as also potatoes suffered similarly wherever they had not shelter by means of intervening high hedges or other structures. The effect resembled carbonization from fire or electricity, which adds to the surprize of its occurrence in the lapse of only a few hours. A less extensive blight of the same kind and from the same cause took place about a month or two prior, when the ash suffered much.

The *floods and rain* of October and November, act in the economy of Nature, (which makes many an effect a *cause* for other *effects*, and suffers no effect to be an *idle* consequence,) by restoring to the earth that quantity of moisture which will in the future summer supply the nightly exhalations or dews so refreshing and even essential to the vegetable world. *Snow* seems to be useful in preventing the deleterious effects of frost, and severe cold on plants, for while these disastrous results are too often witnessed, we almost invariably see, that plants which have lain inclosed in snow a long while, and this envelope been sealed over by a subsequent frost, appear nowise injured, but even fresh and green when a thaw again displays them to view.

Persons generally consider that a *thaw* is nothing more than a solution of snow and ice by an alteration of temperature, and that the muddy state of roads is referrible to this circumstance alone; but I remark, that the quantity of mud is far greater than could be expected from the amount of fallen snow combined as water with the loose soil and surface of roads and ground generally, and that by recollecting that heat is continually being evolved from the interior of the earth, and that therefore the water retained in its substance from the rains and floods of autumn would not only be prevented from being frozen (or if frozen be again reduced speedily to water) but would with the soil wherein it lay, by the effect of gradually accumulating heat form a spongy mass, ready to be amalgamated with the dissolved snow and ice on the occurrence of the thaw,—we have a ready explanation of the circumstance. If there were not this internal heat of our earth, probably frosts would affect its watery particles to some depth, and then by the law of expansion of water by cold, the ground would be rent and upheaved in all directions and without the possibility of solar heat, reducing it again to an aqueous state to its whole extent of depth. But, it is perhaps proof of heat escaping from the earth even through the ice and snows, that we find some portion of this mass is during day volatilized, and by the density of the air at this season kept floating near the ground, and that when the sun withdraws his heat, and night ensues, this vapour falls like dew, rendering substances damp and as it were greasy to the touch. This moisture soon freezes and forms a coating of ice to vegetation, and nnmerous icicles appear clinging to every part of trees and shrubs. At another time of the year too, this terrestrial heat eliminates such abundance of moisture during day, that at night an atmosphere of vapour rests on the ground and proves during the heat of summer of vast utility to vegetation; at other periods again, namely during the spring and autumnal months when rain arrives from the south-west so freely, the amount of floating vapour (different in kind however from the former) is proportionately large, and by its weight or the influence of winds, it rolls into the vallies direct from the sea, or down the sides of the hills to which it had been driven, and there settles. On surveying the country on the mornings after these very common occurrences, the vallies are indicated solely by the dense aqueous atmosphere above them, and on descending to them we find the air moist, the trees dripping, and restoring part of the vapour to the rivers, while the remainder is evaporated when the sun attains sufficient altitude above the horizon.

Since it is a law of of Nature, that water in becoming ice should expand in bulk, we see effects demonstrative of this, not only on the large scale of ice swimming on lakes, rivers, seas, &c. but also on a small scale on very many occasions. The moisture accumulated in old walls and hedges during autumn passes into ice during frosts, and thus assuming a larger bulk, the mould, stones, &c. of which they are composed become displaced; for a while the congelation of the water holds the materials together but when a thaw occurs and the ice is dissolved, the earth, stones, &c. composing their sides, fall by their gravity and form small heaps in our roads. A second displacement of the same kind and of larger amount occurs during the drying winds of March, for, a vast deal of mould, &c. loosened by the frosts, was not so impending as to be precipitated in the thaws, but, when the dry blasts of this month arrive, the work is completed by the partial evaporation of the water holding the mould together, and the physical force exerted by the wind itself. These operations doubtlessly take place in natural elevations, precipices, deposits of soil, &c. and tend to reduce the earth to a more even surface in conjunction with other natural causes of more obvious influence.

When frosts and snow prevail, and we see in all directions the baneful effects they have wrought on vegetation generally, we cannot but admire the wonderful care Nature has shewn for the lives of herbivorous creatnres in endowing the various species of *grass* with unusual powers of resisting cold; I first had my attention particularly drawn to this fact by observing that in the winter of 1837—8, remarkable for its long duration of frost, some rye grass (lolium perenne) I had sown in the previous October, was very sparingly affected, and only at the tips of the leaves, while some groundsel which had sprung up amongst it, notorious as every one knows for surviving our winters was nearly everywhere destroyed. All herbivorous animals resident in climates liable to snow are instinctively aware that they have to dig beneath this covering in order to find their provender, indeed this family of plants not only survive the winter, but even grow and flourish,—the snow keeping back the heat escaping from the earth under all circumstances, gives the whole advantage of this to the plants thus snugly concealed under their protecting coverlid, and I have often been astonished to see that grass plots and fields had advanced greatly in growth during the period they had thus lain concealed from view. But, not only are grasses providentially resistent of frost, they resist great heats also, their tops may indeed wither, and we may fancy they are sacrificed, but the roots retain vitality and take the first occasion to throw forth new shoots. Again, the gramineæ thrive well, at least the majority of the species, in every variety of soil, and hence, gardeners need be no longer astonished at the trouble they encounter in freeing their grounds of grass weeds, the vast number of seeds sown by one plant is astonishing, and if buried by the spade after being thus scattered, other seeds of the same order are brought to light by the act of spading, and those then buried will in their turn be exposed to the surface at a future time. The cerealia grow in most climates and situations as though they were designed for the especial consumption of man, the cosmopolite.

There is one fact which illustrates with us the power of the earth in *conducting sound.* When every thing around is still, and particularly therefore at night, a hollow roaring sound reaches the ear from the direction of the rocky coasts. On paying more attention, we find there are intervals regularly kept when the noise is much less evident, perchance proceeding from echo of what had just died away. Attending to the phenomenon with greater accuracy still, it is remarked that the noise is more plainly heard in vallies than on elevated spots, and lastly it is perceived only when the wind arrives from the direction of the coasts, and especially from the south-west. It is caused by the continued and reiterated blows inflicted by the tide upon the rocks and precipices of the shore. It may be heard at the distance of more than three miles, and is termed by countrymen the "roaring of the cleaves" (cliffs).

There is a circumstance moreover which exemplifies the power and prevalence of our *south-west wind*,—its physical power or force, and its power or influence on vegetation. All the oaks and some other sorts of trees within a few miles of the sea-coast exhibit more or less proof of this effect of the prevailing blasts. Some are bent or are grown in a north-east direction at right angles from their trunks, and have not the least shoot on the opposite point; some however have large branches on their south or south-west side, still inclining at their upper parts to the contrary direction; some without shewing much inclination to the north or north-east, have no shoots whatever on the windward side, proving hereby that the wind had acted inimically on the vegetating powers of the trees, and as some few exhibit in the growth of their chief branches from the trunk a superior power of vegetating on the north-west, this influence of the prevailing winds in checking by their continued power the growth of branches generally within their immediate scope and reach is further demonstrated. The apparent direction then of these stunted trees will vary on the whole from north-west to south-east, but in general they act as compasses to the traveller by indicating the north or north-east. The generality of trees, and especially oak, become "stag-headed" or stunted in their upper branches when planted on hills within reach of the sea winds, and the elm hardly survives a removal to such elevated spots.

There is with us an omen or indication of an *approaching storm* well known to those resident on the sea side. Just as the appearance of the stormy petrel round a ship tells the mariner of a forthcoming squall, so here the hovering of gulls over the water immediately around the cliffs, tells us of a deep-felt commotion in the sea outwards, alarming the fish and obliging them to seek the shallow water of the bays, (whither the gulls follow them) and that anon the storm will rise higher and approach the land in its ordinary furious demeanour.

To cite evidence here of the great power of the south-west gales to which we are at times exposed, so far as regards their devestating effects on buildings and woods, might appear trifling and vague, but there are instances of their power so astounding that I deem it not amiss to record four, two of them occurring during the frightful gale of 1824, in November, a month proverbial with us for its storms. On the night of this storm, the conjoined action of the sea and wind removed immense masses of limestone constituting part of the fabric of the Breakwater, notorious for the strength displayed in the union of its component blocks. These severed members "were washed about like pebbles, and even carried up the inclined plane of this structure." At South Brent Tor the wind hurled from its summit huge stones, precipitating them to its base, and scattering them to great distances. In the spring of the year 1838, during the occurrence of a spring-tide the sea unexpectedly and suddenly rose to an elevation of nine feet beyond the highest water-mark and did considerable damage; one similar instance alone is within the recollection of our oldest men. Both these elevations of the sea were caused by violent south-west wind; in the former case the gale extended to our shores, in the latter it confined itself to the channel, but drove the sea thus violently on our coast. At the mouth of the Erme, a sandbank of two or three acres had been for years gradually accumulating from the washings of the sea; a wave of tremendous power during the above named high tide in March, 1838, carried this vast mass off at one sweep, and scattered it over the adjacent parts of the bed of the river.

A gale of wind from south-west in December, 1838, acted so powerfully on the sea as to cause it to dislodge from its bed amazing quantities of fuci, which were cast up in great piles in spots calculated to receive and detain the rejectamenta of the ocean. At the mouth of the Erme in particular, these great heaps must have amounted to very many hundred tons. This sea-weed however has now obtained such a good opinion from farmers as a dressing for corn lands that this vast bulk of manure was soon carted off and ploughed in for the future crops of wheat.

I trust the reader will forgive me if I conclude my observations on our climate by indulging in one other extract from the great Devonshire Poet, which is in several respects so very accurately illusrtative thereof.

> " O beautiful
> Art thou Devonia, or when Spring awakes
> The bud—the flower ; or when the leafiness
> Crowning thy hills, beneath the Summer noon
> Gloriously rests ; or Autumn sheds her hues
> Divine : and if stern Winter rule the day,
> O'er thee the monarch of the sunken year
> Reigns with paternal mildness. Though his voice
> Is heard majestically urging on
> The loud sea storm ; and haply at his nod
> Cease the sweet murmurs of the streams as blow
> Th' infrequent breezes of the biting East :
> Yet oftner he permits the ocean gales
> To breathe on thee reviving warmth, and waft

The fertilizing shower. With welcome ray,
Though Capricorn detain the parent orb,
The sun upon thy ever-verdant fields
Delights to glance, inspiring oft the bird
To burst into a gush of song. Thy vales—
Thy Austral vales—beneath that quickening beam
Exult; and there, in liveliest green attir'd,
Smiling like hope, and cheering the glad eye,
The meek, *unshelter'd* myrtle sweetly blooms.

Part II.—Chap. I.

LIST OF THE ANIMALS OF SOUTH DEVON, WITH THEIR HABITATS AND OTHER REMARKS.

"Historiam Naturalem, quam vocant, judicabat (Erxleben) animalium, plantarum, fossilium, non catalogum esse, sed physicam. Itaque horum corporum structuram, analysim, proprietates, usus docuit, non neglectis tamen notis quarum ope velut in indices possent referri. Quos indices solos qui memoriæ mandant aut ad evolvendos illos manus habent exercitatas, frustra sibi persuadent, librum ipsum Naturæ se tenere."

In note to Spallanzani's Dissertations. vol. ii. p. 344.

CATALOGUE OF THE MAMMALS RECOGNIZED BY THE AUTHOR OR OTHERS AS INHABITING SOUTH DEVON AND THE ADJACENT SEA.

Those species marked with an asterisk have been found as yet only in South Devon, or off its coasts.

PRIMATES.—Linn.

Vespertilo auritus.—*Long-eared bat.* Not uncommon, but scarcer here than in many other parts of England.

Vespertilio murinus.—*Common bat,* "*Shary, Runner* or *Shady mouse.*" Very common in old buildings, hollow trees, caves, &c. This species is now the vespertilio pipistrellus of modern authors. I have reason to think a black variety sometimes occurs; one of this kind is in possession of Pincombe of Devonport.

Vespertilio noctula.—*Great bat.* Frequents the lime quarries near Plymouth, but is scarce. On July 25th I received from Richard Julian, esq. of Estover House, two male specimens of this kind shot on his estate. Mr. J. states they were so rare that excepting one he saw about ten years since, they are the only specimens he has ever known. He thinks with Mr. White of Selbourne, they are the males of the common species;—he has never seen a female specimen, while on the contrary, all those specimens of the common kind which he has seen were invariably of that very sex. Many were found in August some years ago amongst a large number of the common sort, huddled together in an old building near Plymouth. They have been said however to quit this country in July. Judging by the contents of the stomachs of those two presented to me by Mr. Julian, they seem to feed exclusively on moths, beetles, and such like insects. Mr. White's statements respecting the species were quite corroborated by the appearance and dissection of these specimens.

Vespertilio Barbastellus.—*Barbastelle bat.* Taken at Milton and Kingsbridge. (Montagu)

Vespertilio ferrum-equinum.—*Greater horse-shoe bat.* In caverns at Torbay ; has also been taken at Hooe near Plymouth.

Vespertilio hipposideros.—*Lesser horse-shoe bat.* In caverns at Torbay.

* Vespertilio pygmæus.—*Pigmy bat.* Spitchwick, (Dr. Leach) Ilsington. (Dr. Turton) Confined so far as known to the neighbourhood of Dartmoor; seems however according to Mr. Gray to be only the young of the Pipistrelle. (Mag. of Zoology and Botany, vol. ii.)

* Vespertilio discolor (Kuhl)—*Party-coloured bat.* Plymouth (Dr. Leach)

? Vespertilio emarginatus (Fleming) —*Notch-eared bat.*

FERÆ.—Linn.

Canis vulpes.—*Fox.* Reduced much by the hunt. A variety or smaller species is imported hither from France in large numbers to supply sport to the fox-hunter.

Erinaceus europœus.—*Hedge-hog.* Common, but notwithstanding its great usefulness, much persecuted by gamekeepers and others.

Sorex araneus.—*Common shrew,* "*Shrew mouse* or *Shrove mouse.*" Common in old walls, hedges, and banks ; affected by epizooty in autumn.

Sorex fodiens.—*Water shrew.* Not uncommon, but somewhat local and very shy. G. Leach, esq. of Stoke has one from Launceston, and I think they occur near Yealmpton.

Talpa europœus.—*Mole or Want.* Very common in loose ground. The white variety has been taken at Knighton, Slade, Ermington, &c. and at Polperro in Cornwall. The cream-coloured mole also occurs, though more rarely.

Ursus meles.—*Badger* or "*Greypate.*" Greatly reduced by gamekeepers. Is readily tamed.

Mustela foina.—*Marten or Martern cat.* Woods at Lydford, and at Buckland-in-the-Moor.

? Mustela martes—*Pine marten.* Buckland-in-the-Moor.

Mustela vulgaris.—*Weasel* or *Whitred.* The young are termed by gamekeepers "*Ferries*" and are what White suspected to be a distinct kind. Common but much reduced by gamekeepers. White specimens and others in the progress of change to the white garb are occasionally found.

Mustela putorius,—*Polecat, Foumart, or Fitchet.* Rare, but much reduced by gamekeepers. A white variety is in possession of G. Leach, esq. taken at Marley.

Mustela erminea.—*Stoat.* Much reduced, but still not scarce, occasionally found white, or pied, or blotched with white.

Mustela lutra.—*Otter.* Much reduced, but not scarce. Rivers, sea shores, and fish ponds; pied otters are found on the Dart. Often appear at the Devil's Point, and Dock Yard, near Plymouth.

GLIRES.—Linn.

Mus decumanus.—*Common rat.* Abundant; white specimens have been shot. Infests rabbit warrens.

Mus rattus.—*Black rat.* Seldom noticed. One in the cabinet of G. Leach, esq. was taken at New Passage.

Mus musculus.—*Common mouse.* Abundant. Sometimes found white. A black variety is in the cabinet of G. Leach, esq.

Mus sylvaticus.—*Long-tailed field mouse.* Common. A pied one has been obtained at Yealmpton. "*Ground mouse*" or "*Grass mouse*"

* Mus intermedius.—(J. C. B.) For an account of this new species see the subsequent part of this book and woodcut.

? Mus messorius *Harvest mouse.* Corn lands. Common in Cornwall. (Couch.)

Arvicola aquatica. (Fleming)—*Water vole or Water rat.* In banks of streams ; local, but not rare. Is found on the Plymouth leat ; also near Launceston.

Arvicola agrestis.—*Field vole or Field mouse.* Common in corn fields, grass lands, &c. Very numerous in some years. See other remarks further on.

* Arvicola hirta. (J. C. B.)—*Shaggy vole.* For account of this newly discovered animal see another part of the work and woodcut.

Sciurus vulgaris.—*Squirrel.* Common in all our woods. I have seen a white tailed specimen at Yealmpton.

Myoxus muscardinus.—*Dormouse or "Derry-mouse."* Not uncommon, perhaps commoner than in most counties. In the unique collection of G. Leach, esq. comprising a nearly perfect cabinet of British mammals, there is a white variety taken in Devon.

Lepus timidus.—*Hare.* Common, but greatly reduced. White ones occur.

Lepus cuniculus.—*Rabbit.* Abundant. White ones occur. Warrens are numerous with us.

PECORA.—Linn.

Cervus dama.—*Fallow deer.* Only in parks.

? Cervus elaphus—*Stag or Red deer.* Deep woods near the moor ; one was killed near Oakhampton in 1838. It is however now principally located to Exmoor and the north of Devon, though 50 years ago they were tolerably numerous in South Devon. The progress of cultivation induces the belief that those occasionally occurring here are straglers from Exmoor.

CETE.—Linn. *(Marine Mammals.)*

Balæna boops.—*Razor-back whale.* Found dead off the Eddystone, October, 1831. A variety of sea birds were perched on it and continued to infest it for a long time after it was towed into Plymouth Sound.

Balæna physalus.—*Fin-fish.* In the channel

Physeter microps.—*Smermaceti whale.* Cast ashore some years since at the mouth of the Erme.

* Delphinus tursio.—Captured in Duncannon Pool, five miles up the Dart, in July, 1814.

Delphinus phocœna.—*Porpoise* or "*Sea-hog.*" Very common in small parties at the mouths of rivers in pursuit of fish, where in their haste they are often stranded.

Delphinus melas.—*Ca'ing whale.* Captured off Plymouth, April, 1839.

Delphinus orca.—*Grampus.* Not rare in the channel.

Delphinus delphis.—*Dolphin.* Captured off Plymouth, March, 1839.

Total, 43, of which however three or four may be accounted doubtful. Five of the species are peculiar to Devon.

Among the terrestrial species, I am not sensible of any important movements taking place requiring especial notice. The species of Mus, or some of them, are liable at times through want to shift their quarters, but this act is very rare. In the reported migration of the noctule bat to and from Italy, I place no confidence. The advance of man in the work of cultivation of the soil and other operations connected with his civilized condition, has restricted the number of several offensive and destructive kinds, such as the otter, the weasels, the fox, &c. and has done much towards the greatly-to-be-deplored extermination of others, particularly the badger, and red deer. The same circumstances however, are congenial to the unnatural increase of some sorts, such as the rat, and mouse, and perhaps the squirrel, and nearly all the species of land mammals are influenced in greater or less degree, by human operations in respect of their numbers and distribution. The extent of the catalogue is probably due to the varied kinds of aspect presented by the country, and the general mildness of the climate; it probably exceeds that of any other district of the same size in England. The migrations of our cetacea have not yet been sufficiently determined to admit of any observations. About 13 species of this tribe have been recognised by Couch as occurring in Cornwall. Delphinus deductor has recently been captured in Ireland, a herd having appeared on the coast.

CATALOGUE OF THE BIRDS OF SOUTH DEVON INCLUDING THE RARE & ACCIDENTAL VISITANTS, WITH OCCASIONAL REMARKS ON THEIR GEOGRAPHY.

I have refrained much from mentioning the places where specimens of the rarer birds have been procured, because the maps will in great measure give that information.

Those marked with an asterisk have been observed only in South Devon, or at most in Devon and Cornwall.

ACCIPITRES. (*Turton's British Fauna.*)

Falco chrysaetos.—*Golden eagle.* Has been seen in the county, but not in late years. Avoiding the vicinity of man, they seem to visit but rarely districts gradually yielding to cultivation.

Falco albicilla.—*Sea eagle.* Observed occasionally. Affects the land as well as the sea.

Falco haliætus.—*Osprey.* Chiefly in estuaries and at the mouths of rivers, but though oftener procured here than in most parts of England, is but rarely noticed. I believe three have been obtained here within the last five or six years.

Falco palumbarius.—*Goshawk.* Has been seen on Dartmoor. Probably breeds on the coast, as a young bird was shot near Falmouth in August, 1838.

Falco peregrinus.—*Peregrine falcon*, or "*Cliff hawk*." Affects the cliffs and is the commonest of the large kinds of falcons. Is seen occasionally on the Erme and at Whitsand Bay; visits the moor also.

Falco milvus.—*Kite*. Very rare, and seems limited to uncultivated spots.

Falco islandicus.—*Gyrfalcon*. A specimen procured from the Morwell rocks on the Tamar, Feb. 7th, 1834.

Falco rufipes.—*Red-legged falcon*. Obtained once in the Channel, and is a very rare British species.

Falco cinerarius.—*Ash coloured falcon*. Rare.

Falco lagopus.—*Rough-legged falcon*. Rare.

Falco apivorus.—*Honey buzzard*. Has been obtained on Slapton Ley.

Falco æruginosus.—*Moor buzzard*. Commoner than the other kinds of buzzard, and chiefly found in rabbit grounds.

Falco Buteo.—*Buzzard* ("*Kite*" vulgo) Not so common as the last; roams to woods and cultivated grounds in winter.

Falco cyaneus.—*Hen harrier*. Uncommon.

Falco tinnunculus.—*Kestrel*. On the coast; generally distributed.

Falco nisus.—*Sparrow hawk*. Not uncommon; observed principally during their wanderings after the breeding time.

Falco subbuteo.—*Hobby*. In deep woods, but rare. Summer.

Falco æsalon.—*Merlin*, "*Little blue hawk*." In winter, and rare. I have seen them in October and March. They fly low and very swiftly.

Strix bubo.—*Great-eared owl*. Observed by Dr. Moore near Honiton, in 1820.

Strix otus.—*Long-eared owl*. Not rare; they have been occasionally procured in the neighbourhood of Yealmpton.

Strix brachyotus.—*Short-eared owl.* Rare.

Strix flammea.—*Barn owl.* Not uncommon. Is often abroad in day time.

Strix stridula.—*Brown owl.* Would be as often found as the last if not unnecessarily persecuted by gamekeepers. A pair of the very dark coloured variety has been lately procured from Plympton; the difference is recorded accurately in Yarrel's "British Birds." Mr. Gosling however, who met with the same variety at Leigham, imagines from its habit of roosting on the ground that it is specifically distinct from stridula.

Strix passerina.—*Little owl.* Rarely procured. It has been shot not far from Yealmpton.

Strix nyctea.—*Snowy owl.* A specimen was found at St. Germains in December, 1838, and knocked down with a stick. Though not occurring exactly in this county, I have presumed to add so interesting a bird to our list. Its visit to us can hardly be accounted for.

The *Canada owl* has been taken in Cornwall, the only instance of its occurrence in Britain.

Lanius excubitor.—*Great shrike.* Rare, and frequenting wild spots; has been seen towards Ashburton (Dr. Tucker in "Guide to scenery of Ashburton,) and has been known to build in Cornwall.

Lanius collurio.—*Flusher.* Common, and much in hedges at the sides of road; arrives about May 8th.

Lanius rutilus. (Bewick p. 377.)—*Woodchat.* Shot at Mutley by Pincombe, of Devonport.

PICÆ.

Corvus corax.—*Raven.* Scarce from persecution; seen mostly in autumn and winter when it traverses the country in a desultory manner. Builds chiefly in the cliffs. On the 10th April in this year a man removed five full fledged young from a nest at Wembury cliffs.

Corvus corone.—*Crow.* Scarce from persecution. Mr. Comyns has a white specimen.

Corvus frugilegus.—*Rook.* White specimens have been at times shot round Plymouth, and it is rumoured that a *red* rook was seen repeatedly this year at Ivybridge.

Corvus pica.—*Magpie.* Not uncommon, but much reduced by persecution. Is occasionally seen in flocks of 20 or more in severe winters; at most other times individuals frequent one locality only; feeds occasionally with rooks in winter. Mr. Comyns has a white one.

Corvus cornix.—*Hooded crow.* Winter; but rare.

Corvus monedula.—*Jackdaw.* Common about towers and sea cliffs. Mr. Comyns has a white one.

Corvus glandarius.—*Jay.* Uncommon, but reduced greatly by persecution.

Corvus graculus.—*Cornish chough.* Visits the coast of Devon from the westward about September and October, and then in small numbers.

The *Nutcracker* has been killed in Cornwall and in North Devon, and I believe also on Dartmoor.

Oriolus galbula.—*Oriole.* Obtained occasionally in wooded districts, as at Gnaton and Mount Edgecumbe. Summer.

Cuculus canorus.—*Cuckow.* In summer. Not equally common in all years.

Yunx torquilla.—*Wryneck.* Scarce generally, but at Dawlish are said to be not uncommon. Summer.

Picus viridis.—*Green woodpecker*, or "*Woodwall.*" Not uncommon.

Picus major.—*Greater spotted woodpecker.* Uncommon.

Picus minor.—*Little spotted woodpecker.* Rare.

Alcedo ispida.—*Kingfisher.* Not uncommon about rivers, and during autumn and winter on the sea coast, besides being on rivers, ponds, and swampy spots.

Sitta europœa.—*Nuthatch.* Not uncommon in woods, and towards autumn and winter in orchards.

Merops apiaster.—*Bee-eater.* Rarely visits us, and chiefly in small flocks. Summer. It is probably oftener seen in Cornwall than Devon, as I am informed it has not unfrequently been observed on the borders of the Helford river. Twelve were seen at Helston, in May, 1828. Neighbourhood of Ashburton. (Dr. Tucker.)

Upupa epops.—*Hoopoe.* Rarely obtained. Summer. Is probably more frequent in Cornwall, but has been known to breed in Devon. See "Natural History of Torquay, Dawlish, and Teignmouth." Has been shot lately at Mamhead.

Certhia familiaris.—*Creeper,* or "*Tree climber.*" Common. Partial to woods, but frequents orchards much towards autumn and through winter.

PASSERES.

Sturnus vulgaris.—*Starling.* In great flocks through the winter. Breeds in some few spots in Devon. A white one has been procured.

Turdus viscivorus.—*Missel thrush* or "*Holm-screech.*" Not uncommon. White individuals have been seen.

Turdus musicus.—*Thrush.* Common. White ones have been seen.

Turdus merula.—*Blackbird,* or "*Greybird.*" Common. White specimens, and also two of a cream colour have been shot.

Turdus iliacus.—*Redwing*, or "*Windle.*" Common. In winter.

Turdus pilaris.—*Fieldfare.* Common. Winter.

Turdus roseus.—*Roze Ouzel.* Rarely procured. Summer.

Turdus torquatus.—*Ring Ouzel.* Breeds on many of the rivers on the skirts of Dartmoor. Summer.

Turdus cinclus.—*Water Ouzel.* Chiefly on the moorland rivers, but also at times builds about streams and rivers in cultivated districts, as at Yealmpton, where two pairs nestle yearly, one on the Yealm, and the other on a brook running to Kitley pond; they also stay with us through the winter in the vicinity of this place.

Ampelis garrulus.—*Waxwing.* Rarely procured. Winter. I have reason to think I saw one in a plantation at Yealmpton in the spring of the year 1838. Ashburton. (Dr. Tucker.)

Loxia curvirostra.—*Crossbill.* An uncertain visitor; arriving in flocks in summer, and frequenting orchards.

Loxia coccothraustes.—*Hawfinch* or *Grosbeak.* A very rare visitor. Winter.

Loxia chloris.—*Greenfinch* or *Green linnet.* Very common. Breeds in large gardens in the centre of towns.

Loxia pyrrhula.—*Bullfinch* or "*Hoop.*" Common. In woods and thickets. In winter in small parties living on groundsel seed. Mr. Comyns has a black, and a white specimen.

Emberiza nivalis.—*Snow bunting.* Winter. On Dartmoor, and often shot amongst other small birds, as the *Tawny bunting* or young; it is also rarely seen in open fields during winter in its white garb, and called by countrymen a "*white lark.*"

Emberiza citrinella.—*Yellow bunting*, "*Yellow hammer*, or *Gladdy*." Common.

Emberiza cirlus.—*Cirl bunting*. Not uncommon.

Emberiza miliaria.—*Great bunting*, or "*Horse lark*." Common, but not so plentiful as the last; frequents fields close to Plymouth and Devonport.

Emberiza schœniculus.—*Reed bunting*. Somewhat local.

Fringilla domestica.—*House sparrow*. Abundant. White specimens have been procured.

Fringilla cœlebs.—*Chaffinch, or* "*Mazefinch*," or "*Copperfinch*." Common. White specimens have been seen.

Fringilla montifringilla.——*Brambling*. Rare. Winter.

Fringilla carduelis.—*Goldfinch*. Common. Congregates in winter.

Fringilla spinus.— *Siskin*, or "*Aberdevine*." A rare visitor. Sometimes in small flocks in winter feeding on seeds of the alder. Has been known to build in Cornwall. (Couch)

Fringilla linota.—*Linnet*. Common. Congregates in winter. I have seen a linnet with a white ring round the neck.

Fringilla canescens.—*Mealy redpole*. Very rare.

Fringilla linaria.—*Lesser redpole*. Rare. Winter.

Fringilla montium.—*Twite*. Rare.

Fringilla montana. — *Tree sparrow*. Devon. (Turton and Kingston.)

Muscicapa grisola.—*Spotted fly-catcher*. Common. I have seen it in a garden in Plymouth. Summer.

Muscicapa atricapilla.—*Pied fly-catcher*. Very rare. One shot in March, 1838, at Mount Edgecumbe. Ashburton. (Dr. Tucker.)

Alauda arvensis.—*Sky-lark*. Common. Congregates in winter. White ones have been obtained.

Alauda arborea.—*Wood-lark*. Not uncommon.

Alauda pratensis.—*Tit-lark.* Common.

Alauda campestris.—*Rock-lark*, or "*Sand-lark.*" Very common on the coast.

Alauda trivialis.—*Tree-lark.* Not so common as the other species, and less so than in some other counties. Summer.

Motacilla alba.—*Pied wagtail* or "*Dishwasher.*" Common the year through. Does not shift its quarters either in Devon or Cornwall.

Motacilla boarula.—*Grey wagtail.* Common in autumn and winter. Rarely stays the summer to breed.

Motacilla flava.—*Yellow wagtail.* Not uncommon. Summer.

Sylvia luscinia.—*Nightingale.* Summer. Once heard near Kingsbridge by Montagu, and by my friend Mr. Bartlett, once at Brixham; according to Turton and Kingston, also near Dawlish, Ringmore, and Lindridge.

Sylvia hortensis.—*Pettychaps*, or *Garden Warbler.* Not uncommon, and in some spots frequent. Summer.

* Sylvia erithacus. Linn.—*Red-tailed warbler.* I am indebted to Mr. T. E. Gosling for making me acquainted with the fact of this species having been shot at Devonport. Six of these birds the only British specimens known, were shot in the Lines of that place at one time. This species is described correctly in Latham, excepting that the sides, under wing and tail coverts are in the present cases unmixed with rufous, and are purely of a whitish grey. It is remarkable that whilst in Burgundy and Loraine they arrive in May and depart in October, these few specimens were secured in the end of November.

Sylvia phænicurus.—*Redstart.* Its occurrence with us is rare as compared to many other counties; in Cornwall it has not I believe been ever known to stay. Summer. In 1839 I heard it near Totnes.

Sylvia modularis.—*Hedge warbler.* Common, but not numerous as we might anticipate from the number of its eggs.

Sylvia atricapilla.—*Black cap.* Common. Summer. I have heard it in a garden in Park-Street, Plymouth, June 10th and subsequently.

Sylvia passerina.—*Passerine warbler.* (Bewick) Shot by Pincombe of Devonport, in a garden at Stoke Damerel.

Sylvia tithys.—*Black redstart.* Shot at Stoke Damerel, and has also been known to breed at Exeter.

Sylvia rubecula.—*Redbreast,* or "*Robin.*" Common. A white one has been killed in Devon.

Sylvia cinerea.—*White-throat.* Common. Summer.

Sylvia sylviella.—*Lesser white-throat.* Rare. Summer.

Sylvia rubicolla.—*Stonechat.* Common, especially on Dartmoor.

Sylvia rubetra.—*Whinchat,* or "*Furzechat.*" Summer. Not uncommon.

Sylvia œnanthe.—*Wheatear.* Common in some parts of the sea coast, and about the estuaries. Summer.

Sylvia hippolais.——*Cliff chaff.* Common. Summer. It and the *Yellow wren* occasionally stay the winter. Arrives about March 23rd, as at Selborne.

Sylvia troglodytes.—*Wren.* Common. I understand two white wrens and their three white young ones were procured at Langdon last year.

Sylvia regulus.—*Gold crest.* Common. A white specimen has been shot in Devon.

Mr. Gosling informs me he has reason to think the *Fire crested wren* may be added to the list.

Sylvia provincialis.—*Dartford warbler.* Said to have been common near Plymouth in former years; now scarce and local. First observed here by Richard Julian, esq. of Estover. Ashburton. (Dr. Tucker.)

Sylvia locustella.—*Grasshopper warbler.* Rare. Summer.

Sylvia salicaria—*Sedge warbler.* Not uncommon. Summer. In great plenty at Slapton Ley.

Sylvia arundinacea.—*Reed warbler.* Rare. Summer.

Sylvia sibillatrix.—*Wood wren.* Not uncommon. Summer.

Sylvia trochilus.—*Yellow wren.* Common; arrives towards the middle of April, but I once heard it in the end of March. Is sometimes heard in the gardens of Plymouth during the breeding time, and on to August.

Recently a bird has been shot by Pincombe, Taxidermist of Devonport, at Whiteford in the neighbourhood, which bears great resemblance to the Cliff Chaff in colour, and is but a trifle longer; the differences worthy of note being first and principally, a greater width of the base of the upper mandible; secondly, a want of correspondence between certain quill feathers;—the 2nd and 7th being the same length in the Cliff Chaff, the 2nd and 6th in the Yellow wren, while in this new species each feather differs in length from the rest; thirdly, that the alula spuria is of a brighter yellow, and somewhat larger. The note is unknown to the person who procured it. With such similarities and uncertainties regarding it, there is great difficulty in proposing a name anyway scientific, but since names *must* be adopted to curtail the means of identification in conversation, it may pro tempore be styled *Sylvia neglecta.*

Parus caudatus.—*Long tailed tit.* Not uncommon.

Parus cæruleus.—*Blue tit*, or "*Hickmall.*" Very common. Breeds often in town gardens.

Parus ater.—*Cole tit.* Not uncommon.

Parus palustris.—*Marsh tit.* Not uncommon.

Parus major.—*Great tit.* Common.

Parus biarmicus.—*Bearded tit.* Found only in one or two spots towards Exeter.

Hirundo rustica.—*Swallow.* Common. White specimens of this and the next species have been seen with us. Summer.

Hirundo urbica.—*Marten.* Common in some localities, but shift their abode much from year to year. Summer. Stays later than the Swallow, and a few are seen yearly between 10th and 13th November, at Plympton; Breeds with the Jackdaws in the cliffs of Bigbury Bay, and elsewhere along the coast.

Hirundo apus.—*Swift.* Common in some situations. Summer.

Hirundo riparia.—*Sand marten.* Common in some spots, but vary their residence much from year to year. Summer.

Caprimulgus europœus.—*Night jar*, or "*Night crow.*" Not uncommon. A pied one is in possession of Mr. Comyns of Mount Pleasant. Summer.

The *Carolina cuckow* and *Roller* have occurred in Cornwall, and it is believed that the *Alpine swift* and *Blue-throated warbler* might safely be added to the Cornish list, if not to ours also.

COLUMBÆ.

Columba palumbus.—*Wood dove.* Common.

Columba ænas.—*Stock dove.* In large flocks in winter.

Columba turtur.—*Turtle dove.* Rare. Summer.

Columba livia.—*Rock dove.* On the southern coast of Devon, and I am informed also builds on the coasts of Cornwall. I saw one in June, 1839, on the rocks in a small cove at Dartmouth.

GALLINÆ.

Phasianus colchicus.——*Pheasant.* Common. White ones, and "Ring pheasants," have occurred. This bird is not a native, and hardly deserves a place in this list.

Tetrao tetrix.—*Black grouse.* Preserved in some few spots, and rarely seen on the skirts of the moor; has been shot at Estover; in the cold season roams over the South Hams, and is not unfrequently sold in the markets at that time. Is Cornwall the southern limit of Tetrao tetrix ?*

Perdix cinerea.—*Partridge.* Common.

Perdix coturnix.—*Quail.* Uncommon. Usually found here towards winter at the time of its migration, but some few stay the winter in Devon. Has been shot at Estover in winter.

Otis tarda.—*Great bustard.* Formerly not unfrequent on Dartmoor, but is now a questionable resident.

Otis tetrax.—*Little bustard.* Rare.

Otis œdicnemus.—*Thick-knee, Great plover,* or "*Stone curlew.*" Uncommon. Summer. Chiefly on Dartmoor. I have seen this bird brought to

* In White's Selborne mention is made of a hybrid bird between the Pheasant and Black grouse. Three cases of the same kind have occurred with us, one on Haldon, one on Shaugh Moor, and one at Whidey; in two of these cases the parent birds were seen or secured, and the Pheasant proved to be the male, the young moreover which have been shot seem to resemble most that species.

market during winter, proving Montagu's remark that they occasionally stay with us through that season. Has been shot at Estover, and in the parishes of Kingston and Kingsbridge.

GRALLÆ.

Platalea leucorodia.——*Spoonbill.* In severe winters has been procured here on the sides of rivers and on the mud at low tides, but is very rare in its visits. One shot in 1835, on the Tamar, and one in 1838, both in December.

Ardea Grus.—*Crane.* Formerly resident on Dartmoor, but is now never seen here; one was killed however near Tavistock, in September, 1826. Has been killed in Cornwall.

Ardea ciconia.—*White stork.* Rarely, at Slapton Ley. (Mr. Gosling.)

Ardea nycticorax.—*Night heron.* Shot at Leigham. (Mr. Gosling.) Ashburton. (Dr. Tucker.)

Ardea stellaris.—*Bittern.* Not very uncommon. Procured chiefly in winter. They have been noticed frequenting small rivers and streams, as well as the larger waters. Have been shot at Yealmpton. The Bittern seems to be in some measure a bird of passage, one having been caught on its arrival on the Irish coast, March, 1839.

Ardea minuta.—*Little bittern.* Obtained at Crediton and in the North of Devon.

Ardea cinerea.—*Common heron.* A heronry at Warleigh on the Tamar, at Sharpham on the Dart, &c. Herons during winter extend themselves generally over the country, frequenting rivers, ponds and swamps.

Ardea purpurea.—*Purple heron.* Rare. Has been procured from the Tamar.

Ardea alba.—*Great white heron.* Has been seen once on the Avon.

Ardea nigra.—*Black stork.* Shot on the Tamar, November, 1831.

Ardea lentiginosus.—*Freckled heron.* Shot at Mothecombe, 1829.

* Ardea russata.—*Little white heron.* Shot near Kingsbridge in 1805.

Tantalus igneus.—*Ibis.* Rarely obtained. One shot in October, 1835, at Bridestow ; has also been shot near Exeter and Dartmouth. Winter visitor.

Numenius arquata.—*Curlew.* Breeds on the moor. Found on the shores in winter.

Numenius phæopus.—*Whimbrel.* Uncommon. This and the Curlew are said to be resident the year through at the Scilly Isles.

Numenius pygmæus.—*Pigmy curlew.* Rare.

Scolopax rusticola.—*Woodcock.* Common. Has been known to breed here. White species have been obtained in Devon.

Scolopax major.—*Great snipe.* Rare. Has been shot near Plymouth, and near Ashburton.

Scolopax gallinago.—*Snipe* or "*Heather bleater.*" Common. Has been known to breed here. Arrives first about the end of October, but is not plentiful till severe weather in November.

Scolopax gallinula.—*Jack snipe.* Uncommon. Winter.

Scolopax lapponica.—*Red godwit.* Rare.

Scolopax ægocephala.—*Common godwit.* Not uncommonly seen in small flocks in our estuaries in spring and summer. On May 10th, 1831, I obtained two in full and beautiful plumage, from a flock which were parading the sand-banks of the Lara at low tide. I had also specimens in the previous winter.

* Scolopax grisea.—*Brown snipe.* Rare. Two specimens known.

Scolopax glottis.—*Greenshank.* Rare. Small parties have been seen at Mount Batten, near Plymouth.

Scolopax calidris.—*Redshank.* Uncommon.

Scolopax totanus.—*Spotted redshank.* Rare. Ashburton. (Dr. Tucker.) Pincombe, of Devonport, has a fine pair. (See Bewick vol. ii. p. 69.)

Tringa pugnax.—*Ruff.* Rare.

Tringa vanellus.—*Peewit,* or *Lapwing.* Breeds on Dartmoor, and descends to the cultivated grounds and shores in winter.

Tringa squatarola.—*Grey plover.* Visits us in winter from northern counties, frequenting fields and the sea coast; also on the moor in summer.

Tringa nigricans.—*Purple sandpiper.* Said by Dr. Moore to be common among Purres in winter, and to be also seen in summer.

Tringa ochropus. — *Green sandpiper.* Rare. There is a specimen shot at North Buckland, in the Museum of the Natural History Society. Winter.

Tringa glareola.—*Wood sandpiper.* Rare.

Tringa canutus.—*Knot,* or *Ash-coloured sandpiper.* Not uncommon, but chiefly in winter.

Tringa hypoleucos.—*Common sandpiper.* Common. Summer.

Tringa cinclus.—*Purre,* or "*Sanderling*" vulgo. In great abundance. Breeds on the moor.

Tringa interpres.—*Turnstone.* Uncommon.

Tringa Temminckii.—*Temminck's sandpiper.* Shot at Stonehouse.

Tringa pusilla.—*Little stint.* Rare. Has been shot on the Tamar and Lara, and from its appearance with us at a stated time, namely in August or September is probably migrative. (Mr. Gosling.) Ashburton. (Dr. Tucker.)

Charadrius pluvialis.—*Golden plover.* Breeds on the moor, and descends towards winter to the lower lands and shores.

Charadrius calidris.—*Sanderling.* Rare.

Charadrius hiaticula.—*Ringed plover,* or "*Sealark.*" Common.

Charadrius morinellus.—*Dottrel.* Rare. Probably breeds on the moors.

Cursorius himantopus.—*Long legged plover.* Rare. Ashburton. (Dr. Tucker.)

Hæmatopus ostralegus.—*Sea pie,* or "*Oyster catcher.*" Visits our shores in small flocks (containing young birds,) in autumn, and remains the winter. Dr. Moore has one with a white ring round the neck.

Rallus aquaticus.—*Water rail,* "*Skip cock,*" or "*Gutter cock.*" Common. This bird and the Moor hen frequent inundated spots during winter for the sake of drowned snails, worms, &c.

Gallinula crex.—*Landrail.* Common. Summer.

Gallinula chloropus.—*Moor hen,* or "*Water hen.*" A common resident through the year. Can perch. Visits the shores of rivers at times.

Gallinula porzana.—*Spotted gallinule.* Rare.

Gallinula Foljambei.—*Olivaceous gallinule.* Rare. A specimen procured at Devonport; in a very languid state when found.

Gallinula pusilla.—*Little gallinule.* Very rare. Only two specimens are known.

PINNATIPEDES.

Phalaropus lobatus.—*Grey phalarope.* Obtained towards winter, but mostly after storms, when, together with other marine birds, they enter our harbours to recruit their exhausted strength. On their arrival they are usually so weak as to be secured alive.

Fulica atra.—*Coot,* or "*Baldcoot.*" Breeds here. In winter visits the estuaries. Common at Slapton Ley in summer.

Podiceps cristatus.—*Crested grebe.* Uncommon. Winter chiefly.

Podiceps cornutus.—*Horned grebe.* Not uncommon. Winter.

Podiceps rubricollis.—*Red-necked grebe.* Rare. Winter chiefly.

Podiceps minor.—*Little grebe,* or *Dabchick.* Common. Breeds here, and frequents the estuaries much during winter.

PALMIPEDES.

Recurvirostra Avocetta.——*Avocet.* Obtained occasionally.

Alca arctica.—*Puffin,* or *Sea parrot.* Rare. Visits the Channel in winter. Breeds on Lundy Island in North Devon. Perhaps also breeds in South Devon, as a very young bird has been captured here.

Alca torda.—*Razor-bill,* or "*Murre.*" Rather common in winter. Rare in spring and summer. I procured one on February 7th, 1834, and several were shot in May, 1834.

Alca alle.—*Little auk.* Very rare. Has been seen on the Lara. Teignmouth. (Turton and Kingston.)

Uria Troile.—*Foolish guillemot,* or "*Murre.*" Common. I obtained a young bird July 23rd, 1830, from Oreston.

Uria Grylle.—*Black guillemot.* Rare. Has been shot in the Sound in winter.

Colymbus glacialis.—*Northern diver.* Obtained mostly in the immature state during winter, but a mature one was shot on the Exe in May, 1829. (Moore's Catalogue.) One was captured in Cornwall in February, and one was taken in Bigbury Bay in June, 1838, in full plumage. It was chased a long time by two watermen, and at last became so stupified by such incessant diving as to suffer itself to be secured alive, after a blow from a paddle. On

September 17th, 1832, I observed five off Rame Head.

Colymbus arcticus.—*Black-throated diver.* Very rare.

Colymbus septentrionalis.—*Red-throated diver.* Not uncommon. Chiefly in winter, but on August 1st, 1833, I received a fine one shot off Turn-chapel.

Sterna Boysii.—*Sandwich tern.* Very rare.

Sterna hirundo.—*Common tern,* or "*Sea swallow.*" Common towards winter, and in greatest plenty after storms, when they arrive in our estuaries in an exhausted state, and stay many days eating offal on the shores, and plunging on small fry from a great height.

Sterna minuta.—*Lesser tern.* Uncommon.

Sterna fissipes.—*Black tern.* Rare.

Sterna arctica.—*Arctic tern.* Very rare.

Larus cataractes.—*Skua gull.* Obtained occasionally in winter. Six were shot in the harbour in September and October, 1831. (Mr. Gosling.)

Larus parasiticus.—*Arctic jager.* One shot at the Mewstone, in October, 1833.

Larus ridibundus.—*Black-headed gull.* Rare in summer, but common in winter. One was shot at Oreston in March, 1835. "*Maddrick gull,*" vulgo.

Larus marinus.—*Greater black-backed gull,* or "*Saddle back.*" Obtained in winter, but are not common. In severe weather they will approach close to the houses of sea-side villages. In 1832 one was shot in the Sound, which measured across the wings 6 feet 8 inches.

Larus fuscus.—*Lesser saddle-back gull.* Common, and particularly in winter.

Larus tridactylus.—*Kittiwake.* Very common in winter, rarer in summer.

Larus canus.—*Sea mew.* Common in large flocks about sea-side fields, and often miles inland.

Larus argentatus.—*Herring gull.* Common. Breeds here on the cliffs, as at the mouth of the Erme and elsewhere.

Larus glaucus.—*Burgomaster.* Very rare.

Larus Richardsonii.—*Arctic gull*, or *Black-toed gull.* Very rare.

Larus minutus.—*Little gull.* Very rare. Shot on the rivers.

Procellaria puffinus.—*Shearwater.* Breeds on Lundy Island. Obtained in winter in the Channel, but rarely.

Procellaria cinerea.—*Cinereous shearwater.* Recognized in the Museums of this neighbourhood by Dr. Moore. It is rare.

Procellaria pelagica.—*Stormy petrel*, or "*Mother Cary's chicken.*" Common after storms in a languid state. Breeds in Cornwall.

Procellaria Leachii.—*Fork-tailed petrel.* Obtained after storms, but is a rare species.

Procellaria glacialis.—*Fulmar.* Devon. (Turton and Kingston.)

Mergus merganser. — *Goosander.* Rare, but generally obtained every winter.

Mergus serrator.—*Red-breasted merganser.* Rare, but generally procured every winter.

Mergus albellus.—*Smew*, or "*White nun.*" Not very rare in winter, especially if severe weather. If the *Lough diver* be distinct, a specimen can be claimed as Devonian.

Anas cygnus.—*Wild swan.* Not uncommon in severe winters.

Anas ruficollis.—*Red-breasted goose.* Very rare. Winter.

Anas anser.—*Wild goose.* Common in severe winters.

Anas albifrons.—*White fronted goose.* Occasionally in flocks in severe winters.

Anas segetum.—*Bean goose.*—Scarce, and only in severe weather.

Anas erythropus—*Bernacle goose.* Very rare. Winter.

Anas bernicla.—*Brent goose.* Rare. Winter.

Anas mollissima.——*Eider duck.* Very rare. Winter.

Anas nigra.—*Scoter,* or *Black diver.*—Not rare. Chiefly in winter.

Anas fusca.—*Velvet duck.* Very rare. Winter.

Anas boschas.—*Wild duck.* Common in winter; they begin to arrive here occasionally as early as the end of September. Some are bred here.

Anas marila.—*Scaup duck.* In winter, but rare.

Anas tadorna.—*Shieldrake.* Uncommon. Breeds in North Devon, and visits us in winter.

Anas clypeata.—*Shoveller.* Very rare. Winter.

Anas strepera.—*Gadwall.* Rare.

Anas querquedula.—*Garganey.* Rare. Occasionally in summer, but more usually in winter.

Anas penelope.—*Widgeon.** Common. Winter.

Anas ferina.—*Pochard.* Obtained in severe winters.

Anas acuta.—*Pintail duck.* Sometimes common in hard winters.

Anas glacialis. — *Long-tailed duck.* Several specimens have been captured on the Tamar.

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* A bird intermediate between the Mallard and Wigeon has been procured by Pincombe of Devonport ; the brilliant wing spot being very distinct. It is rather astonishing how prone some animals are to unnatural alliances even when surrounding circumstances are but a degree removed from a state of nature. Montagu relates that in a pond appropriated to wild fowl, Widgeons have been known to form matrimonial connexions with the Pintail, although there was no lack of other Widgeons of both sexes in the same pond.

Anas ferruginea.—*Ferruginous duck.* Only one specimen.

Anas clangula.—*Golden eye.* Rare, and generally in hard winters.

Anas fuligula.—*Tufted duck.* Not uncommon in winter.

Anas crecca.—*Teal.* Common in winter.

Pelecanus carbo.—*Cormorant.* Not uncommon.

Pelecanus graculus.—*Shag.* Common. Explores in-land during winter.

Pelecanus bassanus.—*Gannet.* Breed in North Devon, and appear off the southern coast in winter, and usually arrive both in Devon and Cornwall in the track of the shoals of Pilchards, on which they voraciously feed. I procured a young bird (triangular spots on a ground of dark brown) on October 20th, 1831, from Hooe Lake, which is mentioned in Moore's catalogue.

The *Spur-winged goose*, *Surf duck*, (of Eyton) *Cravat goose*, *Roseate tern*, *Jackson's gull*, and *Grey petrel*, have been taken in Cornwall.

Total, 247 South Devon Birds, three or probably four of which have as yet been noticed only in this district, and considering the highly mobile character of the race, and the great and very general attention paid to Ornithology beyond most other departments of Natural History, this small number is not very remarkable, while the very great extent of the entire list, beyond in fact that of perhaps any other spot of similar size in England, sufficiently attests the remarkable adaption of it in all points to maintain an unusually large number of the tribe. The migrations of birds are so various as to require an investigation in almost every one of those species which *do* change their places of abode, and on surveying the list it is astonishing what a large proportion of them act in this manner, some kinds, such as the *Swallow* spending the summer with us, and retiring subsequently to warmer latitudes; some passing to our shores at the commencement of winter, staying till spring, and then again winging their way to northern abodes, such as the *Wigeon;* some performing a migration to us only from more northern counties on the approach of winter, such as the *Black-headed gull;* some merely passing from the northern to the southern shores of the county on the occurrence of severe weather, such as the *Gannet;* some simply from the recesses of Dartmoor or other breeding spots, to the cultivated grounds and shores, such as the *Lapwing;* some only shifting their positions still more inconsiderably,—individuals of each kind occupying stations during winter where they were not found in summer, as is seen in the *Water-hen;* while the *Robin* is said to visit the sea coasts in autumn; some species are known to appear here in summer only in certain years according to caprice, or some unknown determining impulse, this is witnessed in the *Crossbill*, which comes usually about the end of that season, and departs before winter; some cross over from the continent on the occurrence of particularly warm summers,—the *Oriole*, *Bee-eater*, *Hoopoe*, and *Roze ouzel* are the birds more especially alluded to, though no doubt many others might be similarly classed. The more frequent occurrence of this kind of migrants in Cornwall than in Devon is a clear indication of the circumstances inducing their movement, and of the direction whence they come. A great many birds seem to lead a wandering and uncertain life, though this remark chiefly belongs to the *birds of prey*, and some of the *Pies;* the *Nutcracker* is a good instance of continued propensity to wander, and the *Raven* seems to be incessantly shifting situation at all but the breeding season. *Unusually severe* winters, like very fine summers, produce great effects on our ornithological

Fauna; it is for instance under this impulse that the *Wild swan* migrates in winter so far south as Devon, and the same cause sets in motion the generality of aquatic birds which usually are limited at that time to more northern stations in the Island, and compels them to seek food by roaming over the southern shores. Some unknown causes induce them however *rarely* to visit us at other seasons, both in the case of the inhabitants of high latitudes, and of our own English birds, witness the *Northern diver* and *Crested grebe.* The young only of some species of water fowl stay with us in winter, as happens with the *Guillemot.* On land, many kinds congregate during the cold season, and roam indifferently over the fields to procure food, as occurs with the *Lark.* The *Chaffinch* makes a more direct emigration southwards. The *Missel thrush* after the breeding time keeps its family together, and is seen in autumn traversing the orchards and gardens every where, feeding on ripened berries and similar provender; *Gold-crests* crowd much into orchards towards winter. The individuals of some species influenced by some inappreciable cause remove from their more proper abodes, and are found with us under the title of *straggling visitants,* of which class the *Black stork* is an example. On the whole therefore as before said, the movements and migrations of birds are so manifold as to require an investigation of the habits of each species of bird respectively. The manner in which the question of migration is ordinarily treated is far too summary, and instead of ranging our migrants into three classes or kinds, we ought rather to reflect that each species is endowed with a separate instinct for its guidance and well-being in this respect, and that irregularities of action occur among *even the individuals,* of certain kinds.

Violent squalls of wind drive to our coasts several sea birds which otherwise would hardly occur to us. South-westerly winds in particular are fruitful in this point of view,—the species of *Terns*, the two *Petrels*, the *Little awk*, the *Phalarope*, the *Black-toed* and some other kinds of *Gulls* are instances to illustrate the fact. Again, several kinds of birds in passing over sea from northern countries to France, Italy, the African shores of the Mediterranean, &c. are driven at times it is presumed by the fury of sea winds out of their due course, and obligated to seek temporary domiciles in this country, the *Hawfinch* is stated to be an instance of this kind, being assailed in its transit by northerly or easterly winds, or at least by the *violence* of gales during the autumnal equinox. The same thing happens to the *Ibis*, also an autumnal or winter visitor as before spoken of.

In investigating the Fauna of a locality, attention should be paid to the influences of man in his advances as a civilized being on the natural domains of the creatures around him. In agriculture especially he affects the geographical range of a great number of the feathered race, generally by infringing on the space and situations assigned them, but occasionally also, by inducing them to enlarge the boundaries of their habitats. The restrictions on the species of rapacious birds, far more useful than generally thought, is a deplorable example of this merciless persecution on our parts, while the protections and food supplied to the granivorous birds by the operations of tillage, &c. is an instance of increased numbers, and increased range excited also by ourselves. The great extent to which *planting* is carried, affords shelter, and food (both of the vegetable and insect kind) to an increased number (perhaps) of species, and certainly of individuals of kinds of birds originally indigenous.

Orchards in particular require notice as giving resort to several species, and plentiful supply of food to them in autumn and winter from that large stock of scarabæi and other insects congregated in the bark, leaves, and flower-buds. The differences of habitations and food of the same species in different localities is a subject which has yet attracted too little attention, and without doubt, due consideration of this point would lead to the solution of many apparent discrepancies and contradictions attached at present to the study of ornithology. If we reflect on the extent to which orchards are employed by birds as spots of concealment, and for gathering food, and then recollect how many counties in England are devoid of them, this truth may at once appear. But notwithstanding these influences of man which are so very evident in our ornithological pursuits, there are some facts in the history of our birds which appear contradictory to the above statements, or anomalous,—the sudden withdrawal of the *Kite*, so common a few years since, the entire removal of the *Crane* and *Egret*, in former years plentiful, the lessened numbers of the *Dartford warbler* and some other birds, the smaller migrating parties of *Crossbills*, &c. are cases illustrative of the necessity of being prepared to admit certain changes in a Fauna which are independent of human operations.

In conclusion, I observe that besides possessing nearly all the kinds of birds found at any period in most other parts of this country, we are able to enumerate species from Africa, the Continental States from south to north, and even from the Polar Regions; and that in consequence, our aggregate list stands unrivalled among the English local Faunas, in regard of size and interest. In another part of this book I have analyzed our Fauna in such a manner as to determine pretty exactly the causes of its extent in the ornithological department, and it is here only requisite to remark, that our eligible position towards several portions of the ocean, and several islands, and our proximity to the Continental States, ought to be taken greatly into account from the advantages these circumstances afford in augmenting the variety of the pelagic birds.

From the study of birds may be derived a most useful lesson to the naturalist. Animals so high in the scale of intellect can hardly execute so many subtle actions and so many deviations from what we regard as their more positive instinctive tendencies, without furnishing information regarding the sources whence these actions spring. We find some birds penetrating southwardly in the winter, in proportion to the severity of the season, the *Wild goose* for instance; we find some kinds incited to migration from their summer abodes only if the weather be very severe as seen in the *Wild swan*; we find numerous cases where *individuals* alone choose in some years to emigrate, the main body of the species remaining stationary in its own proper country, instanced in the *Red-tailed warbler*, a native of southern Europe; we find cases of an opposite kind where the main body invariably migrates, some few individuals choosing to remain stationary, witnessed by the *Gray wagtail*, which occasionally stays in Devon to nestle, and rear its young; we find instances of birds which ordinarily appear here in summer, arriving at times in winter, (though this is a very rare fact) and vice versâ of birds which generally come in winter, arriving in the height of summer, (an extremely common fact) the *Siskin* for instance has in some years been noticed with us only in winter, and the *Black-headed gull* has on rare occasions been observed off our coast in summer, and the *Common godwit* been found at the mouths of our rivers in some years at the same season; again, we find cases of birds suddenly appearing in countries and localities where before they had not been noticed, and vice versâ of birds entirely withdrawing from neighbourhoods and countries where previously they had maintained citizenship, examples of which have been already given. In all which instances I maintain, we gain the information that birds (and indeed all the higher animals,) are capable of being actuated by volition, and that instead of being *solely* the blind creatures of a supposed over-ruling agent—Instinct, they have the power of drawing from us a far greater surprise than that elicited through the results of the operations of that principle by demonstrating to us *their combined faculties of Reason and Instinct*, the one prompting them to act in great degree through choice and caprice, the other conducting them securely on the path their volition pointed out.

But, unfortunately for science, naturalists have been hitherto greatly insensible of one direct way in which this doubted truth might all along have been made apparent. It is but recently that they have been any way prepared to admit that the economy and actions of animals vary greatly within small compasses,—a fact however daily being made manifest, and since furnishing a most important key to many of the mysteries of animal life, should henceforth excite observers to put aside prepossession, and endeavour to illustrate the truth still further within the limits of their own fields of observation. Perhaps there is no more opposite case in proof of the necessity of this species of attention to *local* phenomena, than that of the *Rock dove* in Devon,—it is migratory in the south-east of the county according to Turton and Kingston, and stationary in the south-west. The fact of the migrations of birds being so devious and uncertain explains at once why so much doubt appertains to the statements involved in the following "methodus" or table, the use of which in regard of its arrangement is merely to meet the demands of tyros and superficial inquirers. The history of every species is ever open to exceptions and deviations, and it must be inquired into in every portion of its range ere this can be said to be wrought out.—Historia locum, historia specieum est.

In addition to the above instance of the Rock dove, there are certain others of the same class which it will be here desirable to present as especially illustrative of the peculiarities detected during our inquiries into local natural phenomena. *Thick-kneed bustards* are occasionally found to stay the winter with us, though usually migrative, and it is even probable that certain individuals winter with us yearly, and are not detained merely from *mildness of our brumal seasons*, since I have known them procured during very inclement winters. *Quails* have occasionally also been shot in South Devon in winter, contrary to their usual habit of departing in October, and it is likely that this species also habitually remains with us in sparing numbers. A few *Yellow wrens* and *Chiff chaffs* seem yearly to winter with us, but from their quiet habits at that season and from the fact never having been suspected they are but rarely noticed. *Whinchats* which are habitual migrators, undoubtedly stay with us during winter in rare cases. White possibly may have been correct in stating that *Yellow wagtails* occasionally staid the year with him, though the fact has never since been confirmed by any one except Mr. Bartlett, who has in some winters noticed a few on the shores at Torbay. Mr. Couch affirms that they appear in Cornwall *only* in autumn and winter! *Hoopoes* have been known to arrive here soon enough to build and rear a brood. With regard to *Swallows*, White's suspicion of their torpidity in his county may receive partial verification probably with us, for it seems strange that those few which remain with us so late in the year should appear abroad only on certain fine days, and again retire, unless they really possessed the power of remaining in a dormant state in some warm hybernacula. This remark however I am aware does not belong exclusively to the southern parts of England, though I incline to think from observations made several years on their late appearances here in November, that this wintering may occur more commonly in our county than in others. I am informed by a gentleman near here, that he has noticed Swallows in the depth of winter, and he suspects that some pass their intervals of quiescence in the wooden canopy of a large bell connected with his house. *Martins* are said to appear yearly at Plympton between 10th and 13th November. It is not in my power to say whether any *Wheatears* stay with us in winter, but it has been so reported, and White speaks positively on the point in respect of Hampshire; a few winter in Cornwall. The *Stormy petrel* breeds on the Cornish coast, and is not known to be resident the year through I believe in any other part of Britain, Zetland and other Scottish isles probably excepted.

I am informed by Mr. Bartlett that he has noticed the *Babillard* in the South of Devon as late as November.

METHODUS

OF THE MIGRATORY BIRDS

OF SOUTH DEVON. *

* Those who are interested in these kinds of observations, can by inserting a few blank leaves, continue the registration of their dates of the arrival and departure of birds through very many years. The dates which are set down in print will form a sort of commencement of such remarks, and are extracted from a few notes made by the Author.

From the South, being summer birds of passage.—Vernal or equatorial migration.

	Arrival.	Departure.	Arrival.	Departure.
Nightingale				
Reed Wren				
Swallow	Apl.	Sept.		
Swift	May			
Martin	Apl.	Sept.		
Sand-Martin	Apl.			
Nightjar	Apl.	Sept.		
Spotted Rail	Mch.	Oct.		
Blackcap	Apl.			
Whitethroat	Apl.	Sept.		
Chiff-chaff	Mch.	Sept.		
Yellow Wren	Apl.	Sept.		
Wood Wren	Apl.	Oct.		
Wheatear	Apl.			
Whinchat				
Yellow Wagtail	Apl.	Sept.		
Redstart	May			
Cuckow	Apl.			
Sedge Warbler				
Fauvette	Apl.	Oct.		
Corncrake	Apl.	Oct.		
Spotted Flycatcher	May	Sept.		
Hobby		Oct.		
Turtle Dove				
Ring Ouzel	Apl.	Oct.		
Tree Lark				
Woodchat* (Bewick p. 377)				
Passerine Warbler				
Sandpiper				
Grasshopr. Warbler				
Flusher	May			
Babillard				
Wryneck				
Quail		Oct.		
Great Plover		Oct.		
Redtail* (Mot. erith.)				
Pied Flycatcher*				
Black Redstart*				
Foolish Guillemot†				

* *Occasional* summer visitor.

† The young stay here the winter.

Occasional summer visitors from the south, but not arriving soon enough to breed here, or if before the breeding time, never with the pre-existing design of breeding in this country as in the above.

	Arrival.	*Departure.*	*Arrival.*	*Departure.*
Hoopoe				
Crossbill				
Oriole				
Bee-eater				
Rose Ouzel				

From the north, being "autumnal and winter birds of passage,"—brumal and autumnal, or polar migration.

	Arrival.	*Departure.*	*Arrival.*	*Departure.*
Fieldfare	Oct.	Mch.		
Redwing				
Starling	Oct.			
Woodcock	Nov.			
Snipe	Oct.			
Jacksnipe				
Merlin	Oct.			
Tufted Duck				
Snow Bunting				
Greenshank				
Green Sandpiper				
Widgeon				
Knot				
Teal				

Polar, or autumnal and hyemal migration continued. Occasional winter and autumnal visitors from the more northern countries, and those which are not to be regarded as INVARIABLE *visitants.*

	Arrival.	*Departure.*	*Arrival.*	*Departure.*
Brambling				
Golden Eye				
Harlequin Duck				
Long-tailed Duck				
Shoveller				
Scaup Duck				
Wood Sandpiper				
Little Stint	Aug.			
Pintail				
Eider Duck				
Gadwall				
Velvet Duck				
Ferruginous Duck				
Brent Goose				
Red-breasted Goose				
Bernacle Goose				
Bean Goose				
Pochard				
Laughing Goose				
Short-eared Owl				
Smew				
Black Guillemot				
Little Gull				
Pigmy Curlew				
Arctic Tern				
Arctic Gull				
Black-throtd. Diver				
Little Auk				
Great Snipe				
Ibis				
Red Godwit				
Purple Sandpiper				
Phalarope				
Hawfinch		Apl.		
Spotted Sandpiper				
Nutcracker				
Brown Snipe				
Waxwing				

Invariable winter visitors from more northern parts of England.

	Arrival.	Departure.	Arrival.	Departure.
Gray Wagtail	Sep.	Apl.		
Razor Bill				
Whimbrel				
Kittiwake				
Wild Goose				
Wild Duck	Sep.			
Red-legged Gull				
Grey Plover				
Common Tern				

Occasional winter visitors from more northern parts of England.

	Arrival.	Departure.	Arrival.	Departure.
Bittern				
Redshank				
Lesser Tern				
Black-backed Gull				
Arctic Skua				
Hooded Crow	Oct.	Apl.		
Avocet				
Stock Dove				
Black Tern				
Sandwich Tern				
Eared Grebe				
Fulmar				
Fork-tailed Petrel				
Goosander				
Lesser Redpole				
Merganser				
Wild Swan				
Skua				

Birds whose periods of arrival are in great measure uncertain, and are not to be met with during ANY PART *of some years.*

	Arrival.	Departure.	Arrival.	Departure.
Great Shrike				
Little Owl				
Glaucous Gull				
Spoonbill				
Sanderling				
Freckled Heron				
Black Stork				
Great White Heron				
Purple Heron				
Night Heron				
White Stork				
Crane				
Mealy Redpole				
Crested Grebe				
Little Bustard				
Great-eared Owl				
Stilt				
Ruff				
Temminck's Sandp.				
Olivac. Gallinule				
Garganey				
Siskin				
Little Bittern				
Red-billed Heron				
Little Gallinule				
Red-necked Grebe				
Northern Diver				
Red-throated Diver				
Lesser blk-bkd. Gull				
Stormy Petrel				
Scoter				
Snowy Owl				
Turnstone				
Common Godwit				

Birds which migrate within, to, or from the district in autumn or winter, merely on very short journies.

	Arrival.	*Departure.*	*Arrival.*	*Departure.*
Cornish Chough				
Robin				
Kingfisher				
Lapwing				
Purre				
Golden Plover				
Sea Pie				
Curlew				
Coot				
Water Hen				
Puffin				
Shearwater				
Gannet				
Shieldrake				
Black Grouse				
Dottrel				

There are certain other species which on account of the slight acquaintance which has hitherto been gained with their habits and economy, it would be hazardous to assign to either of the foregoing migrating classes, and indeed I have some fears that a few now occupying places in those lists are rather too obscure and uncertain in regard of their movements generally, to have warranted my judging of them by those migrating actions which happened to have been noticed in them in the South of Devon when accidentally met with. But, it is to be hoped that those who rank as field-observers will not be entirely influenced by the statements and rules which I have laid down upon a novel method, and chiefly through individual knowledge and experience.

I have more than once in the course of this work taken occasion to remark how separate is the history of one animal from another, and that notwithstanding closeness of alliance, differences of no small amount may always be detected, even in those notorious for similarity in certain points of structure and economy. In regard of migration this is especially evident, and this contrariety of action may at once be found illustrated in the incongruity of the above assemblages, and still more, by comparing them with the remaining birds of the Devon list which are stationary, or nearly so. Some of the *Warblers* for instance are stationary, while the bulk are migratory, and the same remark applies to the *Gull* tribe. Again, individuals of some species are resident the year through, while the main body passes for a season to some other country, instanced in the *Snipe* and *Chiff-chaff*.

In a former chapter I had occasion to observe in illustration of the effects of climate, that in 1837 our spring birds of passage arrived late, apparently in consequence of a very backward season, or protracted winter. In 1838, which was likewise remarkable for backwardness of its spring, I made the same observation on the vernal migrators, and have since found, that Mr. White in his Natural History of Selborne, in Hampshire, has recorded the same fact. See Part ii. Letters ii. and L. It did not appear however that all species were affected alike, for I noticed this late arrival only in the *Swallow*, *Whitethroat*, *Fauvette* and *Cuckow*, though had circumstances allowed me to have been more abroad I might have found that other kinds came under the same rule, at least in part. Weather is decidedly the most controuling influence on migration, it not only affects the arrival of birds with us, but also their departures, since notwithstanding abundance of food, a summer bird of passage will quit us abruptly on the accession of inclement weather, and while early severity of winter weather obligates the polar migrators to leave their residences in the north abruptly, they likewise quit us late should the weather remain severe through a protracted winter with great paucity of food. Food however is not without its power also, though certainly of a secondary order. Plenty of provision conjoined with mildness and serenity of climate will induce a summer visitant to stay with us beyond its usual period, and again, scarcity of provender with mildness of season will cause a winter visitor to hasten its northward flight. These remarks on migration are supported by those of Mr. White, who apparently however had not adopted this very theory except in part. In Letter vii. Part 2nd, he says, "Swallows and House-martins abound yet, (Oct. 8th) "induced to prolong their stay by this soft, still, dry "season;" and again in Letter viii. he says, "From "hence it appears, that it is not food alone which "determines some species of birds with regard to "their stay or departure. Fieldfares and Redwings "disappear sooner or later according as the warm "weather comes on earlier or later, for I well re- "member after that dreadful winter 1739—40, that "cold north-east winds continued to blow on through "April and May, and that these kinds of birds (what "few remained of them) did not depart as usual, "but were seen lingering about till the beginning "of June."—See also Journal of a Naturalist, p. 395, 396.

LIST OF THE AMPHIBIA OF SOUTH DEVON.

Lacerta agilis.—*Nimble lizard.* A common animal on heaths and commons, and occasionally even in gardens.

Lacerta palustris.—*Water newt.* In ponds and marshes.

Lacerta vulgaris.—*Eft* or "*Effet.*" Common in heaps of stones in damp spots.

Rana temporaria.—*Frog.* Not common; in marshes.

Rana esculenta.—*Edible frog.* Devon. (Turton and Kingston.)

Rana bufo.—*Toad.* Abundant in damp spots, and in ponds.

Anguis fragilis.—*Slow-worm.* Very common in dry fields, and under stones on heaths.

Coluber natrix.—*Snake* or "*Long-cripple.*" Common in damp fields; frequently has its hole by the side of a brook in woods.

Coluber berus.—*Viper* or *Adder.* Not common; in dry hedges, &c. Specimens of a very dark colour or totally black have been seen.

In 1756, two specimens of the *Leathern tortoise* were captured in Cornwall, and a *Hawk's bill tortoise* was captured in the Severn in 1774; these were straggling visitants, influenced probably by unusually warm summers in these trips to ungenial quarters.

CATALOGUE OF FISHES RECOGNIZED BY THE AUTHOR OR OTHERS AS FORMING PART OF THE FAUNA OF SOUTH DEVON.

Those marked with an Asterisk have hitherto been noticed (as regards Britain) only off South Devon, or at most off the coasts of the two south-western counties of England.

CHONDROPTERYGIOUS FISHES.

(FLEMING'S BRITISH ANIMALS.)

Petromyzon fluviatilis.—*River lamprey*, or "*Nine eyes*." Found in our rivers rather commonly, and in the sea from midsummer to the beginning of the next year. On December 5th, 1835, one was brought me which had been taken off Oreston while adhering to the neck of a Mullet. They are often taken in the sand-pits of the Yealm.

Pet. marinus.—In the sea in deep water, not very common.

Scyllium Catulus.—"*Cat fish*." Common.

Spinax acanthias.—*Dog fish*. Common off the coast.

Mustelus lœvis.—*Smooth-hound*. (Turton and Kingston.)

Carcharias vulgaris.—*White shark*.

Carcharias glaucus.—*Blue shark.* With the pilchards and mackarel. A half grown specimen taken in June, 1839, is in the museum of the Natural History Society.

Carcharias vulpes.—*Thresher.* Rare.

Sqalus maximus.—*Sail fish* or " *Sun fish.*"

Lamna cornubica.—*Porbeagle.* Rare. On April 27th, 1836, I examined a specimen taken in a sean off the mouth of the Yealm; it measured eight feet in length, and contained five young.

Squatina vulgaris.—" *Monk fish.*" Rare.

Trygon pastinaca.—Called in Cornwall "*Cardinal trilost.*" Scarce.

Torpedo vulgaris.—*Cramp-fish.* (Turton and Kingston.)

Raia clavata.—*Ray,* or *Thornback.* Common.

* Raia microcellata.—Devon. (Montagu.) Cornwall. (Couch.)

Raia batis.—*Skate.* Common.

Accipenser sturio.—*Sturgeon.* Not uncommon.

* Squalus Rashleighanus, (Couch) * Zygena malleus, Petromyzon Planeri, The Mud lamprey, Myxina glutinosa, Amphioxus lanceolatus, * Scyllium melanostomum, Squatina Lewis, Raia chagrinea, aquila, chardon, circularis, and oxyrhinchus are found in Cornwall. (Couch.)

OSSEOUS FISHES.

Syngnathus acus.—" *Pipe fish.*" Common.

Syngnathus ophidion.—"*Sea adder.*" Not common. Found mostly at Salcombe.

Syngnathus œquoreus.—Salcombe. (Montagu)

* Hippocampus vulgaris.—" *Sea horse.*" Rare.

Syngnathus lumbriciformis, Tetraodon stellatus, Orthagoriscus mola and truncatus (" *Sun-fish*") have been captured in Cornwall.

MALACOPTERYGIOUS FISHES.

Salmo salar.—The movements of *Salmon* are found to vary somewhat in different rivers. In the Yealm, they are reported to spawn in winter, and the young are found to descend towards the sea in April. In the Plym also they descend in April, it occupying about three weeks for the entire fry to disappear. In one of the little streams leading to the Meavy above Shaugh bridge, a farmer once caught during night a large number; where the stream is intercepted by a few blocks of stone placed across it he immersed a deep basket for two successive evenings; into this the fish fell in great quantity, and were unable it seems to extricate themselves, as the man on each following morning took home his basket well filled. In the Avon they are reported to spawn later, and descend later; they are considered to be in season at the time they are infested by lice. Are not equally numerous in all seasons.

Salmo hucho.—*Bull trout* or *Sea trout*. (Turton and Kingston.)

Salmo trutta.—"*Salmon peal.*" Migrations like the Salmon. They are often caught in the rivers by means of "tickling."

Salmo fario.—*Trout* or *Shot*. In all our rivers, common.

Coregonus thymallus.—*Grayling*. (Turton and Kingston.)

Clupea harengus.—*Herring*. Off the coast in July, and the young are chiefly taken about November and December, at the mouths of rivers.

Clupea pilcardus.—*Pilchard*. Abundant, except in an occasional year. In the years 1786—7, not a fish appeared off the Cornish coasts. For other particulars see observations in another part of this work.

Belone vulgaris.—" *Gar pike.*" Not uncommon.

Abramis Brama.—*Bream.* Common

* Exocœtus exiliens.—*Greater flying fish.*—A specimen threw itself on Plymouth Quay. Also thought to have occurred in Cornwall. (Couch's Fauna, p. 40.)

Scomberesox saurus.—*Saury.* Uncommon.

Lepadogaster cornubiensis.—*Cornish sucker.*

Lepadogaster bimaculatus. —Torrcross, &c.—(Montagu.)

* Liparis Montagui.—At Milton, (Montagu.) Cornwall. (Couch.)

Cyclopterus lumpus.——*Lump fish.* Not uncommon. Has been taken in the Sound.

Esox lucius.—*Pike.* In Slapton Ley.

Echineis remora.—*Sucking fish.* Rare.

Morhua vulgaris.—*Cod.* Common.

Morhua æglefinus.—*Haddock.* Common.

Morhua lusca.—*Bib.*

Morhua barbata.—*Pouting.* Common.

Physcis furcatus.—*Fork-beard.*

Gadus Mustela.—I have taken these at the mouth of the Yealm in March.

Gadus tricirratus.—Common.

* Gadus argenteolus.—Devon. (Montagu.)

Molva vulgaris.—*Ling.* Not uncommon.

Merlangus carbonarius.—*Coal fish* or " *Rauning Pollack.*" Common.

Merlangus vulgaris.—*Whiting.* Common.

Merlangus Pollachius.—*Pollack.* Common.

Ammodytes tobianus.—*Launce.* Common.

Merlucius vulgaris.—*Hake.* Abundant, but more so formerly.

Pleuronectes maximus.—*Turbot.* Not uncommon.

Pleuronectes megastoma.—*Whiff,* or " *Mary sole.*" Common.

Pleuronectes rhombus.—*Brill,* or " *Hollibut.*" Common.

Pleuronectes punctatus.—*Top-knot.* Not uncommon.

* Pleuronectes arnglossus.—"*Scald fish.*" Said to have been found only as yet at Plymouth. Mr. Couch however recognizes it as Cornish.

Solea vulgaris.—*Sole.* Common.

* Solea variegata.—At Plymouth. (Hanmer.) Cornwall. (Mr Couch.)

* Monochirus minutus. (Parnell.)—*Little sole.* Brixham.

Platessa vulgaris.—*Plaise.* Common.

Platessa Flesus. —*Flounder.* Common. Has through the effects of floods obtained a locality in Slapton Ley.

Platessa Limanda.—*Dab.* Common.

Hippoglossus vulgaris.—*Holibut.* Common.

Anguilla vulgaris.—*Eel.* Eels devour the fry of their own kind.

Anguilla Conger.—*Conger eel.* Abundant.

* Ophidium imberbe.—Devon. (Montagu.)

Leuciscus rutilus.—*Roach.* In Slapton Ley.

Leuciscus phoxinus.—*Minnow.* Common in small streams.

Leuciscus vulgaris.—*Dace.* Found in the Tamar.

Leuciscus cephalus.—*Chubb.* In the Exe. (Turton and Kingston.)

* Cyclopterus coronatus, (Couch) * Raniceps Jago, * Muræna Helena, Little gorefish, and * Morhua minuta have been taken in Cornwall.

The little Cyprinus auratus, or *Golden carp,* a naturalized species, is found as Mr. Bartlett informs me, in the stream at Brixham.

ACANTHOPTERYGIOUS FISHES.

Cepola rubescens.—*Redband fish.* Two specimens recorded by Montagu as found off Devon. Found off Cornwall not uncommonly. (Couch) Since

Montagu's time, it has been noticed with us on several occasions.

* Lepidopus tetradens.—Devon. (Montagu)

* Blennius ocellaris.—Devon. (Montagu)

* Blennius Gattorugine. —Devon. (Montagu) Cornwall. (Couch)

* Blennius Montagui.—Devon. (Montagu) Cornwall. (Couch)

Pholis lœvis.—"*Shan.*" Common.

Gunnellus vulgaris.—*Gunnel* or "*Nine eyes.*" Common.

Gunnellus viviparus.—"*Greenbone.*" Not uncommon.

Callionymus Lyra.——*Dragonet* or "*Yellow Gurnard.*"

Crenilabrus Tinca.—*Wrasse.* Not scarce.

Labrus Balanus.—*Ballan Wrasse.* Not scarce.

* Labrus Coquus.——"*Cuckoo fish.*" Scarce. Cornwall. (Jago.)

* Pagrus lineatus.—Devon. (Montagu)

Pagrus vulgaris.—*Braize.* Common.

Perca Labrax.——*Basse.* Common in some seasons.

Perca fluviatilis.—*Perch.* In Slapton Ley.

Trachinus Draco.—*Weaver.* Not common. On June 4th, 1836, several were taken off the Yealm. Persons incautiously handling them, received severe and disagreeable wounds from their foremost dorsal fins.

Lophius piscatorius.—*Angler*, or "*Monk*" of fishermen. Not rare.

Trigla Lyra.—*Piper.* Not uncommon.

* Trigla lœvis.—Devon. (Montagu.)

* Trigla lineata.—Devon. (Montagu.) Cornwall. (Couch.)

Trigla hirundo.—*Tub.* Common.

Trigla Gurnardus.—*Grey gurnard.* Not uncommon.

* Trigla lucerna.——*High finned gurnard.* (Dr. Parnell.)

* Trigla Cuculus.—*Red gurnard.* Common. (Devon and Cornwall.)

* Peristedion Malarmat (Cuvier.)——*Mailed gurnard.* (See further on.)

Cottus gobio.—"*Miller's thumb.*" Common in rivers.

Cottus scorpius.—"*Father lasher.*" (Turton and Kingston.)

Mullus surmuletus.—*Surmullet.* Not common.

Mugil cephalus.—*Mullet.* In great abundance. Congregate in the estuaries in autumn.

Atherina Hepsetus.—*Atherine, Smelt,* or *Millet.* Common in estuaries.

Scomber vulgaris.—*Mackarel.* Common. Caught for the market principally in autumn.

Trachurus vulgaris.—*Horse mackarel.* Rare.

Zeus Faber.—*Doree.* Not common.

Gasterosteus aculeatus.—*Stickleback.* In ditches and rivulets. This fish is infested by a small parasite, capable if dislodged of swimming, and again fixing itself on the stickleback.

Gobius niger.—*Groundling.* (Turton and Kingston.)

Gobius minutus.—*Spotted goby.* (Turton and Kingston.)

* Centriscus Scolopax.—*Trumpet fish.* Very rare. (Couch.)

* Serranus gigas, and * Couchii, Zeus Aper, * Hæmulon formosum, Lampris Luna, Lepidopus argyreus, * Crenilabrus microstoma (Couch) * Cuvier's gurnard, Sciæna aquila, Brama Raii, Scomber Pelamis, * Pelamis Sarda, * Labrus Comber, * Labrus lineatus, * Julis vulgaris, * Chœtodon—(Couch) Trigla adriatica, * Gymnetrus Hawkenii, * Trachurus glaucus, and Centronotus ductor, *Pilot fish* have been taken in Cornwall. The * Peristedion

Malarmat, (Cuvier) or *Mailed gurnard* has been captured near the Eddystone, and the specimen is described and figured by Dr. Moore in the Magazine of Natural History. This is the only instance known of its visits to the British coast, and probably our southern shores constitute its northern limit. A specimen of * Sciurus Lusitanicus taken in Cornwall, is in the Museum of the Plymouth Institution. Xiphias gladius, or *Sword fish*, has been known to occur somewhere in the Channel near us.

110, total of the fishes here recognized as forming part of our Fauna, but certainly not comprising all that have yet been noticed. Total of those limited to Devon, or to Cornwall, or to Devon and Cornwall conjointly, 41, so far as can well be gathered. Total of the whole of the species here stated as occurring in Devon and Cornwall, 153, but by no means comprising all mentioned in Couch's Fauna.

The above catalogue includes a variety of rare species, of which however I must regret my inability to say much in regard of their physical distribution or chief habitats, and indeed much information has not as yet been obtained in regard of this department of Ichthyology, but I may at all events affirm that we derive much from our situation at the meeting of several large portions of the ocean, and our approximating position to climates and their productions which differ not a little from our own. But on the whole, want of attention to the tribe of fishes prevents us from making any but very cautious and provisional assertions. Owing to the great exertions of Mr. Couch a larger number of species of fish have been recognized in Cornwall than have been enumerated as occurring with us, but probably the same sort of exertion is alone required in Devonshire to extend the list to an equal size. I do not pretend however that the above species are those only which have as yet been noticed as belonging to South Devon, but they are those of which I could procure authentic information, not doubting at the same time that we claim many of those kinds with Cornwall which are now ranked pro tempore as peculiar to that county, and according to this view of the subject it is but a provisional and arbitrary proceeding to mark any species as limited to the one county or the other, though perhaps many kinds are confined to the south-western shores aggregately considered.

MOLLUSCA.

CATALOGUE OF THE LAND & FRESH WATER SHELLS OF SOUTH DEVON, WITH REMARKS ON THEIR HABITATS, &C.

The species marked with an asterisk have been found (as regards Britain) only in this district, or at most in the county as a whole. The nomenclature of Turton's Manual is adopted.

(BIVALVE.)

Cyclas pusilla. — In stagnant pools, running water, and spots flooded by rivers. We have a shell here, found in the same situations, of a rust colour, but differing so little in shape as to be entitled to consideration only as a variety of the above.

Unio margaritiferus.—In rapid rivers. Dead, and occasionally living specimens are found in the sand-pits dug in the banks. These specimens are always numerous in proportion to the quantity of rain which falls in the autumn and winter; the violence of the stream being thereby increased, the shells are driven into these catch-pits. A person assured me that Crows watch on the banks of rivers for these shell-fish, fly with them into the air, then drop them on some rock in order to break the shell, and descend to devour the contents. Crows are reported to destroy and feed on the Swan-mussel in the same manner.

(UNIVALVE.)

Limacellus parma.—Found in *Limax maximus.*

Limacellus obliquus.—In the common Field-slug. Possibly *Limacellus variegatus* is to be found here, but it has not come under my notice as yet.

Limacellus unguiculus.—In *Limax carinatus* of Leach. Common in gardens.

* Testacellus haliotideus.—I have one specimen of this shell, and it seems as yet to have been found only here and at Bideford.

Testacellus Maugei.—I found the slug to which this shell belongs in my garden in Park-street, where it does not seem likely it had been introduced with any exotic plants. It occupied damp and shady ground, and apparently in consequence of the plenty of earth worms in that spot. (See woodcut.)

Vitrina pellucida.—Among damp moss. Dead shells are very frequent under stones. I think I have found *V. elongata,* or at least elongated specimens of *pellucida.*

Cyclostoma elegans.—I found this species on Berry Head, but not plentifully.

Helix aspersa.—Common in hedges and fields.

Helix hortensis.—In hedges and gardens. Not common.

Helix nemoralis.—Common in hedges and gardens. In winter I find this and the two foregoing species either lying loose in warm hedges with their apertures sealed up, or cemented firmly to stones or old trees. A few remain quiescent without any epiphragm, and stir out for food when the weather is tolerably mild. These species also will on receiving an injury to the mouth secrete a thin lid of the same description, and continue quiescent in this state until the fracture has been repaired.

Helix rufescens. Common in heaps of stones and among rubbish, and generally where there is much moisture and shade. Its colour varies.

Helix sericea.—Common in damp and shaded situations, and especially where dead leaves abound.

Helix virgata.—Very common in dry situations. In some places, and particularly elevated fields, they are so numerous as to be a pest to the agriculturist. This shell and *Bulimus fasciatus* are liable from exposure to become denuded of the outer layer, and bleached. At the approach of winter they retire into warm hedges, and do not appear abroad again till spring has fairly set in.

Helix caperata.—Common in dry situations. In old limestone quarries large and beautiful specimens are found crawling on the rock facing southwardly.

Helix spinulosa.—In woods among leaves, and in heaps of stones. They seem to retire in winter into mould formed by decayed moss on rocks, or into other sheltered situations. Not common.

Helix fusca.—In woods among moss. Rare. My own specimen is greenish amber colour, Mr. Colley's is of a dull brown.

Helix nitens.—Very common among wet moss and under stones. Large specimens are usually found dead. The finest I ever collected, and which were fully three-fourths of an inch in breadth were lying on bare rock sloping down to the sea, a remarkable habitat. They get much into caves of limestone.

Helix alliaria.—In the same situations as the last, but not so common. Full grown shells would certainly be with difficulty distinguished from *Helix nitens* were it not for their odour; but the fry have a remarkably glossy aspect, they look like little gems in the hedges; these have also a considerable depth at the aperture, while the young of *Helix nitens* possess the characteristic bend and narrowness of mouth observable in older shells. Some specimens seem not to emit the scent until immersed in hot water.

Helix hispida.—Not common. In old walls and under stones. Some occur without hairs.

Helix crystallina. — Common in wet hedges among moss.

Helix radiata.—Common under stones, wood, &c. generally selecting damp places. I have found the white variety.

Helix rupestris.—Common in dry walls and old buildings. I have noticed them on the walls of churches, and on rocks plentifully. In summer when a shower falls they will come out in numbers from their recesses, and appear greatly refreshed and enlivened.

Helix fulva.—This rare species is found with us among leaves, and under stones, especially where there is a little moisture. Specimens vary in shape.

Helix pulchella.—Rare. The smooth variety only has come under my notice. I have found it under stones. Mr. T. Colley found a colony of the rough sort in a very dry wall at Trematon Castle in Cornwall. According to Dr. Turton's experience this last variety is found only in *damp* places.

Helix pura.—Found by Dr. Turton.

Clausilia rugosa.—Abundant in old walls.

Clausilia parvula.—A specimen found by Dr. Turton at Torquay.

Bulimus obscurus.—Rather rare. Chiefly found in old dry hedges. I lately ascertained that many of this kind retire in winter to the crevices of rocks, and in spring come forth besmeared with dirt derived from their hybernacula.

Bulimus lubricus.—Found pretty commonly under stones, and in wet hedges among moss.

Bulimus fasciatus.—In fields bordering on the sea.

Bulimus lineatus.—Mr. Colley states that he has found this species, but I have not yet noticed it.

*Bulimus decollatus.—Found formerly at Watton Court in this county.

Balæa fragilis.—Not common. In moss attached to the trunks of trees, in old walls, and on rocks. I have occasionally found it in the cylindrical holes bored by insects in rotten stumps of trees.

Succinea oblonga.—In pools and streams attached to stones and aquatic plants. In corroboration of Dr. Turton's view of the difference of this species from *Succinea amphibia*, I may mention that it is found here without any admixture of the last named.

Carychium minimum.——Common among wet mosses, leaves and stones. I have found great numbers of dead shells in summer among the moss attached to rocks on hills ; the heat of summer destroying the moss, the shells are in their turn sacrificed.

Pupa umbilicata.—Found with *Clausilia rugosa*, and equally common. It gets also amongst rubbish in wet situations.

Pupa marginata.—Chiefly in spots near the sea, under stones. Not common.

Pupa edentula.—Four specimens of this shell have occurred to me under stones in woods, two of them belong to the " more elongated and cylindrical" variety.

* Vertigo pygmæa.——Found by Mr. T. Colley under stones in a damp situation at Bovisand. Hills about Torquay. (Dr. Turton.)

Vertigo sexdentata.—Found by Mr. Colley with the last, and also by him in a similar situation a very short distance from Plymouth.

Planorbis vortex.—Common in pools and streams.

Planorbis albus.—Common in pools attached to plants and stones.

Planorbis imbricatus.—Rather local. In a standing pool near my residence I find them in plenty attached to plants.

Planorbis spirorbis. Found by Mr. Colley in pools. Rare.

Planorbis complanatus. In slow rivers. Confined according to Dr. Turton, to Suffolk and Devon.

* Planorbis rhombeus.—In slow streams near Torquay.

Limneus pereger.— Very common in pools, streams, and rivers.

Limneus fossarius.—Rather common in streams, and pools.

Physa fontinalis.—Not common in ponds, streams, and rivers, attached to stones, sticks, and other objects.

Paludina stagnorum.—Very rare in pools and streams. I have never procured more than two specimens.

Ancylus fluviatilis.—Common on stones and plants, in pools, streams, and rivers.

Ancylus lacustris.—Found rarely on aquatic plants.

4 species of this division of the Molluscs seem to be limited to this district. Observations on their geography, &c. occur in the next chapter.

CATALOGUE OF THE MARINE MOLLUSCOUS ANIMALS USUALLY TERMED SHELL-FISH, &C. RECOGNIZED BY THE AUTHOR OR OTHERS AS OCCURRING ON THE SHORES OF SOUTH DEVON.

Those species marked with an Asterisk have been found as yet only in Devon, or at most in Devon and Cornwall. The nomenclature from Fleming.

BRANCHIFERA.

NUDIBRANCHIA.

Patella vulgata.—*Common Limpet.* Abundant.

Patella intorta.—Devon. (Montagu.)

Patella pellucida.—Not uncommon at the roots of fuci; thrown up in great numbers on sandy beaches.

Patella lævis.—On stalks of fuci. Not uncommon.

Patella virginea.——On fuci. Thrown up in numbers on sandy beaches.

Chiton fascicularis.——Not uncommon under stones at low water, but found also in deep water.

Chiton ruber.—In deep water, Plymouth sound.

Chiton marginatus.—Very common under stones.

Chiton cinereus.—Not uncommon on stones.

Chiton lævis.—Uncommon.

Aplysia depilans
Aplysia punctata
* Aplysia viridis
} "*Sea slugs.*" Devon. (Montagu.)

* Pleurobranchus plumula.—Devon. (Montagu.)

Pleurobranchus membranaceus. — (Turton and Kingston.)

Bulla lignaria.—Not uncommon. Common at Falmouth. (J. C. B.)

Bulla umbilicata.—(Turton and Kingston.)

Bulla akera.—Uncommon.

Bulla hydatis.—(Turton and Kingston.)

*Bulla Cranchii†—Plymouth Sound. (Mr. Prideaux)

Bulla punctata
Bulla truncata Turton and Kingston.
Bulla alba

Bulla cylindracea.—Sandy bays, not common.

Bulla aperta.—Not common.

Bulla obtusa.—Common.

Doris argo
Doris verrucosa
* Doris marginata
Doris nodosa
* Doris quadricornis
* Doris flava
* Doris pennigera Coast of Devon (Montagu) and others.
* Doris maculata
* Doris pinnatifida
* Doris bifida
* Doris longicornis
* Doris cærulea
* Doris pedata

Bulla ampulla.—Falmouth (Montagu)

PECTINIBRANCHIA.

Turbo littoreus.—*Periwinkle.* Abundant. I have found the "*Sea cup*" said by Ellis to be the probable nidus of the young.

Turbo petræus.—Very common on the rocks, and often beyond the reach of the tide.

Turbo rudis.—Very common.

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† Named after Cranch who so successfully examined the productions of our coast, living as I am informed under a boat at Bovisand.

Turbo crassior.—Deep water.

Turbo quadrifasciatus.—Common among sea weed.

Turbo margarita.—Common.

* Turbo nivosus.—Devon (Montagu.)

Phasianella subulata.—(Turton and Kingston.)

* Phasianella pallida.—Salcombe. (Montagu.)

Phasianella polita.—(Turton and Kingston.)

Turritella terebra.—Very common. Thrown up invariably after storms.

Turritella truncata.—Rare.

Turritella exoleta.—Rare.

Turritella nitidissima.—Fine sand. Not rare, especially at Penzance. (J. C. B.)

Turritella elegantissima.—(Turton and Kingston.)

Cingula cimex.—Rare.

Cingula costata.—Obtained by Mr. T. Colley.

Cingula parva.—Common on fuci at low water; I have also found the young attached much to stones from deep water, and to zoophytes, &c.

Cingula denticulata.—(Turton and Kingston.)

Cingula semicostata.—Uncommon.

Cingula ventricosa.—(Turton and Kingston.)

Cingula striata.—Common.

Cingula pulla.—On fuci, and the young much on Lobularia digitata.

Cingula ulvæ.—On stones in the mud of estuaries.

Cingula subumbilicata.—Common.

Cingula interrupta.—Common.

Cingula auricularis.—(Turton and Kingston.)

Cingula calethisca.—(Turton and Kingston.)

Cingula rubra.—Not uncommon.

Cingula vitrea.—Not rare in fine sand, common at Penzance. (J. C. B.)

Cingula cingilla.—Roots of fuci. Common.

Cingula alba.—Common.

* Cingula semistriata.—Not uncommon.

Cingula labiosa.—(Turton and Kingston.)

Odostomia spiralis.—Salcombe. (Montagu.)

* Odostomia interstincta.—Devon. (Montagu.)

* Odostomia insculpta.—Devon. (Montagu.)

Odostomia unidentata.—(Turton and Kingston.)

Scalaria clathrus.—Thrown up after storms. Uncommon. "*Wentle-trapp.*" Taken alive in Torbay, by the Rev. H. F. Lyte.

Scalaria Turtoni.—(Turton and Kingston.)

Skenea depressa.—Shell sand.

Skenea serpuloides.—Shell sand.

Nerita littoralis.—Abundant.

Natica glaucina.—Not commmon. Sandy bays.

Natica nitida.—Not common.

Natica pallidula.—Common on sea-weeds at low water mark.

Natica intricata.—(Turton and Kingston.)

Trochus majus.—Common in deep water.

Trochus Montacuti.—(Turton and Kingston.)

Trochus umbilicatus.—Common on the coast, and in deep water.

Trochus cinerarius.—Common on the coast.

Trochus crassus.—Very common on rocks at low water.

Trochus papillosus.—Rare.

Trochus ziziphinus.—Common.

Trochus exasperatus.—Rare. I have not obtained above a half dozen specimens of this shell.

? Trochus striatus

Trochus tumidus.—(Turton and Kingston.

Ianthina communis.—"*Storm shell.*" Procured after storms. Found also on the north-west coast of Cornwall. (J. C. B.)

Velutina lævigata.—Deep water.

* Velutina otis.—Not uncommon on rocks at high water. May be procured on the rocks under Plymouth Hoe. (J. C. B.)

* Velutina stylifera.—Torbay. (Turton.)

Turbo mammillatus.—Scilly rocks.

SOLENOSTOMATA.

Marginella voluta.—(Turton and Kingston.)

Cypræa europœa.——Common in sandy bays. *Cowrie* or "*Black mens' teeth.*"

Voluta catenata.—Rare. (Mr. Swainson.)

Volvaria alba.—Not rare in the spot where observed by me.

Volva patula.—(Turton and Kingston.)

Tornatella tornatilis.—Procured by Mr. T. Colley. Rare.

Acteon triplicatus.—(Turton.) Guernsey. (Montagu.)

* Acteon bidentatus.—Devon. (Montagu.)

* Acteon fusiformis.——Exmouth. (Mrs. W. Luscombe.)

Acteon denticulatus.—(Turton and Kingston.)

Cassis bilineata.—Plymouth Sound. (Rev. J. Lambert.)

Nasa reticulata.—Common in bays.

Nasa incrassata.—Common in bays.

* Nasa tuberculata.—Exmouth. (Mrs. Luscombe)

Purpura lapillus.—Very common. I find a variety with black circular bands, common at Boveysand, and elsewhere. This I understand has lately been erected into a separate species by some French author.

? Dolium perdix

Buccinum undatum.—"*Whilk.*" Common. The young occur in deep water in summer, and the nidi of the fry are very common on all shores.

Buccinum pictum.—(Turton and Kingston.)

* Buccinum ovum.—Plymouth Sound.

Buccinum glaciale } Turton and Kingston.
Buccinum carinatum }

Fusus septangularis.—(Turton and Kingston.)

Fusus antiquus.—Not uncommon.

Fusus costatus.—Not common.

Fusus corneus.—Not uncommon.
Fusus rufus.—(Turton and Kingston.)
Fusus turricola.—Not uncommon.
Fusus nebula..—Not uncommon.
Fusus glaciale }
Fusus purpureus } Turton and Kingston.
Fusus attenuatus }
Fusus linearis.—Plymouth Sound. (J. C. B.)
Pleurotoma gracilis.—Not uncommon.
Terebra reticulata.—(Turton and Kingston.)
Terebra perversa. }
Terebra tubercularis } Turton and Kingston.

Triton erinaceus.—Rocky shores and also in deep water.

Cerithium costatum.—Common in shell sand.

Rostellaria pes-pelecani.—Among rocks beyond low-water mark, not uncommon.

Sigaretus haliotoideus.—Uncommon.

* Sigaretus tentaculatus.—Devon. (Montagu.)

Haliotis tuberculata.—Common on the shores of the Channel Isles, and thrown ashore at times on our coast.

Calyptrea chinensis.—Not common. "*Chinese bonnett.*" On oysters, and on dead shells in deep water.

Capulus hungaricus.—"*Torbay bonnett.*" Not uncommon in deep water.

Capulus antiquatus.—Not common.

Capulus militaris.—(Turton and Kingston.)

Fissurella græca.—Not uncommon in deep water on old shells.

Emarginula fissura.—Not uncommon on Pecten maximus.

MOLLUSCA ACEPHALA.

BRACHIOPODA.

* Terebratula psittacea.—Teignmouth. (Turton.)

BIVALVIA.

Pecten maximus. — Common in deep water. Excellent food.

Pecten opercularis.—Very common in deep water, Sold in the markets to the poor. "*Scallop*," or "*Queen*."

Pecten sinuosus.—In crevices of rocks, and in Eschara retiformis, but uncommon.

* Pecten tumidus.—Torbay. (Turton.)

Pecten lineatus.—(Turton and Kingston.)

Pecten varius.—Common, and chiefly from deep water.

* Pecten pusio.—Torbay. (Turton.)

Pecten jacobæus.—(Turton and Kingston.)

Pecten obsoletus.— Common on sand banks. Consumed in great quantities by the Flounder, and perhaps other fish.

Pecten tenera }
Pecten lævis } Turton and Kingston.

Lima fragilis.— Obtained by Mr. T. Colley. Very rare.

Lima subauriculata.—Rare.

Ostrea edulis.—*Common oyster*.

Ostrea parasitica.——On crabs and shellfish. Common.

Anomia electrica.—Rare.

Anomia ephippium.—Very common.

* Anomia cepa.—Torbay and other parts.

Anomia squamula.—Abundant.

Anomia undulata.—Common.

Anomia punctata.—Not uncommon.

Anomia cylindrica.—Common.

Anomia aculeata.—On fuci and shells. Not uncommon.

* Anomia fornicata.—Torbay. (Turton.)

Arca Noæ.—Rare.

Arca fusca.—Not uncommon in crevices of rocks at low water.

Arca lactea.—Numerous on the beaches. Found alive in the interior of stones from deep water.

Pectunculus pilosus.—Deep water. Rare.

Pectunculus decussatus.—Not rare. Plymouth, (J. C. B.) Torbay, (Rev. H. F. Lyte.)

Pectunculus nummarius.—Uncommon.

Nucula nuclea.—Uncommon in deep water.

Nucula minuta.—Rare.

Avicula hirundo.—Not very rare on Gorgonia verrucosa, &c.

Pinna ingens.—Only in small beds at certain parts. Falmouth harbour not uncommon, (J. C. B.)

* Pinna papyracea.—Devon. (Turton.)

Pinna fragilis.—(Turton.)

Mytilus edulis.—*Mussel.* Abundant on all shores, and also obtained in the young state from deep water. Are not the reputed pellucid young, separate species?

Modiola vulgaris.—Rare. Deep water. Torbay, (Rev. Mr. Lyte.)

Modiola discrepans.—Not uncommon in deep water.

Modiola discors.—Common at the roots of fuci, and in various marine substances.

Modiola Gibsii.—(Turton and Kingston.)

Isocardia cor.—Rare.

Lithodomus lithophagus.—(Turton & Kingston.)

Cardium aculeatum.—Not uncommon in bays, and at the mouths of rivers, and thrown up after storms.

Cardium tuberculatum.—Common in deep water. Often dredged up in Plymouth Sound. Torbay, common.

Cardium elongatum.—Devon. (Montagu.)

Cardium exiguum.—Plymouth Sound. (J. C. B.)

Cardium edule.—*Common cockle.* Collected in April.

Cardium fasciatum.—Common in deep water.

Cardium medium.—Torquay. (Turton.)

Cardium lævigatum.—Sandy bays ; not uncommon. Performs considerable leaps of many inches at a time by means of its very long foot.

Cardium echinatum }
? Cardium spinosum } Turton and Kingston.
Cardium muricatum }

Corbula striata.—Not uncommon.

Mactra solida.—Common in rather deep water.

Mactra subtruncta.—Goodrington sands, Torbay, common.

* Mactra deaurata.—Exmouth. (Turton.)

Mactra dealbata.—(Turton and Kingston.)

Mactra truncata.—Plymouth. Deep water.

Mactra stultorum.—Common in sandy bays.

* Mactra cinerea.—Paignton, and Weymouth in Dorset.

* Mactra glauca.—Shores of Cornwall. Devon, (Mr. T. Colley.)

* Goodallia minutissima.—Devon and Cornwall.

Goodallia triangularis. (Turton and Kingston.)

* Lepton nitidum.—Torbay. (Turton.)

* Lepton squamosum.—(Turton and Kingston.)

Kellia rubra.—In great abundance in crevices of rocks, below high water mark. Whitsand bay, common.

Kellia suborbicularis.—Numerous in stones from deep water.

Loripes lacteus.—(Turton and Kingston.)

Amphidesma pretenue.

Amphidesma distortum.

Amphidesma pubescens.——Rather rare.

* Amphidesma truncatum.—Torbay. (Turton.)

Amphidesma compressum.—Estuaries ; common. Abundant at Mothecombe.

Amphidesma tenue.—(Turton and Kingston.)

* Amphidesma declive.—Torbay. (Turton.)

Amphidesma album.—Sandy shores.

Amphidesma convexum.——Rare. Falmouth, (J. C. B.)

Donax complanata.—(Turton and Kingston.)

Donax trunculus.—Common.

Donax denticulata.—Very rare. Bigbury bay, (J. C. B.)

Donax rubra.——On corallines. Rather rare. Boveysand, (J. C. B.)

* Tellina lineata.—Teignmouth. (Turton.)

Tellina fabula.—Common.

Tellina squalida.—(Turton and Kingston.)

Tellina donacina.—Not uncommon.

Tellina tenuis.—Common.

Tellina crassa.—Not uncommon.

* Psammobia costulata.—Torbay. (Turton.)

Psammobia solidula.—Not uncommon.

* Psammobia strigillatus.—Torbay and Cornwall.

* Psammobia scopula.—Exmouth. (Turton.)

Psammobia ferroensis.—Common in Torbay.

Psammobia florida
Psammobia rotundata } Turton and Kingston

Astarte Danmoniæ.—Not common.

Astarte Scotica.—Not uncommon.

Lucina flexuosa.—Obtained by Mr. T. Colley.

* Lucina pisiformis.—Falmouth and Teignmouth.

Lucina radula.—(Turton and Kingston.)

* Lucina arcuata.—Falmouth and Teignmouth. (Turton and Montagu.)

Myrtea spinifera
Cyprina triangularis } Turton and Kingston.

Cyprina islandica.—In the mud of inlets. Rare.

Cyprina minima.—(Turton and Kingston.)

Cytherea chione.—Common; frequently polished for ornaments. “*Queens.*”

Cytherea ovata.—Not uncommon in deep water attached to stones and corallines.

Cytherea exoleta.—Sandy bays.

Venus verrucosa.—Common in estuaries.

Venus subcordata.—Falmouth. (Montagu.)

Venus cassina.—Rather rare.

Venus reflexa.—Not uncommon in estuaries, &c.

Venus fasciata.—Not uncommon. Falmouth, common. (J. C. B.)

Venus granulata.—Devon and Cornwall.

Venus rugosa.—Not uncommon.

Venus gallina.—Rather common.

* Venus pallida.—Dawlish.

Venus undata.—Common.

Venus aurea.—Rather rare.

Venerupis perforans.—Rather rare. Usually in lime-stone, but I have also found it in sandstone. Does the solvent therefore vary in individuals?

Venerupis irus.—Rare. Thrown up at Bovisand, (Miss Hook.)

Venerupis pullastra.—Extremely common in the mud of inlets, also in deep water. "*Hens*" vulgo.

Venerupis decussata.—Not uncommon in inlets.

Venerupis virginea.—Rather rare. Falmouth, not uncommon. (J. C. B.)

* Teredo bipinnata.—Exmouth. (Turton.)

* Teredo malleolus.—Torbay. (Turton.)

Teredo navalis.—"*Ship worm.*" Common. The operations of this animal on the piles of Teignmouth Bridge have caused most serious injury, and in one part the fabric has broken down.

* Teredo nana.—Torbay. (Turton.)

* Xylophaga dorsalis.—Torbay. (Turton.)

Pholas lamellata.—Not uncommon. Plymouth. (J. C. B.)

* Pholas tuberculatus.—Torbay. (Turton.)

Pholas dactylus.—"*Pierce stone.*" Common. A deal of the Breakwater in Plymouth Sound is pierced by this animal, and in many parts so extensively as to render the stone like net-work.

Pholas crispata.—Plymouth. (J. C. B.)

Pholas candidus.—Torbay, &c.

Pholas parvus.—Torbay, &c. (Turton.) Plymouth (J. C. B.)

Gastrochæna hians.—Torbay, &c.

Solen vagina.—Very common in inlets, "*Hacks*" or "*Razor fish.*" Collected by the poor during low tides in August. Extracted by an arrow-shaped iron instrument, passed suddenly through the body of the animal from above.

Solen siliqua.—Not common. Found at Whitsand bay.

Solen ensis.—Not common.

* Solen purpureus.—Torbay. (Turton.)

Solen pellucidus } Turton and Kingston
Solen antiquatus }

Sanguinolaria vespertina.—Not rare. Falmouth, (J. C. B.)

Hiatella rugosa.—Very common in rocks, and at the roots of sea weed. In a small block of sandstone I lately found the following species lodged in close approximation ; Pholas crisp. lamel. and parva ; Hiat. rugosa, Ven. perforans, Kellia suborb. and five other kinds not borers.

Hiatella arctica.—Common on stones, &c.

Panopœa Aldrovandi.—Teignmouth. (Turton.)

Mya truncata.—Rather rare.

Mya arenaria.—Rare.

Lutraria vulgaris.—Rather rare. I have it from the mouth of the Erme, and from Torbay.

Lutraria hians.—(Turton and Kingston.)

* Sphenia Binghami } Torbay. (Turton.)
* Sphenia Swainsoni }

Pandora inæquivalvis. (Turton and Kingston.) Plymouth. (Mr. Colley.)

* Galeoma Turtoni.—(Turton and Kingston.)

Mactra fragilis.—Guernsey. *Venus calcellata.*—Guernsey. *Venus dysera.*—Guernsey. *Solen declivis.*—Scilly Isles.

Total of the Molluscs of South Devon here enumerated 304. Total of those species peculiar to the South Devon shores, or in some few cases common to the shores of Devon and Cornwall, 55. Those found in Cornwall and not in Devon are too few to deserve separate notice.

The following sea shells not belonging in strict propriety to the foregoing lists, may here however be noticed.

Nautilus spirula, "*Crozier nautilus.*" Teignmouth. (Turton.) Dentalium trachea. Milton. (Montagu.) Dentalium Gadus. (Turton & Kingston.) Dentalium glabrum. (Turton and Kingston.) Dentalium imperforatum. Falmouth and South Devon. (Turton and Kingston.) * Dentalium politum. Torbay. (Turton.) * Dentalium labiatum. Torbay. (Turton.) * Dentalium striatulum. Devon and Cornwall. (Turton.) Dentalium dentalis. Not uncommon. Dentalium entalis. Plymouth Sound. (Mr. Colley.)

Serpula spirorbis, (abundant) spirillum, minuta, granulata, heterostropha, carinata, and vitrea, are all Devon shells, as recorded by Turton and Montagu. Serpula vermicularis, I have found fixed to shells, and on Eschara retiformis. Serpula triquetra, on Eschara retiformis, &c. (J. C. B.) Serpula complexa, Serpula tubularia on Eschara retiformis. * Serpula rugosa, Teignmouth, (Turton) and * Serpula arundo, are likewise found on our shores.

As in the case of the fishes of South Devon so it is with our marine Molluscs, we rank species in our list which by some are considered to belong in strict propriety to foreign climes, and by others are thought to have the extremes of their geographic range actually on our shores. There can be no question that the Devon and Cornish coasts are actually the extreme limit of several kinds of molluscs belonging to no other parts of Great Britain, and at the same time it is highly probable that our exposed position to the Channels and the Atlantic, enables us to collect on the more exposed beaches the absolute products of other countries accidentally cast up by the fury of the waves during storms from very considerable depths. The "*Crozier nautilus*" (Nautilus spirula) was found some years since on the beach of Ballyskelligs Bay, Ireland, and Mr. O'Kelly the finder, conjectures with propriety that it was washed thither by the Atlantic waves from the shores of America. Dr. Turton has since found specimens on the beach at Teignmouth, so that probably it may hereafter be determined that this species is capable of supporting existence sparingly in our climate. The violence of squalls affecting the Atlantic drives to the coast of Ireland, and more sparingly the western coasts of England the delicate "*Storm shell*"; (Ianthina vulgaris) it has been captured not unfrequently on the north-west coast of Cornwall, and has been also taken at Teignmouth. Gales of wind drive to the southern shores of England specimens of the "*Sea ear*" (Haliotis tuberculata) which belong properly to the Channel Isles. The north-eastern limit of *Buccinum lineatum* is probably the southern English coasts. *Panopæa Aldrovandi*, found in France and Spain extends sparingly to the southern coasts of England.

Presuming that the intermediate coasts have been well examined it ought to be deemed surprising that the coast of Devon participates so strongly in the marine molluscous productions of very distant spots, thus a variety of shells are found solely at Dublin and on the Devon shores, and though it is not very astonishing that so many have been found common only to Devon and Guernsey, and—seeing the more exposed position and greater eligibilities of our county—that we should possess so many more of these animals than Dorset, (about 132 marine shells are enumerated by the author of the Dorset catalogue) it is certainly curious to find some of the shells of Zetland and of the Orkneys generally, identified among the productions of South Devon, and so far as is known recognized no where else, witness the *Buccinum glaciale*, *Cingula vitrea*, *Cardium elongatum*, *&c.*; various species also have been found only in Scotland and Devon, such as *Venus granulata*, *Tellina punicea*, &c., and again in the branchiferous mollusca, *Aplysia punctata* occurs only on the shores of Devon and Orkney. There is however no fact so worthy of observation and in great measure so inexplicable as the number of mulluscs *exclusively* found on the coasts of South Devon, or at most on the coasts of the two south-western counties of Great Britain, and on which I have above remarked.

CATALOGUE OF ANIMALS BELONGING TO VARIOUS MARINE TRIBES RECOGNIZED BY THE AUTHOR OR OTHERS AS FORMING PART OF THE FAUNA OF SOUTH DEVON.

Those marked with an Asterisk have been found (as regards Britain) only off South Devon, or at most off Devon and Cornwall. The nomenclature from Fleming.

RADIATA.

ECHINIDÆ.

Echinus esculentus.—*Sea egg.* Very common at the mouths of rivers, and generally along the coast. Young specimens occur in deep water in summer. Purple specimens are rare. A small zoophite (?) is often found at the anal aperture.

Spatangus cordatus.—*Sea heart.* In sandy bays, as at Whitsand, and several situations along the eastern part of the Devon coast. I have it from the neighbourhood of the Erme. Not common.

Spatangus purpureus.—Very rare.

Echinocyamus pusillus.—Thrown up in shallow bays. Dead specimens are very commonly found in sand towards the Land's End. I have found it alive in crevices of stone taken up in Plymouth Sound.

The *Echinus subangularis* though said to be common on the English coast has not occurred to me, but is included in Turton's and Kingston's list.

ASTERIADÆ.

Asterias cartilaginea.—From deep water. Very rare.

Asterias papposa.——Devon. (Turton and Kingston.)

Asterias gibbosa.—Common in pools left by the tide at low water all round the coast, and frequently found hanging by a single sucker from pieces of sea-weed, &c. under rocks at low tides.

Asterias equestris.—Found at Teignmouth. (See Magazine of Natural History.)

Asterias rubens.—Rare. I have had but two specimens.

Asterias glacialis.—Very common off the rocks. Caught much by crabbers and called *Star-fish.* Feeds on shell-fish, such as rostellaria, &c.

Ophiura granulata.—In vast quantities in Plymouth Sound in deep water, also at Teignmouth. Extremely fragile, very quick in its progressive motion, which it executes in a wriggling manner.

Ophiura neglecta.—(Mag. Nat. Hist. vol. 8, p. 467) Mixed up with Corallina officinalis all round the coast. In great plenty under the Hoe. Occurs also in deep water.

Ophiura bracteata.—Common in deep water.

* Ophiura brachiata.—In sand at Salcombe.

Ophiura bellis.—Found at Teignmouth. (See Magazine of Natural History.)

Ophiura rosula.—Common on marine bodies in deep water.

* Sipunculus saccatus.—Teignmouth. (Martin.)

* Sipunculus strombus.—In the old shells of Rostellaria pes pelecani.

Sipunculus nudus.—Devon. (Turton and Kingston.)

Pennatula phosphorea. — Devon. (Turton and Kingston.)

Astrophyton scutatum has been found in Cornwall by Dr. Borlase, also *Asterias spinosa* and *oculata*, and *Comatula rosacea*.

LAMELLIFERÆ.

* Caryophyllea sessilis.—Not uncommon, attached to stones and shells in deep water. (See description of this late addittion to the British Fauna.)

GORGONIADÆ.

Gorgonia verrucosa.—"*Sea-tree.*" Common in deep water.

Gorgonia placomus and *flabellum* have been found in Cornwall by Dr. Borlase.

CORALLINADÆ.

Jania rubens.—Not common. On rocks at low water.

Jania corniculata.—Uncommon.

Corallina officinalis.—Extremely common on rocks.

Lobularia digitata.——"*Dead mens' hands.*" Common, chiefly in deep water on shells and rocks.

Alcyonium hirsutum.—Common on fuci.

Alcyonium echinatum.—Common on shells in estuaries.

Alcyonium gelatinosum.——Not uncommon on shells, &c.

SPONGIADÆ.

* Tethya sphærica.—Coast of Devon (Montagu.) Bovisand. (J. C. B.)

Halichondria papillaris.——*Crumb of bread sponge.* Common at various depths.

? Halichondria panicea.—Encrusting rocks at low water, Bovisand.

Halichondria parasitica.—Rare.

Halichondria hirsuta.—Rare. Mount Batten.

* Halichondria suberica.—Common. Encrusting dead univalves, especially Nasa reticulata, and these shells being themselves the habitations of the Hermit crab at the same time. I have found it also enveloping stems of sea-weed.

Halichondria fruticosa.—On stones from deep water, Plymouth Sound.

Halichondria coalita.—Not uncommon on exposed beaches.

* Halichondria Montagui.—Kingsbridge. (Montagu.) Plymouth Sound ? (J. C. B.)

* Halichondria hispida.—Devon. (Montagu.)

Halichondria ramosa.—Rare.

Halichondria palmata.—Deep water.

Halichondria ventilabra.—Bovisand. (Miss Hook)

Halichondria plumosa.—Common on oysters, stones, &c. at various depths.

I have in hand a number of yet undetermined, or undescribed species of this genus.

Spongia pulchella.—A specimen from the beach under the Hoe.

Grantia compressa.—Deep water, not uncommon.

Grantia botryoides.—Rarer than compressa.

Grantia ciliata.—On fuci, stones, &c. in rather deep water.

Grantia pulverulenta.—Not uncommon.

I have several new species of this genus for future examination and publication.

MILLEPORADÆ.

Millepora lichenoides.—Not uncommon on all the coast; is occasionally pink or purple.

Millepora polymorpha.——Common on some beaches.

Tubulipora serpens.——Not common. Found growing on stones, escharæ, &c.

Discopora verrucaria.—Common on stones from deep water.

Discopora hispida.—Devon. (Coldstream.)

ESCHARADÆ.

Eschara rectiformis.—Entire specimens from deep water are not common.

Cellepora pumicosa.——*Pumice-stone coralline.* Very common. I have specimens of a purple colour.

Cellepora cervicornis.—Devon. (Dr. Coldstream.)

Berenicea hyalina.—Plymouth Sound, not scarce.

Berenicea utriculata.—On shells and stones, common.

Berenicea immersa.——On stones and shells. Frequent.

Eschara fascialis and *Retepora reticulata*, have been found in Cornwall by Dr. Borlase.

Cellepora ramulosa.—Cornwall. (Pallas.)

FLUSTRADÆ.

Farcimia fistulosa.——*Bugle coralline.* Not uncommon in deep water.

Flustra foliacea.—Rare. In deep water.

Flustra papyracea.—Devon. (Montagu.)

Flustra avicularis.—Uncommon. In deep water on stones.

Flustra membranacea.—Common on fuci.

Flustra unicornis.—Not common on stones.

Flustra pilosa.—Common on fuci.

Flustra hispida.—Common on fuci.

CELLARIADÆ.

* Cellularia Hookeri. —Torquay. (Dr. Hooker.)

Cellularia ciliata.—Common. Occasionally red.

Anguinaria anguina.—*Snake coralline.* Rare.

Crisia eburnea.—*Ivory coralline.* Common in deep water on stones.

Cellularia fastigiata, scruposa, and *reptans.* (Turton and Kingston.)

SERTULARIADÆ.

Sertularia polyzonias. — *Great tooth coralline.* Common.

Sertularia halecina. —*Herring-bone coralline.* Not uncommon.

Dynamena abietina.—*Sea fir.* Very common, especially on oyster banks.

Dynamena cupressina.—*Sea cypress.* Common on oyster banks.

Dynamena operculata.—*Sea hair.* Rather rare. Bovisand, (Miss H.)

Dynamena argentea.—*Squirrel's tail.* (Turton and Kingston.)

Dynamena pumila.—*Sea oak coralline.* Not uncommon.

Dynamena rosacea.—*Pomegranite coralline.* Not uncommon. Bovisand, (Miss H.)

Antennularia antennina. *Lobster's horn coralline.* Common on oyster beds.

Plumularia myriophyllum.—*Pheasant's tail.* Plymouth Sound. (J. C. B.) Devon, (Dr. Coldstream.)

Plumularia pluma.—*Podded coralline.* Rare. Bovisand, (Miss H.)

* Plumularia pennatula.—Devon. (Montagu.)

Plumularia falcata.—*Sickle coralline.* Common on oyster beds.

Plumularia setacea.—Not uncommon on stones and shells from deep water.

Serialaria lendigera.——*Nit coralline.* Rare. Bovisand, (Miss H.)

Campanularia geniculata.—*Knotted-thread coralline.* Common.

Campanularia dumosa.—Devon. (Montagu.)

Campanularia gelatinosa.—Common on sea weed.

Campanularia dichotoma.—Devon. (Ellis.)

* Cymodocia comata.—Devon. (Dr. Leach.)

Dynamena nigra and *pinnata*, Cornwall. (Pallas.) *Thuiaria thuia.* Devon. (Turton & Kingston.)

TUBULARIADÆ.

Tubularia indivisa.—*Tubular coralline.* Not common.

Tubularia muscoides.—*Windpipe coralline.* Not common.

Hydra viridis.—Devon. (Turton & Kingston.)

BALANUS. (*Turton's British Fauna.*) "*ANNULOSA.*"

Balanus communis.—Common towards low water mark.

Balanus balanoides. —Common on shells in deep water.

Balanus punctatus.—Devon. (Montagu.)

Balanus rugosus.—Rare. I have seen but two or three specimens.

Balanus elongatus.—Very common on rocks.

Balanus costatus.—Not common in deep water; found chiefly on Caryophyllea sessilis.

Balanus conoides.—Common.

Balanus tintinnabulum.—On the bottoms of ships.

Balanus alcyonii.—(Conch. Dictionary.) Devon, (Dr. Leach.)

Balanus intertextus.—Not so common as the communis, balanoides, and elongatus; often found imbedded in sponges.

Balanus spongiosus.——(Conch. Dictionary.) Devon, (Dr. Turton.)

LEPAS. *(Turton's British Fauna.)* "*ANNULOSA.*"

Lepas anatifera.—Not common.

Lepas anserifera.—(Turton and Kingston.)

* Lepas fascicularis.—Bovisand, (Miss H.)

* Lepas membranacea.—— Exmouth. (Mrs. Luscombe.)

Lepas sulcata.—(Turton and Kingston.)

Lepas scalpellum.—Not uncommon. Plymouth sound, attached to Plumularia falcata, Antennularia, &c.

Limnoria terebrans, or "*Gribble,*" occurs in great quantities in timber exposed to the sea, at Plymouth and Torbay. The Tubularia arenosa anglica of Ellis, is found commonly at Whitsand Bay, and some other spots. Gordius marinus has been found on our coast. *Sea anemone,* (Actinea equina) common on all rocky shores. Alpidium ficus, common. Aphrodita aculeata, or "*Sea mouse,*" rare. *Cuttle fish.* (Sepia officinalis,) common. *Calamary* (Sepia loligo,) rare. Cuvieria phantapus, * Mulleria digitata, * Velella pocillum, Holothuria pentactes, and Montagui. I might add a copious list of species belonging to the Actinia, Medusa and other tribes, observed by Dr. Borlase on the Cornish coasts and which therefore might probably be found also with us, but as my object is to keep nearly to my own observations without much reference to authors I shall refer to books for this catalogue.

As might be conceived the same remarks made relative to the marine molluscs apply equally to the above animals, being themselves situated under similar conditions of existence; many are peculiar to our coast, some common only to Devon and Cornwall, some found only in Scotland, and off our shores, witness *Halichondria ventilabra, coalita* and *hirsuta*, *Ophiura granulata*, and *bellis*, *Asterias equestris*, *&c.*; one instance occurs in which the shores of America yield somewhat to us, the *Gorgonia flabellum*; doubtless also the coasts of France have an influence on our marine Fauna through proximity, though I am not prepared with instances to that purpose. By inference there may be but little reason to doubt that a similarity in the Irish and Devon productions might be established if greater attention were paid to such subjects in that country so very similarly situated to the south-western parts of England. But it is still probable that with the best conducted researches there or elsewhere in the same latitude, no catalogue of the marine radiata of a locality of the same will ever be drawn up, capable of vying with ours in regard of extent, variety and interest.

"Hail bounteous Nature! hail Eternal Source
Of loveliness and harmony divine;
Still ever mingling, ever yet unchanged!
Though various, pure; simple, though multiform;
As more admired, more admirable art thou!
More sought, still ever to be sought the more,
And newer as more known. So vast thy works!"

BIDLAKE.

Chapter II.

ON THE GEOGRAPHICAL DISTRIBUTION OF ANIMALS IN GENERAL, AND PARTICULARLY THE GEOGRAPHY OF THE ANIMALS OF SOUTH DEVON.

Great exertions have been made in every department of science to determine principles and ascertain laws. The successful prosecution of this subject must depend in a great measure upon acquaintance with detail; and since this species of knowledge has recently received great accessions, philosophers have been guided by a reasonable hope that a renewed inquiry after principles would be attended with proportionably important results. It is to be feared however, that the difficulties of the investigation have been very often insuperable, and have hitherto prevented us from acquiring any satisfactory knowledge, particularly as concerns the geographical distribution of animals. Indeed, as to primary or first causes, the reasons of the institution of laws, or of the occurrence of facts in connexion with this interesting subject, we know absolutely nothing. It has been customary until very lately, to confound together primary or general laws and secondary or partial laws. By *primary* laws, I understand those ordinances constituting the plan, system, or method, according to which the whole animal kingdom is arranged or distributed over the surface of the globe; it being opposed to reason and at variance with all scientific considerations, to suppose that living beings have been placed on the earth promiscuously, indiscriminately, and without regard of order and adaptation.

Since the greatest benefits and most important uses of natural science depend upon the determination of principles and of general conclusions, the labour bestowed on the study should centre on this great object; and in the enumeration of facts we should be careful to inquire as we proceed, what effect that detail has on admitted doctrines, or what influence it might have in establishing or disclosing new views and theories. In accordance with this idea I shall combine a recognition of laws with a statement of facts in the present chapter; first mentioning the primary and secondary laws by which the distribution of animals is governed and then entering upon the detail of zoological geography as observed in the south of Devon, availing myself in this second part of the subject, of every occasion to advance the knowledge of the higher department of principles and general results. It will be needful to remember that this subject of the Geography of Animals is intimately associated with several others of great interest, and more particularly with migration and the "polity of nature," and these have, equally with the present question, laws and general considerations connected with them, which are by no means to be confounded with those we are now about to state.

On enquiring how far the dispersion of animals is affected by, or connected with the relative temperature of the earth according to distance from the extreme points of heat and cold, we find that the animal creation is greatly accumulated within the tropics and that it gradually diminishes in extent as we recede toward the poles. Throughout these vast spaces however, numberless exceptions and deviations from this general ordination occur in consequence of the influence of secondary or partial laws, as will be shown in the sequel ; but the fact of the tropical countries being the great seat of animal creation, the temperate regions possessing fewer, and the polar districts the least number, is incontrovertible.

But not only do the intertropical regions contain the largest proportion of animals both as regards species, and as regards the number of individuals, but they are characterized also by giving place to the most highly organized creatures of the whole series ; while the temperate climates, and polar regions, are respectively characterized by animals having less and less of this endowment. Corresponding latitudes will therefore be found to agree in their animal productions in so far as they will present to view creatures possessing similar degrees of organic endowment. These statements however, although defensible in a general way, are greatly qualified by secondary influences, as will subsequently appear.

The laws which we have here stated, will receive elucidation by reference to the Fauna of continental mountains, where, on a small but similar scale as regards temperature, we see the progressive advancement of numbers, and of organization, from the summit to the base, though the occurrence of highly and of lowly organized beings in both extremes forms a partial exception to the principle. It would almost appear that we had arrived at the knowledge of one of the primary causes of natural phenomena, in finding such definite results in connexion with heat and cold; but there are too many and too palpable exceptions to this rule to allow of such a conclusion. If animals were governed in their dispersion, by heat and cold, except in a secondary and partial way, quadrupeds and birds belonging to the same tribes as are found within the tropics. would not be present in polar or alpine situations.

There is no portion of our globe, even the most desolate, which is not at times visited by certain of the higher animals, and also permanently inhabited by certain kinds of insects and inferior creatures. It thus appears, that besides the lower orders of animals being more numerous than the higher classes, they are likewise more generally dispersed. The resources of the lowest tribes are in all probability so obscure and occult as to be not only unknown, but even inconceivable by our minds ; on the other hand, wherever vegetation attains to any tolerable degree of perfection in its various forms, there a whole series of animal productions presents itself. If the extent of the Flora and Fauna of any given country be examined into the above result will infallibly be arrived at.

We may suspect that one primary law on which the distribution of animals depends, having a pretty general influence and which seems indeed altogether in unison with the aggregate of our zoological knowledge, is the gradual failure in number of individuals of a given species as we recede from the point which from their comparative plenty there, we presume to be their principal seat. Together with this numerical failure, we see likewise as might easily be conceived, a failure or deterioration in size, in qualities, in colour, and in all other endowments. To so great an extent is this occasionally carried, that naturalists are frequently at variance in their decisions on the species, some considering such specimens as deteriorations, others viewing them as separate species, or at least as formal varieties. It is seen that independently of distance from the seat of luxuriant growth and great numerical increase, specimens having all the appearance of such as are found at the very verge of the geographical range of a species are constantly detected within short distances of, or absolutely within the metropolis itself. There are unquestionably two sets of causes in operative influence on animals in regard of distribution, and it is of great moment to refer the phenomena connected therewith to the right sources. The primary causes are quite unknown to us and are likely to continue so, though it would appear that the various parts of the organized creation being ordained to counterbalance each other, that, as the laws of dependence pervade the world of living beings in all its parts, any determination or regulation such as the one mentioned,—the diminution of numbers and deterioration in size and qualities of individuals—provided it were general and observed in all classes and species, need not excite surprise.

The *secondary* causes appear to be temperature, food, situation, and the hostility of other species. The influence of these appears to be very considerable, and though we cannot be altogether warranted in attributing the above-named circumstance of diminution of number and deterioration in size, &c. to these causes, however plausible it might seem to do so, they are undoubtedly the agents that cause deteriorations generally. These secondary causes become indeed of the greatest moment in investigating the zoology of a given district. Primary laws can be seen and estimated only by reference to zoology as a whole, by taking into our view the phenomena exhibited by the entire series of animals; secondary causes must be appreciated by examining the phenomena of animal geography on smaller scales. It is then we see temperature, food, situation, and other circumstances, operating to the production of certain modifications in the distribution of animals within a comparatively small compass, while the primary laws influencing their situation on the earth are uninterrupted, and, as it were, overrule the others. In confirmation of the supposition that the gradual lessening of numbers, and gradual deterioration in size and other qualities of individuals of a species as we recede from their metropolis, depend on a primary law, we see the same rule applied to entire tribes and classes of animals in numerous instances. If secondary causes, such as food, or climate, determined the limits of species, it would not be found that the verge of the range of one species was the principal seat of another possessing similar endowments and organization, and feeding for the most part similarly. The reasons or causes then of this peculiar law or ordinance of Nature are hidden from us. The great seat of the feline tribe is in the tropical regions, and we see the species there found gradually diminishing in number of individuals as we advance northward. We see also that the individuals situated at the outskirts of this great metropolis of rapacious creatures are diminished in their size and bodily vigour, and that their ferocity has suffered decrease. The place of this tropical series is now supplied by a new set, and a third still more northwardly may without exaggeration or difficulty be detected, each undergoing within its own limits the same gradual diminution and deterioration. Eventually, if we compare the contents of the two opposite points with regard to this tribe, the difference becomes remarkable; we find the species few, the individuals also few, their size small, and their vigour and ferocity greatly reduced at their northern limit, while at the point where we commenced, these features are totally reversed. The principal seat of the cetaceous animals is in the arctic and antarctic seas, different species occurring at these two extremes; they gradually diminish in number as we enter the temperate regions, and are at their minimum in the equatorial seas. The Turtles and Tortoises are chiefly inhabitants of the warm latitudes, yet they extend sparingly northwards, and even in England a few stray individuals have been captured—the Hawk's bill Turtle in the Severn, in Orkney, and in Zetland, and the Leathern Tortoise in Cornwall. Peron says, "the seat of the Phasianellæ is at Maria Island; all traces of them are lost at King George's Sound, after passing through insensible degradations." The corals and other zoophites so plentiful and luxuriant in tropical seas, are replaced in temperate climes by (for the most part) a new series of less size and less luxuriant aspect; yet the tropical genera and species still follow us in sparing quantities. In England, the madrepores are reduced to two or three species of rare occurrence and diminutive size; the Gorgoniæ are also comparatively small; but the *Gorgonia flabellum* of the tropics has been two or three times found on the Cornish and Leith shores. Instances of this kind might readily be multiplied.

It appears from the foregoing remarks that however desirable it might be in all inquiries like the present, to determine general or primary laws, and that however obvious it may be that such determinations should be the principal aim of naturalists, yet the subject we are enquiring into will scarcely allow us to proceed farther than the discovery of secondary influences. And since these are liable to have an undue importance ascribed to them and to be viewed as primary laws, it would be right as far as possible to ascertain their absolute weight, and to see how far they modify those more general influences.

It remains to be observed, that there are a certain number of facts in the Geography of Animals which do not appear to come under any law, nor are they explainable by, or referable to any cause of which we have knowledge. No species of animal is cosmopolitan, but the extent of geographic range of species varies very largely. The greatness of this extent however, is, except in a comparatively few cases, so ordered, that there are certain divisions of the globe inhabited by races of animals peculiar to them, these races defining as it were by their limits, the zoological divisions of the earth. Thus, with a few exceptions (not considering those cases in the northern parts, where the two continents join or approximate,) the Fauna of America is peculiar to it, and the same may be said of Australia, with the difference only of still fewer exceptions being present. Now, besides the exceptions to this rule of exclusive Faunas, the ranges of animals within their zoological divisions is frequently very extensive; whilst on the other hand, the limits of very many are extremely circumscribed, sometimes a small spot of land, or a single river being the extent of the habitat; in all of which cases, no clue to the cause of such peculiarities can be discovered. Indeed, unless we at once confess that animals occupy stations on the earth assigned to them by the will of the Creator and determined only by a Providence and an Omnipotence perfectly inscrutable by us, we must be content to believe that animal distribution depends on circumstances connected with the constitution of the species of the nature of which we are ignorant, and are likely to continue so. It is not enough to point out instances of evident adaptation of animals to the circumstances which surround them, or to show that their peculiar food is found around them; for it might easily be demonstrated, that in numerous cases the same circumstances and the same food abound where the animals never come, and where if brought by man, they readily become naturalized. It is not enough to say, that in the instances where no adaptation is manifest it nevertheless must exist, because we see that these animals are invariably found in one particular kind of situation, for, although some do certainly confine themselves as thus stated, yet they are frequently peculiar to one region or spot and denied to others equally suited to their existence; besides which, there are kinds which in seeming opposition to the whole analogy of zoological science, occupy a range of country or of abode including opposite kinds of circumstances and situations, and these instances occurring too in the same tribe or family where, as above stated, adaptation was in some species proved by the uniform character of the abode. With respect to migration also, the causes are not always obvious, for, birds of precisely similar endowments and character observe different habits, some migrating, and some being fixed; whilst at times the migrating species will for the winter remain with us, and seem to live as well as our common residents, so that the reason of migration is not always clear. The Llama and Vicugna, and the Sapajous, are peculiar to America, the Ornithorhyncus, Kangaroo, and Wombat, to New Holland. The Jay inhabits equally almost every country of Europe, and the immediately adjoining Asiatic countries, but extends no farther. The Barn Owl inhabits Europe, America, and part of Asia, as well as some of the South Sea Islands. The Peregrine Falcon inhabits Europe, America, and Australia. The Blue Jay is confined to North America, the Asterias irregularis to the southern shores of England; the Physa alba to the River Towyn of North Wales. The Sapajous, or prehensile-tailed monkeys, are certainly well adapted to the forests of America, but are they less suited to the forests of other countries? The *Nightingale* certainly finds its peculiar insect food in those countries, and counties of England to which it now resorts, the climate also being congenial to its feelings and habits, yet, though it is found in Sweden and Germany, it is absent from Scotland and Northumberland, and though it is found in the middle and some southern counties of England, it is hardly known in Devonshire. The *Great Bustard* is found enjoying a distribution latitudinally, whereas the same climate, situation, and food, could be obtained to the north and south of this zone. The Achatina acicula, though found in some limstone districts of England has never been seen in the south of Devon, where lime abounds. The *Swallow* never migrates to America or China, though the food and climate there would suit its constitution. The *Hedge Warbler* is stationary, while the *Blackcap* migrates. Lastly, the *Yellow Wren* which ordinarily migrates, will yet at times remain with us through the winter.

The first of those secondary causes or influences ranking as laws of geographic distribution of animals which we shall mention, is *Climate*, a term which includes a consideration of temperature, of seasons, of winds usually prevalent, of the dryness or humidity of the air, of rains, drought, continued cold or heat, &c. It deserves notice, that the presence of mountains, rivers, seas, barren spots, the quality of soil, the degree of cultivation, and the clearness or cloudiness of the sky have all some influence in forming the climate, and in consequence the Fauna of a country. Secondary laws seem to act and re-act largely on each other, so that no one of them appears to have a separate or unmixed influence on animal distribution. The influence of climate on the distribution of animals may at once be seen by considering the vast increase of living beings as we approach the equatorial regions from the poles; but then it must be clearly understood, that this effect of climate, or rather of heat, is observed only in a very general way, and that owing to a great variety of causes, some quite incomprehensible, others connected with food, situation, &c. the interruptions to this rule of increase are both numerous and important; still, on the whole, heat may be considered one of the secondary causes that influence the geography of animals. The alterations of the seasons, which besides bringing an alteration of temperature, induce considerable difference on the food of animals, have a decided influence on their situations, causing a variety of movements termed Migrations. These changes of place are more immediately dependent on temperature and the state of the atmosphere, than on food, or other causes. Winds frequently affect the Fauna of a country by driving aquatic animals to land, or by putting migrating animals from their destined courses. The state of the atmosphere as regards dryness or humidity, together with a continuance of rains or drought will affect the general nature of the climate, and thereby the vegetable produce and animals of the country in which such conditions occur. Unusually hot or fine summers are most likely the causes of our receiving certain birds from the southern parts of Europe at that season. Long continuance of wet and cold at the time of the autumnal migration, will influence the period of departure of perhaps all our summer visitants.

Geographical situation, relations, and arrangement of a country, have considerable power over the extent and nature of a Fauna. The adjacency of an ocean, or large river in connexion with the sea, implies of course the presence of marine productions ; the intersection of a country by smaller rivers and inland waters will afford fluviatile and lacustrine animals ; mountains and hills are the resorts of a variety of creatures ; heaths and uncultivated spots have their peculiar animals ; cultivated land, by originating a large proportion and variety of plants and trees, invite thither a great variety of passerine and other birds either in search of insects in connexion with the vegetation, or for the purpose of feeding on the various seeds ; together with the passerine birds are found the climbers they being insectivorous, and lastly, certain of the hawks or other predatory birds allured thither by the presence of smaller species.

Such is the usual ornithology of many of our wooded districts in Devon, and notwithstanding that we owe much to our hills and heaths, perhaps our geographical position and our relations to other countries, and above all, the extent of our woods and cultivated ground, may be considered as more generally influential in determining our species of birds than any other secondary cause. Certainly Devon and Cornwall are two of the mildest counties in England, and in conformity with that character, the *Stone Curlew* has been known, according to Montagu, to remain all winter with us at the Start the most southern point of land in England, except the Lizard in Cornwall. So also the *Chiff-chaff* was observed by the same eminent naturalist to stay the winter with us near his house at Kingsbridge.

Storms and other phenomena of weather referable to the head Climate, are as above said, and as will in the sequel be illustrated, of considerable consequence in forming and influencing a Fauna; but Climate is very much dependent on situation, arrangement, and other local circumstances of a country, especially adjacency of sea which renders the temperature of all countries bordering on it mild and agreeable, provided the prevalent winds are in a direction from it. If Devon were not situated in connexion with the sea, of course no mildness of climate, or storms, or phenomena of that kind, could confer on us those marine products so conspicuous in our Fauna; and if our situation were not at the southern limits of the island and opposite to the southern states of Europe, we should necessarily have none of those animals which by accident or the invitations of unusually fine weather cross over to experience the gentle warmth of our summers, or else are driven by the violence of equinoctial storms on our coasts, or lastly in the case of autumnal migrants, are enticed to stay the winter with us by reason of our southernmost locality together with agreeably genial warmth.

The *Flying-fish* has occurred here, and to our north in the Bristol Channel, possibly under the influence of equinoctial gales, yet our situation must be taken into account rather than this phenomenon of our climate. The *Hippocampus vulgaris* and *Echineis remora* have both been captured on our shores, yet, situation equally with, or probably more than climate, should be regarded as the cause. Many of our birds are influenced in their visits hither, and in their stay with us in winter, as well as in many peculiarities of movements exhibited in them, by our climate, but the abundance of wood and shelter, and the diversification of the surface of our country will alone supply some explanation of the vast number of terrestrial birds found with us. Consequently, not only must we be compelled on most occasions to consider these two causes of distribution,—climate, and geographic position with the other physical conditions of a country—in connexion, but to reflect that the latter influence is of the two the more powerful and extensive in operation.

If it were demanded of us to state the general nature and qualities of the climate of South Devon, we should say it was characterized by equality of temperature and humidity of atmosphere. Our summers are short, often fervent and attended with long droughts; our autumns are usually rainy; our winters stormy, and sometimes very cold and lengthened; our springs chilly, unsettled, deceptive, and on the whole characterized by frequent intervals of gentle warmth of short continuance between the long-continued rains, the protracted blasts and blighting winds ordinarily prevalent. Vegetation having made several unavailing efforts in these intervals, and having received frequent checks and blights, is at length permitted to put forth its energies in May. Occasionally this month is with us unusually dry and fine, so as to be productive of calamitous consequences both as regards the feeding of cattle, and the crops of grass and corn; for at this period vegetation makes its greatest efforts and requires a supply of moisture to proceed with, in defect of which the harvests are rendered late and scanty, and cabbages and other garden produce are greatly injured. All this happened to us in 1836. Occasionally also, (and such was our lot in 1837) May is uncommonly unpropitious, and vegetation makes no decided advances till June. On 24th March, 1837, snow fell, and lay three or four inches deep, and ice formed in the estuary of the Yealm half an inch in thickness. On the 2nd April, snow again fell; on the 11th and 22nd, fresh deposits took place, and in some spots remained two weeks. There were no leaves on the trees till after the first week in May! In the end of March, frosts even entered our hothouses and destroyed the young grapes.

According to my remarks, the arrival of spring birds of passage is deferred in accordance with the weather experienced in that season. They arrived late in the last mentioned year, or at all events were not seen or heard till after their usual periods. It is much easier to state facts than to assign reasons for facts, and so in the present case it will be found rather speculative to trace out the sources of these characters of our climate, and which it is requisite to do, because these sources will be found in the other physical conditions of the country, themselves also influential on the geography of animals, proving as before said that these secondary causes do not act independently of each other.

The great source of the general equability and mildness of our climate is certainly our connexion with the sea. The humidity of the air is referable also to the adjacency of the ocean, the sea winds conveying with them the continued exhalations from its surface; but it depends likewise on the presence of our hills, which are great accumulators of vapour and attractors of the lower clouds. A great influence is also exerted by our inland waters which exhale considerable quantities of moisture. Lastly, the great abundance of trees, and of vegetation generally must have the effect of condensing a large quantity of vapour, and of collecting a great quantity of rain, and subsequently yielding it to the atmosphere. But the great alterations effected in the appearance of our country by such extensive plantations and culture of various kinds of vegetable produce, influence not only indirectly our Fauna through the medium of climate, but also act directly on animals by accommodating a larger number than could otherwise find subsistence with us. This adoption of new residences by animals is a fact so generally allowed that I need not here insist on it.

I have stated that equability and mildness of climate influence our Fauna; but does humidity also? I am not aware that it does. The two principal seasons in which our Fauna is rendered extensive, are on the one hand winter, when cold and storms cause a great variety of waders and and water-fowl to seek our shores, and on the other, summer, when the sun approaches us for a short space of time, and when humidity is in a great measure obviated by sea winds being of less frequency. At all other seasons but summer, our climate is rendered colder than it would otherwise be by the great abundance of our wood, which forming considerable shelter keeps off the benign influence of the sun's rays. Perhaps also when our summers are not very hot, the earth does not imbibe so much caloric as to allow of its giving off any subsequently to temper the severity of the winter's cold. This is in some measure borne out by our experience of the year 1836. On the other hand, a compact soil such as ours is, generally has the quality of imbibing the fervour of the summer's sun without restoring it to the air so readily as do loose sandy soils, so that a scorching atmosphere is to a great extent prevented. On the whole, our summers may be stated as being generally moderately hot, thereby preserving the character of uniformity to our climate, other circumstances above named having only minor degrees of power. Other alterations in the surface of a country besides planting and culture affect the number, condition, and situation of animals,—many are exterminated by man's interference, some are thereby excited to unusual multiplication, many are restricted in their numbers, or in their range, or in both, and some are encouraged to disperse locally or generally. The alterations here referred to comprise tillage, draining, irrigation, fencing, building, &c. As regards Devonshire, we find the number of quadrupeds diminished by the advances of agriculture and civilization. Many kinds of birds also have been thereby lost to us, though possibly some species have been gained, and certainly the number of individuals has in many cases been increased, and a great variety of alterations effected in geographic position. The number of our insects and molluscs has certainly been increased, and their geographic limits and positions considerably interfered with, contracted, or enlarged. Many instances in point will be afforded in the sequel.

Very little need be said on the subject of food as affecting the geography of animals. By the polity of nature the vegetable world and the series of animals are intimately blended and connected: an extensive Flora will for the most part imply a large proportion of animals, and so likewise the weaker creatures draw to them the carnivorous tribes. In our county we find an extensive Flora, and our woods are numerous and deep; the series of animals also is found very perfect, and the parts of it would, if not subjected to our interferences and persecutions, be relatively proportionate. Food influences the migration of animals to and from this country, subject however to the higher influence of weather. In order to comprehend the relative proportions of influence exerted by these two causes, we must suppose adverse and propitious cases in point. If food is plentiful and the weather intemperate a summer bird of passage will forthwith undertake its journey if it be near the usual period for migrating; if food is scarce and the weather fine, it will also depart; if both circumstances are adverse, it will hasten its departure still more decidedly; and if provision be in plenty and the weather fine, its stay will be prolonged. Similar remarks might be made relatively to winter migrants. Food has considerable influence in determining the other kinds of migration besides the vernal and autumnal. It also causes a variety of unusual movements in animals, as will appear in detail.

Food is known to determine with precision the habitats of many kinds, though as shown under the head of Primary Laws it has not that amount of power supposed by some, and many situations producing the required pabulum do not produce the animals so dependent, and where, if removed, they thrive well. Our *Bulimus fasciatus* and *Helix virgata* which seemingly need maritime localities from some preference of food, do not occur universally all along the coast though the vegetation is seemingly uniform in character, but are collected together in parties at certain spots. *Cyclostoma elegans* occurs at Berry Head, but is absent from the loose tracts round Plymouth.

Man conducts a warfare against certain animals which he finds or supposes to be prejudicial to his interests. In some cases, as where by our agricultural operations, &c. animals have been permitted to multiply more than their natural enemies would have allowed, our destruction of their superfluous number is justifiable; and likewise in the case of such creatures whose lives and actions are incompatible with our security and operations, extirpation is demanded. Many of those animals however, consigned to unlimited destruction, form important links in the chain of creation, and in consequence their deficiency will cause alterations of various kinds in the proceedings of those other creatures with whom they were associated in the general scheme and polity of nature. The merciless destruction of our rapacious birds by gamekeepers and others must permit a vast accumulation of those species of smaller animals on which they feed, and in consequence, a more general and unnatural dispersion. A consideration therefore of the operations of man, whether as respects his agricultural or his other improvements and refinements, or whether as regards his hostilities to the animal creation, is worthy of some regard in framing an estimate of the causes in active influence on the positions, ranges, and migrations of our native animals of Devon.

It is fairly to be presumed that our acquaintance wth secondary causes is as yet very imperfect; at least we are still unaware of the reasons of a very great nnmber of phenomena which from being peculiar to certain tribes or to certain species cannot possibly be referable to general laws; and until some light has been thrown on these circumstances, our knowledge on this head must be deemed incomplete.

Upon the whole it will be found difficult to render an inquiry into circumstances and detail interesting, though the chief objects and questions we shall have in view will be—firstly, to determine or illustrate general laws if the limits of such an investigation should by possibility admit of it; secondly, to determine and illustrate secondary laws or causes of geographic distribution by attention to the following circumstances,—comparisons of the phenomena of this district with others of similar extent and similar or dissimilar aspect and contingencies, irregular distributions, the occurrence of varieties and other modifications as provisions to suit local circumstances, the times selected for migration, (of the various kinds) with an attention to the causes possibly influencing these movements, modifications of habits, peculiarities in the Zoology of the whole of the spot selected, or in any of its parts, remarkable deficiencies in its Zoology, general, numerical, and other results. Lastly, it will be right to make mention of a variety of other circumstances, though no explanation of their occurrence can be given, since records of unexplained facts may serve to invite notice and inquiry into causes.

There are two methods of considering the Natural History of a given spot, each having its peculiar advantages. We may investigate it with regard only to those phenomena and circumstances properly and peculiarly its own, irrespectively of all interferences and additions by the inroads of agriculture, planting, &c.; or we may consider it in its present state under all its alterations. The first mode has the advantage of being the more natural, and it is also calculated to display a great number of remarkable features of the spot. The second plan has the advantage of setting things in their present light, and serves also to show to what extent animals are influenced by our proceedings, how far their distributions are modified by our advances and operations, the instincts guiding them in their defences against our intrusions, and lastly, it serves to demonstrate an important principle in the economy of a great proportion of creatures, that namely of adaptation to variety in surrounding conditions, a quality almost unrestricted in the human species but enjoyed in a more limited degree by the lower animals, without which however their lives would be dependent upon the slightest alterations in surrounding circumstances, and without which we should not have been enabled to subject any of them to our uses and pleasures. I believe it will be expedient to examine the Zoology of this district with reference both to original and to existing features, giving to each its respective value and peculiar considerations.

We include in our local survey that portion of Devonshire which extends from the heart of Dartmoor to the southern coast, and which is included between the rivers Exe and Tamar respectively on the east and west. There is thus presented to the view an extent of country having in its northern part the character of sterility, and in its southern that of fertility. Now, as we have already had occasion to observe, the animal part of the creation is almost entirely dependent on the vegetable world, whilst the vegetable kingdom in its turn is dependent on inorganic matter. Accordingly, if it appears that the northern division of our limits is incalculated from the nature of its superficial soil to maintain vegetable life except in a limited degree; so also it is obvious that the animal productions of this spot must be likewise restricted. The central districts of Dartmoor present to the eye a series of hills of great size covered with detached blocks of granite. On the summits of many of these hills are found swamps, and even pools of great depth, and between them streams pass on for future coalescence, and where the surface is level for a sufficient space, the drainings of the country rest and form morasses and lakes. Altogether, Dartmoor and its vicinity presents a large proportion of water, since it appears that five principal rivers, twenty-four secondary streams, fifteen brooks, two lakes, and seven heads are found on it.

The Flora of this wild district consists with but few exceptions of the lower tribes, such as mosses, ferns, lichens, &c., and of such plants as are peculiar to marshes and other collections of water. The soil cannot possibly support many of the higher orders, but the beauty, variety, and luxuriance of those vegetable forms which mantle the rude blocks of granite, spring from the spongy soil of the bogs and marshes, raise themselves into notice above the stream, or maintaining their existence in the body of the current attached to some fixed point, move in conformity with its undulations, are sufficient to attract the notice of even the incurious. In this sterile spot the most common creature excites regard, and those which are peculiarly its own cannot fail to be contemplated with much interest.

The Quadrupeds of Dartmoor, though now reduced to a small number, were formerly pretty numerous. The following are recorded as its ancient inhabitants,—the *Wolf*, the *Brown Bear*, the *Boar*, the *Wild Ox*, the *Red Deer*, the *Elk* and the *Wild Cat*. The Wolf appears to have become extinct on Dartmoor about the close of the reign of Elizabeth. It was a pure native of our country and required great exertions for its removal. The Bear seems to have been extirpated in the eleventh century, and unless its food consisted chiefly of vegetable productions it is difficult to understand how its existence could have been maintained. The Boar and Wild Ox have been taken under the protection of man, and the date of extirpation of the wild stock is not recorded. That noble animal the Red Deer was until within the last fifty years pretty common in the remote wooded districts of the county ; its race too has undergone extirpation in a very gradual manner. "Sometimes, but rarely, one has been perceived near Ashburton," and it is not more than three years since that I saw an account in a paper of the chase of one near that town, it having unfortunately been espied in some coppice. It is quite reasonable to suppose that the Goat was a native or rather a frequenter of this district so perfectly congenial in aspect to its nature. All these were most likely found in a less degree throughout the woods and wilds that lie to the south of Dartmoor, but by increase of population and agculture they were no doubt soon removed from these spots and eventually their limits restricted to the Moor itself.* But here also they

* One such spot where these wild animals abided was Berry Head, as appears by the discovery of numerous teeth of the *Boar*

suffered extermination soon after the king took part in the more noble field amusements, and when punishments were inflicted for interference with the game.

(For the existing quadrupeds of South Devon inclusive of the Moor, see catalogue in the last chapter, and the map accompanying this text.)

The present state of Dartmoor would by no means lead to the belief of its supporting more than two or three quadrupeds of the smaller kind, and indeed upon inquiry into facts we find that the barren open portions are frequented only by the *Rabbit*, *Mole*, *Weasel*, and perhaps the *Stoat*. How then can this region have maintained those other large animals recorded as extirpated? There is undeniable evidence that the central department of what we ordinarily term Dartmoor was in former years a forest, and that it was set apart for the king's use as a royal chase. With this explanation difficulties vanish. At the present period the woods and plantations in the immediate vicinity of the Moor harbour the same quadrupeds as those found in the southern districts. The *Martin* and *Polecat* however, are now more peculiarly frequenters of the deep woods remote from cultivated parts. The *Otter* is said to confine itself (as respect the Moor) to the river Dart, probably from its superior size and depth, and from its being better supplied with fish.

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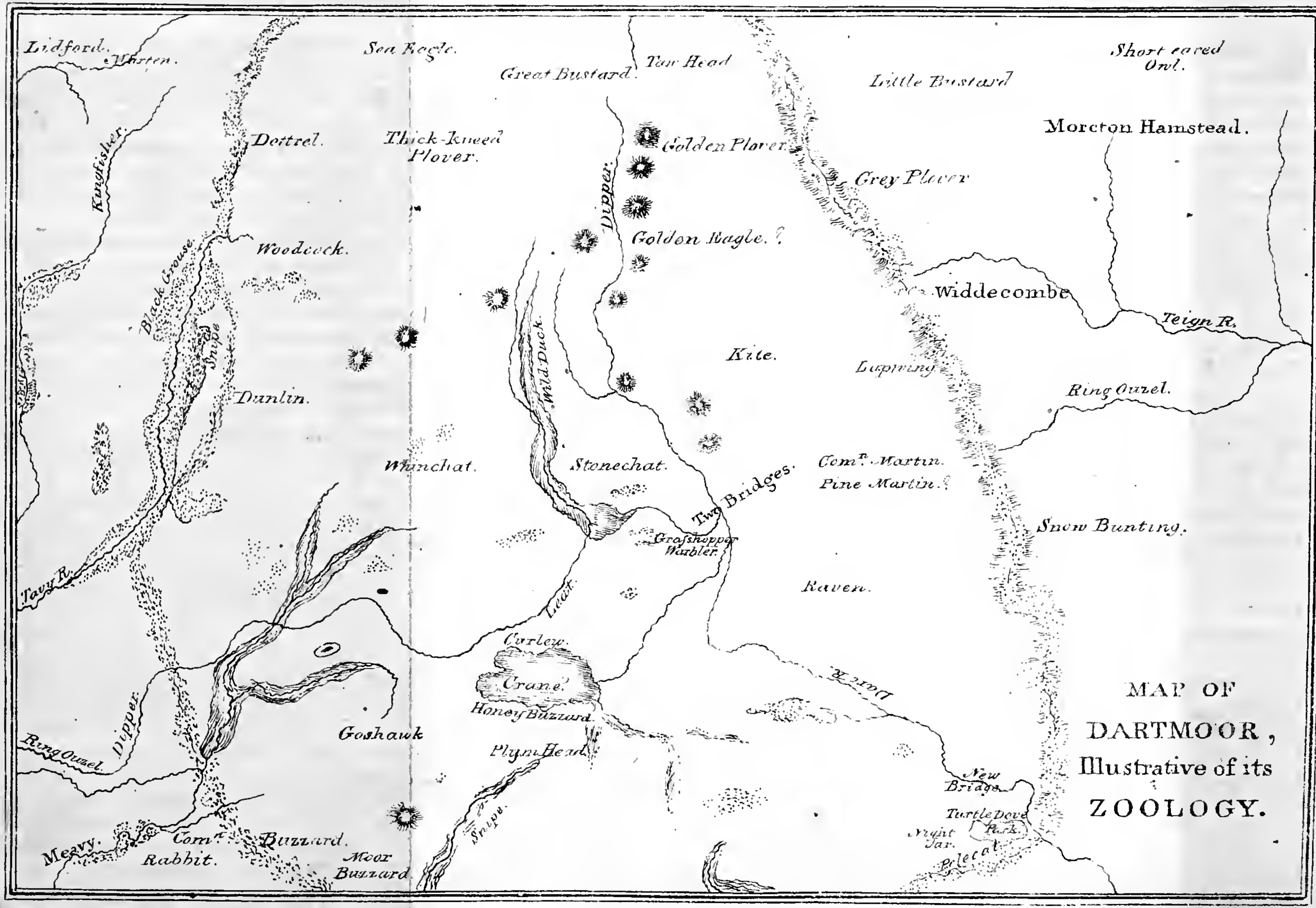
and *Red Deer* in the soil of a field adjoining the sea. Berry Head is known to have been the resort in ancient times of those who devoted themselves to the chase of such animals.

As for the bones of the *Elk*, of the occurrence of which in alluvial or diluvial deposits so much doubt exists, Moore's assertion of their discovery with us, and in circumstances not diluvial in their character, has been lately supported by their disclosure in a peat bed at Mevagissey.



MAP OF DARTMOOR, Illustrative of its ZOOLOGY.

The *Mole* is a creature by no means limited to cultivated districts, as appears by its occurrence on a barren hill of very considerable height in the immediate neighbourhood of the Moor. The most numerous and characteristic species however, is the *Rabbit*, which as will subsequently be seen, draws thither a variety of rapacious birds that otherwise would not find food in such a district.

The Ornithology of Dartmoor is in many respects interesting. The Rabbits which abound there draw numerous species of rapacious birds to it, and the *Raven*, *Carrion Crow* and *Hooded Crow* likewise traverse in their wanderings this wild spot. The *Ring Ouzel* frequents many of the rocky and rapid streams in parties, nestling to my knowledge in hollows of the rocks. The *Water Ouzel* is a frequenter of similar situations being a great lover of solitude, and I am not aware that either of these birds has been traced, except sparingly, beyond the barren portions of the Moor. The *Titlark*, *Stonechat*, *Whinchat*, and *Grasshopper Warbler* are found occupying their respective stations on the heaths and stony fields; and the *Wheatear* and *Reed Warbler* are reported to make their abode within the limits of the more barren parts of the district. It has been told me that *Cuckoos* are at times seen haunting rocky spots on the borders of Dartmoor, and this may be true enough, although it is possible that my informant may have mistaken the *Nightjar* for it, as they are not very dissimilar in appearance, and since I well know that Nightjars are found on the borders of the Moor in large wooded inclosures, but particularly at Buckland-in-the-Moor, where the oaks have attained a great size. From these woods they usually select positions in the adjoining commons or brakes for nestling. The *Great Bustard* which formerly frequented the Moor has I fear been extirpated. In times past also, no doubt, the *Crane* frequented Dartmoor. One was shot in 1826 on the borders, and there is a hill in the heart of the Moor having on its summit a pool of great size called Cranmere Pool, a name signifying the abode of Cranes, as though these birds had been in the habit of resorting thither, as is the practice of some other birds at present. The *Thick-kneed Plover* frequents the downs and wastes; and it would seem that some wintered with us and were driven to inclosed lands, as in severe winters they have been brought to Plymouth Market, where I have myself seen them, though rarely. In the summer months I have seen *Curlews* on the marshy grounds, where indeed they breed, but I presume the numbers killed on the coast in severe winters must be derived principally from the northern counties. It has been proved that many individuals of the *Snipe family* breed on Dartmoor, but it is only of late years that this fact has been observed. The same observation applies to the *Duck*, *Wigeon*, and *Teal* according to report, though I can answer only for the *Wild Duck*, which unquestionably breeds in several spots on the Moor, besides in those situations in our cultivated grounds where care has been taken to protect it. The swamps of the Moor are also the breeding-places of many individuals of several species of wading birds found in the autumnal and winter months on our cultivated lands and shores.* The *Lapwing* descends in flocks

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* This rule of the limitation of the waders to such spots during the breeding time, like most other rules of our formation on natural subjects, is arbitrary and open to exception. *Curlews* have been known to breed on the shores of Falmouth and Plymouth Harbours. Parties of *Purres* (a half dozen or more) are seen on our coast at times as late as the middle of May. *Lapwings* some times breed in our large open fields, and I believe also on the coast.

in winter; I have noticed them arriving in vast quantities in December yearly on the high grounds bordering Bigbury Bay. It has been found also that the *Golden Plover*, *Grey Plover*, and *Dunlin* breed there, and there is great reason to suppose that very many other similar birds do likewise. The *Coot*, *Water Hen*, and *Water Rail* are well known to breed not only in the marshes of Dartmoor, but also plentifully in very many swampy woods, and other secluded watery spots not far from Plymouth, dispersing from these retreats as soon as the cold sets in. The *Black Grouse* is sparingly dispersed over the moors, and in winter roams with its progeny over the woods and cultivated parts of the country, being occasionally shot and brought to market in the severer months.

Besides the above named birds there are others recorded to have been observed *sparingly* on or in the vicinity of the Moor. The *Honey Buzzard*, *Sea* or *Cinereous Eagle*, *Golden Eagle*, *Goshawk*, *Kite*, *Little Owl*, *Short-eared Owl*, *Nutcracker*, *Greater spotted Woodpecker*, *Lesser spotted Woodpecker*, *Roze Ouzel*, *Wryneck*, *Cross-bill*, *Hawfinch*, *Hoopoe*, *Snow Bunting*, *Turtle Dove*, *Quail*, *Little Bustard*, *Great Snipe*, *Barker*, *Spotted Rail*, and *Little Rail* are some deserving notice. But it is to the deep and unfrequented woods before named as bordering the Moor that we are principally indebted for these rarities, and it cannot be altogether surprising that these spots so secluded and so generally calculated to be the abodes of the feathered tribes should contain within them objects so precious to the naturalist. They who have read Vaillant's "Travels in Africa," will I think agree with me in the remark, that the transition from these woods to the contiguous sterile tracts of the Moor, where even in summer little else can be seen save the Curlew flying from the summit of one tor to another and by its harsh note adding to the dreariness of the scene, the Stonechat and the Ring Ouzel, or perchance a Buzzard hovering aloft, is not very unlike the sudden changes experienced by that adventurer and which he so touchingly describes,—at one time surrounded by hundreds of beautiful birds, enlivening by their actions and notes the thick groves, then situated in a trackless desert, and guided only on his way by the harsh note of a duck flying at a great height in quest of some rock which might happily contain water in its basins.

The arid and remote portions of the Moor are frequented by only a few birds, never found (or but rarely and at certain times) in the southern and cultivated districts. The *Eagle*s and birds of that kind are generally however partial to remote spots, or restricted to them by our interference. The *Golden Eagle*, if still a Devon bird, must be accounted as in some measure peculiar to Dartmoor, though most of this kind roam to immense distances at certain periods. The *Sea Eagle* has been seen both on Dartmoor and frequenting cultivated land, and has likewise been captured at the Eddystone. The *Goshawk*, *Kite*, and *Honey Buzzard* may be considered almost confined to Dartmoor; the first however has been met with on the coast, and the last at Slapton Ley. The *Short-eared Owl* has been killed both on Dartmoor and Exmoor, but seems to be very rare and to confine itself to open and remote spots. The *Black Grouse*, *Little Bustard*, *Thick-kneed Plover*, and the various waders before named as most likely breeding on the moors, together with the *Great Bustard* and *Crane* (if they be still resident in the county) must be considered in some degree peculiar to Dartmoor, though they are all constrained on the occasion of severe weather to seek shelter and food in the cultivated parts.

The woods bordering Dartmoor are well adapted to shelter a variety of birds of the rarer kinds, but yet none that I know of are limited to them; the *Turtle Dove* however is more frequent in these situations than in the southern parts, and several species of the rarer *Hawks* are mostly obtained from thence.

I am not aware that anything need be said relative to the amphibia of Dartmoor, excepting that the *Lizard* and *Viper* are both found pretty commonly on the downs and other dry situations, as indeed they are throughout the whole county. Nothing can be said relative to the Icthyology, nor any thing on the Conchology, unless it be that *Helix trochilus* has been noticed close to the Moor. Having but slight acquaintance with Entomology I can only say that the lists of the Dartmoor insects are very extensive.*

When we come to examine the Fauna of the central districts of South Devon we find considerable alterations in its character, besides its extent being greatly increased. The diversification in the surface of the country, together with every variety of soil and vegetable produce are no doubt great reasons of this circumstance, while another cause is our being situated at the southern limits of the Island, by means of which we are more likely than

* Vide Carrington's "Dartmoor," in which the catalogues of animals are supplied by Dr. Tucker of Ashburton, and by Dr. Leach, formerly of Spitchwick. The former gentleman also contributed a list of rarer birds to Jones' "Guide" befere quoted, and commenced a periodical entitled "Ornithologia Danmoniensis." The labours of the latter naturalist are chiefly to be found in the transactions of learned societies.

other counties to partake of the ornithology of the continent, and likewise to receive a variety of birds which migrate from northern counties or kingdoms.

Reverting to the mammalia we have still a few remarks to make. Our woods and thickets are so numerous and sometimes so little frequented that the *Hedgehog*, *Badger*, *Fox*, *Hare*, *Squirrel* and *Dormouse* are all found pretty abundantly, and the *Shrew*, *Weasel*, and various kinds of *Mice* frequent in plenty our fields and hedges. I am not quite sure respecting the *Water Shrew*, but I believe I have taken it while a boy in the stagnant waters of the entrenchment round Devonport, and it is generally believed to be an animal not rare, though very shy in its nature. In the space of ten years I have not seen above three or four specimens of *Polecat* in this neighbourhood though I have been much in the habit of inquiring on such subjects among gamekeepers. On the other hand the *Stoat* and *Weasel* are plentiful throughout the county. The *Harvest Mouse* is found in Cornwall, and from reports there is great reason to believe it is tolerably common in Devon. I very lately captured the new species of mouse described and figured further on, and designated *Shaggy Vole.* The *Black Rat* is scarce with us.

The assumption of the white fur in quadrupeds has been ordinarily supposed peculiar to northern latitudes, or at most to our northern counties and to depend on great cold, but a white Hare was seen in a wood near my house one winter and though that season was unusually severe it is certainly difficult to understand why certain individuals of this animal and of the Stoat and Weasel should assume this garb in not very cold seasons. White Rats have been captured at times in warrens, where this species is known to resort for the sake of the young rabbits. White and cream-coloured Moles are also found here, and particoloured specimens of all the above named.

In all cultivated districts abounding in wood and productive of an extensive Flora, as is the south of Devon, we necessarily meet with a great variety of birds belonging to the Passerine order. In the central portions of South Devon, now under consideration, there are but few birds besides the Passeres (Cuvierian system) observed, and these excepting a very few species, may be regarded as in great measure *peculiar* to this central part. The *Ring Ouzel* and *Water Ouzel* may to a certain extent, be considered as Dartmoor birds, but some no doubt have been seen beyond those precincts, and a pair of the latter build yearly in a fish-house not far from me, and very close to a flour mill, a saw-mill, and several other houses, being also within fifty yards of the main road. The *Raven*, *Hooded Crow* and *Nutcracker* likewise, are birds which can scarcely be claimed for the ornithology of a cultivated tract, though the first two roam at times over every variety of country.

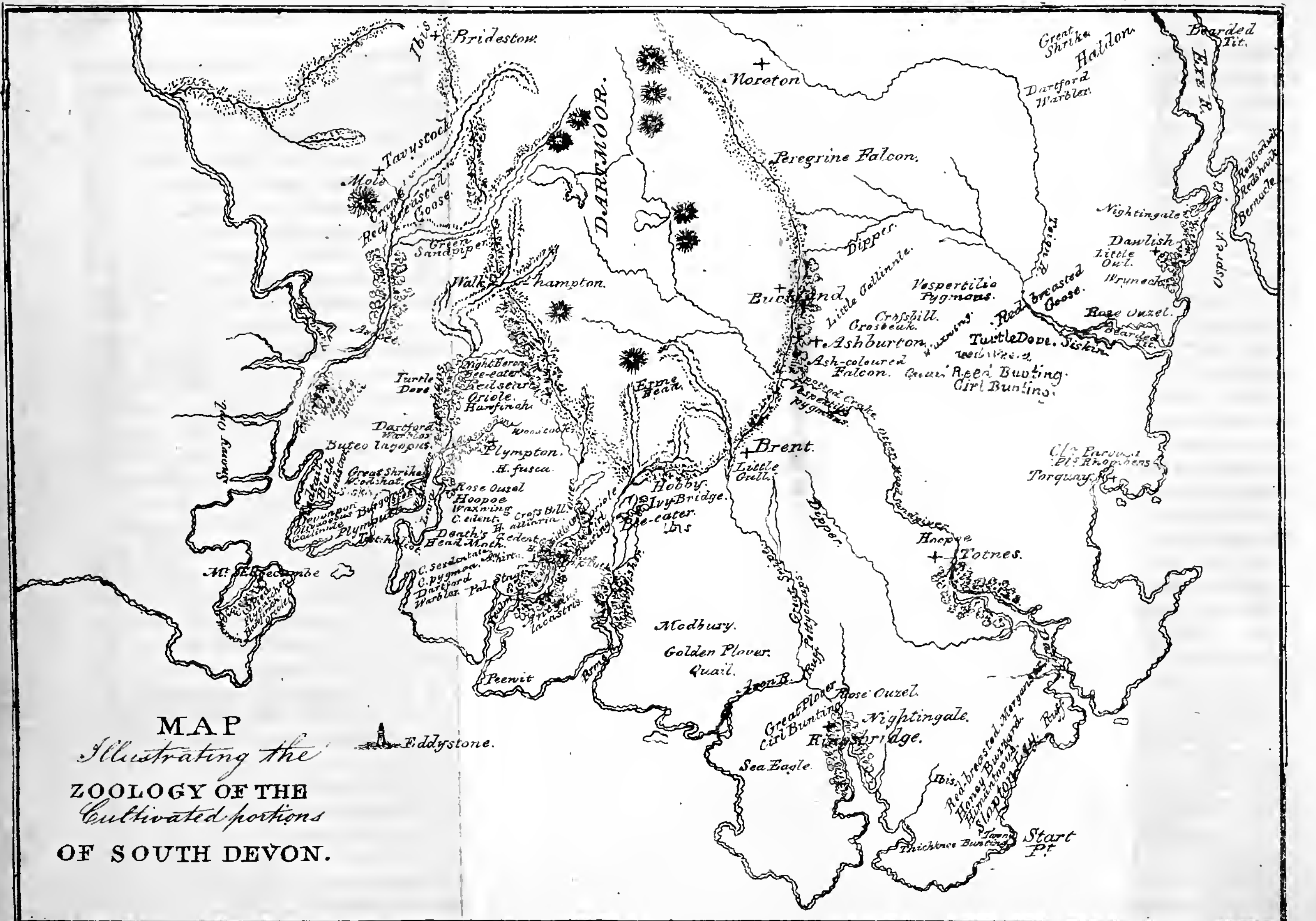
The entire number of birds wholly or partially inhabiting the cultivated, wooded, and well watered part of Devon we are now speaking of may be estimated at about 141,—allowing about 13 to be Accipitres, 5 Scansores, 5 Gallinæ, 8 Palmipides, about 22 Grallæ, and 88 Passeres,—the total being more than one-half of the whole South Devon list, computed at 247, the remainder being made up by those few birds more peculiarly belonging to the Moors, and by the great variety of those waders and web-footed birds furnished by our coasts and hereafter to be noticed. But, giving all due weight to these last-named sources in swelling our ornithological list, that part of it which we are now more especially examining is found by comparison with ornithological lists of well wooded and well cultivated counties, to be unusually extensive. The number of birds in Oxfordshire does not exceed 120, inclusive of several kinds of web-footed birds (besides the more common sorts of Ducks, &c., which we may presume would form part of most ornithological lists) which occasionally roam inland, or are driven thither by stress of weather, such as the Herring Gull and Leach's Petrel, and three kinds of Waders which are at times detected in inland localities, the Ibis, Phalarope, and Greenshank, so that more properly not above 106 land and fresh water birds are found in Oxfordshire, making a difference of 35 species between the two counties. This difference we shall examine into, as it will serve to illustrate in some measure the peculiarities and more remarkable features of the ornithology of the cultivated parts of Devon.

First with regard to the Accipitres, the deficiencies consist of these birds, (not taking into account certain species which I shall have to mention in considering the third portion of the south of Devon)—the Rough-legged Falcon, Ash-coloured Falcon, Moor Buzzard, Great eared Owl, Snowy Owl, and Little Owl. In examining into such subjects we may perceive, that with respect to some species the reasons of absence are evident enough, while with respect to others, the causes of restriction of limits and occasional or vacillating appearance are quite unknown. Speaking generally, the cause of our possessing so many species of this tribe, indeed all the British species except the Scops Aldrovandi and Egyptian Vulture, stragglers, seems to be the rocky and mountainous character of our county together with so great an abundance of uncultivated land interspersed and a vast number of woods of great depth removed from the neighbourhood of man. The only species of the Accipitres however which may be accounted at all common in Devon, are the Kestrel, Sparrowhawk, Common Buzzard, Moor Buzzard, White Owl, and Brown Owl. In former years the *Kite* was a common bird in this country, but at the present day it is particularly scarce, furnishing an illustration of the uncertainty of the geographical position of rapacious birds, and a proof likewise that we are inadequate to fathom very many of the phenomena of animal dispersion, for we know no reasons why that species should abandon us. According to Dr. Pulteney, it is very frequent in Dorset, and by an authority of my acquaintance it is not very uncommon in Oxfordshire. But this uncertainty of position is not confined to rapacious birds.

When we turn to the Passeres of Oxfordshire we do not find more than 17 deficiencies, allowing 88 to be the number observed in the cultivated parts of Devon, so that it is not in this department that the chief part of the difference is found. They are the *Red-tailed Warbler, Woodchat, Mot. neglecta.** (Yarrel's British Birds,) *Passerine Warbler, Black Redstart, Sylvia neglecta, Mealy Redpole, Golden Oriole, Pied Fly-catcher, Dartford Warbler, Cirl Bunting, Bearded Titmouse, Twite, Bee-eater, Siskin, Lesser Red-pole,* and *Reed Warbler,* (the last two being doubtful) the whole of which are rarities in the British Isles. I have considered the Ring Ouzel and Water Ouzel to be almost wholly moorland birds in Devon, but although the latter is not met with so far as I know in Oxfordshire, the former has been sparingly observed. I have likewise noticed the following birds as common in that county

* After my Catalogue of Birds had passed through the press, I learnt from Mr. Gosling that in the month of November, he saw a bird of this species accompanying a small flock of the pied sort between Plymouth and Stoke.

which with us are scarce,—the Redstart, Grasshopper Warbler, Lesser Whitethroat, and Pettychaps. The *Nightingale* is common in Oxfordshire but in Devon has not been noticed far west, though in Dorset it is plentiful, hereby defining very accurately its south-western limits in England. Now in all these instances of remarkable dissimilarity between the two counties, no explanation whatever can be given of the preference for localities so observed. The distribution of some animals is latitudinal, that of others longitudinal, some species inhabit a district of a rounded or irregular form, some are found regularly dispersed through the whole of a natural geographical division of the globe, some are found inhabiting one division and only partly one or more of the others, some inhabit one or more countries, omitting or refusing to dwell in certain spots in that range, whether large or small, some are uncertain in their stations, are continually changing their position, or remain an indefinite period and then disappear in toto, or return after the lapse of some time; in all which phenomena little can be detected of secondary causes exercising a decided influence, and yet I cannot but think we are largely indebted to these causes for the great variety of natural productions of which we boast, allowing all necessary weight to those unknown primary laws of dispersion under which very many species appear with us, and many are denied to us. But depending upon all these causes combined, we are enabled to rank as Devon birds a very large number of rarities, perhaps more than any other county in Great Britain. Perhaps the whole number of British birds may be considered as 302, and upon inquiry where our deficiencies of 53 chiefly occur, it is found that they consist in part of stragglers and rarities, and in part of birds whose limits of distribution are confined to the



MAP
Illustrating the
ZOOLOGY OF THE
Cultivated portions
OF SOUTH DEVON.

Northern Isles, to Scotland, or to certain counties to the north of us, or lastly whose geographical position may with greater propriety be referred to the north than to the south of Devon.

There are certain passerine birds which are irregular visitors of Great Britain, such as the *Bee-eater*, *Oriole*, *Rose Ouzel*, and *Hoopoe*, which have several times been found with us, and which properly speaking have their station in Africa but migrate into Europe yearly, and at times pass over to the British Isles, so that this offers some explanation of the fact of so many of the British specimens having been captured in the south, and especially in Devon. Another class of irregular visitants seem to arrive from opposite sources; the *Nutcracker* is in our list an instance of this, as the northern countries appear to be its true station, the cause of its coming hither not being evident. A third series of irregular emigrants, consisting of the *Pied Flycatcher*, *Red tail*, *Bohemian Chatterer*, *Crossbill* and *Grosbeak*, are in all probability derived from the Continental states. The *Bearded Titmouse*, has been noticed only near Thorverton and Dawlish, and the *Tree Sparrow* only in the east of Devon. The *Reed Warbler* is found sparingly with us, though it has not been noticed in Wilts, Somerset, and Dorset. The Brambling and Snow Bunting are chiefly observed in winter. Our other rarities are noticed only sparingly and casually.

(For the localities of our rarer and more interesting birds of the South Hams, see the catalogue in the last chapter and the second of the maps accompanying the present text.)

The remark which we made relative to the Accipitres being prone to roam, of individuals of one species being stationed in localities of very different natures, of their partaking of a variety of food, and of the same species being found in various quarters of the globe, applies, though less forcibly, to the family of the Pies and to the Shrikes. The appetite of the Raven extends to every sort of animal food: it has of necessity a roaming disposition and it is spread over the globe from the northern countries to the Cape of Good Hope. The Crow and Magpie also enjoy a very extensive range and the latter is found in America. Those Pies however which are in some degree granivorous, or less decidedly carnivorous, are not so widely dispersed or of so roaming a disposition,—the Rook, the Jackdaw, the Jay, the Hooded Crow, and the Chough. The Great Shrike has a range almost equal to that of the Raven, while the Flusher, which is chiefly insectivorous, is confined to Europe or extends at most to Egypt. Among land birds therefore, the Accipitres, and rapacious or carnivorous Passeres enjoy the most extensive distribution. The Kingfisher, a piscivorous bird, is also very widely dispersed, being common to Europe, Asia and Africa. The Waders and Web-footed birds are however more extensively distributed than land birds, more especially the former, as we may have occasion to observe hereafter. Fish enjoy a very wide range, but quadrupeds seem to characterize the natural divisions of the earth, at least in a great measure. The other tribes are likewise in some degree characteristic of different quarters of the world.

Proceeding in our comparison of the cultivated parts of Devon with Oxfordshire we come next to the Scansores, in which division we do not possess more species than are met with in Oxfordshire, or most other counties.

In the Gallinæ we have the advantage of Oxfordshire in possessing the *Stock Dove*, a bird which appears here in large flocks in winter, but is not noticed at other times.

The order of Waders (Cuvierian system is still followed,) comprehends some which reside in swampy situations, or in connexion with inland rivers and lakes, besides being principally composed of those usually termed shore birds, (which likewise at times resort to rivers and lakes, and for the most part breed in fens or retired swampy spots) and a few other species which are by no means water birds, and are found in very different situations from the other Grallæ. Accordingly, some birds of this order find a place in the Oxfordshire list, and may with propriety be enumerated amongst our own birds of the South Hams. Of these some breed on Dartmoor and appear in autumn and winter on the cultivated lands, as before noticed with respect to the *Golden Plover*, the *Grey Plover*, and the *Lapwing*. Some individuals of the *Woodcock* and *Snipe* also breed in retired moorland situations, and appear with the main body of those migrators in the cultivated parts on the occurrence of the first cold. The *Curlew* and *Dunlin* (or some of them) breed on the moors, and pass over to the shores and rocks in winter, while very many species may be regarded as common to the cultivated parts and to the coasts, rendering it in some degree questionable which situation should claim them. The Grallæ however generally are shore birds. I enumerate about twenty-two Waders as frequenters of the cultivated districts of South Devon, and of these thirteen are found in Oxfordshire, the remainder consisting of the *Grey Plover*, the *Great Snipe*, *Olivaceous Gallinule*, *Spotted Gallinule*, *Dottrel*, *Little Bustard*, *Little Gallinule*, *Ruff*, and *Green Sandpiper*, all of which are as in the preceding instances of birds found here and not in Oxfordshire rarities, or at least uncommon birds. Nor does that county claim any species not found with us, as may readily be imagined from the fact that there are but two other British Birds belonging to that division of the Grallæ which we may term inland and fluviatile Waders,—Sabine's Snipe and the Courser which have been seen in England but twice or thrice. The *Thick-kneed Plover* however, which in our cultivated districts is scarce, is in Oxfordshire common, though probably this depends on that county possessing such a noble and extensive forest and other uncultivated tracts. In Oxfordshire the *Golden Plover* appears only in winter, whereas here it breeds on our moors and appears in the southern parts afterwards. Considering the very confined limits usually observed by the *Ruff*, it is surprising that any of them should have been noticed in Devon, however rarely. One Devon specimen was shot in December, 1808, on that fertile source of aquatic birds, Slapton Ley, which may serve perhaps in some degree to illustrate the eligibility of our county for such birds; and species from every class of birds are known occasionally to remain in England through the winter, whilst the main body observe the accustomed migration; on the other hand some also remain to breed if the position is found eligible, whilst the bulk of such species retire to other counties or other countries, where the rearing of young is conducted with certain concealment. These may possibly be cases of altered character of species, but in respect of the rarity of the *Ruff* in this county, it should be taken into consideration that though it is now restricted to certain of the eastern counties, it may possibly in former years when cultivation had made no great advances, have extended generally over a much greater number, our own included. Slapton Ley is a lake of rather large size, situated towards the verge of the southern coast of Devon. By a wise ordination of Nature, the birds peculiarly termed marine, or rather some of the species, upon the occasion of want in the winter months, divide their search after food between the ocean, and inland waters, besides which, some individuals of these species betake themselves wholly to the waves, or wholly to inland water, roaming for the entire season from spot to spot, or keeping constant to one locality,—conclusive proofs against the notion of instinct being a defined, constrained, and very limited mental operation in brutes, a doctrine adverse also to the history of most species in which instinct is detected. Upon the occurrence then of cold, Slapton Ley adds to its visitors a great variety of shore birds and pelagic fowls, so that this piece of water alone sufficiently shows the abitrary nature of making the coast a geographical limit for the marine birds. In consequence of our maritime situation, and the freedom with which marine birds pass the limits of the coast, it becomes difficult to state precisely which of the Grallæ should be enumerated as belonging to the cultivated districts, and I have allowed myself to be guided in some measure by the Oxfordshire list, because that county is not maritime, but it is very likely that many birds of the *Heron* kind which I shall rank as shore birds are equally entitled to be considered as inland Waders. It should be mentioned that not only do the shore and marine birds pass the limits of the coast and obtain food inland, but the land and fresh-water Grallæ are very often in winter, especially if it be severe, found exploring the shores for provender. The *Heron*, *Coot*, *Gallinule*, *Lapwing*, *Golden Plover*, *Grey Plover*, and I believe some other kinds act thus. I am not aware of any species of the Waders we are now speaking of quite peculiar to South Devon, but the *Little Gallinule* deserves notice, as having been first discovered here; only three specimens are known, two of these being Devon birds, and the other obtained from the river Ware.

The last tribe of birds belonging to Oxfordshire and to the cultivated districts of South Devon consists of those few web-footed birds which roam to inland waters, meadows, stubbles, &c. from our own coasts, or which breed and abide wholly or partially in such situations. In order to state the case as near the truth as possible, I have allowed the same number of these birds to South Devon as are found to occur in Oxfordshire, though from our adjacency to the sea, those species which in an inland locality would be stationary, with us change their situation, and again some marine birds of our coast at times repair inland, which in counties remote from the coast are never seen. The following are the species referred to,—The *Little Grebe*, the *Wild Duck*, *Teal*, *Widgeon*, *Grey Lag Goose*, *Common Gull*, *Great Black-backed Gull* and *Golden-eye*. The Little Grebe breeds in all the fish-ponds and small lakes in the county, and in winter, very many are seen busy diving in all our inlets. The several kinds of Ducks frequent the marshes and large ponds during winter, some of the Wild Duck as before stated breeding with us. The Wild Goose is a frequenter of meadows, marshes, and stubbles, besides the sea coast during the winter. And lastly, the two Gulls, and perhaps other birds also, particularly the Red-legged Gull, make excursions in winter to inland waters and marshes after food, and some of them are known to abide during the breeding season at certain ponds and other collections of water in the south of this county. We here bring to a close our comparison between the ornithology of Oxfordshire and that of the South Hams of Devon, finding a difference of 35 species preponderating in the latter district. It is of course always desirable to trace out the principal features in such deficiencies, and upon examination it is seen that the proportion of deficiencies in the Accipitres and

Grallæ is equal. It is here then that our county excels in the ornithological department, at least such is the fair conclusion by comparison with the products of this other county possessing a tolerably extensive ornithological Fauna, and considering the respective histories of the species in which Oxfordshire is deficient our advantage cannot be set down to maritime position. On the contrary, I believe the true reasons may be stated as follows:—1*st*, There are certain European birds whose chief situation is in France, Italy, Holland, and other adjoining countries, but whose range extends to the southern portions of Great Britain, just as the range of others is found to extend from Europe to the northern shores of Africa. There are other species also whose principal station is in Africa, and which migrate yearly into Europe, reaching in small numbers the British Isles ; and since the number of animals generally diminishes northward, the proportion of birds resident in, or migrating to the southern shores of Britain will be greater than that of the northern parts. 2*dly*, Montagu states as his opinion, that in the autumnal migration of the long, soft-billed Waders (and I suppose other kinds also) from their northern haunts to the southern portions of Europe, they experience in their transit across the north sea, equinoctial gales which gradually drive them to the southern parts of England, so that hence we are more likely than northern counties to have rarities conferred on us. 3*dly*, This county contains almost every kind of retreat for the various sorts of birds : it is mountainous, well-wooded, and well watered. 4*thly*, In the retreat of those birds which visit this country from southern latitudes to their winter residences, the southern coasts of England offer them a resting place previous to their departure, so that here we see a larger number both of individuals and of species than the generality of other counties, besides which, many upon finding suitable abodes and mild climate, are induced to abide with us through the winter. *Lastly*, the occurrence of some species in this county, which have never been noted or but sparingly in others, must be set down either to accidental causes or to influences of which we are ignorant. And since there are such various reasons for our ornithology being so extensive the species of which we boast as supernumeraries or as being found here whilst they are very sparingly scattered over the rest of England, cannot be exclusively Grallæ or Accipitres, although as before hinted it is in these classes that the greatest preponderance is observed; neither must we be altogether guided by the ornithology of any one county such as that selected for comparison, in arriving at conclusions respecting the peculiarities of our own, or respecting the ornithology of the southern counties of England generally. As we proceeded we pointed out instances which illustrate the various reasons here given for the extent of our ornithological list. Other cases might be cited, but as our knowledge of their geographical ranges is imperfect they could be mentioned only with great hesitation.

A few words on the remaining tribes of animals will close our consideration of this division of our subject. With respect to the Reptiles of South Devon but little can be said, as they do not differ materially either in number or in geographical position from those of most other counties. The *Nimble Lizard* is found in plenty on our heaths and commons, but is not confined to these spots, as I have taken it in gardens, and I have likewise once seen it on the stump of an old tree in a willow-ground. The Dumfries-shire Snake and Natter Jack Toad do not occur in Devon so far as my knowledge extends.

Lists of the Fresh-water Fishes and of the Land and Fresh-water Shells of the county appear in another place, and it is here only needful to observe in regard of the molluscs, that there are two chief peculiarities in the physical character of our South Hams, namely vast abundance of wood, and great number of rivers and streams. The land and fluviatile shells certainly correspond in great measure to these circumstances, but I believe no instance can be adduced where the Fauna of a locality accords so precisely with its physical conditions, as to include all those creatures generally found in such spots, and to exclude those generally absent from the same. Perhaps indeed our woods being particularly damp and shaded, a number of Land Shells may on that account be denied us, such as Carocolla lapicida and Clausilia biplicata, and again, our deficiency in large ponds, pools, and other standing or slow running water, may cause us to be deprived of the genera Anodon and Mysca, but then Succinea amphibia is denied us, while the Succinea oblonga is granted us, and yet they are in some counties found in the same marsh. Paludina stagnorum occurs here, but its congeners do not. It is to be remarked how singularly well defined are the limits of some species of these tribes, so much so as to induce the belief that these limits in some cases correspond with the boundaries of soils, or with the geographical distribution of certain vegetable and other productions on which they feed, though possibly the facts of these cases may after all be quite as inexplicable as the limits of dispersion observed by the Nightingale, and some other birds. At the least however, it will be allowed that comparisons between the geographical limits of the various productions, mineral, vegetable, and animal, of a given district, would in all probability lend considerable assistance in the determination of the causes of a great number of now unexplained facts; for the three kingdoms of nature are not merely associated, but intimately connected, and since secondary causes have so great influence on animal and vegetable dispersion, we may not unfrequently discover the cause of distribution of these to rest with the qualities of the soil on which they are maintained, and still more frequently the phenomena of animal distribution to depend on the nature of certain vegetable products occurring on the spot, or diffused over those tracts to which certain animal forms are peculiar. Again, the selection of particular food by certain of the carnivorous animals will in a great number of instances determine with exactness the limits of such species.

We now pass on to consider the third division of the subject, the shore and marine productions of South Devon, subjects in a great measure apart from those first discussed; and although we found it convenient to consider the Fauna of Dartmoor, and that of the cultivated districts separately, the productions of those spots are not so distinct or peculiar as we shall find those of the shores and sea. Divisions of this kind arbitrary as they are, will nevertheless be found useful, because as the qualities of the elements and constitution of the climate in each may be expected to differ, it might be also ascertained that the tribes of creatures inhabiting or frequenting them were more or less classified or brought together by reason of those influences. It is farther convenient for the purpose of comparison with other spots of similar or dissimilar natures. We must in the first place say a few words on the Mammalia.

The chief abode of our *Bats* is toward the coast, because they principally reside during their daily and brumal quiescence in the caves and fissures of our limestone rocks, and these occur for the most part toward and on the shores. The two common sorts seem (perhaps because more plentiful) to resort as freely to old buildings, hollow trees, &c., as to cavities of rocks, but I believe there is no decided preference shown by these animals for natural cavities of the earth, hollow trees &c. being the appointed substitutes where and when caves cannot be obtained. It is the same precisely with the *Barn Owl,* to which hollow trees form a natural resort, and caves a natural succedaneum ; but both with Bats and the Barn Owl, old buildings, such as barns and sheds are to be considered in some respects as unnatural habitations, because the creation of animals was anterior not only to the erection of such buildings, but to the adoption of this island as a residence by our race. It has however been most wisely directed that the instinctive faculties of brutes should not be so definite and so limited in their operation as to preclude all departure from their more peculiar habits and actions, and hence it has been found that the construction and situation of the nests of birds have at times varied remarkably from ordinary rule ; hence birds have been enabled to sustain themselves on novel food, when driven by stress of weather or other adverse circumstances, to countries which they have never before seen ; hence, when detained by weakness or the allurement of climate and supply of food, from making their accustomed migration, they can support themselves against unaccustomed impressions; and hence amongst a great variety of other instances not only with birds, but with other kinds of creatures, we are enabled to domesticate them, and to cause by our interference extraordinary alterations in character, and variations or rather improvements in instinctive powers. With respect however to the adoption of our buildings as places of resort and situations for nestling by birds and other animals, I believe too little has been said by writers, because such irregularities have been made to pass current in their mode of expression, and doubtlessly in the minds of many readers, as the natural habits of such species, whereas an useful lesson might be thence drawn relative to the faculties and mental operations of the beings around us. With us the natural nestling places of the *Jackdaw* are on the sea-cliffs, and rocky eminences in general are its natural abodes wherever found. In defect of these however, Nature has prompted it to make use of hollow trees and rabbit holes in some instances ; but towers and ruined buildings are such faithful imitations of its native cliffs, that this bird is diffused very generally through our county. With the *Wheatear*, old walls and heaps of stones answer the purpose of rocks, both for obtaining food and for nestling. This bird chiefly resides during the breeding time on our coasts; and though it frequents quarries and old walls, these situations are never far removed from the sea-side. At other seasons it either quits us, or frequents fallows, &c., for food. The natural breeding-places of the *Martin* with us are the cliffs, but owing to similarity of position, and that extraordinary dependence on man observed in this and other species, it usually builds against houses and frequents their neighbourhood. It is remarkable however that in the *Swift* and *Swallow* so few instances should be on record of their building in other situations besides houses, out-buildings and churches. It would be easy to cite other cases of adopted nestling-places of the same class, but these are here named because the birds in question seem to belong almost wholly to that portion of South Devon into the productions of which we are now inquiring. The whole character and history of species, and consequently the philosophy of Zoology in general can only be arrived at by tracing the habits, physical endowments, &c. of animals in each different locality they inhabit, and hence this is one cogent reason for prosecuting the natural history of districts, and comparing and combining the same.

Now the *Otter* is an illustration of this. It is usually thought to be a fluviatile animal only, but in Devonshire it is both fluviatile and marine, quite as many residing on the coast and fishing to a short distance off the land, as on the banks of our rivers. In the former case they take possession of small hollows in the rocks, and are yearly hunted in these situations near Plymouth. It might be expected that the *Seal* would find a place among our Devon animals, but I know of no instance of its capture here, though from its occurrence in Cornwall we might reasonably expect that it would be found with us also.

The Cetaceous Mammalia of our coast deserve more than usual notice in this place, because these animals have never been properly examined by British naturalists, and because those which have been seen on our coasts have as yet received very limited notice, at least in respect to the number of species. In the first place it is highly probable that the distribution of this class has never yet been completely understood, and that so far from their being scarce in the British seas as usually supposed, they are tolerably common even now, and were doubtlessly more so formerly. I have a most respectable authority for stating that in the middle of July, 1836, several Whales were seen between the Azores and the Land's End. The crew of the ship in which he took his passage indeed captured one, and one was noticed by him immediately off the Land's End. The species however he could not tell. A Whale was found dead off Penzance not long since. Amongst the "rarer fish of Cornwall" is mentioned the Blower or Fin Fish, *Balæna Physalus*, Linn. Now besides these notices, our catalogue (p. 196) will shew that at the least our sea produces eight species, and that the "Cornish Fauna" records many more.

We have now to conclude the subject of the Birds of Devon by speaking of those on the shore and sea. With regard to the Accipitres we enumerate the following as more or less peculiar to the coasts:—The *Peregrine Falcon*, *Red-legged Falcon*,* *Osprey*, *Sea Eagle*, and *Kestrel*. In this tribe of birds we perceive that besides their disposition to roam and change residence, there are remarkable examples of diversity of habit in the same species. Thus, while the *Kestrel* is found pretty commonly in inland counties, with us it is almost wholly confined to the coasts. The Peregrine Falcon and Osprey are not very uncommon, but the Sea Eagle is decidedly rare. The *Gyrfalcon* and *Goshawk* have both been taken on our coast but once. A few passerine birds must be mentioned in connexion with the coasts. The *Rock Pipit* is stationary, its food seeming to consist of the smaller marine insects. The *Chough* is likewise a coast bird, but is not stationary on the Devon shores, visiting us only in small numbers towards winter. These two seem to me to be the only true passerine birds of our coast, at least, alterations have taken place in the geographical situation of the Wheatear, Jackdaw and Martin,

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* I have derived my knowledge of the occurrence of many of our rarer birds from Dr. Moore's catalogue in Loudon's Magazine of Natural History. Dr. M. enumerates 243 Devon species. I find also from the same author that the Sussex list amounts only to 175, and that of Norfolk and Suffolk conjointly to 217.

as before named; in addition to which, these do not confine themselves to one abode, and are moreover observed to affect *inland* rocks equally with shores, their appetites are not limited to shore productions; and though the Chough is in some other countries an inland bird, it is not so in England, save through accident or necessity. The *Raven* at times builds on our cliffs. The *Crow* is noticed very frequently in autumn and winter, examining the rejectamenta of the tide. The *King-fisher* migrates partially to the sea-side in October, and those which are found there remain till spring. This is another instance of diversity of action in individuals of one species according to situation. It is certainly an ordination of Nature, to allow of more extensive dispersion of the whole of the species during the season of greatest want, for by this arrangement of their appetites the removal of some portion of the species to the estuaries and coasts permits a very general though very slight change in the position of all the members of the kind, giving to each a more extensive range for capture of prey during the time of necessity. Mr. Knapp observes that the universality of the *Robin*, that is to say its general dispersion, is remarkable. This is confirmed by my notice of it, though rarely, on the furze of our cliffs, and in copses at our embouchures. How remarkably does the history of one species differ from that of another when thoroughly investigated, and how evident is it that the completion of these histories is essential to the unravelling of those various plans instituted by the Creator for the perfection of his wondrous scheme of nature! There is one of the Gallinaceous birds an occupant of the shores, namely the *Rock Dove*, which builds sparingly in the caves.

We calculate that there are fifty-six Waders belonging to South Devon, and since twenty-two of these may be regarded as belonging to the terrestrial and fluviatile portion of this class there is a preponderance in favour of the marine portion. With respect to very many of this class, it is quite impossible as before remarked, to assign to them unequivocally an inland or marine station. They are either so imperfectly known that their preference is merely suspected by their accidental occurrence in one of these situations on the occasions when seen, or they have been found to resort equally to both kinds of habitats ; even in the case of those species which breed on our moors, and appear in autumn and winter on the coasts, allowing that they do not at those seasons visit lakes and rivers also, it must cause a doubt on the mind whether it would be natural to refer them to the inland or to the marine class exclusively. In fixing the numbers however as above, at twenty-two for the cultivated districts, and the remainder thirty-four for the uncultivated parts and the shores I have been guided thus : I first selected those respecting whose station no doubt could be felt, and then classified the rest by ascertaining as far as possible which parts of South Devon they evinced the most preference for, or in the case of the rarer birds by considering that to be their station where each had by good accident been observed, unless it seemed to me that this station was at variance with the general character of the bird and assumed only by mere casualty. Of the thirty-four then, I have reckoned two as belonging to Dartmoor, and thirty-two as shore birds. Then, besides the two which are peculiar to the moor, namely the *Great Bustard* and *Crane*, more than two dozen other species have been noticed on that spot, very many of which breed there. Some of these I have considered as belonging to the cultivated parts and some to the shores, according to the bias they betrayed. Again, of the twenty-two

Grallæ of the cultivated parts, seventeen are also at times visitors of the coast. And lastly, of the thirty-two shore birds about to be named more particularly, only one-half have *exclusively* been seen on the coasts and at the mouths of rivers.

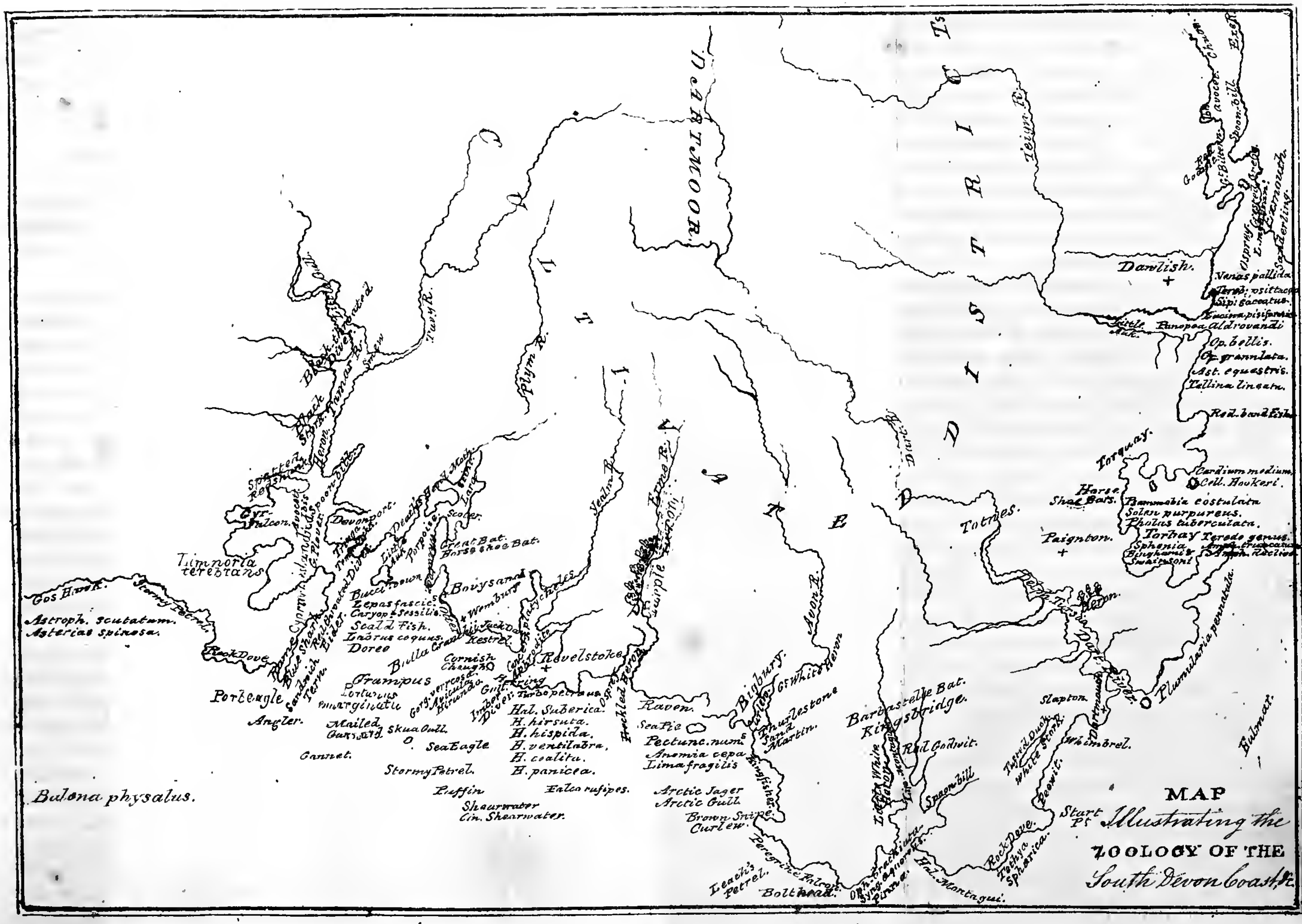
Devonshire boasts of nearly all the English marine Grallæ, the deficiencies in our list being either stragglers, or such as have only a northern range. Among the rarer Grallæ of our shores, the following deserve enumeration, the *Great White Heron*, *Purple Heron*, *Little White Heron*, *Freckled Heron*, *Night Heron*, *White Stork*, *Black Stork*, *Little Bittern*, *Spoonbill*, *Ibis*, *Brown Snipe*, *Pigmy Curlew*, *Temminck's Sandpiper*, *Wood Sandpiper*, *Little Stint*, *Sanderling*, *Phalarope*, *Greenshank*, *Stilt*, *Avocet*, *Spotted Redshank*, and *Pectoral Sandpiper*; * and if the records of the occurrence of these birds in England be consulted, it will be seen that not only are they of extreme rarity, but that some of them have occurred more frequently in Devon than elsewhere. Some of our other Grallæ also are tolerably common, while in other parts they are scarce. What then are the reasons of our possessing so very many rarities, and of having so many individuals of the less rare birds of this division of the Grallæ? Is it because our climate is so genial and uniform; because our shores and harbours are so suitable for their sustenance and retreat; on account of our southern station; or from all these causes combined? The *Oyster*

* While superintending the press at this portion of the Work I learn that specimens of this bird were shot on the Tamar, and preserved by Pincombe of Devonport. For a description of this and nearly all other rarities, see Eyton's "Rarer British Birds," a book containing also the most perfect catalogue of the feathered tribes of our Island.

catcher seems partial to the rocks and portions of the coast far out towards the open sea, where it occurs in small parties in autumn and winter. The *Ringed Plover* has been supposed to repair to other countries on the occurrence of the winter's cold, but in Devon I am quite sure it resides on the coasts of our estuaries through the winter.

(For the localities of our rarer and more interesting birds of the South Devon shores, see the catalogue in the last chapter and the 3rd of the maps accompanying the present text.)

The web-footed birds of Devon are very numerous, compared with those of other maritime counties; and yet if we regard Devon relatively to its marine ornithology alone, the greatest number of deficiencies will be found amongst the present tribe. These deficient species are either rarities, or such as are limited to the northern isles, so that we may fairly state that we possess all the English birds any way common and which are not by the laws of their physical distribution confined to more northern abodes, and further, that we have a very large proportion of those rare birds which occur however sparingly, in nearly all parts of our island, or on the other hand which have been noticed a very few times in the whole of the country. The following are the rarer birds of this class observed with us,—*Crested* and *Red-necked Grebes*, *Black-throated Diver*, *Black Guillemot*, *Little Auk*, *Puffin*, *Cinereous* and *Common Shearwaters*, *Fork-tailed Petrel*, *Skua*, *Fulmar*, *Arctic Jager*, *Burgomaster*, *Arctic*, and *Little Gulls*; *Sandwich*, *Arctic*, *Lesser*, and *Black Terns*; *Goosander*; *Merganser*; *Ferruginous*, *Eider*, *Scoter*, *Velvet*, *Gadwall*, *Long-tailed*, *Garganey*, *Pintail*, *Scaup*, *Shieldrake*, *Golden-eye*, and *Shoveller Ducks*; *Bean*, *White-fronted*, *Red-breasted*, *Bernacle*, and *Brent Geese*, and *Wild Swan*. The occurrence of



W. J. Griggs, Lithog. Plymouth

so many of the rarer pelagic birds on our coasts seems to allow of readier explanation than that of rarities from amongst other tribes, because we find that the former are bestowed on us in most profusion and very frequently *only* on the occasion of storms, or of very severe cold. The object of nestling has likewise influence with some, but winter is the season in which by far the greater number of the web-footed species appear here, and not only do many of those reared in more northern countries migrate thus far south, but others come from their breeding places in our own island, A great many of the water birds however occur on our coasts without our being able to assign any cause for their appearance, as they have arrived independently of storms or severe cold. The *Little Gull* has been obtained in England seven times, and five of the birds were from Devon. The rarer kinds of *Tern* mentioned above have occurred without assignable causes, besides many other birds, but possibly the security of our bays and harbours together with the mildness of climate, may be the attractions to such of them as lead a wandering life.

The geographical distribution of fishes is so very imperfectly known that but very little can be offered respecting it. About 150 species have been recorded as British, and of these about 120 are found on the south-west coasts. Many approach our shores at fixed periods, and of these none is more interesting than the *Pilchard* on account of its numbers, and its importance as an article of winter food to the poorer inhabitants. It appears in August, and generally remains till the end of September. Its comparative scarcity with us for the last few years is remarkable. There is a prevailing opinion that it arrives later and later every year, and indeed about forty years ago it did not ever appear until November. In 1837 it came off the coasts of Cornwall in October after it had quitted us; but again in 1838 great numbers appeared on the same coasts in March and afterwards in July, before coming to us in Devon. These facts added to others continually heard of or read in newspapers, shewing the irregular or uncertain appearance of this fish on the coasts it frequents, strongly announces the incorrectness of the idea of its multiplying within the Arctic circle and passing bodily at a certain time from thence to the temperate regions.

Our subject gradually loses interest as we descend to the lower tribes. Of the Mollusca we possess a considerable number. They seem to predominate however in those portions of the class which characterize bold rocky shores, and possibly the same remark holds good relatively to other tribes of marine animals. It is likely that this will account for the same animal being frequently found on shores of the same character, though far distant. Thus, we very often meet with shells stated to have been taken on the coasts of Devon and of Shetland, so that although the geography of shells is so very intricate it may yet be detected that situation has much control over it. More than 300 marine molluscs have been recognised with us.

Since the time of Montagu but little has been done in illustration of the remaining marine tribes of Devon, the Radiata, of which however at the present time we can boast of nearly 120 species found on the Devon shores, and I have certainly no doubt that this number might be greatly increased by diligent and keen research. The sponges of our coast in particular require illustration, and I am of opinion that not more than three-fourths of them have been named. We see frequent instances among the lower tribes, of species peculiar to the southern shores of England representing by their general similarity species peculiar to more northern stations. But altogether these facts require elucidation and careful consideration, and no naturalist should deem such matters unworthy of his attention upon finding that detail of this kind is not merely essential to the development of the laws of animal geography, but that it is requisite to complete the history of species, and to become acquainted with many of the laws regulating their existence and their actions and in general operation upon the entire series of living beings.

We have shewn that our county yields to none in the importance of its Fauna, and this chiefly because of the peculiar eligibilities of its physical conditions. I do not know therefore that it would be of use to inquire into the relative proportions borne between the various tribes, or to institute further comparisons between the animals of the south of Devon and those of any given spot of the same extent. An answer to the former question will be found only by tracing the dependence observed in nature from the inorganic kingdom to the highest conditions of organization. A competent reply indeed cannot be given till our knowledge of the laws of life shall be greatly increased, and till we recognize as the denizens of our country, hundreds of creatures which have as yet escaped notice. A comparison of our animals with those of any other district would avail little, since an enumeration of species does not imply a knowledge of the conditions which influence their situation or control their limits. In framing a list of animals inhabiting a given spot or country it would be very right to apply the principles of zoological geography. To speak of the frequency or scarcity of animals independently of these is to betray ignorance to those who can judge, and to perpetuate error to those who would learn. It is not questionable but that one half of the lists published have been formed without regard to the circumstances causing the residence or visits of animals; nor is it doubtful, but that in asserting that an animal is *scarce* or *frequent*, the authors of these lists have overlooked the fact that it is one scarce or frequent in the country as a whole, or scarce or frequent in many countries conjointly. Supposing a bird stated in books, and known to be found generally as a common inhabitant of England to be recognised as such in any provincial list, it is clear that no knowledge is this communicated; and supposing that in any other district it was found not quite so common, and yet reported as common in the ornithological catalogue of that district, it is obvious that the truth is kept back. In short, the manner of these communications is altogether far too general, and deficient in the necessary precision. If such terms as "common," "scarce," and the like, be not used relatively, and if there be not precision used in referring to the occurrence of animals, but little information is imparted by these lists, and I think also that their value would be doubled, if to the bare intimation of the frequency or scarcity of occurrence relatively to the aggregate of each animal respectively, there were added the *causes in operation*, and a reference to the *conditions by which the number is controlled.*

Part III.

REMARKS ON NUMEROUS SUBJECTS OF NATURAL HISTORY BUT MORE PARTICULARLY ON BIRDS.

"————————all things speak of God; but *in the small*
Men trace out Him; in great he seizes Man!"

YOUNG.

New kind of Mouse.—Not long since a large sort of Mouse seemingly differing from all other kinds, was captured by Pincombe of Devonport in the stables at Whiteford, the seat of Sir W. Call. Entire length 7¼ inches, the head being 1 inch, the body 3 inches, and the tail 3¼ inches. The fur is remarkably fine; close to the body it is of a deep dove colour, but it terminates in a tawny tinged with ferruginous; the muzzle and under parts shade into ash, owing to the presence of dull-white hairs, and to the colour of the under fur or dubbing becoming still greyer and silvery on the belly and feet. The tail is but small, and scarcely larger at its root than at its termination, hairy; the ears protrude considerably beyond the fur; the whiskers are very long; the head flat on top; thumbs rudimentary. Mr. T. E. Gosling to whom I am indebted for the beautiful drawings from which the engravings of this and the other new species were executed, assures me he has every reason to feel convinced that he has more than once seen the present kind in the stables at Leigham. From its intermediate appearance as regards the Rat and Mouse, and the absence of other decisive peculiarities or characteristics, I have named it *Mus intermedius.*

Caryophyllea sessilis.—There is a kind of coral found pretty commonly off our coast, and apparently coming into the division of Madrepores, which is taken up generally from deep water attached to stones and old shells. Those which I have yet seen had their animals of a bright red, but it seems they are also found "white, yellowish, orange-brown, and green." This Madrepore first came under my observation in the end of the year 1836. Examination led me to suspect that it ought to be separated from *Caryophyllea cyathus* of Fleming's British Animals (*Madrepora cyathus*, Ellis's Zoophytes.) My largest specimens are half an inch high, of a compressed figure, and measuring at the star four tenths in the largest diameter and three tenths in the shortest. They are generally inversely conical though the smallest are of nearly the same size at their bases as at the stars. One specimen has the star oval, and presents a curved figure from its base to the smaller end of the star. Two small specimens have the star nearly round. They are generally rough on their exteriors from the attachment of *Serpulæ*, *Flustræ*, and in two instances, of *Lepas costata.* All of them present longitudinal striæ on the outside, derived undoubtedly from the three different kinds of lamellæ of the interior. The margin of the star is observed to project in every instance, and the lamellæ are devoid of the external crust for a short extent of their depth. The depth of the disk varies greatly, the centre of this spot consisting of small convolutions, or twisted plaits situate on or rising from the basis of the fabric. The smallest kind of lamellæ are sometimes deficient, but the second sized invariably occur between the primary ones. The only circumstance in the history of the species calculated to afford a specific name of any value, seems to be its great deficiency of stem, and I therefore propose to name it accordingly. *Caryophyllea sessilis.*—Primary lamellæ of the star usually thirteen; three lamellæ of less size occupying the intervals, and the middle one of these predominating slightly in height and breadth and sending off from its base a thin flexuous, and erect plate or process; all the lamellæ rough with small tubercles, and more or less plaited on their edges.

The engraving of this species of madrepore to which I would here refer the reader, is copied from a specimen which had only 10 primary lamellæ, but the prevailing number is as above stated. I have lately had an opportunity of examining "Johnston's British Zoophytes," (1838,) where I perceive that this species had been observed by others on the southern coast prior to my own notice of it. It is the Caryophyllea Smithii of that work, though judging from the description of Dr. Fleming's Caryophyllea cyathus found in Zetland, I cannot agree with Dr. Johnston in making the two synonymous. Surely a specific difference must subsist between specimens with 40, and those with 13 or 14 primary lamellæ. I refer the reader to Dr. Fleming's account, and to the plate of Caryophyllea cyathus in "Ellis's Zoophytes."

Sponges.—In this tribe we manifestly trace what in the gradations of creation must be regarded as an intervening step between animals and vegetables. The evident animal forms termed "polypi" observed in the other zoophytes—above the sponges in the scale of endowment—are here lost, together with all motion; the external form, and in some measure the *appearance* of the texture approximate most closely to vegetation, but still the substance and integral composition is animal. These animals therefore are the last grade in creation before we pass over to the class of vegetables. Still it must be remembered that no tribe can in propriety be termed intermediate physiologically—not combining the qualities of both classes, except to superficial appearance, and as it were by simulation of characters *not actually possessed.*—It would seem therefore by the above statements that animality is not constituted by forms which we habitually call *animals,* the polypi or architects of corals for instance, but by the production of substance which is chemically animal, and yet not assuming forms recognisable as *animals.* It may now be asked however, and with the utmost propriety, how the substance of these productions is derived and assimulated, and yet no absolute animal, or creature, or direct agent, be discernible? It must be confessed that this question cannot be answered by the means of occular or of physiological enquiry, but that on the contrary we are obligated to look to the analogy of plants, likewise destitute of ostensible and circumscribed beings, and to reflect that there a power exists of abstracting nourishment from the earth and air and of assimilating the particles, and so in like manner it must be concluded, that the tribe of sponges are empowered with the capacity of drawing atoms for the sustenance of their peculiar structure from the medium wherein they live.—As in vegetables, so in the sponges, the mere vital property operates without the aid of any demonstrable agent, and probably only on chemical principles.

Notice of a peculiar faculty in Man and certain animals.—There is an extraordinary power possessed by man, (at least by those individuals whose faculties are in due development) of directing his course in any required direction of the compass. Having once acquired a knowledge of the position of one point, the minds of such persons ever after retain a continued impression of the same, and in consequence, of the rest. Let such persons be where they may, or have their countenances directed anywhere, they can with the rapidity of thought, intimate or recognise the actual position of the four points. My own experience informs me that this power is retained after a long succession of turnings and windings in all possible directions, and what is more I have further noticed that the mind, or one especial portion of it, continues engaged in ascertaining or observing the direction being pursued through all these deviating courses, without our consciousness of the activity of this sense, and in short it operates while the aggregate of the reflecting powers are abstracted on some given question. On reverting from the abstracted condition of the mind, this ever-watchful faculty is ready to acquaint us with our relative position as respects the cardinal points. I acknowledge that this sense cannot be purely instinctive ; we cannot fancy that if transported instantaneously to some desert we should still have the advantage of this faculty, indeed occasional disasters happening to us, and exposure to unknown localities, inform us that since in these cases we are utterly at a loss, this sense cannot be of the instinctive order. Moreover we are peculiarly liable to err when abroad in the dark, and it sometimes happens that under even ordinary circumstances we are occasionally subject to mistakes, and again, particularly so when surrounding appearances are found on moving situation to be similar, with at the same time a contrary direction in the heavens. Although therefore it is most probable that this is a providential endowment for our greater security, and though it certainly must be admitted that we are allowed to argue on the presumption of no accidents accruing to us calculated to disturb the uniform operation of the power, of no possible exposure to unknown spots without this retained power on our passage thither, of no exposure in the dark, and of no imperfect development or inefficient state of the faculty, the question at length comes,—what is its precise range of action? If we were only in possession of the power of guiding ourselves by appointing certain objects as waymarks, our ability of investigating new tracts would be very limited, because our memories would inevitably be fatigued and become deceitful by keeping in recollection so many objects and their respective relative bearings, we should also be liable to distraction by the effect of multifarious other objects continuedly crowding on the sight, precisely indeed as we are wont to be perplexed when endeavouring to retrace our steps to some particular spot by the aid of the memory of those things we had noticed on our passage from it. To enable us to disregard these minor subjects of direction, to enable us to proceed at once to a distant locality without consideration of relative bearings and positions of objects by the way, above all to enable us to gratify our propensity to enterprize, and to suffer us to advance beyond our immediate range of abode without hesitation or fear of being lost,—these are the special operations of this power as granted to us in our conjoined moral and physical condition on the earth. But not only is this faculty of enterprize an assistant of the more recognisable faculty of the memory of localities and relative positions of objects, but they seem actually blended and to be portions of one indivisible power; for it is matter of fact that in taking cognizance of any cardinal point for the purpose of first-knowledge, or for refreshing the perceptive operations of it, we instinctively notice and record on our memories the relative bearings of objects connectedly and simultaneously observed therewith ; we likewise are apt at times and especially when somewhat divided in opinion, to call to our aid the recollection of those very connected objects which had formerly impressed some cardinal point (or rather the four points) on our mind, and then to compare our present relative position as respects those connected land-marks to deduce a conviction of the actual spot in the horizon equivalent to one or other of those points ; thus I bear in my memory the position and direction of Plymouth Sound, and I can as I now sit stretch out my arm parallel with the eastern coast of, and I have a conviction that in so doing I point nearly south, again, in tracing our course to some distant spot by the aid of this said faculty, we instinctively take into account as assistant directors, objects noticed on the way from it, and since indeed we cannot make our way without experiencing minor interruptions in our path, we need the power of rectifying these errors of deviation by considering relative positions of these encountered bodies, moreover it appears that if blindfolded, or if pursuing our course during the dark, we are not capable of proceeding uniformly or correctly to the desired point ; this sense therefore is not simply internal or mental, it requires the sense of sight to perceive the straight lines presented by the natural bodies and subjects on the way, and therewith to regulate our course conformably to obstructing objects to compensate for deviations, and to compare the various straight lines one with another for a discretionary consideration of our position from time to time. One of the commonest errors among philosophers that I know of, is to mistake accidental benevolent results in nature for intentional ends in the great schemes of economy and providence;* I will not however affirm that

* This accidental description of natural economy has not yet been properly noticed,—it has been distinguished only in the current reflections of naturalists, and never systematized.

In the process of reasoning there is a simple effort to connect cause and effect, and carrying this mental process into the observance of nature we too often unite or link together circumstances having no *ordained* connexion in the system of the world,—we find an accidental meeting and agreement of facts having no intentional relationship, in the same way as fortuitous *disagreements* and *departures from accustomed courses* occur to us also occasionally, in nature. On due enquiry and comparison of a suspicious piece of economy with the ordinary situations and conditions of the respective subjects, our error may in general be corrected. Perfectly in unison with the sentiments entertained by myself relative to the proper way of pursuing the study of Natural History, I find that Sir G. Mackenzie ("Illustrations of Phrenology," p. 193,) observes, "while some naturalists pursue with avidity the open ways that lead directly to the knowledge of the forms and distinctions of external objects they add little to the expansion of our minds, though much to the stock of our knowledge. Others when they see an effect are not content with the mere fact, but begin immediately an attempt to trace the chain which binds it to a cause with the view to discover that cause; and they put all their mental faculties into action."

Instances of this accidental economy are witnessed not unfrequently in a truly natural state, but it is principally observed with animals and plants removed from a wild condition to domestication and cultivation. The reason of its frequent notice under the latter circumstances must be obvious, since by their removal from a state of nature they become exposed more abundantly and more effectually to promiscuous conditions around which often are at discord with them, but which often also produce a one intention of this said faculty was not to keep the perceptions awake during intervals of mental

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false appearance of intentional agreement, similar to cause and effect. Thus it is that in hasty moments of observation we ascribe to Providence what is due to our interferences with his works, and setting these remarks down as additions to our insight into the secrets of nature, we preclude ourselves afterwards from giving due weight to *real* cases of economy because they are not allied in purpose to the suppositious one. Although however there is in such instances frequently, or most commonly, an absolute accordance of the subjects similar to designed economy, it often happens that they only *appear* to agree, whilst closer inspection detects a want of adaptation.

It is an accidental economy that the appetites of many birds are so accommodating as to enable them to feed on substances foreign to the country of which they are natives,—the Chaffinch on the seeds of the sunflower of our gardens for instance.

It is a portion of the providence and economy with which our earth has been formed, that mountains and hills occur over its surface, by which the clouds are intercepted and contribute to the fertilization of the lower lands, by which vast loads of snow are accumulated and augment the bulk of rivers, by which springs arising on their sides or summits pass down and onwards through the lower tracts with a force commensurate to certain objects required to be attained, and for the immediate purpose of supplying this necessary to all living subjects of creation resident therein, by which the superficies of the globe is greatly increased, and by which the winds are obstructed and divided into currents, so as to dissipate occumulating noxious vapours, and act in various ways favorably on the earth by directing their power on it from different quarters. But it is an *accidental* piece of economy and providence that mountains act as the resorts of man under oppression and pursuit, or that by encircling any region they render it more secure from invasion, or enable the sceptres of adjacent kingdoms to be wielded the more effectually.

abstraction in walking or moving to prevent the mind from losing its cognizance of the position of our persons from moment to moment during those periods, but I incline to the belief that as physical beings presumed to be in constant motion and in continued enterprise we have had this sense given us in its ever-careful capacity, and that since most usually in contemplation, our eyesight notices objects as we pass, relative position of these is as a consequence remarked, and therewith also would this very concomitant action of the same faculty of perceiving localities and relations of objects be drawn into operation as a fortunate though *accidental* result. I deny positively that it is a modified action of "the knowledge and memory of localities." Animals possess this alone,* to man is superadded

* Notwithstanding this assertion however, there are many animals and indeed tribes of animals which in addition to the knowledge and memory of especial localities around their immediate dwellings, are in possession of this very faculty now traced in man. The fox when pressed by the dogs often runs to a lengthened distance from his home, and not unfrequently takes a *straight* course in this flight. When the spot is subsequently examined he is again found at his old quarters, though perhaps the hounds had left him at a distance of twelve miles from it. Migratory birds which indeed take their passage mostly *by night*, no doubt exercise this very power for their means of direction. Nay there are instances of birds being detained at sea by tempests, and kept on the rigging of sailing ships for very many hours, and yet renewing their flight in the very direction they were taking when first obligated to recruit their strengths. The bee wanders from home to great distances, and then having loaded himself with honey, rises into the air and flies directly towards his hive. Instances to the same purpose may be seen in "Hancock on Instinct," and other books, and perhaps there are few persons unacquainted with the conduct of dogs, horses, and cats, which

the faculty now spoken of; to the former who have prescribed theatres of action and high endowments of external sense and instinct it would be superfluous, to the latter in whom the individuals exercise for the most part, *separate ranges* of mental occupation and enjoyment, who lead individual existences, acting apart from all other, and in whom there exists the enterprising spirit of research,—it is indispensable. There is a fact which occurs to me at this

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illustrates in a marked manner this directing faculty. A horse bred at North Buckland, and taken into service at the age of three years by a landowner close to Plymouth, happened some years after to escape into the roads, when he directly made off for the farm where he had been reared though at the distance of fourteen miles and by a road he had never travelled in the interval. A cat reared and domiciled in Falmouth was taken in a bag to Penzance; she soon became uneasy and disappeared, and within two days was observed at her original abode. Dogs and horses in their journeyings with us are very observant of all objects which they pass, and thus on losing themselves, are often able to regain their homes, but this is accomplished through the faculty termed phrenologically "*Locality*" whose sphere of action is the observation of the relative positions and bearings of objects, and differs greatly from the above-named, though I feel no reason to doubt that as *we* exercise the two conjointly on many occasions, and find that they are probably traceable to one and the same "*organ*" of the brain, so those animals endowed with the directing faculty often exercise it in conjunction with the recognition of localities and objects. A gentleman just returned from the Continent to London, went directly on his arrival to Blackheath, through the City and over London Bridge. After he had quitted his friend's house on Blackheath he found that his dog had been detained behind, but yet on arriving home at the West End he observed the dog waiting for him at the door. In such cases I presume the two faculties operate connectedly.

moment strongly indicating the truth of some portion of the material here advanced, and with the relation of which I close my remarks. A clergyman travelling to a distant place of worship with the road to which he was unacquainted, was thrown from his horse and received a severe blow on the head ; he got up stunned and stupified, and without knowing his actual position ; fancying however he might now proceed, he mounted his horse again which however happened to have its head directed in the contrary way to that it had been pursuing. The gentleman hastened to make up for loss of time, but did not discover his error till he actually entered the town whence he had set out.

No mention is made of this sense or faculty in any work to which I have referred. It must be understood that though I have assumed the cardinal points as those referred to by persons in the exercise of this power, I have merely used those names and points because these would be acquired by education in all civilized nations and communities, not doubting at the same time but that other arbitrary points and names would be set up by men in an uncivilized condition, as indeed the savage tribes of Africa actually do; the argument applies similarly in both instances, it contends that men innately appoint for themselves certain spots of the horizon, and unerringly remembering these they act as guides for distant journeyings and directors in long-continued courses.

The *Cirl Bunting* (Emberiza cirlus) is a bird by no means uncommon in the South Hams. It has been said to be more frequent about this village,—Yealmpton, than anywhere else, but I am quite sure this is an error, as I have heard it in all the adjoining parishes,—Holbeton, Newton Ferrers, Plympton, Plymstock, Wembury, Kingston, Revelstoke, Brixton, &c. as also at Mount Edgcumbe, Mount Gould near Plymouth, and near Kingsbridge. Like its congeners it keeps much to one spot, ranging only to short distances from its favorite hedge. It seems particularly partial to such fields and hedges as have trees planted in them, and it passes repeatedly from the shrubs and hazels in the hedgerows to these, and back again, and so perpetually makes its circuits throughout the day. In winter it forms small associations, and should the weather be severe it is induced to quit its summer haunt, and roam over the fields in company with the yellow species, but as soon as the severity of the cold abates it again returns to its former quarters, so that there are certain spots at which an ornithologist may be sure of finding a Cirl Bunting all through the year, save indeed during severe weather. Though somewhat shy in its movements, this bird like many others has been known to build in a much exposed situation, and to appear to a great extent unconcerned at the presence of man during that period alone, thus in this village a pair built yearly in holes of the wall of a stable, or in the sides of a hayrick, and though on one occasion one of them was shot, the other presently mated and continued on the spot. In Cornwall it is found nearly as commonly as with us about the vicinity of Penryn and Falmouth, and has there been shot during winter in furzebrakes. It commences its note very early in the year, as soon indeed as the slightest indication of spring intervenes between the severities of winter, again however ceasing on each renewed fall of snow, great cold, heavy rain, or other severe wintry symptoms, but on the whole it seems a bird of considerable hilarity, as well as a species of robust and hardy nature. In fact its habits in respect of winter song are similar to those of the Missel Thrush, Blackbird, &c. In the year 1838 it began its song or reiterated note in the end of January when the weather was tolerably severe, and it ceased after this on occasion only of unusual inclemencies, but it not only sings thus early and on through spring and summer, but it is also an autumnal songster on to the end of September usually, its note however at this last period having undergone some change, and being repeated with longer intervals of silence. Individuals differ somewhat in the intonations of the song, but in general it may be compared to the following syllables repeated in quick succession and often with a tinkling utterance—twit a, twit a, twit a, twit a, twit. They seem to pair about the middle of April, and do not object to rear their brood within pistol-shot of houses. I have noticed the species resident in fields overhanging the sea. The species seems almost limited to the south-western parts of the kingdom, where it enjoys a climate more in unison with that experienced by the aggregate of the kind on the continent, its chief station.

The Laws of dependance of one animal on another, or others, are as yet but slightly comprehended, and of the uses of the lower subjects in the economy of Creation we are particularly ignorant; yet at times a glimpse of some intention of nature comes across the path of the naturalist, and animates his pursuit at least temporarily. Slugs and worms find abundant consumption by the generality of insectivorous birds especially during winter, and in regard of land-shells respecting which a doubt might be entertained by some as to whether they were really of any use in the system of the world, it occurs to me that they are the especial provision for the Thrush and Starling tribes during the period of greatest want. Throstles from September onwards are greatly occupied in the consumption of large helices,—aspersa, nemoralis, hortensis, &c. and Blackbirds and Missel Thrushes are also occupied much in the same useful work. Probably also the H. virgata is sought out by those wanderers, the Fieldfare and Redwing. Starlings during their winter peregrinations consume the smaller sorts indiscriminately; in the stomach of one in January, 1838, I found H. nitida, costata, caperata, fusca, virgata, and Bulimus lubricus. This shews they search with diligence, and with a pre-existing instinct relative to their resources in severe times, for the whole of these testacea were at the period mentioned lodged deeply in hedges and rubbish, and under stones. I find also that the same time of trying necessity obliges the Gold-crest and Titlark to resort in some degree to this food. The former will on these occasions seek out Balea perversa, Clausilia perversa, Pupa muscorum, &c., and the Titlark finds under stones on his open pastures a sufficiency of H. caperata to provide him a daily meal in conjunction with the beetles his more favorite diet. The fresh-water shells are the favorite dish of Water Rails; and LandRails, during summer become fat on the snails which infest corn and grass lands. As for the marine molluscs, they also appear to be the pabulum of numerous species of fish, and on our own shores no tribe seems more active in this consumption than the genera of Trigla, Pleuronectes, Solea and Platessa, judging by the contents of their stomachs. I was much surprised some short time since by finding in the stomach of a Tub a miscellany of univalves, nearly the whole of which were devoid of their animal contents, they were indeed what collectors term "dead specimens;" so that either these fish must resort to this dead matter from some peculiarity of service which it bestows on their economy, or else in their rapacity they seize indifferently on all that they meet with. These specimens were derived from the genera Natica, Nasa, Rostellaria, Fusus, and Turritella.

But there is no instance of such care and providential consideration for the well-being of animals so clearly shewn and so demonstrative of adaptation of means to ends, as the exclusion of such a profusion of Coleoptera and lighter insects towards autumn, seemingly at an ungenial period of the year, and to thoughtless persons serving no useful purpose, but rather encumbering the air with pestilential inhabitants. At this juncture it will be remembered, the smaller birds which have to pass from us for a season need to be well prepared for that great exertion as regards bodily powers, and the young more especially require the most rapid and efficient growth during the few weeks preceding their departure. To meet such a demand, Providence has directed the coincidence of the generation of that vast quantity of insect food above alluded to, and which the insectivorous portion of these migrants are found busily occupied in consuming, as if by instinctive preparation for their flight. Thus do we gradually gain acquaintance with the modes of existence and with the relations of the creatures about our paths, and learn to set bounds to our foolish depreciation of what we are apt to term the lowest and meanest links in the chain of beings.

The Hirundines as noticed in South Devon.—It is not in my power to add much to the present state of knowledge with respect to the Swallow tribe, and the little I can add is chiefly regarding their periods of arrival and departure from us. Fortunately this kind of information is that most desired, because serving to decide the great question relative to their torpidity, or at least tending to shed some light on the mode of their quitting our Island. Not that the few facts in my possession have any intrinsic value, but if the point is to be settled by reports from a variety of situations, it will then appear that the least information on the subject is of consequence towards bringing about a final settlement, distant as that may be.

Our *Swallows* usually arrive from April 12th, to 17th or 19th, and in some years are not general till May, I mean as regards the bulk of their kind, for they have been sparingly noticed even on the 1st of April. They seem to arrive by successive flocks, and to disperse gradually, for they are found to appear later by a day or two in situations towards the interior of the county, than in the maritime localities. Yet this remark applies only to such flocks as choose to settle *here*, being in short in all likelihood the same individuals which had previously resided with us, or their progeny. I am not aware that Swallows arrive later in proportion as the situation is removed further to the north in regard of England generally. Late springs appear to retard their arrival, as Mr. White remarks with respect to the Swift, and I believe also generally of the hirundines. In the spring of 1837 which was unusually backward, I saw none till April 23rd, and the bulk did not discover themselves till many days after, and this delay would appear to have influenced the species generally in their visit to the Island, for they arrived on the 22nd in the vicinity of Falmouth, which also it must be observed is a little to our south. Although it may be a general rule for Swallows to arrive sooner than Martins, yet in 1835 they came just a week after, at least in the immediate vicinity of this village.

Swallows depart as they arrive, by successive companies, though now they apparently congregate in greater numbers to each body, because in addition to their increase by the young broods, successive flights from more northward positions would naturally enough connect themselves to flocks just ready to depart in the southern counties and districts. This rule however of the departure of the species earlier more northern parts than from the southern, is not invariably abided by, and perhaps as temperature and food both operate on them in determining the time of their migrating, one of these (most likely the former) or both might be so far favorable in some particular district or county, as to cause the Swallows or Hirundines as a whole there resident to protract their stay. At all events after the Swallows of our own neighbourhood have disappeared, flocks arrive hither and rest awhile previously to undertaking their passage over the seas, thus on October 15th, 1831 an immense flock was collected on the buoy of a reservoir adjoining the coast of Plymouth Sound, another flock was seen departing Oct. 23rd; about October 28th, 1834 a large company was seen approaching the coast; on November 1st, 1835 a flock settled at a village not far from Plymouth, and after recruiting their powers mounted high in the air and departed in a south-eastern direction. So far as I am able to decide, our own Swallows quit us at different periods and in different distinct companies from the latter end of September to about the 5th of October; flights have more than once been noticed on October 16th, but these most likely came from more northward situations. Food has great power in determining the time of their quitting us, but no doubt temperature or weather generally has still more, especially as this may itself greatly influence the supply of the former. The comparative powers of these two circumstances, together with other useful information might be gained, if naturalists would take means of comparing the times of departure and the circumstances attendant thereon as regards food and weather in different situations. But if weather is granted to be of so much consequence, the difficulty of explaining the long protracted delays of some few individuals becomes so much the more increased, unless we be content to admit the principle of torpidity. Yet even if this phenomenon be granted as established, it seems strange that these few stragglers should exhibit themselves on some occasions on cold uncomfortable days. On October 30th, 1837, we had at this village cold showers with intervening gleams of sunshine, and then, a pair of Swallows haunting a chimney of my house came forth to feed; on November 25th and 30th, when the sun shone rather warmly for the season, they again issued forth. On the other hand, my brother-in-law writes me word, that on November 16th and 19th, 1837, when the weather was decidedly cold he saw two Swallows hawking at a spot near Falmouth. In 1838 two Swallows were seen by me on November 14th and 19th, which were rather fine days; frosts however had been experienced before. I had also seen several on Oct. 20th. Mr. Lyte, jun. of Berry House informs me that on Christmas eve, 1837, he saw a flock of Swallows frequenting a field overhanging the sea at Berry Head; they remained several days, but disappeared in a very abrupt manner.

In 1835, *Martins* were playing over a large fish pond in this parish on April 17th, which was a clear, sunny day; stragglers had been noticed for a few days before. On November 13th, 1837, a flock of Martins appeared flying about in their usual manner over a marsh near Falmouth, the weather warm and sunny.* Martins are very prone to take up new residences, and are particularly fickle and undeter-

* The wet spring, summer, and autumn, of 1839, proved particularly unpropitious to the progress of the rearing of the broods of all kinds of birds. The Hirundines in the bulk departed early, but young Swallows were noticed by me in several spots on to the end of September, and so late as October 4th, parties of young Martins were noticed along the coast, feeding previously to

mined. They have been often observed with us to take up their abode in small parties in villages where the inhabitants had never seen them before. I have also noticed that they even resolve on new settlements after rearing a first brood; in the end of July, 1835, a party suddenly arrived in this village and examined minutely my windows and eaves, as also those of a house opposite; after continuing this scrutiny and consultation a whole day, they again quitted us. On July 19th, 1838, they acted in the same manner at a house at Yealm Bridge. White Martins have been seen here at times.

Sand Martins also, are quite as uncertain in fixing their abodes and they are soon scared from their haunts by a gun; they used in former years to affect the banks of the river about a mile from my house, but have not been seen since. They haunt in great numbers the river Exe at this time, and are, as I am told, frequently noticed there at periods through the winter on the recurrence of fine days. A party also haunts the sand-banks near Hoo Meavy. The species occurs likewise at Thurlestone.

Reverting to the question of *torpidity* I may relate the experience of a naturalist with whom I had the happiness of being acquainted a few years ago. A lady brought to him a Swift in a torpid state, which she had just found clinging to her window curtain; he held it to the fire and it revived, but perhaps through excessive reaction it perished soon after. This was in autumn after the generality of Swifts had departed. An elderly gentleman of my own profession also relates that two or three Swifts

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their departure, and in a Village, near Looe in Cornwall, one pair still had young in their nest at the same date. Probably the wet and storms had more than once destroyed their hopes of progeny.

were once discovered in a torpid state in the rubbish of an old building in his neighbourhood. Other narrations of this kind prove that birds of the above species have certainly been found in a state of torpor in this county.

A gentleman of my acquaintance who is captain in the Navy has favoured me with the following extract from his log "March 17th, 1809, Latitude "32° 59″ North; Longitude 10° 44″ West; Salviges. "We this morning observed a very large flock of "Swallows passing us from the coast of Africa "towards the north-east, and two which appeared "more fatigued than the rest hung for some time "about the mainsail." It would certainly seem by the date of this observation, that Swallows consume a longer time in their route hither than is usually conceived. Probably they linger much on the continent before passing the Channel.

Naturalists ought in the case of birds which build much about houses, and attach themselves greatly to the dwellings of man, to consider what may *naturally* be their mode and place of nidification. In the case of the Swallow it is probable that in the course of nature it would select hollows and recesses of rocks, and at times it has been ascertained that they will build in holes of houses and bridges, and as if they chose to *descend* in preference to other methods of concealment, they have been known also to have their nests down the shafts of wells and mines. Swifts and Martins both build frequently in our ivied sea cliffs and as above intimated we actually find that a few of our Swallows select the same places for nestling.

Cornish and Devon Ornithology.—Mr. White observes that the probable reason why Nightingales are not found in Devon and Cornwall is because they cross at the narrowest part of the Channel and do not stroll so far westward. Analogy does not support this idea, for though Nightingales and Redstarts* are reported to be absent from Cornwall, and the Yellow Wren to be very scarce, the Nuthatch a *stationary* English bird, and some other species of the same habit, are, though not deficient in the Cornish Fauna, particularly local. Tree Sparrows, Reed Wrens, and several other birds common in many counties, are in Devon and Cornwall great rarities, and besides these cases indicative of peculiar likings, it should be observed that on a principle long recognised of "*adopted residences*" by animals, these species above named would ere this have become even plentiful inhabitants of apparently so desirable districts as Devon and Cornwall, did not some hidden circumstances interfere and regulate the limits of their range. A further instance of indisposition for, or incapacity to endure our climate (or whatever may be the obstacle) is seen in the Starling which breeds but sparingly in these counties. It is also likely that it is only in *late* years that this species has *ever* abided the summer with us. The choice of localities by animals is a subject altogether of the utmost obscurity.

Concord and discord as observed in Birds.—In the class of birds, actions and feelings of very opposite characters are sometimes discovered, these for the most part are referrible to the difference of circumstances which present themselves at different seasons, and also occasionally through accident or unexpected emergencies, at the same season. I allude to those actions derived from jealousy and personal consideration on the one hand, and to those derived from concord and combined interests on

* Redstarts have been seen in Cornwall, but only in their passage during migration. See Couch's "Cornish Fauna," a most elaborate and for the most part scientific compendium.

the other. The causes productive of jealousies, are rivalry among the males of a species in the time of their amours; among the individuals of both sexes indiscriminately in some species, especially during summer when each pair observes certain limits for its range after provender; among birds of the same and of opposite species on account of aggressions; and among birds of one and of opposite kinds during times of scarcity. The causes of union and combination of interests are, first, the better resistance of danger, observed chiefly among those of a species, but also frequently among incongruous kinds; secondly, a sort of friendship or desire of rendering service, seen between individuals of one species, and more rarely between different kinds; the better discernment of food by combined powers and senses; the easier attainment of a given object, as that of arriving at a destination by the shortest route in the case of migrators; and lastly and principally, a desire of society, as men assemble to concert for their common good for a variety of reasons.

The generality of birds separate in pairs at the time of the alliance of sexes, when each couple (save in some rare instances) observes a certain range without interfering with the domains of others of their kind, yet some species congregate at this period, making a conjoint nursery at some one spot, as the Rook, (which however is gregarious *at all times*,) and very many of the aquatic fowls. Jealousies however, and bickerings commonly disturb these harmonious combinations. It is strange also that some instances occur, of pairs, in species usually collective at this season, retiring to some secluded spot apart from their kind, as seen in the Cornish Chough and many other birds.

Besides the circumstance of rivalry among the males of a species, keeping such birds apart, the distribution and occurrence of food is ordinarily such, that it is natural birds should have been endowed with jealous temperaments, by which each is enabled to preserve to itself a sufficient space for its procurance. This feeling mostly obtains during summer, for in winter a disposition to combination of numbers is so general from that desire of society, on the occurrence of want and danger, that former envyings and quarrels are forgotten, so far as those particular species are concerned in whom these actions are remarked. Yet there are some species of birds known, which hunt their prey in concert irrespectively of season, besides which, Swallows and other species habitually keep together and live in harmony while collecting their food over the same meadow. On the contrary, some kinds retain their quarrelsome temper during winter, or rather they possess a larger share of it, this I have witnessed in the Robin, which in that season is particularly envious of intrusions on his territories, and drives away with blows any new comers when food is scattered for him. Moreover, strife is sometimes conspicuous among the individuals constituting associations apparently (except when food is the cause of quarrel,) the most united, as we see in the Sparrow during winter; one proof to my mind, that food is by no means a principal reason of the "winter congregating" of birds.

Aggressions are not only the cause of contentions among birds of one species, but also among species noways related. A person on whom I place reliance, assures me he saw a Swallow which had been hawking after insects over the Lara, pursue and punish most vehemently a Ringed Plover, which made but slight resistance to this treatment, and was eventually precipitated into the water by a severe blow in the head inflicted by its opponent. Rooks and Gulls when hunting after their common prey in the ploughed and other lands, are perpetually harassing one another, the Rooks however usually being victors. But that incongruous species can abide together without quarrels or disputes, even gathering the same food in conjunction, may be easily shewn. In a tree not twenty feet high, I have seen the nests of three incongruous birds, the Thrush, the Bullfinch, and the Creeper. The Reed Bunting, and the Cirl Bunting frequently congregate with the Yellow species in hard weather. Starlings frequently gather their food in harmony with Rooks.

Birds of one species often resist danger in conjunction, as we see with Sparrows and Swallows on the approach of a Hawk or other bird of rapine, and these will on such occasions call together birds of various other species, to assist in the cause also.

Extraordinary instances of attachment between individuals of one species, as also between animals of even dissimilar natures, and particularly in a domesticated state, when sefish considerations are less called forth, are on record. The contradiction of these benevolent actions, to the selfishness of such personal considerations as are commonly remarked in the brute creation, is greatly augmented on reflecting that these demonstrations of pity and kindness, are even observed in those species ordinarily distinguished for contentious demeanour towards their own fellows. Happening to capture a Robin in my bedroom, I removed it by night in a cage to a distance of four miles, here I exposed it next day in its cage in a garden, when by its querulous note it soon attracted the notice of one of its species, which forthwith taking compassion on its situation was its constant companion for the several days I imprisoned it, and though I provided it a plenty of food, it preferred receiving its supplies from the bill of its affectionate associate and friend.

By combination birds may perhaps discern food, and eligible situations the readier; and it is not unusual at these times for sentinels to be appointed to warn of danger. During migration, a combination of individuals may give more facility to their transits, and leading birds are often observed to be appointed. Yet as before said, many kinds do not associate when food is scarce; many birds also do not migrate in concert.—Upon the whole, we should naturally think it would be more advantageous for birds to remain separate during times of scarcity, and therefore, though we do not know why they act oppositely in this respect, or why many kinds migrate singly, seeing also that associations of single birds take place when danger is threatened by a rapacious animal or such like causes, and that strife concerning food is common among apparently very harmonious communities in other respects it seems to follow that there is some other principle at work inducing them to congregate in the several emergencies of their lives. This principle I take to be a desire of society, and mutual commiseration of suffering. It is worthy of note that severity of cold has a most decided influence on this propensity to associate. Magpies collect in small parties only when the weather is severe; at other times they keep pretty much aloof, and when thus combined their chances of finding sufficient sustenance for the party must, one would think, be greatly diminished. The Cirl Bunting joins the flocks of Yellow-Hammers only in those seasons which are very severe; ordinarily they keep together in winter in small assemblages, near the seat of their summer abode, these little companies being perhaps families. This propensity in families to remain united is a very common observance among birds. I believe also it is more usual for pairs to continue together during winter than is commonly supposed; certainly we see in that season a great many couples, having an evident intimacy and friendship, as also a great many collections of of three, four, or five, formed to all appearance on the score of friendly combination. With regard therefore to the "winter assembling" of birds, if scarcity of food does not cause all birds to congregate according to their kind; if migration does not induce all species to unite in companies during that eventful undertaking; if the better discernment of food and eligible situations for feeding be a very questionable result of combinations; if danger and want seem rather to be consequent on this act; if quarrels respecting food occur in apparently united companies; if combinations occur as well in the season of plenty as in that of want; if birds instinctively unite on the occurrence of sudden danger; if we find that they render mutual aid when misfortune has assailed them; if cold and necessity ordinarily cause some kinds to unite and others only when these are unusually severe; if families commonly remain associated through the winter; if small temporary associations are frequent occurrences at that period; and if combinations of incongruous kinds take place; then, notwithstanding that combinations traceable to harmony of feeling, and desire of society do not appear in all species, and in many only at times, we are drawn to the conclusion that these gatherings depend on the sentiment of friendship, alliance, and mutual commiseration.

Songs of Birds.—The sounds proceeding from the tribe of birds, from the simplest monosyllabic utterance to the protracted and highly executed song, should be classed together; and a pretended separation of the latter from all other kinds of vocal sounds be regarded as extremely arbitrary. There is found every intermediate step between the harsh discordant scream of the Peacock, or the simple, though penetrating note (twee) of the Creeper, and the plaintive melody of the Nightingale, or the musical performance of the Song-thrush. But to augment the beauty of the universe, Nature has bestowed on certain species of this class the power of emitting intonations agreeable to the ears of mankind, and these we term by way of pre-eminence, *songs*.

Birds seem to me capable of expressing themselves with regard to their appetites, and with reference to their feelings of enjoyment and pain. It is not only accordant with reason, but in accordance with observed facts for us to refer the generality of their songs to pleasurable sensations, but I believe that some few of the less pretending vocalists may utter sounds long denominated songs, from associations connecting them with those of better execution and with seasons of gladness to the human heart, which are rather attributable to hunger or to some feeling of necessity.

Yet naturalists have not been content to ascribe these songs to agreeable emotions, but have inconsiderately asserted that they were due to love, and devotion of the one sex (male) to the other. Independently of reasons hereafter to be stated, it seems to me to be a violation of the natural barrier of separation between the minds of brutes and our own mental constitutions and affections to allow those kindly sentiments to the former, which are *not always* to be found in man, and for deficiency in which he is so frequently condemned. But if songs are indicative of love, and love only, how comes it that all birds were not equally endowed? how is it that the language of love is not at all uniform in the different species, and that the individuals of some species, as the Thrush, differ continually in the wordings of their suit, and that occasionally remarkable deviations occur in species otherwise pretty uniform in their "love-notes"? how also can we account for these same pretended invitations and devotions occurring in some species at other seasons besides in that of love, and that these notes also are greatly influenced by weather, as I intend presently to shew? That song-birds possess the faculty of music in various degrees according to the species, is shewn by the superior ability displayed by some *caged* birds over others in the acquisition of new notes better even than those of their kindred; in the wild state, the Linnet is an instance of this. But the organic apparatuses subservient to mental faculties, ever display in greater or less degree, conformity of structure to differences of actual power. The larynges and tracheæ of song-birds and of those not musical exhibit according disagreements and minor differences have even been pointed out. Now such elaborations of mechanism and structure would hardly have been ordained as the instruments for conveying amorous and temporary intelligences. Hen birds which through altered food and modes of life acquire male characters, have been known to sing, which is a reversion of presumed order in the matter of love.

By some few naturalists, songs of birds were thought to be dependant on imitation, the young invariably deriving their notes from their parents, a notion scarcely deserving serious refutation. By others these sounds have been ascribed to rivalry, and though it is ridiculous to consider them as solely dependant on this feeling, there is no doubt that some variations of their songs are thus excited. Some persons consider that food has considerable power in the production of song, and though I feel no hesitation in assenting to this from observing the effects of plenty of food in producing extraordinary aptitude for singing in caged birds, and from remarking the suspension of song in wild birds when snow or other obstacles preclude the procurance of food, I yet think that this is no further an influence than by its power of controuling the animal spirits, for many song-birds are silent during seasons of abundance. Although therefore by this very same argument it would seem that excitation of their spirits was not the absolute or precise cause of song, yet this is of all others the most plausible source, and that one which will bear the most scrutiny.

In support of this opinion that the songs of birds are the result of flow of animal spirits, and indicate feelings of hilarity and cheerfulness, prompted by *various* agreeable stimuli, I proceed to observe (without returning to reasons before given in opposition to the notion of love being the cause) that song is suspended during the time of moulting, that during the season of love, song is very generally suspended when inclement or rainy weather suddenly comes on, that some species give vent to their spirits beyond others, and seemingly exert more energy in delivering their songs, they apparently also are more easily acted on by stimuli than others, instances of which will appear below, while lastly I remark that the winter songs of birds which are for the most part the same as those they deliver in the spring and summer, are dependent on the weather experienced through that season. Mr. Rennie is right in contracting the statement of White, that the Redbreast and Wren do not sing in hard frost, but even if they do, it seems only to shew their superior resistance to want, and greater fortitude against suffering, and it would by no means subvert facts I can relate respecting other species of winter warblers. It is clear that Colonel Montagu had observed the same facts I am about to state, but from their manifest tendency to establish a doctrine contrary to the one he tries to advocate, he makes them of no value whatever. Mr. Rennie on the other hand does not appear to have been aware of them, but altogether concludes that weather has no effect except in so far as it influences the supplies of food, whereas I am of opinion that weather is of equal importance with food in stimulating the animal spirits,—Mr. Rennie makes it subservient to food, *I* wish to elevate it to the same rank in exciting the animal spirits, for allowing all necessary weight to the influence of food on song, it would follow that if weather had no separate influence, and food a direct influence, song suspended when snow and frost concealed supplies of food, would be resumed during ordinary weather when food was easily obtainable, whereas by the following facts we shall see it is resumed only on the occasional occurrence of unusually fine weather in the brumal season, so far as regards those species in which they were observed.

I take it, that if song is capable of being excited through stimuli on the animal spirits, the circumstances attending on particularly fine weather are as likely to act as excitants, as the circumstance of the occurrence of food; and by analogy we see that intervals of fine warm weather in the more uncomfortable months act favourably on the vigour of our own frames, and on the domestic creatures about us.

By the geographical position of South Devon as respects the poles and the equator, and by the ordinations of nature for equalizing the general temperature of the earth, besides a number of other benefits obtained by cold, it has been directed that we should experience severity of weather in the course of the winter months, but owing to the operation of some secondary influences on climate, these cold periods consist only of temporary cessations of the *ordinary* heat, or rather we have an extraordinary and general mildness of air at the times when it should least be looked for. Whether this is a peculiarity in the climate of South Devon, or usually observed through the southern coasts of England, I am not enabled to determine; but the fact is certain that while some parts of our winter are excessively inclement, other and the larger portions are equally temperate, agreeable, and inviting. The Christmas of 1837 was as mild as many days of July are, but the middle of January 1838 was intensely cold; frost killed plants in the windows of houses, it did great damage to hedges and old buildings, milk was frozen into solid masses, and the inlet called Stonehouse Pool was frozen over, and a fair held on it! With such extremities in climate, it were rational to expect phenomena of a remarkable nature in the animal world. By remarks made by me for several winters, it appears that brumal songsters, especially Blackbirds and Thrushes, were called into song during those periods only, when the air was genial, the sun shining, and the whole face of nature for a while reanimated under these transient and deceptive smiles. I am not of course about to allude to the Robin, Wren, or Hedge-chanter, because these are known to sing at all times during winter, but the two above-named, the Skylark, Titlark, Missel Thrush, and Woodlark, (besides others not properly song birds) were those species in whom I remarked songs similar to those we are accustomed to hear delivered during spring and summer.

Birds seem to me to be affected by stimuli very differently, and to feel the effects of the same stimuli very differently at different times. Blackbirds are more readily induced to sing by these unseasonably fine days than Thrushes, they are also steadier in their continuance of song. Missel-

Thrushes are not known to sing before January, and then only when fine. Skylarks frequently sing in fine weather in autumn, Blackbirds and Thrushes but seldom. Woodlarks select fine weather both in autumn and winter for their carols. In the winter of 1833—4 Blackbirds and Thrushes were in very good song during the end of December and some parts of January, the weather being then particularly fine, the Thrushes however did not sing so often as the Blackbirds. Titlarks also sang in the latter month. In January, 1835 Thrushes and Blackbirds were in good song through the month ; some other species were also in imperfect song, and the Blue Tit began his summer notes. On the 14th, Woodlarks were in good but short song. On October 20th 1835, Skylarks sang delightfully, Woodlarks also were in good song, but it was of a different kind to that above named. At intervals in January, 1836, Blackbirds sang. The Blue Tit likewise commenced his spring note, but the weather in this month was never very inviting. Missel Thrushes were also observed at times to sing at short intervals. When the weather relapsed into its ordinary character they all resumed their winter notes. On February 20th, 1836, Chaffinches were in pairs and in usual summer song, but all these things were interfered with and ceased on the recurrence of sharp and stormy weather. This phenomenon of sudden discontinuance of song in accordance with the variableness of weather I remarked on to the middle of April of that year, when no doubt a great many kinds had paired. Moreover on fine days when a general concert was held, birds not usually in song till after the above date, began their warbles. In the previous December we had very mild weather at times, and then Blackbirds commenced singing. The commencement of the year 1837 was particularly inclement, the end of March brought us snow and ice, and song which had occurred during certain bright intervals, now ceased. In the following month, the fact of this said alternation of severe weather and ordinary spring weather with the corresponding cessations of song, was well seen. A day or two before April 2nd, we had song, but snow now descending and the weather being gloomy, it ceased. On the 8th, 9th, and 10th, the weather induced a return of song, but on the 11th it stopped owing to a fresh descent. These alternations continued till May had fairly set in. In the autumn Blackbirds began singing in the end of September and continued on to October 3rd, they sang also at intervals till the 20th, but their notes were not full nor so melodious as in spring. That peculiar scream of the Greenfinch which we hear first in April, was resumed for a short time during the first week in August, and I have known it continued through the month, and to occur on fine days in warm sheltered spots both in September and October. In the fine weather of the middle of October, Skylarks sang beautifully, together with some other of the commoner kinds of songsters. Chaffinches on fine days in this month, often utter an imperfect execution of their cheering song. I have often noticed Skylarks in good song in November, January and February, dependent on sudden returns of fine and mild weather. At periods during the end of November and through December Blackbirds broke forth into short and desultory song, the weather being then unusually fine and spring-like. During the whole of January, 1838, the weather being extremely severe we heard no more of their melody, even the Missel Thrush was discouraged from song till February 23rd, when he began his loud clear whistle, the Thermometer standing at 44° Faht.;

his song was resumed only on fine days after ;* in fact the Thrush tribe are not the most readily acted on by the approach of spring, being regardful as it were of intervening discouragements and obstacles, for besides the perpetual winter songs of the Robin, Wren, and Hedge Sparrow, the Chaffinch and Ox-eye (not exactly a song bird) are found in this

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* In the "Journal of a Naturalist" Mr. Knapp speaks confidently of the Missel Thrush prognosticating storms and bad weather generally, and Mr. White mentions a belief of the same kind existing in Hampshire. Independently of the omission of a *stated duration* of time between the prediction and the storm, (which even in February might amount to a week or more !) it will be seen that the Missel Bird and in general the other winter songsters select fine enlivening days for their songs and omit them on the recurrence of bad weather, so that by examining the argument I have here adopted, a very different explanation of the selection of occasions for singing by this bird may be drawn.

As the time approaches towards the breeding period, birds become less particular of weather, but utter their various notes coincident with incubation even on gloomy and uninviting days. The early morning is more particularly the portion of the day when their voices may be heard, and very often their songs or notes are altogether suspended afterwards.

I take the opportunity of observing here that there is no little fallacy and no slight error induced, by authors fixing on the date at which certain birds commence their spring notes, seeing that they are so greatly under the influence of weather, and not unfrequently of food, and thus often defer their songs or even *anticipate* the stated time to which books would bind them, and (as every one will confess) omit them subsequently to the announced period should cold or very rainy weather supervene; thus White says that the Ox-eye begins his notes in February, whereas with us at least he may be heard on fine cheering days in December and January.

respect to excel them, thus on February 8th and on to about the 16th, the Chaffinch sang not unfrequently, and the Ox-eye delivered his cheerful spring notes, yet snow was lying on the ground, and the only inducement seemed to be the clear sunbeams in which they preened themselves, but on the 14th and 15th it was even cloudy and snow descending, and yet the Chaffinch was still in song! After this the weather got sunny and the snow melted, the Chaffinch assumed a merrier, more perfect, and more frequent song, and Blackbirds for the first time that year began on the 18th. These illustrations of the almost exclusive power of weather on the hilarity and animal vigour of birds, is still further supported by the Yellow Hammer, which though a very late breeder, began his song, (wanting in however the concluding note) on February 21st, when it was fine and rather warm. The Greenfinch also began on February 25th, a tolerably warm day, and the snow fast melting.

But be it here observed, that dependance cannot *always* be placed on this rule of the re-assumption of song under the circumstance of favorable weather, nor vice versa will it *always* be found withheld under the condition of unfavorable weather. I have often speculated on the probability of hearing certain winter songsters when I perceived the air genial and the sun shining clearly, and yet have not seldom been disappointed, and again I have been agreeably deceived in hearing their carols on occasions when I least expected them. It is however somewhat consolatory to find that though these facts apparently in some degree weaken the present theory, they by no means assist in the establishment or strength of any opposite conclusion or idea. Besides which, it remains yet to be observed in contradiction to the theory of food, as well as to that of love being respectively the excitants to song that there are some birds never classed with songsters but yet having utterances indicative perhaps of the same feelings with those which lead to harmonious songs, which deliver their notes the year through, save on occasions of stormy, rainy, and very inclement weather; thus Owls hoot every night when fine, and Woodpeckers continue to laugh through every month of the year, having however a more imperfect kind of note during autumn and winter than at other seasons. Again many kinds of birds preserve their songs or notes through spring, summer, and autumn, and desist on the arrival of severe weather as noticed in the Ox-eye; some of these species observe regular alterations in their note or song according to season, as we find in the Nuthatch. Whether these alterations and defective deliveries above mentioned depend on some organic changes in the larynx, or on altered feelings, cannot exactly be determined, but the probability rests in a belief that both circumstances operate and for the most part separately in different kinds. Little doubt for instance can exist as to the altered laugh of the Green Woodpecker in winter being dependant on diminished power of execution, and little doubt can exist that the spring and autumnal songs of the Robin depend for their difference on some altered disposition or sentiment. Leaving however temporary organic defect out of the question, it may be suitable to the present argument, and be found accordant with the general views of philosophy, to remember here, that each species of bird has habits œconomy, temperament, and general constitution in great measure isolated and separate from all others, and that consequently that part of their history which concerns expression of feeling, will likewise be in each case different, and incapable to some extent of being brought under the trammels of given, arbitrary rules.

On the whole therefore, we are called upon to conclude that weather has a decided effect on the animal spirits of birds ; * that while in summer plenty of food, rivalry, animal desire and the smiling face of nature conspire to produce melody as the evidence of the excitation of these spirits, and while in autumn, plenty of food and fine mild weather call forth a diminished quantity of and less powerful kind of song in the generality of birds in whom it is then observed, winter with all its sternness and and want, does still in its intervals of unusually fine weather present us with a return of song as if in anticipation of the future incubating season. We see also by the foregoing facts, that a forward spring will call forth songs otherwise not heard till later in the year, and that a backward spring on the other hand seemingly defers or impedes the more ordinary course of nature by preventing vernal songs, whereby the effect of weather on this matter is clearly indicated. Although some few birds as the Lark and Snipe are reported to become very fat in winter, yet in general, want prevails, and a sudden re-appearance of scanty supplies seems very unlikely to draw forth songs at this season. In the character of our winters above named should be peculiar, then there is still stronger evidence of the power of weather in elevating the spirits. Col. Montagu observes that the Missel Thrush "begins to sing in "January if the weather is mild, but ceases so soon "as the thermometer sinks below forty degrees." White says that the Linnet "re-assumes its note "when they begin to congregate in October, and "again early before the flocks separate,"—state-

* There appears to be some truth in the vulgar belief that the crowing of the cock is louder and more frequent just prior to a favorable change of weather, thus acting as a prognostic.

ments which favour the opinion I have here advanced. There are probably some species which sing under the influence of amorous excitation of the spirits more decidedly than the rest of birds, and the facts (such as those recorded by Montagu) appearing to support this have originated the hasty deduction regarding the whole class, that love was the sole reason of song; but while the Nightingale exhibits so strongly the result of this power on his spirits, the Woodlark his competitor sings deliciously at periods *during all seasons.* Although then a mystery and degree of doubt prevent a ready inference on the subject, there seems room to conclude that several stimuli act on the animal spirits of the feathered tribes and in the case of song-birds induce their melodies,—that though in them there is no love without song, there may be song without love.

As connected with the above statements, I propose now to enquire whether a forward state of spring can induce a disposition to pairing before the usual time, besides inducing song at an unusual early period. Food is known to induce amorous feelings in domesticated birds at very early periods, and it therefore remains to be seen whether weather is of equal importance. It would seem at first particularly unlikely that the period of nestling should be anyway interfered with, it appearing so rational to conclude that an express time has been ordered for every species, and that this is immutable; yet there is ground to believe that the incubating period may be both deferred and prematurely induced in accordance with the character of weather at the opening of the year. I have already expressed a suspicion that such might be the case, but as yet I have advanced no proofs on the subject lest I might rather obscure the argument I have just quitted by connecting together the exclusive question of song with that of nestling accompanied by song, for though winter songs seem to be continued into spring and at last appear to resolve themselves into the pure vernal notes of exhilaration and enjoyment, I trust it has been sufficiently shewn that song is far from being any test of the incubating processes; so that prematurely induced song even in those species not accustomed to chaunt during winter is not an evidence of prematurely induced love, the two questions of song and love being in short distinct and worthy of separate investigation, though the two circumstances in song-birds are for awhile naturally connected and coincident.

That food is capable of inducing precocity of love, and consequent incubation in domesticated birds, we have proofs in the common fowl and duck, which are frequently known to lay through the winter. It is also known that Canaries will even commence building in cages so early (or rather *late*) as November, but though there can be no question that food is in these instances the main stimulus, and furnishes sufficient bodily powers for these offices, I believe it has been remarked that mild and fine winters greatly influence the proceeding, contributing as I think, to induce the irregularity. That food is not the sole reason, would appear by those exceptions to the rule of the fowl and duck laying in winter, during severity of season, and by the instances I shall presently name of wild birds being influenced in their nestling-period by circumstances of weather. And by the same rule it appears that weather cannot be the *only* influence, because these same two species in their wild state are never known to nestle and incubate before the usual vernal season observed by the generality of birds; but it will be noticed that Robins occasionally build at Christmas on the occurrence of unusually fine mild weather. I have myself seen a nest with eggs of this bird taken at that period in my neighbourhood, as also one with two eggs taken the first week of February, 1835. On the 31st January, 1834, the weather being very mild, Sparrows had young in a spot near Plymouth. The Wren, Rook, and a great variety of other birds, are well known to build a few days sooner than usual, on account of an early spring. On the other hand it is equally well known that inclement weather at the accustomed period of nestling of the respective kinds of birds, will cause them to defer their operations, and occasionally even when there could be no reason to imagine any deficiency of provender as the cause of this delay. Witness the late springs of 1837 and 1838, though no doubt scarcity was felt on these two occasions.

It is further well worthy of note, that as song is capable of being induced in many species at late and early periods of the year from the influence of weather, so it has happened that birds have from probably the same cause, bred at a very late season. In 1837, a pair of Sparrows in my garden had eggs in the middle of September.

New species of Vole.—A suspicion has long existed in the minds of naturalists that other species of mice than those now described in books, would in process of time be discovered not only in those parts of the world generally inhabited by species of this race, but even in this country, better explored perhaps than any other. Discoveries of this kind however prove in a remarkable and decisive manner how deficient even English naturalists are in a knowledge of the productions of their island, and how requisite are local scientific institutions to concentrate the knowledge to be gained in each particular district.

The specimen of Vole, of which a representation is given, appears to be a male; it measures altogether 4 inches, or 3 inches from the nose to the root of the tail, and 1 inch in the tail itself; the broadest part of the animal is at the back of the head, where it measures inclusive of the hair 1 inch; the highest part also is the occiput, which indeed rises slightly above the vertebræ of the neck and back, and renders this part of the animal (when standing,) $1\frac{1}{2}$ inches in height. It has four toes in front, and five behind, the whole furnished with claws; the front feet are hairy down to the toes, the hinder are similarly clothed, but the hair is very short. The tail is covered with short bristly hairs, and the tip is provided with a slight pencil. The length of the head is nine tenths of an inch, it is broad and deep, with bristles nearly an inch long. The ears are nearly concealed by the fur, are margined by some short hairs, are broad and capacious, and have a valvular projection at their bottoms. Incisors, light yellow and with very keen edges. The whole head and body are covered by a fur peculiarly rough in appearance because long and scanty; the hairs measure generally as much as four tenths of an inch in length; on the lower parts however the fur is shorter; its colour on the upper parts is ash terminated by brown towards the ends of the hairs; on the lower parts and sides the hairs are ash colour at their bases, and whitish brown at their ends. Altogether, the creature has a very rough aspect and bears a strange resemblance to the rough breed of terrier dog. It was captured by myself about June, 28th, 1837, in a hay field in a very dry situation near my residence at Yealmpton, and I am tolerably sure that other specimens of the same kind occurred the next year in the very same spot where the first was killed, but I was not fortunate enough to obtain them from the man who mowed the grass and killed them.

There might be some ground to suspect that this animal was no more than a variety of the Meadow

Mouse, or Field Vole (*Arvicola agrestis*, Fleming) especially as there is a rough haired Mouse figured in Shaw's Miscellany as a variety of that species. It is also well known that the Meadow Mouse is said to vary much in size and colour in different situations. It must however be observed that although an occasional case does occur among the higher vertebrata of animals suffering not a little extent of variation, yet there are some marks which ought to be regarded as decisive of specific difference, and perhaps there are but few instances in which it is proper to rank the cases as "varieties" when the differences amount to more than latitude in size and colour. Accordingly I suspect that the animal figured by Shaw whether in reality similar to mine or not, is a species by itself, and with regard to the present specimen I proceed to enumerate those points of difference between it and the Meadow Mouse which I regard as establishing it a distinct kind. In the Meadow Mouse the legs are much shorter, and the bulk of the body more considerable; in the Meadow Mouse there are on the fore feet three toes with claws and the thumb without a claw, while in this animal the thumb itself has a claw, and quite as large as the others; in the Meadow Mouse the bristles are shorter, and the muzzle blunter than in this species; in the Meadow Mouse the fur is compact and short, while in this kind it is curiously lengthened, scanty, and lax, and makes it appear in some measure shaggy. With regard to dimensions of the head, body, and tail, and colour of the fur, nothing distinctive can be mentioned, from the liability on the part of the Meadow Mouse to vary in these respects. It is not improbable however that at some future time authors may agree to elevate these reputed varieties in size in that species to another rank, and so far as regards those found on the Continent, it is to be observed that recent comparisons between certain species of animals generally imagined as common to England and the Continent, have shown that sufficient differences exist to warrant a separation into species. But until this sort of enquiry has been applied to the Meadow Mouse, it is manifestly incorrect in writers to rest their specific characters of that animal on its dimensions, thus Fleming characterizes the *Water Vole* and the *Field Vole* or Meadow Mouse on the dichotomous method in this way;—*Water Vole*, body 7 inches long, tail 3 inches. *Field Vole*, body 3 inches and a half long, tail $1\frac{1}{2}$ inch. Now, if the reputed varieties of this latter animal are not distinct species, the dimensions here given are not descriptive of the animal! In his account of the latter, he says also that "*it never exceeds half the size of the former.*" Bingley says that "in England it usually measures to the root of the tail six inches, while in France it seldom measures more than three"; authors generally agree in the tail being no more than $1\frac{1}{2}$ inch long. Some writers so far from agreeing with Fleming in making dimensions of primary importance in the description, have from its great uncertainty, omitted it altogether. In this neighbourhood I have found that the Meadow Mouse usually measures from nose to tail about $3\frac{1}{2}$ inches, but a specimen I obtained from Whitney in Oxfordshire measured from nose to tail $4\frac{3}{8}$ inches; tail $1\frac{1}{2}$ inch; a specimen also belonging to G. Leach, esq. of Stoke, and taken in Devon, measures in the head $1\frac{1}{4}$ in., in the body 3 in., and in the tail 2 in. excluding the little pencil. There are some other respects in which the reputed varieties of this animal differ, but they are not so very important or sufficiently clear to be noticed here. When variableness of size does not obscure the characters of animals, the size and shape of the cranium form excellent distinctive marks.

Notwithstanding the differences shewn to exist between the present animal and the species just alluded to, it is certainly more allied to that, than to any other kind. Its place among the Voles is clearly established by the hairiness of the tail and its shortness compared to the body, by the great size of the head, and the coarse appearance of the fur. Its specific and distinctive characters may for the present be concisely enumerated thus;—*Shaggy Vole;* head, body, and legs covered with a very long shaggy, and scanty fur; whiskers long, snout rather produced, toes and thumb of the fore feet all provided with claws; tail covered with short, and rather bristly hairs. I propose the name *Arvicola hirta* for this species. When possible to provide a specific name from some peculiarity of outward, or superficial appearance, I think it right to do so, and the word "*hirta*" here implies at once that the animal is covered by long, weak hairs, or by a *shaggy fur*.

Movements of the Motacillæ in South Devon.—The Grey Wagtail, *(Motacilla boarula,)* visits us without deviation yearly in the month of September, and remains until the end of March or the first week of April, frequenting rivers, brooks, spring-heads, and the sea-coast. Some circumstance determines a slight irregularity of a few days, both in their arrival and departure,—most probably it is their food; but in respect of number there is apparently little difference. They seem to come in a body, and attract immediate attention by their tameness, and the briskness of their motions. Their retreat however, is accomplished in a straggling manner: suddenly we lose the bulk of the party, and hear only the twit of a solitary bird or so on the bank of a river, or at a spring-head; in a few days these also are gone, and we see no more of them for a season. But, this species has been known to remain all summer and breed. One was shot May 28th, 1839, by Pincombe, and I saw one myself subsequently on the 25th, apparently engaged in breeding. In 1831 I saw one frequenting a pond near Tavistock on the second of September; this may have been an unusually early arrival, or one of a pair that had stayed through the season. Their chief resorts are rivers and streams, but some repair to the sea-coast, and fare with the Pied Wagtail. In hard weather they seem all to frequent the roads, and seek support from the droppings of cattle, frost seeming to cause a general retirement of the insects on which they feed, or sealing down the soil and stones beneath which they harbour. I believe that if any precise dates for their arrival and departure could be ventured on, they would be September 15th and April 8th; yet in 1835 I saw a flock arrive at a small village on the sea-coast on August 13th. In their retreat also in the spring preceding, I observed an unusual tardiness, and they disappeared *gradually*. No phenomena that we know of, can enlighten us respecting these irregularities, any more than concerning the cause of their migrations: we see that the Pied Wagtail haunts the same situations feeds similarly, and is content to remain with us the year through; but some impulse carries the Grey sort hundreds of miles northward to rear its young. It is now clearly made out, that in the spring our flocks retire to the northern counties, it being there a stationary bird also; but, independently of Selby's authority for this, a paper which I possess, written by a naturalist living at Kendal, tallies so well in its account of the transits of this bird there, with its movements in this county, as to have led me to suspect the nature of their retreat before I read Selby's statement. This gentleman, Mr. Gough, thus writes:—"The Grey Wagtail is a partial migrator; a few remain about the town through the winter, and these are joined by great numbers from the south in March, when they all retire to the rugged banks of the river Mint to spend the season of incubation." A remarkable feature in the habits and economy of birds is their adaptation of appetite to a variety of food, both as regards one season or time, and as regards various seasons, in which we frequently notice a change in their food. But few of the class confine themselves to one particular species of food, whereas a very large proportion partake of a variety, but still not similar in character. Thus, the Grey Wagtail searches out various insects, and is content to feed on such as are found on the shore, which necessarily must differ widely from those inhabiting the sides of rivers or of streamlets. Very many birds again, have appetites still more accommodating, and will devour food quite incongruous. This portion of the economy of the Grey Wagtail permits the extension of the species much more than would otherwise be effected, and we see also that it even protects the species to a great extent from death, for if it could not on emergency betake itself to the food afforded by the roads when frost deprives it of more genial supplies, it must necessarily be the victim of want. We conclude also, that it is this principle of accommodation in the appetites and digestive powers of birds and other creatures, which fits and enables them to live in the midst of alterations in their ordinary provender effected by the operations of man, and which permits us to avail ourselves of their services in a domesticated or reclaimed state without much trouble or inconvenience, their appetites shortly becoming adapted to an unaccustomed diet. And so, in their habits and actions we must not fail to note a principle of accommodation of the same description. A little reflection must bring to our minds a thousand alterations in the face of Nature wherever man has fixed his abode, or extended his domains; and though primâ facie we might imagine the actions and habits of animals to be as undeviating and determinate on all points as are the fundamental laws of their organizations and constitutions, we find on the contrary a corresponding alteration and conformity of action in them to suit our intrusions on their territories, our planting, our tillage, our building, and all our various operations on and perversions of Nature. In civilized and cultivated territories scarce an animal moves but it encounters alterations of our making; and though the lower tribes can experience but slight impediments, and can have to adapt themselves thereto only in a very minor degree, yet the higher tribes must certainly employ some portion of thought at times to overcome these hinderances ; and as before said, if instinct were so confined and restrained a power as usually conceived, these alterations in Nature would infallibly disarrange all their proceedings. Judging by the analogy of a vast number of instances of departure from accustomed actions, and by the anomalies of individual cases as contrasted with the species taken in the aggregate, we conclude that the instances of the Grey Wagtail's breeding in Devon are determined purely by choice, and are not dependent on any human causes or interferences, and that these are also cases showing that instinct is not so very constrained a faculty, but involves a certain portion of thought and volition. If the instincts implanted in the Grey Wagtail were of a definite, precise, constrained, and unalterable nature, they would necessarily pervade every member of the species ; and so far from any pair of birds choosing to stay the summer with us, while all their fellows were preparing to migrate, no inducement of food ever so great, nor even any accidents or ailments impairing their bodily power, would prevent their essaying a flight ever so short and feeble; in fact they would be compelled to exert themselves to the very utmost, and to sacrifice every feeling to this one object.

The Yellow Wagtail (*Motacilla flava* of Ray and other English writers) offers an illustration of the same diversity of operations among individuals of one species. This summer Wagtail arrives here about the very time the Grey Wagtail leaves us, and it also quits us about the period the winter species comes. Still, stragglers are seen on to November (according to some remarks I made in 1831) frequenting both the coast and inland stations, and in October, 1833 and other years, they have been noticed haunting the beaches near Plymouth, so that without contending for their stay through the whole winter, I have reason to infer that like the Grey sort, they are occasionally induced to act differently from the aggregate of their kind. Facts of the same nature as those I have recorded relative to these two birds, are also named by Mr. Markwich in Linnean Transactions. I. 126. The Yellow Wagtails congregate in August and September, and abide for several days on our sheltered beaches, feeding among the sea weed, likewise affecting open fields. The number collected at these times is disproportioned to our summer stock, so that probably this species approaches the southern parts of the kingdom previously to departure. Some no doubt have been seen here in winter, and Mr. Couch affirms they reside in Cornwall at that season alone. But, without presuming to contradict the authorities for these statements, I would ask whether the newly discovered *Motacilla neglecta* may not have been sometimes mistaken for it?

The Pied Wagtail (*Motacilla alba* of most English writers) appears to be a bird of more enduring constitution than the other kinds, because it suffers the alternations of our seasons without removing to other situations. It is resident with us all the year. Its actions however clearly indicate the possession of powers of accommodating itself to circumstances of necessity ; not that the species acts in concert, or that the movements and operations of the individuals are simultaneous and uniformly similar, on the contrary, each bird seems intent on its own peculiar interests, and it having been ordained that the appetite of this species of bird should not be restricted or very limited in capacity, some individuals are found to diet on the sea-shore, whereby greater space is allowed to other individuals to procure food. In summer however, when the supply of food is so ample for the generality of creatures, the number of Wagtails haunting the beaches is very small, whereas towards winter they augment greatly. Although I have said that the individuals appear to have separate and exclusive interests, yet it seems that some portion of the kind congregate, shifting their residence and their search for food from spot to spot, moving in small societies. During summer they may be found distributed by the sides of rivers and ponds, on roads, and in gardens, besides being also on the shores and inlets, as before said. In June, I have seen them both in that situation, and in my own garden, and before the house on the road searching for insects. The young are seen much on commons, feeding on the flies, &c. disturbed by the tread of sheep and other grazing animals. About September, they are more particularly noticed arriving in the vicinity of houses and stable-yards. From that time on through the winter, they obtrude themselves greatly in gardens, where they pick up the insects disturbed by the spade of the gardener, which had secreted themselves and been wrapt in their winter's sleep, or in temporary torpor. This species has a slight tremulous note hardly amounting to a song, assumed in April.

The Long-eared Bat.—Having had opportunities of keeping specimens of the Long-eared Bat in confinement, I am enabled to present a few particulars regarding its habits and economy. This species is not near as common with us as the other generally known kind. It seems partial to holes of walls and caves for its retreats, and is not unfrequently found amongst parties of the common sort. The animals I have possessed would all take food from the hand freely as soon as taken under care, and altogether exhibited not only freedom, but considerable tenacity and resentment. The food I have always given has been flies and raw meat chopped small, which last was eaten as greedily as though it had been natural food. These bits of flesh were swallowed with a gulping movement, no doubt in a similar way to that in which bats capture and swallow insects, but owing I presume to the want of force which they would naturally obtain by being on the wing, these individuals secured the generality of the flies I offered them by a method which I conceive evinced an apprehension of their escape; the manœuvre was this, the fly was seized by the mouth though somewhat insecurely, the bat then in a moment bent its head under its body, drew forward its caudal membrane and approximated its wings in a semi-expanded state towards its body; whilst this took place the bat was seen intently securing its prey, which perhaps had escaped its jaws, but owing to the envelope formed by its enemy became a ready victim. The moment the bat obtains firm hold on the fly with his mouth, he gulps it down after I believe crushing it once or twice between his teeth. Not uncommonly the bat through haste and agitation in fastening on his prey, turns completely over on his back, but still by keeping his membranes closed, he never fails to attain his end. At those times indeed when I presented these bats with large blue flies, they found greater difficulty in getting effectual hold on them, and before this could be done, the captive insect would on some occasions escape into the space between the bat's wings and tail, but here after a slight scuffle, and after the bats had drawn their membranes still closer together, the victims would be seized on and devoured. This provision for securing their prey Mr. White describes as a "hovering," a term quite objectionable. Whether this act occurs at times while bats are feeding on the wing I know not. Mr. Bingley remarked the same action here described in the Common Bat, but his explanation and remarks on it somewhat differ from the above.

Mr. White in speaking of a tame bat says, it clipped off the wings of insects offered to it, but I really believe this must have been fortuitous. I have not seen this act performed more than three or four times, and I am persuaded there was no positive dislike to these parts, for as often as I presented my bats with these members, which I had myself removed from flies, they were seized and swallowed. Indeed I see no reason why bats should reject wings, since they are found in plenty in birds which feed similarly to the genus vespertilio.

My bats would lap water from the palm of my hand, and I remarked they threw back the head to swallow their draughts in a manner like birds.

While feeding them in the day-time they seldom opened their eyes, but they were instantly apprised of the proximity of substances by their simple, and slightest contact with any of the long, stiff hairs around the mouth, and about the ears. In this way, by touching these bristles, the bats would make sudden springs, and seize the substance which had irritated them, so that there seems little reason to doubt that the use of this highly sensitive apparatus is to apprize the animals of the presence of insects, and partly also to entangle and detain them. Those hairs also situated on the interior of the ears, will be of use in preventing the ingress of offending bodies, and may possibly possess that exquisite sensibility which informs the creatures of the adjacency of passing insects and bodies in general not perceived through the eye-sight. When these bats slept, they provided against intrusion of foreign bodies, and the disturbance which would result to them in their repose if the large sensitive surface of these ears continued expanded, by folding them neatly down over the orifice of the ear, and confining them in that place by bringing forward and over them, their folded anterior members. Occasionally they would withdraw but one ear, as if desirous of exercising some caution during sleep, and if the still expanded ear were now touched, the bat would either fold it down like the other, or else start up and prepare to seize the offending substance.

The eyesight of bats is doubtlessly extremely perfect during night. One of my captives found his way into the air by going up a chimney at night, and another I lost by its going out through a hole in a broken pane of glass. According to Mr. Bingley, there is something very remarkable in their eyes, for they might be touched with a pen, and yet no notice be taken of it. We might reasonably imagine that daylight should ill suit them, though many nocturnal creatures do manage at some certain times to venture forth during day. The White Owl I have several times seen abroad in daylight, and is often out in evenings long before the bats come forth. But strong lights by their dazzling power, distract both Owls and Bats, and the latter are commonly captured in summer evenings in bedrooms where there are lighted candles, and the windows open. Several species of birds of the aquatic kind, when driven towards our shore by severe weather, and kept from retreating to land for security, when within the sphere of light emanating from the Eddystone lantern, become confounded, and are thus dashed by the waves against the edifice, and killed. The Stormy Petrel in particular, suffers thus during our severer storms. On the same principle also, a neighbour who rears great numbers of chicken, and is greatly troubled by the visits of Hawks, has now adopted the expedient of fastening a bottle on the top of a very long pole planted in the earth of his poultry-yard, and the Hawks now visit him, and hover aloft over the spot without being able to fix their eyesight on any object below them; so effectually does this bottle interfere with distinct vision that they cannot fix on their prey,—the dazzling and radiation paining and distressing them, they retire.

Bats seem rather quarrelsome and resentful, they bite keenly when interfered with, and utter at the same time a squeaking noise occasionally rather loud and vehement.

My captives would run or straddle rather swiftly on a table, and I have seen them on the ground run as quickly when pursued as the greater part of small quadrupeds. I likewise think I have seen them move by a succession of springs performed by the hind legs. The scythe-like claws of their anterior limbs are employed only to cling momentarily to buildings, &c. as is their usual habit. I have seen a party of bats playing about an old outhouse, and each clinging repeatedly and for an instant to one particular spot of the building by these claws, as if to rest itself; but as Mr. Bingley observes, if they are placed hanging by these claws, they directly reverse their position and suspend themselves by the opposite members. When seen attached to the ceilings of caverns, it is surprising to observe by what very small eminences or points of the stone they hang; the least breath of air also causing their bodies to swing to and fro. When disturbed during summer in these retreats by noise or the light of a candle, a tremulous movement is seen to agitate their whole frames, and I have moreover seen the same tremor on other occasions.

Bats do not often come forth from their retreats during rainy weather in summer, and in winter the amount of cold regulates their torpor. In November I have seen them quite torpid, in severe weather in January, active, in September only lethargic, but much depends on the place selected for retirement; I have known numbers removed from holes in lime kilns, and from crevices over bakers' ovens, where warmth would keep them in a semi-torpid state,—susceptible of impressions made by slight increase of atmospheric temperature.

The Crossbill.—We are, at uncertain periods with usually very long intervals, visited by flocks of Crossbills. I am informed that a flock of about 60 or 70 visited the estate of Leigham one year, and it does generally appear that they arrive in very considerable parties and subsequently separate into smaller communities. A small flock visited this village the beginning of October, 1835, and I find on enquiry another was here about seven years since, and one about twenty-five years before that. They commonly abide in orchards, busied in splitting up small apples for the sake of the contained pips, and seem very partial to the sort here termed "majets." They are dexterous operators, and continue intent on their work notwithstanding the presence of inspectors and even the explosion of firearms, so that there is little question they come to us from some wild and uninhabited district.

Those which frequented an orchard opposite to my house on the date above named, fed most voraciously, and crammed their stomachs quite full, indeed they filled their gullets also, and the man who shot specimens for me expressed himself that "their stomachs seemed to be in their throats and above rather than below their necks." On proceeding to dissection I really found that the gullet was not only capacious, but crossed and recrossed the vertebræ to allow greater space for the food taken by them. It crosses the spine once within the body, proceeds loosely along the side of the neck, so that it may not press against the trachæa, and is capable when filled as before said of rising superior to the vertebræ. The trachæa itself rests directly against the bodies of the bones of the neck. The direction taken by the lower jaw varied in different cases. I know not how long they continue to abide with us, but four were seen here on November 13th of the same year. They have been seen to feed on the seeds of fir cones besides on the pips of apples as above spoken of.

The Woodlark is tolerably common with us, though less generally dispersed than other kinds. It seems to adhere to one locality pretty much through the year and yearly, though in severe weather it is obligated to quit its quiet abode and seek sustenance where it may be found in company with others of its congeners. It delights much in meadows and pastures adjoining woods, frequently passing from the one situation to the other. In the milder portions of winter it continues solitary, and gathers its subsistence from the same fields, stubbles, and turnip plots day after day. In summer it is either much concealed in woods and utters its delicious notes from the top of some tall tree, or is seen aloft suspended in the air, with unremitting song. But it is not confined to the vicinity of woods for I have noticed it frequenting a neighbourhood almost destitute of trees. On approaching a Woodlark on the ground, it suffers you to come very near, but suddenly rises and flies off to a short distance with an undulating movement in the air. In winter it observes the ordinary rule, and is silent during cold and inclement weather, but being like some few other birds, particularly its congeners the Skylark and Titlark, habitually a winter songster, it breaks forth into its melodious intonations immediately on the recurrence of finer and milder intervening days. During the latter part of autumn and through the winter months it ordinarily preserves a short but highly enlivening and pleasing strain, which greatly resembles the song of the Treelark; yet what may be the rule for its congregating, its rule for night-singing, and the occasions it selects for pouring forth its completer song I am by no means sure, for being abroad at 11 P. M. on January 14th, 1835, when the air was frosty and clear, and the weather generally fine, I heard three Woodlarks singing deliciously and continuously while perched on trees within about a gunshot of each other. It occurred to me at the time that these songsters were rivals in courtship, but the early date of this complete strain is somewhat against this idea. I have oftener heard this lark while perched on trees, than while mounted in the air, and I have never heard its incomplete and simpler song during night. It would almost seem that these little birds were more influenced by love of society than by love of competition and rivalry in their associations when occupied in the delivery of their night songs, for I have heard a small party engaged in singing during May (and I believe also June) when in all likelihood there were young in the nests. But besides a desire of congregating on these occasions to within short distances, I haye known Woodlarks chaunt within hearing of one another, and seemingly taking pride in responding ; on these nights I found that each continued its warble a certain space of time, and then ceased to allow another the same duration of song. I have heard a small party of these birds during summer within a gunshot of the eastern end of Plymouth, and I have also heard an individual in a garden in the town itself. Setting their winter songs out of the question, they seem to commence their vernal notes indicative of nidification in the beginning of April should the weather be suitable.

Honey.—Hancock ("On Instinct") says that the honey made in different localities of England and Ireland varies in quality and flavour. With regard to Devon and Cornwall this is found to be true, as the honey made in the vicinity of our heaths, where little but that flower and wild thyme is obtainable by bees, is very rich and singular in taste.

The Hedgehog notwithstanding the persecutions to which it is subjected, is tolerably plentiful with us, living chiefly in thickets and hedges producing much shelter. It is a night feeder, and by standing quite still on moonlight evenings of summer in spots where urchins occur, you may see them issue forth and run actively over the turf to secure worms, &c. On opening a hedgehog November 4th, 1830, I found in its stomach a great quantity of earth worms, and an eqnal number of beetles, besides which there were fragments of the blades and roots of grass ; the worms had been swallowed after having been bitten through at one spot of the middle of the animals. When I kept a hedgehog in confinement, I placed some worms enveloped in very thick paper in its cage, and I saw the animal presently advance and tear open the parcel to devour the contents, so that it appears likely they capture this portion of their food by the means of scent. When seized by a dog the hedgehog emits a cry very similar to that of an infant. In winter, we find them very frequently laid up in hybernacula underneath woodstacks and such like warm situations. I am not aware that during the cold season they stir out at any time, but it seems by a date above mentioned that their retirement does not commence till the inclement season has fairly set in; at what time they again usually come forth I am not aware, but perhaps as they do not provide a store they do so early in spring, and I have reasons to think in March. When hedgehogs are engaged in searching for their food,—that is worms, beetles, snails, &c. they glide along the ground with tolerable swiftness, directing their noses all the while toward the earth, and frequently inclining them laterally, just in the manner of a spaniel. I have known cruel persons throw urchins into ponds with the view of drowning them, but if not greatly injured by previous maltreatment they never fail to swim readily towards the sides for escape. Whilst nature has provided ample means for speedy flight from danger in a vast number of her creatures, others have been curiously endowed with mechanisms and instinctive actions to preclude injury or to elude the cognisance of enemies. The present animal when it perceives the movement of a dog or man, or any suspicious object, stops suddenly and remains motionless, then, if its enemy approach it slightly contracts itself, and finally when touched it withdraws its head and limbs closely under its body, and presents altogether an oblong and rounded figure. One species of Armadillo rolls itself up similarly when molested. The Slow-worm (anguis fragilis) though generally inert and almost motionless when discovered in its lurking places, seems to have the property of stiffening its body when touched and interfered with, and may thus be knocked about without its altering this assumed appearance of a bit of crooked stick. Something of the same kind is noticed in the Snake and Viper, though they also frequently glide away from observation on the approach of man. The common Lizard contrives to prevent notice by remaining perfectly still when suspicious of intrusion, and will even keep a limb elevated from the ground some time, but when about to be seized, he removes with the rapidity of light. The Slug when disturbed and touched, contracts itself into a small compass and remains quiescent for some time. Several species of Spiders when handled or touched, contract their limbs under their bodies, and so allow themselves to be rolled about or dropped on the ground, as if inanimate substances. The English Centepede when touched, assumes the shape of a corkscrew, and thus rolls about with the earth that has been disturbed with it, as though it were a lifeless mass. It is remarkable that although nature has devised a variety of methods of this kind of escape from danger, yet occasionally there appears a great external similarity in these contrivances as they are displayed by creatures of very different stations in the scale of creation and very different general endowments. While the Hedgehog and Armadillo contract themselves as above stated, how strange is the similarity of arrangement observed by the Millepede when touched. While the Lizard remains as devoid of motion as a stone, we trace the same contrivance in the common Blackworm as it stays its course across the parlour on hearing our footsteps. While the Slow-worm appears like a fragment of crooked stick, how curiously does the Earthworm simulate itself dead by appearing like a bit of bent and shrivelled twig as it is knocked by the spade in our gardens.

The Squirrel is common with us, haunting principally tall trees in the more wooded parts, but is found likewise in plantations of fir trees before they have attained a height of twelve feet, but possibly they are drawn here only at certain periods in search of the cone seeds. During the summer they are all activity, but in October they prepare their winter's stock of provision and their warm bed of leaves in the hollow of some tree at a good distance from the ground; after this they become lethargic in proportion to the severity of the season, but in all probability, notwithstanding they sleep a great deal, they awake daily for a longer or shorter period to partake of the food they have set apart to support them in these months. I have seen them descend to drink in the middle of winter, so that they certainly are not perfectly torpid creatures at that period, save perhaps in the *severest* winter days. It is a highly endowed animal both as regards its mind and its body, as I had an opportunity of discovering by one I had in confinement in the commencement of the year 1834. This individual was young, and had been captured a short time before it came into my hands; after remaining in a gloomy and disconsolate mood a few hours, he stirred out of his box and examined the room with great attention, and partook of some food I set before him. I then put a piece of woollen into his box, and this he presently appropriated, and on retiring to sleep he coiled himself up between its folds, and drew in by means of his paws the edges and ends of it, to exclude all draught and cold. He slept much and at intervals, being awake about six hours per diem, but as the summer advanced he became less and less sleepy, and considerably more active. He became playful, familiar and affectionate, but if interrupted at his repasts, displayed tenacity and anger, frequently snarling and biting if irritated; he had also a grunting noise when annoyed, and would stamp and hiss if disappointed. He was very timid, being apparently conscious of his powerless state, but when excited by repeated annoyances, would display some degree of effrontery, and when a cat appeared in view, though his heart palpitated from misgivings, he would stamp and twist his body about in a sudden manner, feigning real bravery. Sheep act very similarly when molested by a dog, this fictitious courage being as it were a resource previous to flight in many of the harmless tribes. He frequently retreated precipitately to his box on the slightest alarm, but more particularly when I surprised him at any mischief for which I had previously corrected him. He would sometimes run away with his food between his teeth as if suspicious of interruption, and would usually prefer solitude for devouring his morsel, though he did not object to receiving food from the hand. He avoided strangers, retiring on their entrance, to his domicile, of which he was very fond. I believe he at times secreted a few nuts in a corner of his box, as a reserve. He was a cleanly animal, frequently licking and washing himself after exercise or meals, he also kept his bed-place clean, with the exception of leaving the remnants of his repasts strewed about on the woollen which formed it. He ate heartily of bread and milk, sugar, nuts, and potatoe, he also liked greasy substances, and even bits of raw and tainted meat, which he would steal from me while I was dissecting animals. When about to eat, he took the substance between his teeth, then threw himself into an erect posture, balanced by his tail, and seized the food between his paws, the "rudimental toes" of which, were those more immediately in use to feel and support the contained body, and are for this end more extensively endowed with nerves and vessels. For some time after I had him, he was not able to nibble holes in the nuts to arrive at their contents, but was glad enough to eat the kernel after I had broken the shell. May we conclude the teeth had not acquired sufficient density, or that the muscular power was not yet sufficiently developed, and that naturally their food while young consists of tender vegetable substance? The jaws of a Squirrel do not separate beyond a half inch, and the lower incisors are used to scoop out the kernels of nuts, and such like fruits, or to scrape other food towards the mouth in minute morsels. He rejected portions of the skin covering the kernels of nuts. Some persons suppose Squirrels capable of discovering by the exterior of nuts whether the kernels are edible or not, but after repeated experiments I could not detect this faculty; he opened both good and bad. His hearing, eyesight, and smell were extremely perfect, particularly the last, for by this means he discovered where I kept my supply of nuts, and I often caught him nibbling at the drawer, which was so situated that he had first to make several leaps upward, and then to suspend himself by his hind legs, a feat which disclosed to me an arrangement of his hinder extremities not a little extraordinary and wonderful; for the toes of the hind legs are pointed directly forwards, and to hang by them the thigh-bone must have the power of revolving most completely on its axis. The under eyelid of the Squirrel has very limited motion, the upper one being almost entirely concerned in closing the organ. Besides his cries already mentioned, he once only delivered his peculiar call note. He had moreover a peculiar noise, proceeding as I found from his habit of rubbing his upper and under incisors against one another, to cleanse them or remove superfluous sharpness. During the confinement of young animals, we see the most inoffensive portions of their lives, and though the Squirrel on the whole may be characterized as a gentle and timid being, yet when this favorite of mine came to the enjoyment of his faculties and bodily endowments in their perfection in the first and last summer of his existence, he betrayed so much proneness to mischief, in spite of corrections, so much activity and energtic defiance of controul, that I resolved on putting a finish to his life, and making the last use of him as an osteological preparation; wherein the beautiful adaptations of his frame to the objects and conditions of his existence and whole economy are evident and remarkable. The whole skeleton is light, being compounded of bones small in themselves, and having thin parietes as in the generality of birds, and thus superfluous weight is avoided in an animal destined to move by a series of springs, and to execute light, graceful, and varied movements. To perform their bounds from branch to branch, they are provided with lengthened hinder limbs, the feet of which are capable of efficient prehension on alighting on a bough, the claws being also at this time brought downwards and employed to steady their hold, these last organs being further useful in climbing. The anterior limbs imitate the human arms,—they are widely separated, powerful, extensively moveable, the lower arms capable of rotation, and the feet at once adapted for clinging when climbing or alighting after a spring, and for holding food, in which latter operation the two feet, or rather hands, are brought together, and form a hollow inverted cone for the reception of the substance, which is more especially steadied and felt by the "rudimental toes" or more properly, thumbs. The tail, by its length and great freedom of movement, assists greatly in balancing the body in their springs and while sitting up to eat. The cranium is capacious, and the head altogether large, and were it not that the neck is found to be short, and that there are such powerful muscles, and such a large tail by which the body of the creature is sustained most admirably, we should rather suppose it an inconvenient weight to a being performing such aerial actions.

Towards winter Squirrels turn to a sober grey colour. On August 10th, 1838, I saw in a wood near my house, a Squirrel of a bright chesnut colour on its head, limbs, and body, and having its tail milk white. This is the only specimen I have ever seen having such colours, but in Hampshire and some northern counties they are said to have the ordinary colours on their bodies, and their tails white.

The Dormouse which from small size and unobtrusive character so much escapes notice, is however found on due enquiry, to be tolerably common in our woods, thickets, plantations, and copses. The time when they are usually found, is the rinding season, February, March, &c. when the workmen in moving the timber and examining the hedges and woods, detect the nests of this animal usually placed in small depressions or pits in the ground in sheltered positions, but frequently also in the decayed tops of pollards, in the hollows of trees, in the warm parts of hedges, and also, though rarely, loosely fixed in thorns. These nests are generally much larger than cricket balls, of a close texture, and at one part have a strange, twisted appearance, the substances employed being turned or produced into a point or conical shape, and this proves on inspection to be for the formation of a tube passing to the chamber where the dormouse lies; the use of this passage I conceive to be the admission of air. The nest itself is usually constructed of ingeniously or rather laboriously woven dry blades of grass, to which in some instances is added a profusion of dry oak leaves and fern. I have often been surprised at the very considerable difference in size among these beautiful little creatures, some being nearly half as large again as the others I have examined. It is curious to observe how accurately they fill their abodes, lying in a coiled posture, their tails passing over the head, neck, and pretty much of the back, the fore legs being brought into apposition with the pelvis, and the hind feet with the shoulders. My specimens have generally seemed to me in tolerable plight, but how they can have fed through the winter is not clear, for I have never heard of, or seen any store adjoining their dormitory. It seems moreover that very slight warmth restores them to activity and pursuit of food in their natural life, while in confinement if they are kept from cold, they will remain active through the greater part of the winter. On the whole therefore though it is quite certain that they are very impatient of cold, and do not come forth from their hybernacula permanently till the milder days of April, yet their sleep is not profound, and they are readily kept active by continuing them in a genial temperature. When I have had them brought to me in winter enveloped in their nests, I have always found that by holding them (nests and contents) in my hand a minute, the animals would wake, and presently a squeaking note would follow, especially if I grasped rather tightly. Moreover on removing them from their bed, they very soon give signs of animation and allow themselves to be aroused with little trouble ; besides warmth also, noise and movement near them will affect the soundness of their slumber, and then it is common to hear the same squeaking noise, which from being plaintive resembles greatly the ordinary note of the Creeper. I have further some suspicion that a plentiful provision of food may independently render their sleep unsound and light, for besides that domesticated dormice well fed are wakeful whether through food or warmth, or both, I remarked that three brought to me March 12th, 1835 were not equally drowsy, and that those which ate most were least so. But since in the domesticated state they experience both unacustomed warmth, and are usually supplied with a plenty of provender, it would not be possible save by experiment to determine the relative effects of these powers. In the autumn of 1835 I had a Dormouse given me which fed sumptuously every night on oats, apples, bread, grapes, &c. until November 12th, when after an uncommonly warm season the cold of winter was first felt; after this however we had intervals of rather mild weather, and though his sleep so far as I could observe did not depend on, or was regulated by the temperature of the air, he would frequently come forth and feed largely, and again retire. Again towards the commencement of the following year, the weather became decidedly cold, and he now lay lethargic a whole month; in February he roused and fed abundantly every night, and though he never after became thoroughly lethargic as before, he continued to repose however unsoundly through the greater part of April during the day time.

One would naturally think therefore that if they are thus wakeful, generally light in their sleep, for the most part readily rendered active when awaken, and so susceptible to slight warmth during their hybernating season, they would not be found very impatient of cold; such however is not the case. They do not quit their nests (except perhaps at times for the procurance of food) until the warmer days of April; one was brought to me on April 27th of 1837 in a lethargic state, though the spring of that year was certainly unusually backward; it came out to feed on May 3rd, but was still impatient of cold, and habitually betook itself to the corner of the box huddling close up to two others in the same torpid condition. Mild intervals in the preceding months do not seem to draw them forth to continued active life, however much the soundness of their sleep may be influenced, and when aroused by handling or noise they never fail to seek some warm position, or to envelope themselves in any warm materials at hand. I have always found them fond of getting together in order to secure heat, but when straw was put to them they would nibble it into shreds for a nest, or appropriate tow, wool, flannel, &c. for that purpose, and all this susceptibility at the period when all other dormant creatures had fully awakened; and however strange it may seem that in their natural state they should not be awakened occasionally so late as April 27th as seen above, I found in 1835 that those I possessed and kept in a tolerably warm spot relapsed into torpor so late as April 29th, owing to a return of cold weather. Notwithstanding also, that they are generally so readily roused from sleep, should they be disturbed when the weather is very cold they appear in a drowsy state with their eyes half open, and crawl away slowly when touched, just like persons overcome by fatigue; I have seen them also shake and quiver with the cold, and I once remember a captive dormouse upsetting his cup of water and lying on a wet bed of tow, the consequence of which was that after a few hours I found him to all appearance expiring, and I had the greatest difficulty in restoring him by holding him near the fire; the weather was however decidedly cold at the time.

I am afraid that without some very precise experiments, the mere circumstance of keeping dormice in confinement will not throw light on their economies, and natural habits. The exact influence of food on their hybernation requires to be ascertained separately, and in conjunction with heat of various degrees. Should temperature be regarded as the sole cause in operation, it is evident that the combined experiments of Naturalists will not solve the point, presenting as they do, such inconclusive results, and so many anomalies. How, for instance, can we account for dormice becoming torpid in confinement at a temperature which at other times would not have affected them, and at which perhaps they would have been active in their wild state? How also is it to be explained that dormice in confinement during winter, so habitually wake up to eat at night, and fall profoundly asleep each day? Spallanzani thought it might depend on the returning periodical calls of hunger, but yet he himself reports that his dormice became thoroughly lethargic in the month of March on the return of cold, which however could not have been greater, if as great, as during winter, and I have myself had them brought to me in the end of February in their torpid state, when the weather has been particularly mild, and on which occasions they have not remained awake after being roused.

So far indeed from experiments such as have been made, being useful to throw light on this subject of causes, we may rather consider it premature to enter on that question while it yet remains unsettled whether these animals ever venture forth to feed during winter from the time they first retire, to the period of their permanent re-appearance. I have taken the authority of Bingley for stating that they come forth to feed on sunny days during winter, but there are several Naturalists who hold a different opinion, and though the general tendency of the experiments and observations that have been made, would seem to shew that naturally they are wholly under the influence of weather as regards their torpidity, I have never been able to get any account of their being seen abroad from autumn till the milder parts of April. Possibly we may conclude that after the warmth of spring has been first felt, they stir out for food, and again assume a torpid, or partially torpid state during any unexpected relapse of cold after that time. Three which I possessed tried to escape from their box in the beginning of April, by incessantly gnawing the cover at one spot, and I did eventually find them at large in the room, examining all its parts; these became torpid afterwards, as I have above stated, from return of cold.

Dormice eat amazing quantities of food, but acorns they principally delight in. In summer they get extremely fat, at least in confinment, and after eating they will retire to a corner of their box, and either lie rolled up as during their hybernation, or in a reclining posture. They are shy and timid, and occasionally repose with one eye open to prevent surprise in some suspicious quarter. They are able to carry great weights by their mouths but when the substance is too bulky they will rest it, and steady it by their fore paws while eating it.—They have the extraordinary habit in common with swine, ferrets &c. of befouling their vessels containing food or drink. Are affected with ticks.

Butterflies.—A curious fact connected with torpidity deserves record, this is, that two or three kinds of butterflies appear abroad as early in the year as February, and though they probably had not been dormant through the winter, they become so on inclement days, and occasionally lay up for a week or more at a time, like other kinds of insects in whom torpidity is observed.

Warty Eft or Newt.—This animal appears to undergo some great constitutional change during the time of hybernation, since like Tortoises and probably other kinds of reptiles, it refuses food on its first reviviscence, and only gradually attains its appetite; by the time the spring has fairly set in however it is both active and possessed of a good digestion. When these newts steal from their ponds they invariably, I think, keep to damp places, as those which I have kept, always lingered away their existence when I suffered them to crawl over the floor of the room, and as a last resource instinct would direct them to draw close together, so that they might retain all the moisture of their skins yet remaining, and thus confer mutual benefit on one another. Unless left too long, a damp cloth would reanimate their enfeebled and stiffened bodies. Newts feed much on earthworms, and perhaps this food is what causes their rambles on the land.

House flies linger on till very late in the year, when frosts destroy all that have not laid themselves up in a hybernating state. Warm days greatly reanimate the species and recal many that had become torpid in hedges, to activity; on warm banks we may see them in numbers enjoying the short noon-day gleams of sunshine, and regaling on some favorite liquid, or other substance which they find on the berries of the ivy. About October, the first symptoms of declining strength are manifested with them, a few days of cold enervate their constitutions and call them to their winter's sleep, or to the consummation of their lives. Numbers now crawl feebly on the floors and windows, and are touched and captured without tokens of alarm; some prompted by the hybernating instinct seek in the most extraordinary way to conceal themselves in crevices and inaccessible crannies where the temperature is favorable to protracted life, but as they commonly seek very dark recesses, the difficulty of emerging on the return of spring one would think must be particularly great. Many at once betake themselves to beds and creep between the coverings, conscious no doubt of the advantageous warmth. In short, the instincts of all hybernating creatures at the period of taking on their torpid condition is highly curious and pleasing. When a fire has been lighted in my bed room I have always found that this artificial heat calls flies out even during the severest weather, and when, as often happens, a few warm days occur at Christmas, they are also resuscitated, though in fewer numbers, and seemingly in possession of less vigour. March seems to be the first period of the emergence of flies and other dormant insects; on March 7th, 1838, I found a beetle just issuing forth, but this happened to be an unusually warm day; the generality in my opinion are not revived till warm days in April, and even then are susceptible of semi-torpidity on the intervention of cold inclement days; on April 10th, 1838 which was a cold day, a fire in my bed room called forth many flies, and none were to be seen in other rooms without fire, or out of doors. On April 11th I remarked a kind of bee in a semi-torpid state in a hole of a wall, so that it is with insects as with reptiles, temperature is the grand agent on their constitutions, and sets in action those instincts which promote their welfare at this juncture in their lives.

Bats appear abroad during every month of the year, and in winter principally select fine and warm evenings, though I have also noticed them on keen frosty nights; once particularly, I remember seeing one crawling or running on the snow during a very cold night, January, 19th, 1838; I attempted to seize it, and it eluded me with great dexterity and finally escaped into the hedge. I should suppose however that this anomalous kind of reviviscence is attributable, as Mr. Rennie remarks, to that wise ordination of Nature which causes great cold to revive some torpid creatures and thus saves them from becoming its victims. Query—Does the depending posture of the head in torpid bats, contribute to their lethargic state.

Earth-worms for the most part retreat deeper into the ground in winter to avoid the cold, but though not torpid are very lethargic and inert, and when touched do not display their usual fear; these and slugs seem when disturbed, as if half awaken out of a profound sleep. Their torpor is not of that perfect kind which suffers the application of heat and other stimuli a long time before resuscitation is effected,—vital operations are but partially suspended,—the state may be termed semi-torpidity.

Slugs mostly are semitorpid, but some few continue active or sparingly so. Their winter habits seem to vary in different species, for the field slug is tolerably active, whilst the Limacellus unguiculus is laid up in decayed vegetable matter, &c. and admits of being squeezed between the fingers before animation is restored. This kind moreover lays itself up early in October. Some sorts retire deep into the soil like worms, and when disturbed shew slight motion, some are concealed in rubbish, and some content themselves with a domicile under a loose stone. Intervening mild weather in winter probably restores all the kinds of torpid slugs as also the earth-worm to their usual habits of life.

The Blackcap arrives here with tolerable regularity about the last week in April, and often earlier, though it is evidently retarded in its transit by unusually cold or inclement and wintry weather, and then is not seen till the first week in May, but I do not say that it may not actually arrive before that time, and remain perhaps unobtrusive till milder and sunny weather invites it forth ; and yet I see by a catalogue of summer and winter birds of passage furnished me by an intelligent naturalist of Kendal in Westmoreland that in that neighbourhood it does not arrive till May 4th, besides which, I am certainly of opinion that birds intuitively put off their migration on the occurrence of unusually severe or wintry weather; thus, the spring of the year 1837 was extraordinarily late, or rather the winter preceding extraordinarily long; accounts appeared in the newspapers of the effects of these inclemencies all over Europe, and with us the summer birds of passage were in each case late in their arrivals, the Blackcap not appearing till May 2nd, whilst in 1836 it was heard on April 20th. Even on its arrival in that year the country wore a desolate aspect, not a tree was in leaf, and I believe insects must have been scarce. Mr. Blyth in a paper in the "Field Naturalist" observes they not unfrequently arrive in the end of March, and I find also that Montagu says they feed on their first arrival on ivy berries, so that I presume in the event of their early arrival they partake of this food in common with some of our resident birds, until insects become revived by milder weather; but that they live entirely on ivy berries during the first part of their stay with us is I know incorrect, they may combine this food with insects and indeed I have seen them haunting an ivied wall some parts of the day and returning again to trees in the intervals, but small scarabæi, aphides, and aureliæ form I am convinced the staple portion of their support for a long time. The berries of the ivy seem to be a provision for many of our resident birds, which indeed but for this stock might stand much in want, and not unfrequently it has been found so far needful that every berry has been devoured before the arrival of the Blackcap, so that here again there appears reason to doubt if this food is greatly depended on by this bird. On the contrary, as soon as it arrives it is a frequenter of apple, pear, and other fruit trees, amongst the branches of which it moves in a desultory manner, searching all the while for its food; at intervals it utters its sweet note or flies off for a while to some adjoining tree.

As the summer advances it eats caterpillars as I have found by opening them in June, and I believe it feeds now on a variety of insects also ; after that it betakes itself with a rapacious appetite to ripe fruits, and continues on this diet till the time of its departure. This bird seems to pair very soon after its arrival in this country ; they build so far as I have seen, on low trees or shrubs, and frequently near houses, but they are however very suspicious of intruders, the female will, if she fancy her brood in danger from the approach of any one, feign herself lame and disabled, hobbling before him and uttering notes of distress. Blackcaps are tolerably common, but they are detected for the most part through an acquaintance with their song, for they secrete themselves in trees, and are difficultly seen. They keep to the neighbourhood of man, and frequent yearly the same trees, never quitting the locality to which they have annually resorted except when they wing their way to the continental states, or wherever their resort may be upon the failure of our supplies of food. During the first part of its stay with us it does not frequently pour forth a continued or very powerful song, seeming to be too deeply engaged in search of food, but about midsummer we hear a more protracted and impressive strain. But with its best efforts this bird as found in my neighbourhood fails to give me the idea which White and other authors entertain concerning its song, and I am reluctantly led to infer that as the Nightingale is known to differ in vocal powers in different districts, so does the Blackcap, and that here, circumstances do not suit its constitution to this end.

Oysters.—There was one effect of the severe weather of 1838 deserving notice. It was found that a very large number of Oysters had perished at the period of the great cold in January, and this circumstance was quite new to the most experienced and oldest persons. It was never supposed that frost could have had this influence on animals resident in such a medium.

The Crow is found in South Devon in about the same numbers as the Raven. Having gone through the great offices of nestling and rearing its brood in some deep unfrequented woodland, it is ever after a wanderer, and is seen with us at a variety of seasons examining the country in company with its mate. It is especially a prying, investigating bird; in the cold parts of winter it is often noticed on the shores turning over what the tide has cast up, and is occasionally noticed there in pairs in summer also; as we walk the roads at other times, our attention is drawn to the hoarse note of this bird, watching on some tall tree in the midst of an adjoining wood, whence however, having assured himself that nothing is there to be obtained, he sails off in his strange circling flight to join his partner, uttering as he goes, discordant cries, and now and then stooping from aloft to inspect somewhat behind a hedge; then away go the pair bound for yon distant wood-crowned hill; as we walk by the side of some river during summer, we suddenly disturb on rare occasions, a solitary Crow, which had with patience and scrutiny, been looking out the Alasmodon margaritiferum from the bed of the stream. When the crow secures one he flies upward, and seeking a convenient rock, suspends himself directly over it, and lets fall the precious shell to be shivered into pieces below, and thence the animal itself be readily available to this cunning finder. The Crow is said to treat similarly the Swan-mussel and Common-mussel. The species is more common about the south-east of Devon than elsewhere in the county. The squires of that part, I conclude are more merciful and liberal to the brute creation, than those with us in the south-west.

Destruction of Animals.—The inconsiderate manner in which we destroy animals is deserving of great condemnation in the present boasted day of enlightened and philosophical refinement. In proportion as we enjoy this advantage of extended learning, shall we be expected to act with a becoming dignity and liberality towards God's creatures,—equally worthy of life and the subjects of His consideration with ourselves as physical beings. Next in importance to the study of ourselves as moral agents, is the study of created matter and of the intentions of God relative to our conduct in the world as physical beings endowed with dominion over all others. Exercising this power hitherto to its utmost, and without discretion or judgment, temporary convenience has been at best the only result in many cases, and in others a permanent evil, the origin of which remaining hidden through prepossession and obstinate caprice. Many kinds of creatures ought by their natures to give place to the advancement of civilized man on his assumption of any new territories, and a great many also are destined to become his prey and continued sustenance; but it is mere wanton caprice and cruelty in us, to take the lives of creatures which act not in the main inimical to our interests, and sometimes even favourably towards them. Thus, in my neighbourhood gamekeepers are suffered to kill Woodpeckers, Hedgehogs, Squirrels, Nightjars, Owls, &c. and there are persons sufficiently unmanly and cruel to shoot every sort of bird haunting their gardens during summer,—Flycatchers, Blackcaps, &c. &c. besides destroying every Toad, Slow-worm, and Snake, which crosses their paths. If due consideration were had, a great many kinds which at periods do us slight damage, would yet receive protection for the counter-balance of good which they ordinarily render us, such as the Titmice, Hawks, Sparrows, Thrushes, Blackbirds, &c. using however some necessary precautions against their plunder at the stated seasons. Further also, there are several kinds of predatory birds whose injuries are so trivial as to make it matter of astonishment how it should first have been deemed worth while systematically to pursue and destroy them, especially as their lives and persons are so interesting and elegant, witness the Jay, Magpie, Raven, and Brown Owl, and among quadrupeds the Badger. The lower class of persons who by want of education have not been fortified against ignorance and error, may to some extent be excusable for such acts; fishermen for instance are from their boyhood taught to consider Starfish as great destroyers of Oysters, and as therefore fit only to be condemned to extermination, but when persons of liberal education treat such matters with indifference, and inconsiderately kill every animal against which some capricious verdict has been issued by the multitude, they certainly break the laws of the Creator by frustrating His designs, and usurping a power they were not destined to possess.

Of late years, branch Societies for the "Prevention of cruelty to Animals" have been instituted in most neighbourhoods, and whilst the philanthropy of its chief members is exercised and developed in the trial of various expedients to lessen the sufferings of several kinds of domesticated creatures, and in the due punishment of offenders against *present* laws, it is matter of astonishment that no one has yet thought of extending the original intentions of the Parent Institution beyond the sphere of *domesticated* animals to those in a wild state, for it is undeniable, that great enormities are day by day committed on the large scale against these unprotected victims, and more especially by those nuisances called *Gamekeepers*, who absolutely seem bent on exterminating Creation by terming every thing "*vermin*," which is not "*game*."—Surely it is time for the benevolent and thinking members of these institutions to extend a befriending hand to those animals so continually experiencing pain and death, and to reflect that even

> "——the poor beetle which we tread upon,
> In corporal sufferance feels a pang as great
> As when a giant dies."

The *Sea urchin* through some faculty, (probably scent) is enabled to detect the bait set by fishermen in their crab-pots, and of which by its constant capture in these traps, it seems to be remarkably fond. It appears to climb the wickerwork and arrive gradually at the summit, perceiving there the entrance, and so tenaciously does it adhere to the rods that the creature is not uncommonly dragged up towards the surface of the water on the crab-pots being examined. Fishermen affirm that they effect this hold by their mouths. By the contents of the stomach of a Lobster examined in the end of May it appeared that this animal feeds on the young of Echinus esculentus, wrinkles, young crabs &c.; hard parts of these species remained in the cavity and constituted the ingesta as I conclude, the softer portions having been withdrawn. Judging by these facts does it not seem unwise in fishermen to destroy the sea urchin as they are accustomed to do? This echinus contains spawn in April.

The poor *Slow-worm* though so great an object of hatred and so habitually destroyed, so far from being a fit subject for extirmination, is not only innoccuous, but by its pursuit and consumption of earthworms is extensively useful. Gardeners also act both cruelly and improvidently by endeavouring to kill worms by dividing them into parts with their spades. I find that *nearly all* these portions survive and become perfect individuals in a short time. It would be a great saving to such persons if they were to fling the worms they meet with, into a tub of water or of quick lime placed at hand whilst they proceed in their operations.

Frogs and Toads.—Sound philosophy and public opinion are ever at variance; and when the deductions of science are but matters of common sense, and appreciable by ordinary minds, and yet are opposed by the public voice, how can it be said that the march of intellect has been rapid? Men are ready enough to profit by the advice and assistance of science in matters of economy, and commerce; but in abstract and abstruse questions there is no thirst of enquiry, and they are as bigotted in the sentiments of their progenitors, and as averse to conviction of their errors on such points, as are the inhabitants of any uncivilized country in the world. From this cause the destruction of harmless animals is conducted in our time with almost as much avidity as ever; thus the toad, an animal not only innocuous but useful, is destroyed in the most disgusting manner because it is accounted venomous and unseemly. From this cause also, toads are very generally thought to remain for an indefinite time (ages I suppose) enveloped in the cavities and crevices of hard rocks, and sometimes to be similarly situated in the substance of trees. Not long ago a respectable person assured me he had seen a toad taken from the substance of a piece of oak, which was being sawed; upon enquiry respecting some aperture or entrance, he persisted that none existed. That toads are found in *crevices* of rocks is a fact which I have witnessed, and since these crevices are frequently deep and intricate, the animals may be found at times far removed from the surface, and lead quarrymen to the notion of their being actually imbedded. Toads are great lovers of seclusion from light, and after their night rambles in search of provender they seek hollows and other retired abodes, and amongst other dark and gloomy recesses which they invariably select, are not unfrequently discerned as before said, in the crevices of rocks in quarry pits; to account for their being found here, we need only recollect that their jumps are in great measure desultory and precipitate, and may therefore bring them at times into these places. They are not however incapable of removing from hence; two which I once kept could climb the sides of a box in which I confined them. The respiration of toads and of other reptiles is not incommoded by their position in such circumscribed retreats; I carried one a distance of four miles, wrapped in three papers, and these again covered by a handkerchief. Their capacity for abstinence is very considerable; in June 1830, I placed one on a plate and covered it over with a cup fitting accurately; it sustained a fast for three months. Their food, so far as I have seen, consists of various sorts of beetles and the common earth-worm. I cannot say if they drink, but it is understood by naturalists that they do not, absorbing in lieu fluids by their skin, which is extremely well supplied with pores for the purpose. I have remarked that if I kept a toad for some time from water, and then put in on a plate holding water, it would expand itself to its utmost width and squat on the plate, as if conscious of thereby presenting its utmost extent of surface for absorption to the fluid. The quantity of water was also found to be diminished after this. Some persons suppose that toads and frogs differ in colour according to the nature and colour of the medium wherein they exist. This is certainly an error, for frogs and toads of all colours are found in one and the same pool; they are permanent differences having some other cause, and no doubt some particular use. Toads are troubled with intestinal worms according to my observations, but I am not aware that any author has hitherto remarked this. Early in spring the females produee their spawn, and subsequently to this, or about the middle of April the species is engaged in shedding the cuticle of the previous year. The "Bull Frog" of countrymen is I believe an enlarged specimen of the common sort of toad; these bull frogs are reported to be of great size and as living under foundation stones of hedges &c. Mr. White in his History of Selborne shews that by plentiful and highly nutritive food, toads will attain to a great size.

Toads come forth from hybernation in March, should the weather *be propitious.*

Tortoise.—A curious fact in connexion with the torpor of this kind of animal, I became aware of whilst resident in London. An individual of a species with which I am not acquainted, was kept in the botanical garden of Guy's hospital, and at the time I first noticed it, its tail was considerably bent sideways under the shell, and so firmly as to resist being drawn out again. As it was towards the hybernating season I suspected that the two circumstances might be connected, and that probably this was a provision for the more perfect preservation of every part of the creature during its subterranean repose, in the same way as the eyes are provided with a dense horny coverlid. On enquiring of the gardener, a respectable and intelligent individual, he assured me that this gradual and powerful retraction of the tail took place with regularity every autumn towards the time of its retreat into the earth. I subsequently noticed the same circumstance in other species. Another fact also somewhat strange deserves notice, namely that at the Zoological Gardens in Regent's Park, a fine tortoise was to be seen in the winter of the same year, in a state of torpor, while a number of its young beside it were all life and animation. But notwithstanding this seemingly somewhat contradictory occurrence, the whole history of our imported tortoises shews in the clearest way, that arrangements are naturally made in their constitutions for the same hybernation which they assume in their own countries.

Moles probably sleep much during the cold of winter, but on occurrence of the slightest thaw they are to be found active in repairing their underground roads. It is likely that frosts by causing expansion of the water of the soil might be the means of forcing into their galleries large quantities of mould, and of thus obstructing these adits, making work for the moles each time of its occurrence. Since moles repair their galleries during any intermissions of frost, are they torpid at a certain degree of cold?

The Kingfisher is not very numerous here; it is noticed mostly during winter, when, owing to diminished resources, some of the species appear on the coasts of our harbours, inlets, and estuaries, as also on the margins of large ponds and other collections of water; by this migration, on the part of these individuals, greater space is allowed for the main body living throughout the year on the banks of rivers to capture their prey in a season of comparative scarcity to the race. This removal to the coast takes place about October. It is here, as before noticed, that the bird attracts most notice, its splendid plumage coutrasting strongly with the rock on which it is perched, waiting an opportunity to dive at some passing fish. Several of the species were seen collected together on a small piece of water near Plymouth, which could have contained no suitable prey, but minnows, and sticklebacks; this party kept up an incessant noisy harangue. I have been informed that a nest of this species was found on the side of the river Yealm, placed in a hollow of an ash stump, the entrance to the cavity being just wide enough to admit the birds. Other kinds of birds, besides the present, are known to shift their quarters in the same way as above described, giving opportunities for dispersion of their species taken as a whole; but I recollect no instance so remarkable as the Kingfisher. Although the Kingfisher is nearly always a breeder in the banks of rivers, it does occasionally nestle on the coasts. They are almost invariably seen in summer at Berry Head.

Vegetables.—The torpid state of the vital powers so often noticed in the animal kingdom, is manifestly extended to a large proportion of the vegetable world indigenous to cold countries. The Potatoe which with us is placed in a climate not very different from that of which it was a native, is an instance. Its vital powers continue through the winter resident though dormant in its tubers, and as with animals, exposure to the sun and air awakens its vitality at that season and induces a deteriorated quality in its farina. After being " caved" they ought not to be disturbed till wanted for use.

Insects.—Towards October, great numbers of bees, flies, centipedes, slugs, and a profusion of other kinds of insects lay themselves up in a semi-torpid state under the warm covering of the moss on trees in plantations and on rocks, and though this instinct may be admired in the economy of these animals themselves, we may perhaps be more struck with the Providence thus shewn towards the insectivorous birds which reside with us through the winter, and which would in the absence of this stock become the victims probably of famine.

The Banded Helix (H. virgata) shews by its great numbers in some particular spots, the habit of hybernation in a decisive way. During winter, and on to the first week of April not one can be seen, they having retired most likely into hedges, but after that time on through the summer they swarm in those places to such a degree that as one steps they are crushed in numbers under the feet.

The Common Fly which infests beaches in such numbers lays itself up in a torpid or semi-torpid state in crevices of the rocks on the coast, in order to pass the severer parts of winter.

Torpidity as exemplified in this climate seems to be a provision against cold, or want, or both, appointed for certain kinds of animals, and in some kinds of Helix a provision against drought. It involves no peculiarity of structure, but on the contrary is capable of being assumed by many in a voluntary manner, and as the constitution, œconomies, and habits of life differ so widely in the generality of animals we have no ground left to expect an uniformity in the appearances or characters it presents. Being therefore extended in so unequal and changeable a manner to the animal world, instead of expecting to discover *a great number* of laws directing its effects, we should rather expect that some singularity or slight difference attends each subject of it. It is a condition variable in its nature and phenomena in many different subjects of it. It appertains to no division or tribe of creatures exclusively, but on the contrary may probably be found exemplified in some manner in every order of beings, frequently also affecting one or more species of a genus, but not influencing the rest. Many species are *not invariably* torpid at the hybernating period, some of them possessing the power of voluntarily resisting it, and others waiting the arrival of a *certain amount or measure* of that influence which in them induces it. It is not caused in all hybernating animals by *only one*, or even perhaps by *only two* circumstances external to them. Is perhaps invariably preceded by some remarkable instincts and reasoning processes, securing the subjects of it from many inconveniences, and lædentia which might else obtain during the torpid state. Does not of necessity affect every individual of a hybernating species. Its duration in different animals (and its interruptions when such occur) is apparently always determined by the state or amount of that influence which caused it. May be suspended by artificial means,—but does not seem conformable in all times and cases to the presence or absence of its very exciting cause. Is in many instances capable of being induced by artificial means at unnatural seasons, and by accumulation of the amount of its probable cause may be brought about in the individuals of many species which happened not to have been affected by it at the natural time. Is perhaps capable of being induced in species never habitually its subjects by great concentration of some exciting cause. Its intensity varies greatly in species, in individuals of a species, and is not uniform in all seasons in any kind.

Tortoises.—Decidedly the most instructive example of the tendency to torpidity occurs in tortoises as we see them in this climate, several degrees colder than their natural homes. All the individuals whose habits I have received information of, shew a degree of sensitiveness to the amount of cold deciding their torpidity and revival which is altogether beyond our comprehension, and may be termed in truth exquisite. In the first place, the period when they disappear is the end of October, seemingly without fail. Next, they select a *sunny situation* for their inhumation. One which my brother possessed, first buried itself for the depth of two feet against a wall facing S. E. and under a myrtle tree; dissatisfied with this place it came forth again, and disappeared under a wall facing S. W. Again it came up and retired to its first spot, but quitted abruptly, and betook itself to the angle between two walls facing respectively S. and W. and a situation also which happened to be damp. Perfect seclusion from the air seemed to be the animal's intent in the choice of this spot, having also an instinctive perception of the warmest place of retreat; and it is remarkable that some poultry occupying the same garden invariably withdrew all the winter to the same spot to sun themselves at noon,—no bad instance of similarity of animal feeling in creatures totally separate in form, but one only out of a vast number which Naturalists discover continually; Mr. White for instance observes that his tortoise came forth simultaneously with snails from their respective winter sleeps. Again, the nice discrimination of heat is evinced by the fact that while my brother's tortoise disappeared on October 31st, 1837, with the temperature of the air at 56 ° Faht., it rose on March 27th, with the temperature of the soil around it at 57° ! Again in 1836, this tortoise issued forth April 15th, and one kept by a gentleman in this village, nearly simultaneously, that is to say on the 16th. In the very backward and inclement spring of 1837, they both kept in their quarters till May 2nd or 3rd. Lastly, it seems that tortoises are in their way excellent barometers, displaying an exquisite sensitiveness to change of air, and retiring to shelter a long while before the descent of rain or other atmospheric alterations inducing depressed heat. I conclude therefore, in consideration of our winters being unnatural to their constitutions, and that food would be easily obtainable, that temperature is the immediate cause of their hybernation, and that they possess a high susceptibility of that exact heat determining their torpid condition. If there were an instinct implanted in them causing them to disappear for a season merely from the absence of proper or sufficient food, it would not be found that they abstained from food for several days after their revival, or that when kept from burying themselves till the beginning of the year, they immediately resorted to that act on the first occasion, though food were obtainable, thus one given me in February, 1837, on being put into the garden, directly thrust itself into the ash-heap, and subsequently found a convenient spot for the remainder of the hybernating period. Artificial heat keeps them from positive torpidity, but never induces them to feed, and fails to rouse them from a permanent sleeping state. My brother finds that his tortoise which weighed four pounds on its disappearance, lost in the five months six ounces.

Night Songsters.—There are a greater number of birds which sing by night than Ornithologists usually conceive, and in fact a complete list has never yet been drawn up, the entire number of facts having been gradually ascertained and by Naturalists whose localities are far apart and who have communicated their observations to the world with considerable intervals of time. Some of these nocturnal songsters perhaps pour forth their notes at that time by mere accident or whim, having been disturbed in their repose and excited to song by the cheerful moonlight, by the pleasant warmth of the nights of midsummer, or on the contrary by the sharp piercing cold of a winter night, rendered in some measure cheering however by the stillness of the air and the freedom of the sky from clouds. Others on the contrary are habitual night songsters, or at least, though not quite constant or in some measure capricious in the matter, it may be considered as a characteristic of the *species taken as a whole.* First on the list naturally ranks the Nightingale, notorious the world through for the exceeding sweetness and plaintiveness of his notes. He is frequently however silent on the choicest and most serene nights, but sings much by day also, and thus apparently divides his time betwixt sleeping and activity, allowing short periods in general to each. Next ranks the melodious Woodlark, often mistaken for the Nightingale. In summer nights he is suspended in the welkin, or perched on some tall tree pouring out his rich notes. He sings also at night occasionally in the midst of winter. Like the Nightingale he is not constant to night singing, but often omits it on the most inviting nights of summer. The Sedge Bird next claims notice, not from sweetness of voice but from his night song being so commonly noticed. It amounts more to a gabble resembling the notes of various small birds than to a true song, or melodious effusion. It is only for a short portion of its stay with us, namely the height of the breeding season, that this night warble occurs. The Reed Wren, Dipper, Reed Bunting, and Whinchat are likewise habitual night songsters, though decidedly less attractive than the aforementioned, and from their several localities less generally noticed. On March 12th, 1836, I heard the Whinchat sing very blithly late in the evening, and when quite dark. The Redbreast, Skylark, and Redstart are only occasionally known to sing at night, induced probably by such causes as I have above named. The Wren, Grasshopper Warbler, Hedge Sparrow, Thrush, Blackbird, and I believe one or two other sorts have also been detected though very rarely in this act, and doubtlessly induced by caprice or adventitious circumstances. In the height of summer these birds seem reluctant to desist from song at the close of day, and once in particular I remarked the Song-thrush in full delivery at half-past nine on June 7th. But besides these birds arbitrarily designated song birds, a great variety of other species are active during darkness, and consequently then principally emit their respective notes, such as the Owl, Goatsucker, Plovers, Landrail, Quail, many kinds of water fowl, and a host of others recognised by naturalists; and again there is one instance known to me in which the bird is no songster, but was through some accident set on the cui vive in the depth of a moonlight night. This instance was in a Magpie which was chattering in high glee on the night of October 1st, 1838.

The long-tailed field Mouse stores up grain and roots for its winter provision, and sleeps during the *severe part* of that season. Often however it takes up its abode in "potatoe caves," where a store and comfortable habitation are at once provided. On January 11th, 1839, I opened a "potatoe cave" in my garden, and found three mice, which had formed nests for themselves of the reed which covered the roots. The thermometer stood at 48°, and they were then so active as to make an immediate escape; hence the habits of this species in regard of torpidity are sui generis, it obeys the instinctive call to a quiescent state at a precise degree of cold, and which according to Fleming is that of eleven degrees above the freezing point.

New species of Helix.—In my somewhat successful searches after the beautiful series of our land molluscs, I fortunately in October, 1839,—subsequently to my catalogue being printed, met with a specimen different from all others I had seen, and perhaps distinct from all known to our conchological authors. Its habitat was near Mevagissey in Cornwall, and when taken, was crawling on a stump of a dead tree adjacent to a wood; the locality altogether is very similar to our own woodlands, as indeed are numerous other portions of that interesting county,—so much the rival and counterpart of our own in appearance and productions.

This elegant little helix when measured across its base, proves to be circular, being three tenths of an inch broad in all directions, and reaches to two tenths in its depth. There are in the extreme, five whorls; three and a half of these are very small, but from that point they are seen to increase in size remarkably, and are protuberant and round; the increase is not however continued to the mouth, so that it leaves the diameter of the shell, as before said, the same in any measurement across its base. The minor whorls are strangely depressed, so much so, that when the shell is tilted on its edge and looked down upon, none are apparent beyond the margin of the last and large one, the whole however are divided by a distinct separating line. The base is rounded, the lip is found slightly reflected over the pillar cavity, by means of a narrow triangular or spear shaped fold, the umblicus itself small, but yet admitting a moderate sized pin, and a partial view of one whorl. The mouth is ample, scarcely thickened at its margin, nearly as deep as the body of the shell, and occupies one half of the diameter, but becomes contracted at the body whorl, the upper part of the lip here rather sloping downwards; the entrance is hardly narrowed by the body whorl, so that it is thus nearly circular. The animal was of a dark colour, and could withdraw itself far into its chamber. The shell is diaphanous, and of a greenish horn colour, crossed by distinct rounded striæ, delicately thin, and covered somewhat sparingly with hairs, which are short, lax, silvery, and very fine.

On referring this species to Mr. T. Colley, I found that he already possessed two dead specimens, and which he had referred to the *subrufescens* of Fleming. With this shell, so far as description can be trusted, it certainly greatly accords, but then Mr. Miller the discoverer, says in his account (Annals of Philosophy vol. xix. p. 679) that his shell is "*subumbilicated*, very slightly *carinated*," and "*not hispid*," so that independently of the high probability of the present specimens being new, it would seem that if synonimous with subrufescens, Mr. Miller has failed to discriminate some of its most conspicuous features. No size is named for subrufescens by Mr. Miller. Dr. Turton has no notice of that shell, or of ours. I suggest the trivial name *subvirescens* for the present supposed novelty in British Conchology. I am indebted to Mr. Colley for drawings of my specimen, and by his suggestion, the engravings have been limited to correct outline and proportions, not attempting the finer markings, the pubescence or elaborate shading, lest wrong appearances should be given.

Cuckows apparently enter into a compact with those birds on whom the nurture of their young is to devolve; frequently the Titlark is seen flying in company with a Cuckow, a fact I once witnessed quite close to the town of Plymouth. Young Cuckows stay with us long after the old birds, in order to gain enough strength for their migration, for whilst the latter quit us in July, the young are often found straggling with us in September, and I am told one was shot in October 1838, by Mr. Hannaford of Plymouth. On the authority of R. Julian, esq. of Estover, I am here enabled to add a curious feature in the history of this bird: he observed one for several successive evenings, to keep on the alert late, and to pass frequently from the spot it had chosen to an adjoining piece of meadow, as if in the act of pouncing; having shot the bird on the ground, he found in the stomach a field mouse. This explains why such a similarity exists between the bill and claws of the Cuckow and Kestrel, and shews though the chief diet of the former may be insects, and such like, yet that it still is furnished with the means of being in some degree "rapacious" or carnivorous. Is it because of their short stay with us, namely about three months, that Cuckows entrust the nurture of their young to one of our stationary species of birds?

The Cuckow usually arrives in the end of April, but its note is seldom heard till May 1st or 2nd, on account of cold or inclement weather. I have heard it as early as April 12th near London. In the beginning of June the male birds attend small flocks of the females, which seem to be more numerous than the former sex, these amours however lasting but a few days. The note of the male at this period, is not much unlike that of the Kestrel.

Honey-dew.—I never remember seeing honey-dew but once in Devon, and that was many years ago, during a hot summer, when it was collected in profusion on the leaves of the underwood that overhangs one part of the River Yealm.

Terns.—Towards September, we frequently receive visits from flocks of Terns, being I presume migrating parties of birds passing from cold countries to more genial situations for the winter.—Though greatly disturbed in our harbours by the sportsman, and on dissection shewing by their condition that they had undergone great privations through hunger, they yet stay with us, and pass the occasionally fine month of September in recruiting their strengths in our creeks, and at the mouths of our rivers; in these spots it is amusing to watch their mode of securing food; they rise deliberately into the air for the space of 30 or 40 feet, and then plunge headlong into the water, but with what kind of success I could never ascertain. Later in the year, parties driven by storms make their appearance with us, sadly overcome by hunger and fatigue, and will in this pressing condition come close up to houses by the water side, to seize on offal. In 1831 a party entered Plymouth Harbour on October 6th, the precursors of a coming storm. By the middle of the month they had all quitted us.

Blue Tit.—During spring and summer this little bird has an abundance of food supplied to it in the insects then so generally abundant, and in particular in those small beetles, and other insect races so profusely accumulated on apple trees. It is re-remarkably serviceable to us, in consuming the "American," or "white blight," in our orchards and gardens, and in ridding fruit trees generally from infesting insects. Towards winter, the Blue Tit seems to have more scanty fare, and is very industrious in searching for the eggs, and aureliæ of insects in the crevices of all kinds of trees, and even vines, and current bushes, and I have also noticed this bird clinging to walls, and extracting the same food from the minute crannies. Being thus worse supplied than in summer, it becomes in some degree carnivorous, for it will haunt in small parties the neighbourhood of chandlers' shops in the country villages, and feed on the tallow in some cask or vessel outside the buildings. I have several times amused myself in winter by suspending bones at the end of a string hung up in my garden, for the purpose of observing the interesting actions of the Blue Tit, which would presently cling to the bones and peck the bits of meat in apparent enjoyment, and by its notes give notice to its comrades, and thus every atom of eatable matter would soon disappear. The Blue Tit (or "Hickmall" as it it is termed generally in the country) is even entrapped by boys by the means of suet as a bait, but it will by no means regard this food in summer. In the beginning and milder parts of the winter months "hymenopterous and dipterous insects swarm on ivybushes" (White), and seizing these occasions, the Blue Tit resorts in parties to such spots and consumes quantities of its favorite food. The spring notes of this species of Titmouse are various, so different, and oftentimes so quickly succeeding each other, as to lead one to think that two or more individuals were engaged in conversation. Though very familiar in its habits, it is wary and suspicious when watched, or near to an observer. It occupies gardens in towns, even the smoky atmosphere of the garden plots of the Borough of Southwark, where they will approach close to the windows, and examine the vines or other trees growing within reach of the hand. The Blue Bonnet builds invariably in holes of trees, or of walls, generally very secure from remark, the nest formed in bulk of moss and lined with hair, wool, and feathers. I well remember an instance of this bird exhibiting its strong attachment to its young; some idle masons loitering in a farm-yard, perceived the spot where a pair had their brood concealed, and one of the fellows, perhaps esteeming these poor birds as no other than vermin, scaled the wall, and insinuating his fingers into a hole just below the thatch, drew forth both nest and the 7 young, the parents vociferating and shewing great distress, and now descending from an adjoining apple tree, and fluttering immediately over the head of this vagabond intruder; he however appeared to be not at all discouraged, but even accustomed to such actions. Contrary to the assertion of Bewick, the Blue Tits suffer eggs to be withdrawn from their nest without quitting it, but will continue to lay, one egg being taken daily from them.

In some years this bird does not visit certain trees in gardens, and if these be examined, they will be found free of insects, a clear proof of the nature of the food *generally* consumed by this species.

Nuthatch.—That amusing bird the Nuthatch is far from scarce in the district, but save at such times as it is busily occupied in the consumption of the little scarabs so abundant at the chief season of necessity to our smaller winter birds under the bark of apple trees, it is but rarely under the immediate inspection of naturalists, but is rather known to us by its peculiar utterances, emitted from situations not easily discerned. Its trilling or rattling note delivered whilst it ascends the bole of some tall elm, and often as early in the year as the beginning of March, is by far the most remarkable from loudness, clearness of delivery, and even penetrating effect. This note is not taken up in real earnest till April, for cold intervening weather of the former month keeps it to its winter intonations. The Nuthatch during spring is very constant to one locality, and day by day a certain spot may be visited with the surety of finding the bird somewhere near. Tall trees are his greatest delight; pursuing his avocation along the bare boughs of the oak, ash, beech, or elm, he repeatedly calls the notice of passers-by to his importunate notes, so remarkably disproportioned in their loudness to the bulk of the creature they proceed from. Nidification, &c. being completed, the Nuthatch takes up a somewhat similar rattling modulation at the end of July, or beginning of August, when first entering orchards. His visit there being ended, he becomes through the winter a woodland bird, haunting the tops of trees, flying hurriedly from one site to another, and delivering a *clicking* note, each "*click*" separated from the other by a short interval. Towards spring, I have also remarked one other kind of utterance, single, and resembling, except in being much louder, the call of a young chicken.

Return of Spring.—Not only do animals generally by their actions give intimation of the approach of spring, but the very earth contributes symptoms also, indicative of the same circumstance. In the few fine days of February, which so often cheer us in that month, relieving the gloom otherwise so prevalent, we notice during our walks a peculiar, and not unpleasant *odour proceeding from the soil* of the hedges; this appears partly earthy, and partly herby, and may be derived from the minute particles of soil conveyed into the air in company with the moisture which the sun now draws up by these temporary gleams, and from the buds and shoots of expanding vegetation. In March, the power of the sun is reduced by the low temperature of the winds, but in April the succession of rain and sunshine highly favours the elimination of this scent so characteristic of the season, and so associated with rural things. The *hazel* now—in February,—puts forth its catkins; on the sheltered bank blooms the *snow-drop*, and in some favorable years the *sweet scented violet*, and often the *daisy, primrose, furze,* (scentless however at this time) *pilewort,* and *dandelion,* besides that hardiest of plants, the *groundsel.* On the same fine days of this first but partial spring month, we are reminded of all the former pleasures of that season by the loud, clear whistle of the *Missel Thrush,* the nearly perfect songs of the *Chaffinch, Yellow Hammer,* and *Cirl Bunting,* the quaint notes of the *Ox-eye,* the cheerful notes of the *Blue Tit,* the melody of the *Woodlark,* the simple modulations of the *Gold-crest,* and the invariable but always welcome songs of the homestead birds,—the *Robin*, *Wren*, and *Hedge-sparrow*, and to these are at times added those of the *Blackbird* and *Thrush*. When evening approaches, the *hedge scent* is more obvious, for now the evaporations of the day which had lain in a medium above us, begin to descend by their condensation and weight, and bring with them the odoriferous particles previously carried up by the evaporated or steamed wet so abundantly accumulated every where. These things are among the first proofs of returning spring.

The *month of March* brings us acquainted with other developments of vegetation still more pleasing from their varied characters. The *Lentlily* blooms abundantly in orchards and sheltered hedges, the *coltsfoot* expands its yellow petals amid the sods of the ploughed lands, the *alder* is decorated with its pretty catkins, the *elder* puts forth its terminal leaves, the *sallow* its decorations of yellow heads, and all the plants which opened their flowers in February (save the snow-drop) are now in still gaudier trim,—these in connexion with certain additional cheerful notes of birds which the woods afford us, render a walk in the meadows and plantations very agreeable, and productive of pleasing meditations. In wooded districts, a survey of the country from the summit of some hill, displays to us the first efforts at budding by the *oak*, *lime*, and *elm*, their tops having acquired a beautiful brown tint from the vast number of little bulbs at the extremities of the branches. The *plane* trees afford now a curious sight from the shedding of their barks in small flakes; the inner bark is of a fine yellow colour, so that the boles of these trees wear a blotched appearance. *Rooks* commence their noisy operation of nest-building. *Goldfinches* still in flock, join in a low song while congregated on some tree or hedge. *Missel Thrushes* pair. *Bull-finches* attack the *buds of the gooseberry*, *pear*, &c.

Flies and certain *coleoptera* are revived from their hybernations. In some years however, the month of February brings us acquainted with the greater number of these things, though on the other hand they are not seldom deferred by protracted inclemencies till April, or even May, and the cold winds and frosts of March, in years even generally favorable, interfere temporarily both with animal and vegetable creation, suspending the songs, nestling, and resuscitations of the one, and the blossomings of the other. *The spring of the year* 1839 was particularly forward, but in March, severe frosts occurring with the sharp winds, punished most unusually the *Laurels*, *Laurustinuses*, &c. which had put forth very early shoots, and though the sun shone out brightly, put a stop to nearly all the music of the groves, the *Chaffinch* and *Blackbird* alone remaining undaunted. These frosts however must be regarded as in one sense salutary to vegetation since they restrain the blossoms which must otherwise be too greatly in advance of summer heat. Notwithstanding March winds and asperities however, those hardy hedge shrubs,—the *wild rose*, the *thorn* and *honeysuckle* are found to be putting out their first buds in preparation for leafing. To the above named plants may be added the following which disclose themselves to us in our varied walks, gradually expanding their blossoms to put to shame the simpler beauties of the previous month,—the *hairy cardamine*, the *barren strawberry*, the *wood sorrel*, the *chick-weed*, the *bearsfoot*, the *ground ivy*, the *whitlow-grass*, the *golden saxifrage*, the *lesser perrywinkle*.

Hedgehogs.—As a labourer was engaged in removing an old heap of straw in an orchard in the beginning of March, 1839, he observed several runs in the grass as if rats had frequented the spot, but when he got to the bottom of the rubbish, he found a community of three or four Hedgehogs revived at that early period of the year, and which absconded with due speed. This assembling of Hedgehogs is I think unnoticed by authors.

Migration.—Under the head of "*Hirundines*" I remarked that Swallows seemed to arrive late on occasion of backward springs, and gave instances to that effect. Still however though our backward springs may be connected with similar conditions of the season in those countries through which they pass, or rather linger, and though backward seasons may cause them to conceal themselves in spots unexposed to cold till warmer weather invite them forth to general observation, there can be no doubt their arrival hither is determined as to time by the state of weather in those countries which are their abodes during our winter. A general persuasion has crept into vogue that the Hirundines are affected in their transit to us by a condition of the season similar to what we are experiencing whatever that may be, but in reality nothing as a general rule is more unlikely; storms for instance may arrest their progress at sea. In 1839 we had an uncommonly fine April, and yet Swallows were very late; I saw none till April 26th, and they were not general till May, and some cause indeed, external to this country had a similar effect on other migrants as appeared by the late arrival of the Whitethroat, Blackcap, &c.

Snake.—There seems some explanation of the fact of Snakes being at times seen swimming over small streams, in the food of which they occasionally partake. G. Leach, esq. of Stoke, informs me that at a farm which he manages near Launceston, he has a pond with a small island in its centre; on this he once found a large Snake, and it being very big in the body, he killed it, and by squeezing it from the tail towards the mouth he forced out seven young *water rats* recently swallowed.

References to the Plates of the animal remains of the grauwacké series.

It is my object to conclude the present work by references to and some additional notes on our interesting series of fossils, which the reader will find very faithfully delineated in the accompanying tables. I am unwilling to trespass longer on my reader's attention, feeling that I may have already written more than the public will choose to read, but as many naturalists are looking eagerly for information on the above subject, I am induced to intrude two or three additional pages devoted to a classification of those notes which I have from time to time made in reference to the various specimens which I have collected.

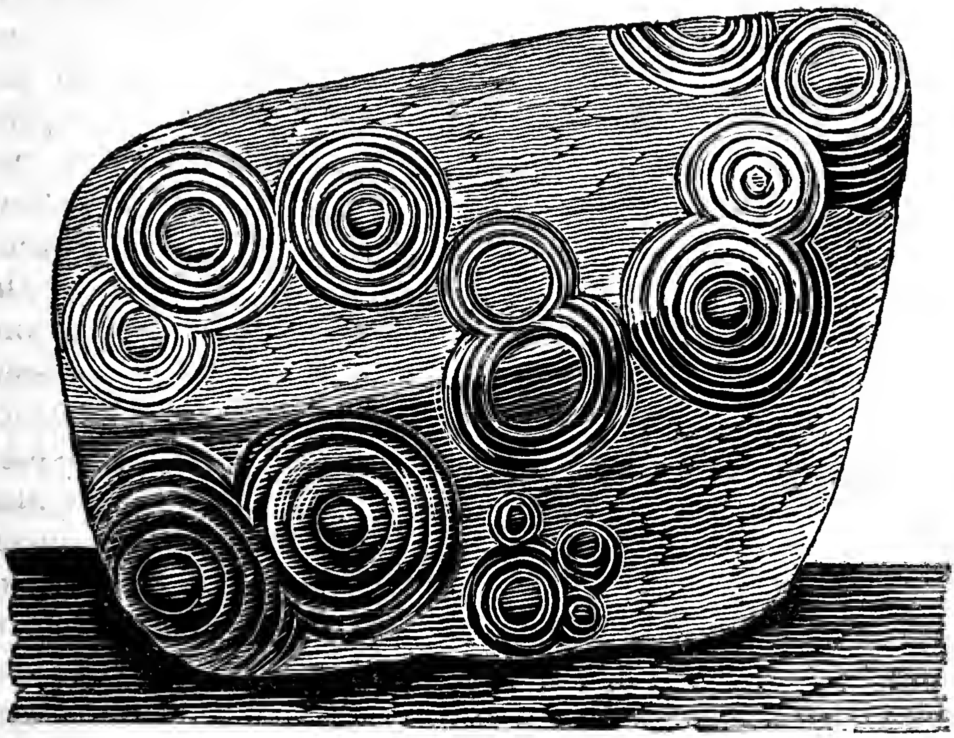
The whole of the engravings and lithographs in the following tables represent the specimens in their natural size, *and the same remark applies to those of the fossil bones, and to those of the animals which follow.*

TABLE 1 represents a series of *Turbinolites* in slate. *Figs.* 1, 2, 3, are of specimens collected in a roofing-slate quarry on the new road near Brixton, though all three sorts are to be found in other localities also. *Fig.* 4 is of a large specimen of the Turbinolia which was found to be so common in the dense slate at Boveysand by Miss Dixon, and afterwards by Miss Hook ; this species likewise is not limited to this particular spot, but occurs as I have lately discovered at Mudstone near Brixham, in a slate to which I can give no other title than *clay slate ;* it is far more sectile and frangible than that which is the matrix of the specimens at Boveysand. Of this genus there are besides the present, many other species, but as yet I have met with no specimens of these in a sufficient state of perfection to admit of their being engraved for their indentification by collectors. Turbinolites occur both in limestone and in sandstone. TABLE 2.—*Figs.* 1 and 3 represent two kinds of *Cyathophyllum* from the slate at Mudstone, the first being of an ivory whiteness. *Fig.* 2 appears to be of an *Astrea* which I procured from the same locality ; the specimen itself is not more than ¼ inch deep, is of a pink colour, and is surrounded by a space of pure white, as the engraving well exhibits. *Caryophyllites* probably occur in our slate, as they undoubtedly do in our sandstone and limestone, and I believe I may affirm that the sandstone participates in the genus Cyathophyllum, of which specimens are found in our slate as above mentioned. *Fig.* 4 is an excellent engraving of a very rare description of *Astrea* found by me in the roofing quarry at Yeo near Yealmpton, and which I have seen only twice since in a quarry at Elburton ; the figure itself gives but the impression made by the end of the creature, there being a cylindrical and long tube of the same diameter in the slate and leading down to it, occupied of course in the first instance before dissolution occurred, by the body of this zoophyte ; lying on the centre of this impression or cast and fitting exactly its markings, there is a thin and loose fragment of hard material probably part of the remains of the animal substance. Astreas are I believe present in our sandstone, as they are in the slate and lime ; something of the sort I found plentiful in sandstone at Newton Ferrers. *Fig.* 5. presents a view of I believe a *Berenicea,* several specimens of which I collected in a roofing-slate quarry at Coffleet, and once or twice since, elsewhere. The engraving I am sorry to say is hardly satisfactory, (a remark I shall not have occasion to repeat) the specimen being in fact an aggregation of small, inclined cells rather pitcher-shaped, imitating indeed very remarkably the modern B. utriculata. *Fig.* 6 is a small fragment of *Coral,* (but from what genus I do not pretend to determine) taken from the slate at Mudstone. There are altogether several kinds of Coral to be discriminated in the slate of Devon and Cornwall, and one in particular which is very common in that same locality and less so in some other spots, is somewhat analagous in its fan-shaped expansions and perforations to the *Gorgonia flabellum.* We see commonly, only the impressions which its flat surfaces leave on the rock, and the bits of its substance which I have yet procured are so insignificant that I have given no engraving of the species. Mr. Peach however, of Goran in Cornwall, has some satisfactory specimens derived from his neighbourhood, and he has seen one in the rock about a foot long. The bare impress of the branches of this coral might most readily be mistaken for specimens similar to those at Figs. 1 and 2. Table 4.—*Fig.* 7 delineates a curious relique which I procured at Noss Mayo from the arenaceous schist, a coarse material, and which predominates on all the coast. I take this to be either some obscure *zoophyte* or a *vegetable* production ; the slate directly surrounding it and forming it, is a delicate pink; I have once or twice seen it in other spots and seemingly always presenting a squared or oblong figure. *Fig.* 8 (left hand fossil) is a representation of a beautiful and most delicate as well as curious remain, which I have several times noticed in the quarry towards Brixton ; it invariably offers a defined outline, and is raised and rounded. I have some idea from its markings it may be a *Spongia*. TABLE 3.—*Fig.* 1 is I apprehend an impression of a *Cyathophyllum,* or at least of some cup-shaped zoophyte. It is from the slate near Kitley. Were it not cup-shaped, it would not be distinct so far as the markings indicate, from the group just underneath,—*Fig.* 2 ; these have been estimated by some as impressions of bivalves, but from an observation of the same description of fossil in other spots, I believe them to be zoophytes having the shape and outline of expanded leaves. The specimen is from Cann quarry, a short distance from the confines of Dartmoor ; the slate is particularly solid, though on the other hand I met with a collection of the same fossils in the highly frangible brown slate or schist at Kitley Point. *Figs.* 3, 4, and 5 are interesting fossils of the old red, or rather *grey sandstone* of Whitsand near Plymouth, but on the Cornish side. I did not originally design to extend myself to that locality, but owing to the interest which these and other beautiful specimens convey in exhibiting the identity of our fossils, generically speaking, in the three rocks of the grauwacké series, I thought the reader would excuse the trifling fault of going beyond the precincts of the districts for illustrations of the animal remains of the above named rocks, hitherto so little known. *Fig.* 3 seems to be an *Alcyonium*. *Fig.* 4 is is apparently allied to that in slate at *Fig.* 2. *Fig.* 5 is a fragment of that beautiful and rare corallite the *Pocillipora* which I believe occurs likewise in our slate, and undoubtedly in the lime, as at the Thatcher rock in Torbay for instance, where I collected specimens. TABLE 4.—*Fig.* 1 presents us with a view of a most singular and rare fossil from the slate at Cann quarry ; it appears to have a little circle for its centre, the other ovoid shapes being arranged around it. I presume it may be the impression of some zoophyte, and probably of the *Alcyonium* tribe. I do not recollect that it has occurred to me elsewhere. *Fig.* 2 is perhaps something of the same description, though here to each of the circular marks, is a central dot; the specimen is from Boveysand. Both have been designated *Strombodes* by some who have inspected these specimens. *Figs.* 3 and 5 represent a univalve similar in shape to the Haliotis, and one valve of a bivalve perhaps similar to the Arca, which were found by me in the "grey dunstone" (a schist not distinctly laminating, and having a different texture from our slates properly so called) at Mount Batten. I had been induced, prior to this discovery, to consign this modified form of slate to the series devoid of fossils, though properly speaking I know of no reason why it should be wanting in those reliques found in the rocks into which it graduates. These and other fossils of this spot are greatly marked and stained by iron, but fossils do *by no means occur in the iron itself,* nor do they even *impress their shapes on its free surfaces* as I have unfortunately been induced to state at p. 54 from the representations made to me by several geologists. *Fig.* 4 shews a somewhat indifferent specimen of an *Orthoceratite* from Boveysand, obtained by Master T. Jones. I might have given a view of a larger one, (not so perfect however as the present,) and indeed I suspect from the forms which I occasionally see in large blocks of slate, that this description of fossil shell is not very rare with us, and that moreover there are several kinds. Mr. Peach of Goran lately shew me a most beautiful and satisfactory specimen of a sort different from the present, and I then immediately perceived that the specimen, which, following up Professor Sedgewick's estimate of it, I had, with some precaution, named the entrails or coprolite of a fish, (Table 7, *Fig.* 3) was in fact a specimen of the same description. It gives a view of three of the chambers, the central dot corresponding indeed to the syphon. This multilocular shell belonging to the nautilite cephalopods is nearly characteristic of the grauwacké series. Professor Buckland it seems found a *Nautilus* at Filleigh,—North of Devon, and Mr. Johns, as recorded by De la Beche, found a *Trilobus* at Whitsand Bay in the sandstone, an animal purely characteristic of the series. Table 5.—The uppermost figure represents a *Turritella* procured from the new red sandstone conglomerate by Mr. R. Hunt of Paington, and lent to this work by Mr. G. Bartlett. It has been here introduced because the conglomerate of this county has been all along considered as devoid of fossils, whereas the present specimen occurred *between* the different fragments of which the stratum is composed, and was further so distinctly a relique of that æra to which it is ascribable, that its structure actually consists of particles gained from the surrounding bits of rock which compose its matrix. It is assuredly the only animal remain which has ever been found in the new red sandstone. The middle figure is a *Turbo* from the slate at Boveysand, discovered by and lent to this work by Miss Hook ; specimens from the same genus have I believe been procured from roofing slate in Cornwall. The lowest figure seems also to be a *shell,* (bivalve) found likewise by Miss Hook at Boveysand, but there is a degree of obscurity attached to its character.* Mr. Peach has discovered a *Spirifer* in slate near Goran, and similar to such as I have found in the slaty lime close to Plymouth. He is also the discoverer of a cluster of *Terebratulites* in a quartzose rock associated with slate and limestone in his neighbourhood. This gentleman in bringing to light these and other novelties in the Cornish series of organic reliques, has with great industry traced their presence in the rocks of the coast—sandstone, slate, quartzose rock, and lime

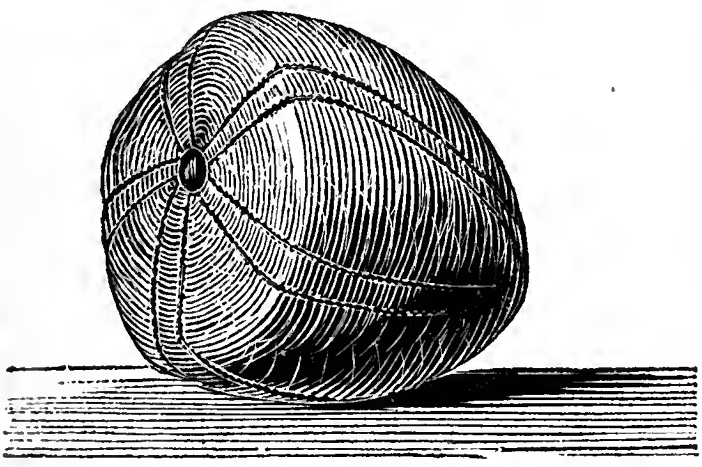
* This and the Turbo were painted in preparation for the lithographer by Miss C. Jones, her name as the artist having been accidentally omitted in the Table.

(sparingly)—from East Looe to Gerran Bay, and finds that they take a course across the county to the north-west coast, appearing in the slate at St. Anne's, so that, conformably with the transition strata, they pursue a direction east and west. TABLE 6.—*Fig.* 1 is an *Encrinital head* and piece of the stem attached, taken from the slate rock where it closely joins to limestone under Mount Edgcumbe, by the Rev. R. Hennah, who has kindly allowed it to be employed for the benefit of this work. The stem seems to have a twisted appearance like a bit of coarse cord, and has its counterpart at *Fig.* 5, which pourtrays a specimen taken by me from the slate rock at Staddon Heights on the opposite side of the harbour. *Fig.* 2 represents the largest of a great number of *Encrinital heads* of varying shapes which I found in one small spot under Puslinch on the Yealm. The rock seems to be of that kind intermediate between slate and sandstone, these being on either hand, while the structure of the fossil itself—which is always curiously enclosed in a sort of rude case or shell, allowing the relique itself to be withdrawn and replaced at pleasure, in the same way as a cast fits into its mould—is of a somewhat cheesy texture, greasy as it were to the feel, and having on its surface very often curious small markings of organic remains. The present specimen is different from all others I have procured in possessing a joint of the stem of the animal apparently peculiar in its character. I have observed the same fossil in one particular spot at Boveysand, as also in a part of the rock—arenaceous schist—at the mouth of the Erme. The scarcity of encrinital heads has been noticed as observable in the lime, but it is equally so in the slate, indeed the present are nearly all the kinds which I have seen, though encrinital columns of several species are noticed in all directions, more indeed than the present series of engravings exhibits. *Fig.* 4 gives a view of a sort of *encrinital column* from Boveysand, which bears on its surface in regular order a number of tubercles, distinct in fact from all other kinds. Procured by Master Jones. *Fig.* 3 is a beautiful specimen from the slate at Mudstone; it has a groove running along its whole length, and is of a compressed or flattened figure. TABLE 7.—*Fig.* 1 is a view of an *encrinital column* from the coarse grauwacké slate of Jenny Cliff near Plymouth, where fragments of the same species are not unfrequently perceived; but I have seen this kind no where else. *Fig.* 2 is a representation of a fine description of *encrinital column* which I procured at Mudstone, and where it seems to be not very rare, but I have never noticed the same species in any other locality. *Fig.* 3 (already noticed) *Fig.* 4 are encrinital joints of a particular kind, from the loose and poor clay-slate at Kitley Point, where I have never obtained above three specimens in the same perfection, though the impression of the surfaces of these joints is to be observed in several quarries and other spots around Plymouth, as at Staddiscombe, a specimen from the roofing-slate of which is represented at Fig. 7, but besides this common kind of impression of encrinital joints, there are others very similar to it, but yet apparently specifically distinct. *Fig.* 5 presents a view of a beautiful sort of encrinital vertebræ which I found in Hangers quarry near Newhouse; the rim of each joint is marked with oblique lines similar to those we see on the rims of penny-pieces. *Fig.* 6 is given because in connexion with *Fig.* 7, it will afford the collector a knowledge of the two commonest fossils presented by our slate, and which indeed appear in the generality of quarries, and in the generality of the common clay-slate of the county; it presents very thin laminæ for its joints, and the present figure gives only the pillar traversing through their centres, with the remains only of the plates at their attachment round the little stem; the impression made by these plates is very frequently discerned, but the occurrence of the vertebral column in mass is rare; three of the joints somewhat perfect are engraved at Fig. 8, Table 2, (right hand fossil) and it often occurs to us to find the same remain or one similar presenting many partitions or transverse plates, and the central pillar removed by decomposition, the case being the reverse of Fig. 6 in the present Table. *Fig.* 8 is an engraving of a small series of *encrinital joints,* possessing distinctive characters from all others, which I found in clay slate at Elburton. But besides the present, there are other varieties of encrinital reliques to be detected in our slate, though not admitting of being engraved, or of being defined by mere words. Indeed nothing but very considerable experience can enable a collector to pronounce on distinctive separations between specimens approximating so closely as do the present series, and possessing at best, characters both obscure and equivocal for specific limitations. One other species I will however venture to name beyond the present, and that is a sort whose stem seems to be quite simple and whose head resembles greatly in figure the Lepas anatifera. Mr. Peach has a specimen also from the Van in his neighbourhood, which is probably a *Pentacrinite.* TABLE 8 presents a view of a *Spatangus* from the *limestone* of Ashburton, procured by Mr. G. Bartlett, and here introduced because it is the only one that has been obtained from our limestone. TABLE 9 is a species of *Ananchytes* from the walls of one of the celebrated ossiferous *limestone* fissures of Oreston, but which I have also had from the limestone of Plymouth Hoe; it is introduced from being as yet unknown to geologists. TABLE 10 recurs to the *encrinital remains* of the grauwacké series, and is devoted to the more conspicuous and evidently distinct species from Whitsand Bay *grey sandstone,* and from that which is similar at Boveysand on the opposite side of the harbour. *Fig.* 1 is a joint having a very flat surface, curiously divided by white lines passing from the centre. *Fig.* 2 is a series of joints from Boveysand, and these like a sort before named have oblique lines on their rims. *Figs.* 3 & 4 are series of joints apparently different from all others, and finally, *Fig.* 5 is an elegant fossil vertebra of the same order, distinct in general shape, and by its surface sloping to the central opening, with fine lines arranged as radii.

I have only to note in conclusion that the slate fossils both from the south-east and north of Devon and from Cornwall are very analogous to those in South Devon, and altogether indicate that the same series extends itself around us. The old red sandstone also of the coast is continued from the south of Devon most regularly onwards into Cornwall taking a westerly direction, and betrays along its course the presence of those genera of animal remains which confirm it as a member of the grauwacké order.



Piece of limestone from under Plymouth Hoe, having on its surfaces strange, circular, raised markings, evidently the remains of former organized matter.



Echinite from the neighbourhood of Exeter.

References to the Plates of Fossil Bones.

In the subsequent series of engravings, I have presented the geological student with specimens of the teeth of the various sorts of animal reliques found in the cavern which I discovered at Yealm Bridge, not indeed embracing every one of the species there found, but still exhibiting those which characterize more particularly the habits and natures of this ancient race. The series includes also two or three specimens from other spots.

TABLE 11.—*Fig.* 1 represents the molar of a small species of *Elephant ;** *Fig.* 2 the back molar of the same animal ; *Fig.* 3 one of the large molars of a *Rhinoceros.* TABLE 12.—*Figs.* 1 and 2 represent molars of the same Rhinoceros ; *Figs.* 3 and 4 the two largest molars of the *Horse* in my possession (the " *crusta petrosa*" is here as in all the other cases deficient, having disappeared through decay) ; *Fig.* 5 one of the lower molars of an *Ox.* TABLE 13.—*Figs.* 1, 2, 3, 4 delineate different molars of the same animal ; *Fig.* 5 is either a young back molar of the same, or of the *Elk,* and I think the latter ; *Fig.* 6 seems to be an incipient grinder of that last named species. TABLE 14.—*Figs.* 1 and 2 are grinders from both jaws of the *Deer* tribe, Fig. 2 being of a species the size of our C. dama ; *Fig.* 3 is a front grinder of a species whose under jaw is nearly a foot long ; *Figs.* 4, 5, and 6 are grinders from a species of *Sheep* or *Goat ; Figs.* 7, 8, and 9 are teeth of a *Boar,* the first of the three being one of the lower incisors, and is the specimen respecting which I was originally in doubt as named at p. 83. TABLE 15.—*Fig.* 1 is the fore part of the upper jaw of a *Hare* or *Rabbit ;*

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* The drawing of this tooth, now at Kitley, was obligingly lent to this work by the Rev. J. Yonge of Puslinch, together with many specimens.

Figs. 2, 3, and 4 are halves of the lower jaws of three distinct species of *Mice ; Fig.* 5 presents a view of a fragment of the under jaw of a *Wolf ; Fig.* 6 is a grinder of the *Hyæna*. (H. fossilis, Cuv.) TABLE 16.—*Fig.* 1 gives a view of the fragment of an under jaw found very lately amongst the ancient beach under Plymouth Hoe ; it seems in the estimation of Col. Smith to belong to the *Pachydermatous tribe;* the teeth are greatly worn, and present dubious characters; respecting this discovery see below. *Fig.* 2 is a tusk of a *Bear* (Ursus spelæus of Buckland's Reliq. Diluv. p. 17) *Fig.* 3 represents a large portion of the half of a lower jaw of *H. fossilis.*

To these somewhat explanatory references, I will here add a few other scraps of information mostly obtained since the body of the work was printed, and belonging exclusively to the subject of fossil bones.

Solitary fossil teeth occur in nearly all the caves of the district; one such instance I have already recorded ; Mr. Hearder of Plymouth very lately informed me that at the entrance of the cave under the Hoe, he once found a *Rhinoceros' tooth,* rounded by its exposure to the tide which now flows into it. The discovery of this tooth in a locality of this kind, and with the assumption of the cave having been the habitation of Hyænas, strongly indicates the proposition of the sea, at the period of the existence of the Hyænas, Elephants, &c. having had a less elevation than is now presented by it, or on the contrary should it not have been such a domicile, it shows the boundary of the sea as assumed on its diluvial retreat; (see p. 107) whilst the occurrence of bones of the same class,—*Rhinoceros,* (?) *Elephant, Horse,* &c. in the ancient beach above, tends to confirm the ideas which I set forth at p. 112 and 119 to the effect that the rise of the sea causing the formation of that beach took place subsequently to the æra of the cave animals, since, without doubt the tide in its elevation to that point would wash out the contents of intervening cavities, and throw up the more durable and resisting substances in common with the pebbles which indicate its precincts. Together with the bones of the above named animals are some of a large description of *Whale,* respecting the age of which a doubt may rationally exist;—they may have been portions of carcasses partaken of by the carnivorous creatures of the antediluvian æra, or they may be fragments only of individuals of more modern times, washed up by the tide in the common way, and accidentally associated with the former specimens.

I learn from Col. Smith that a tusk of an *Elephant* has been found in soil towards Exeter, it was of that kind which presents the double curve.

It has occasionally happened that molars of the *Elephant* have been found thrown up on our beaches ; these may be either from caves now submerged, or due only to such as may have been thrown overboard from ships lying off the shore ; exact enquiry as to the markings these specimens present would alone determine the question.

We learn only from time to time the natural and antiquarian riches which this county has presented to us, and often without any use having been made of them. An ossiferous cavern presented itself to view at Stonehouse a few years since. Another, as I learn, was disclosed not long since at Anstess cove in Torbay. Other spots have also been similarly productive, and a small accumulation was detected (a few weeks after the geological portion of this work was printed) in a cave at Pomphlet Lake near us, and which I saw ; it consisted almost wholly of the teeth of the *Horse,* but the bulk was undoubtedly lost in blowing away the rock. Besides the occurrence of *ovine bones* at Yealm Bridge and at Berry Head, they were found amongst the accumulation at Oreston ; ovine teeth from thence are in my possession. Their presence among our fossil bones constitutes a peculiarity in the geology of this district.

The cave at Berry Head known under the name of Ash Hole, presented us with many singularities. We discriminated 3 or 4 species of *Mus, (Arvicola Fleming)* and as the cave at Yealm Bridge did not seem to furnish this number so unequivocally, the engravings here given are from specimens from the former locality. *Fish* bones, belonging to several species, fragments of the head of a *Fringilla,* and of a *Corvus* were amongst its products. The horn of a *Deer* analagous to the C. capreolus, and the skull of a very small *Ox* have also very lately been dug out. The Rev. H. Lyte in his researches found the stump of a *shed* horn of the *Elk* in a small fissure near Ash Hole, and reposing in clay, and some few years previously, a single *Elephant's* femur was removed from a similar and adjacent locality,—facts which shew the influence of a flood in carrying this class of fossils into their present situations. It would now seem that the number of species of *Deer* belonging to the ossiferous caves is even greater than was first thought, there is first the *Elk,* which I would here observe by the way, seems to me possessed of specific characters which separate it from the creature of the same name recognized amongst *alluvial* deposits, as also equally from the existing Elk of the northern countries (see Annals of Phil. vol. xix. p. 305) ; 2dly, one of the *size of C. dama ;* 3dly, one whose skull is about the same size, but differently shaped from that of the Fallow Deer, and perhaps having the horns above described as somewhat like those of the Roe ; 4thly, a very small species ; and perhaps to these might be added a 5th, whose lower jaw is a foot long.

I cannot avoid expressing my conviction in conclusion of these desultory remarks, that much is capable of being yet added to our knowledge of fossil bones, and that consequently the opinions of any author on this important subject should be read with great reserve of private judgment, and not with the impression that nought remained to be added to them, or to be subtracted. The folly of adopting any definite theory of the sizes of these extinct beings relatively to those now existing, (and which furnish names to the former merely from the circumstance of similarity in appearance of their bones,) as well as the folly of prospectively precluding the discovery of new species in this department, will be seen by reference to the 2nd Vol. of Menageries, p. 377, et seq.

Quæ minimo quidem naturalia in spatio inveniuntur terrarum, ea omnia ad pernoscenda, hujusmodi rerum indagatorum perscrutantium, summi, et non-intermissi conatus vere postulantur.

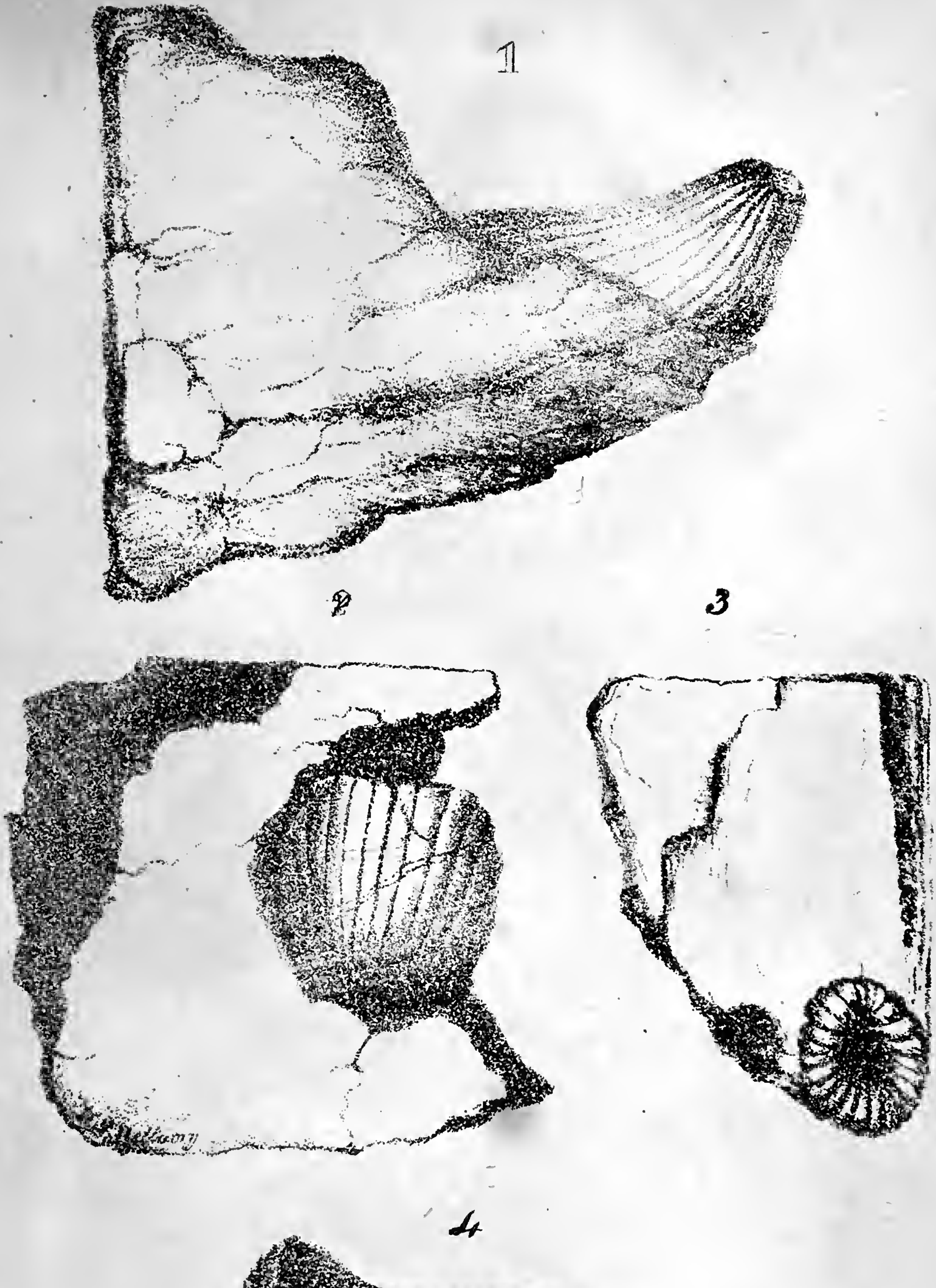
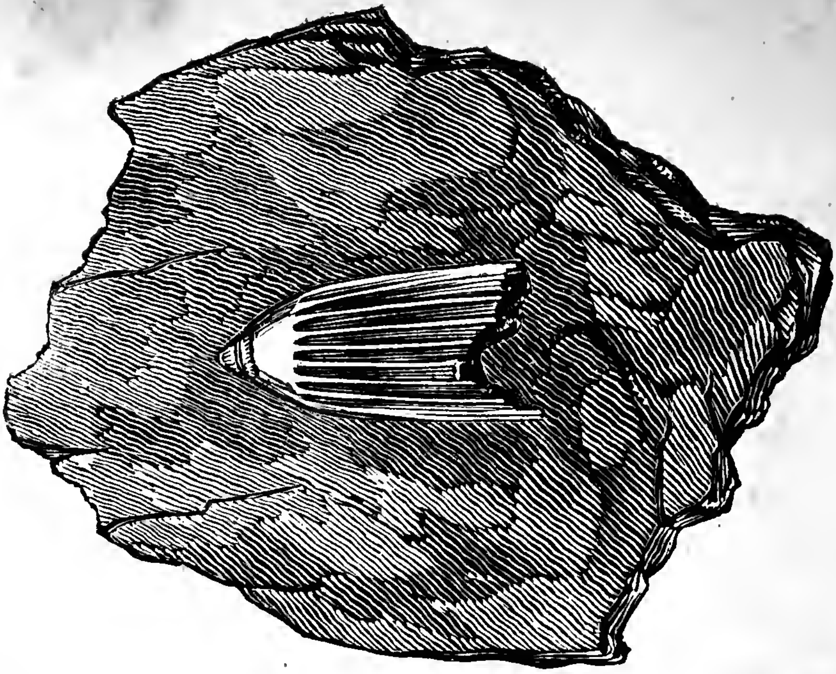


TABLE. 1

A. M. Bellamy, del.

W. Briggs Lithog

1



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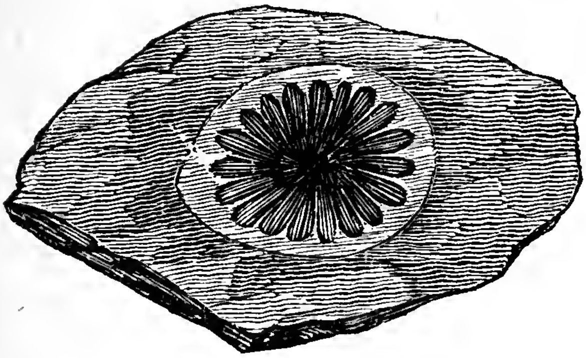

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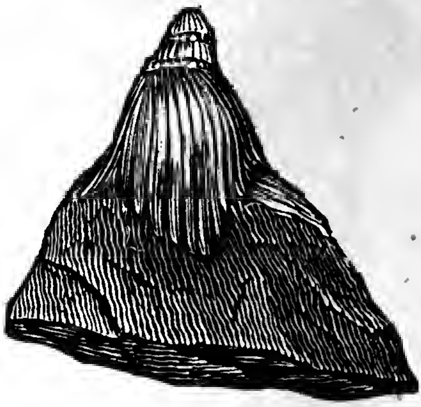

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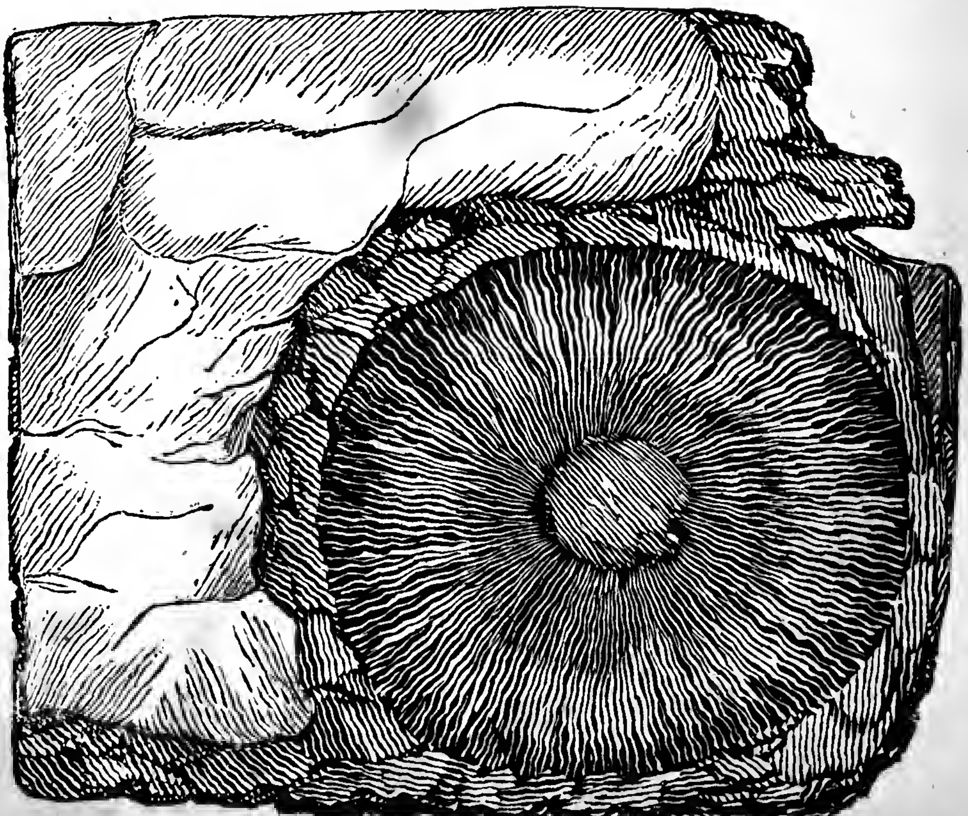

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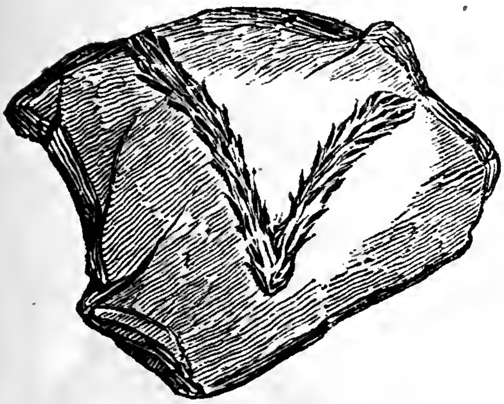

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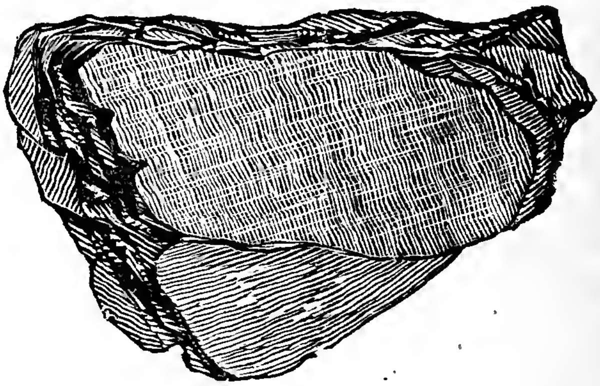

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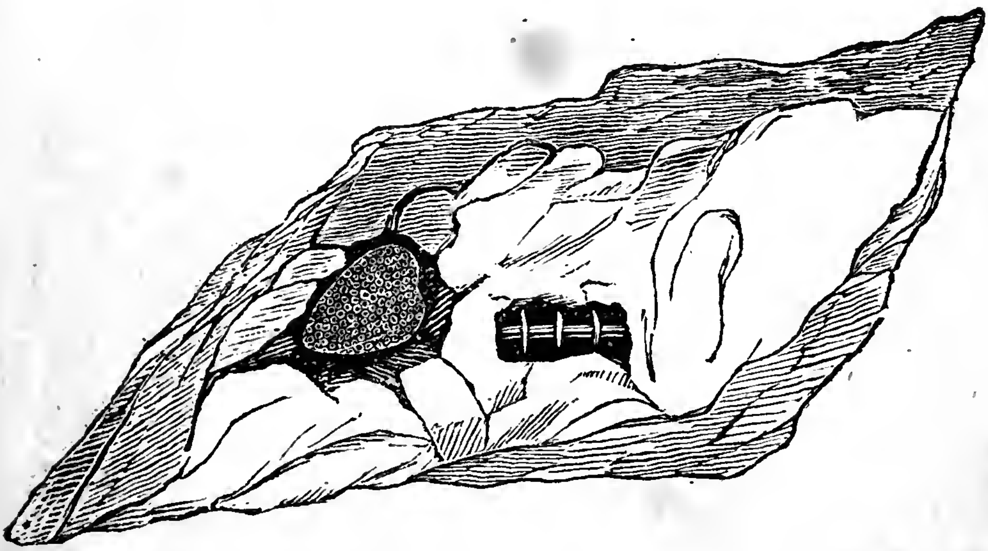

A. M. B., del. **Hearder, sc.**

TABLE 2.

1

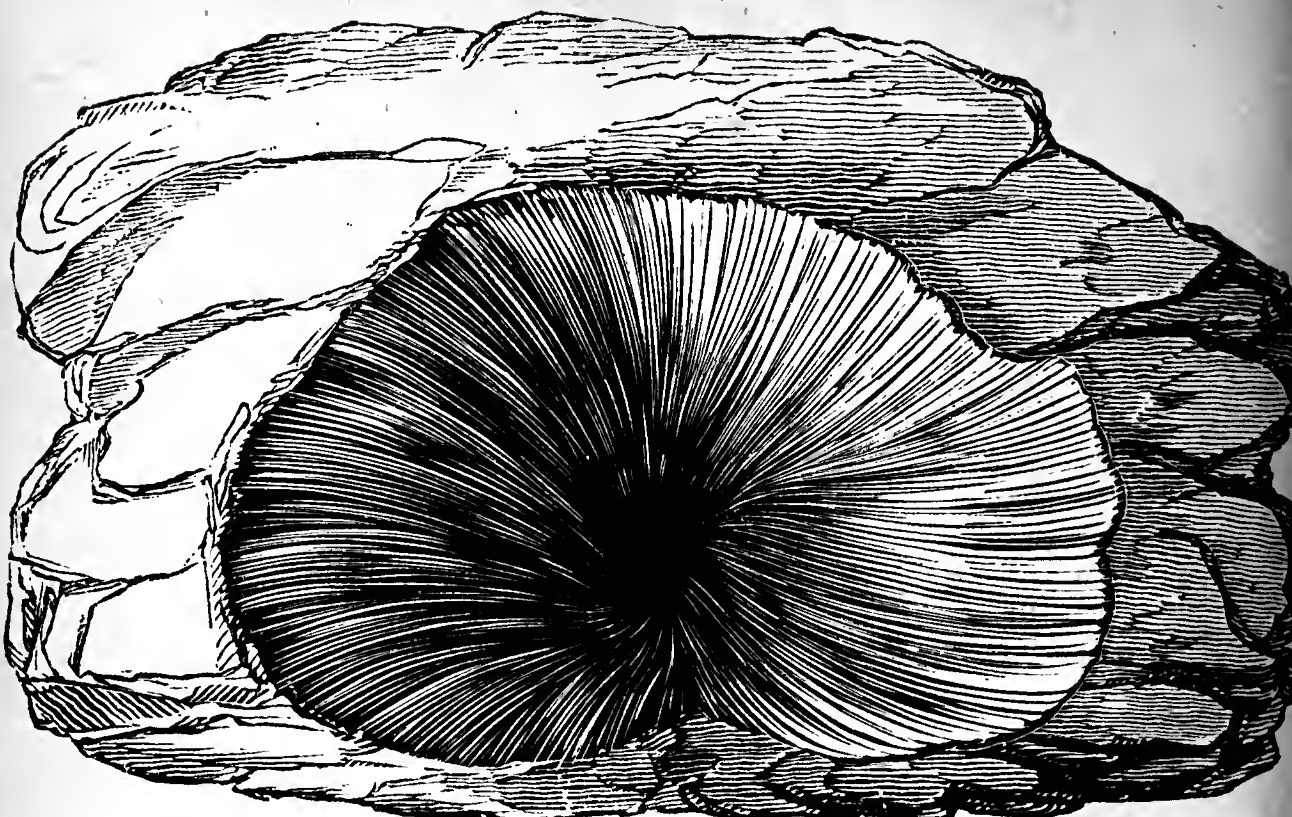

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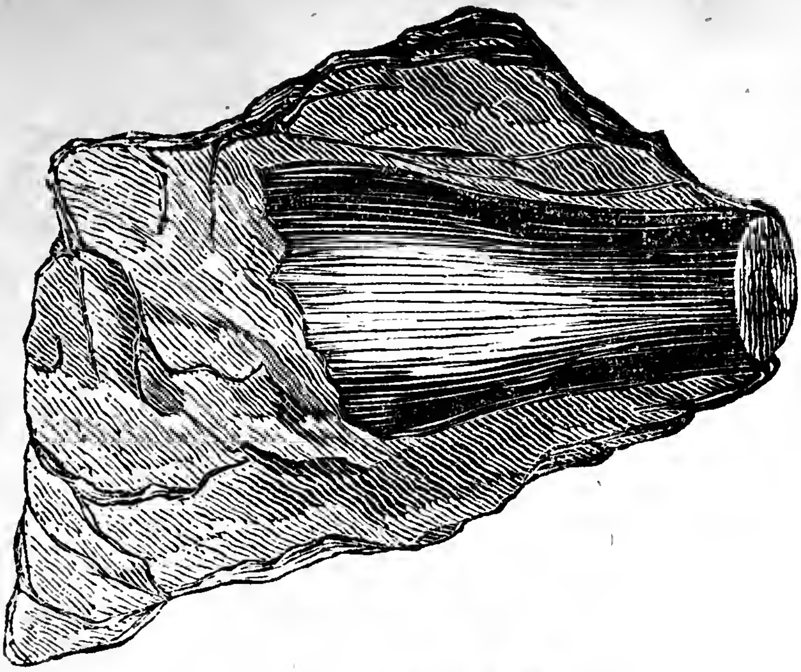
TABLE. 3

A. M. B. Del.

3



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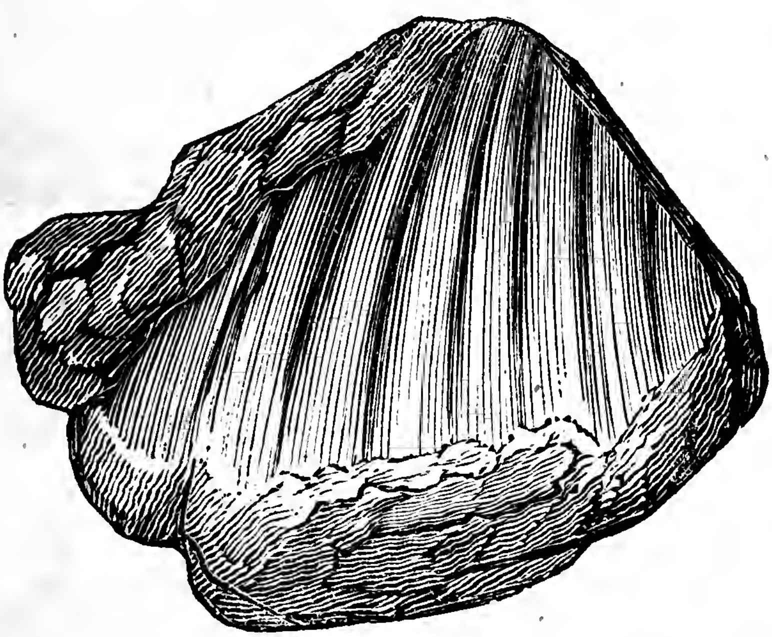

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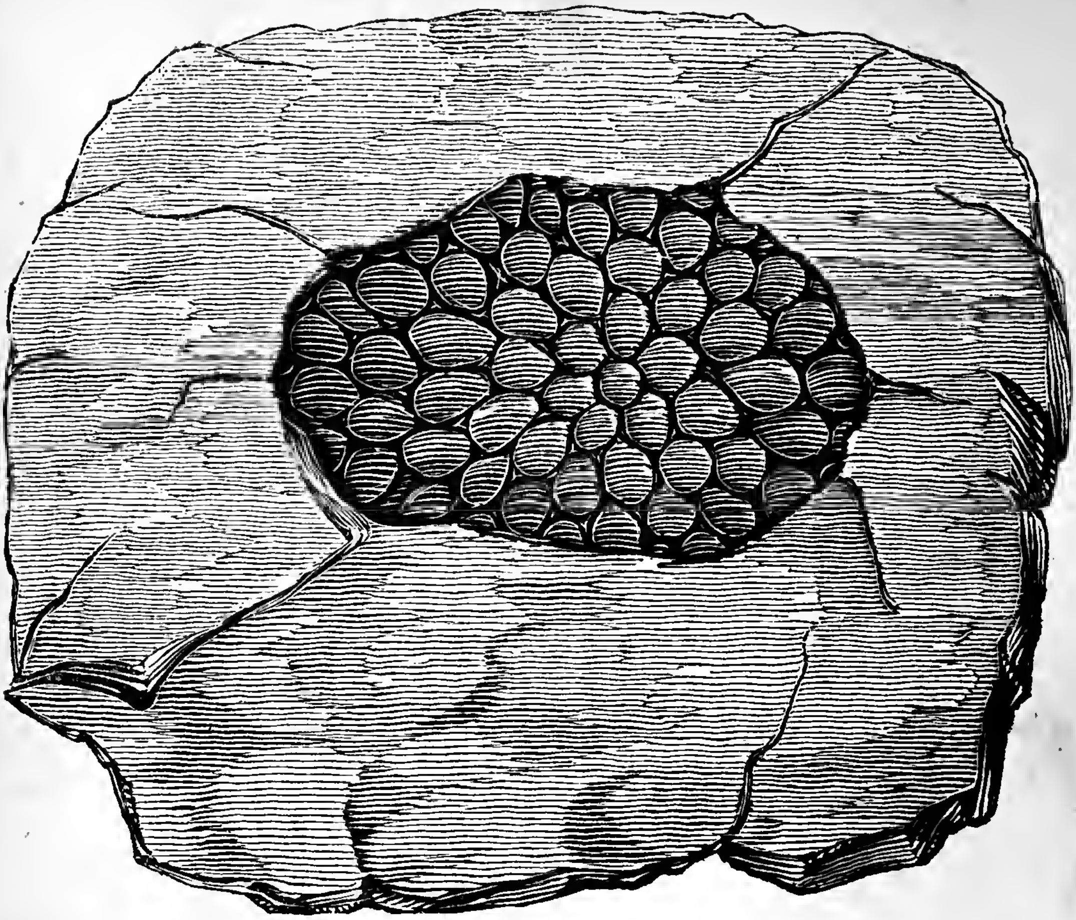
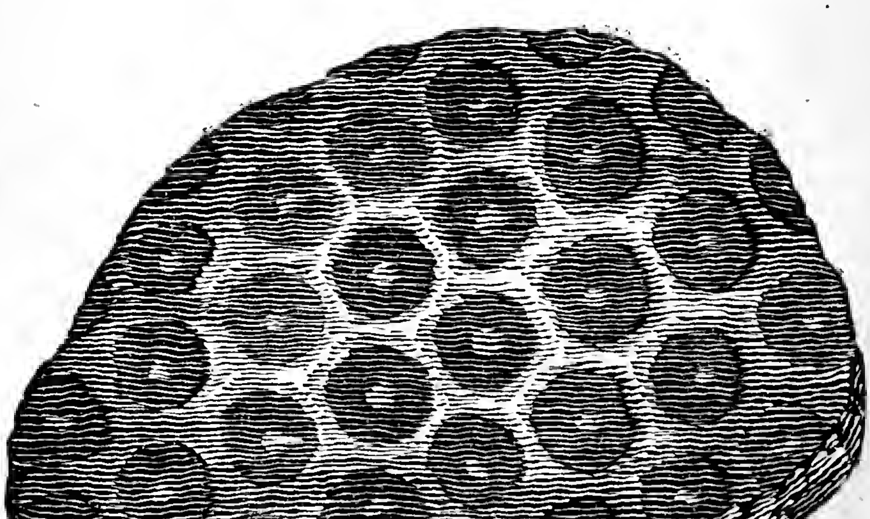


A. M. B., del.

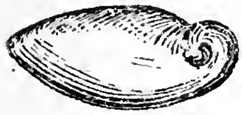
2



Miss C. Jones, del.

TABLE 4.

3



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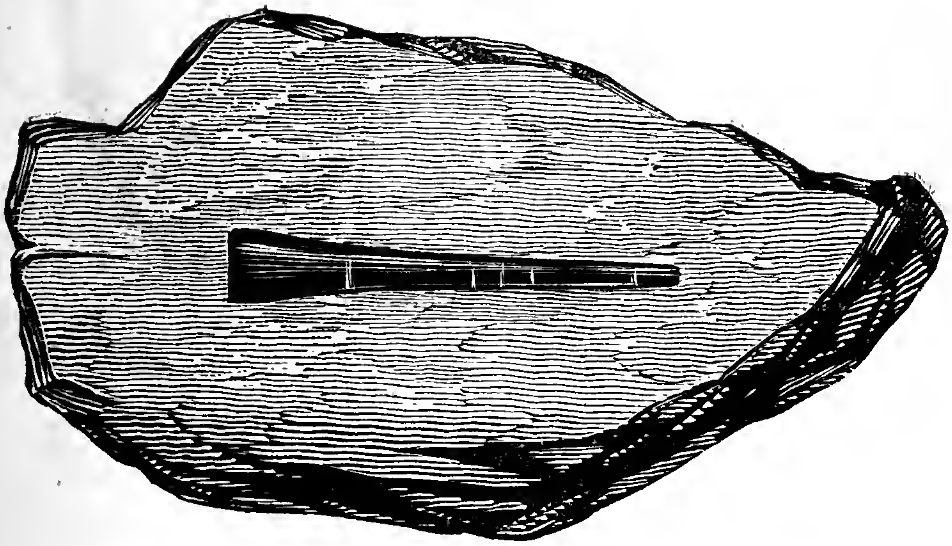

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A. M. B., del.

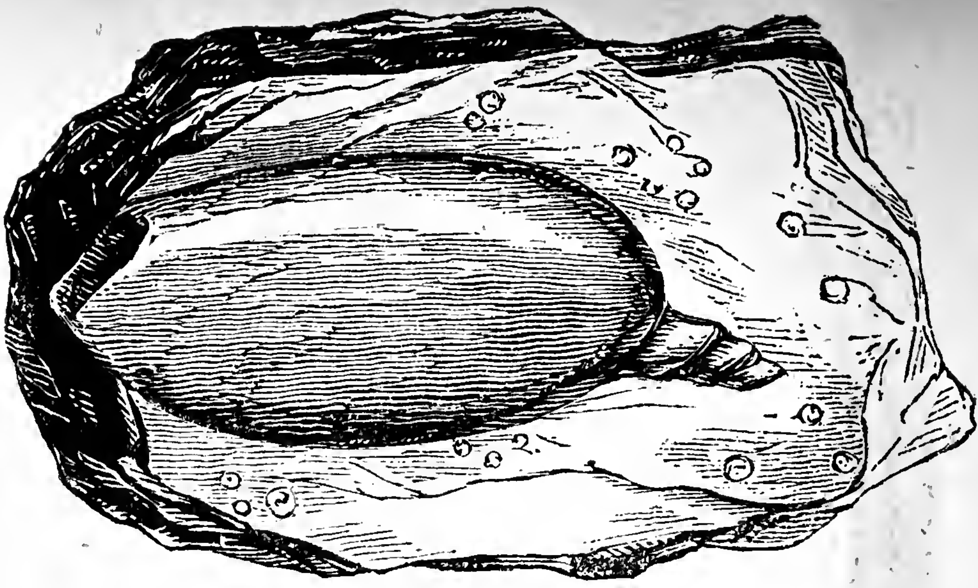
Hearder, sc.

TABLE, 5

A. M. Bellamy

W. Briggs, Lithog.

1



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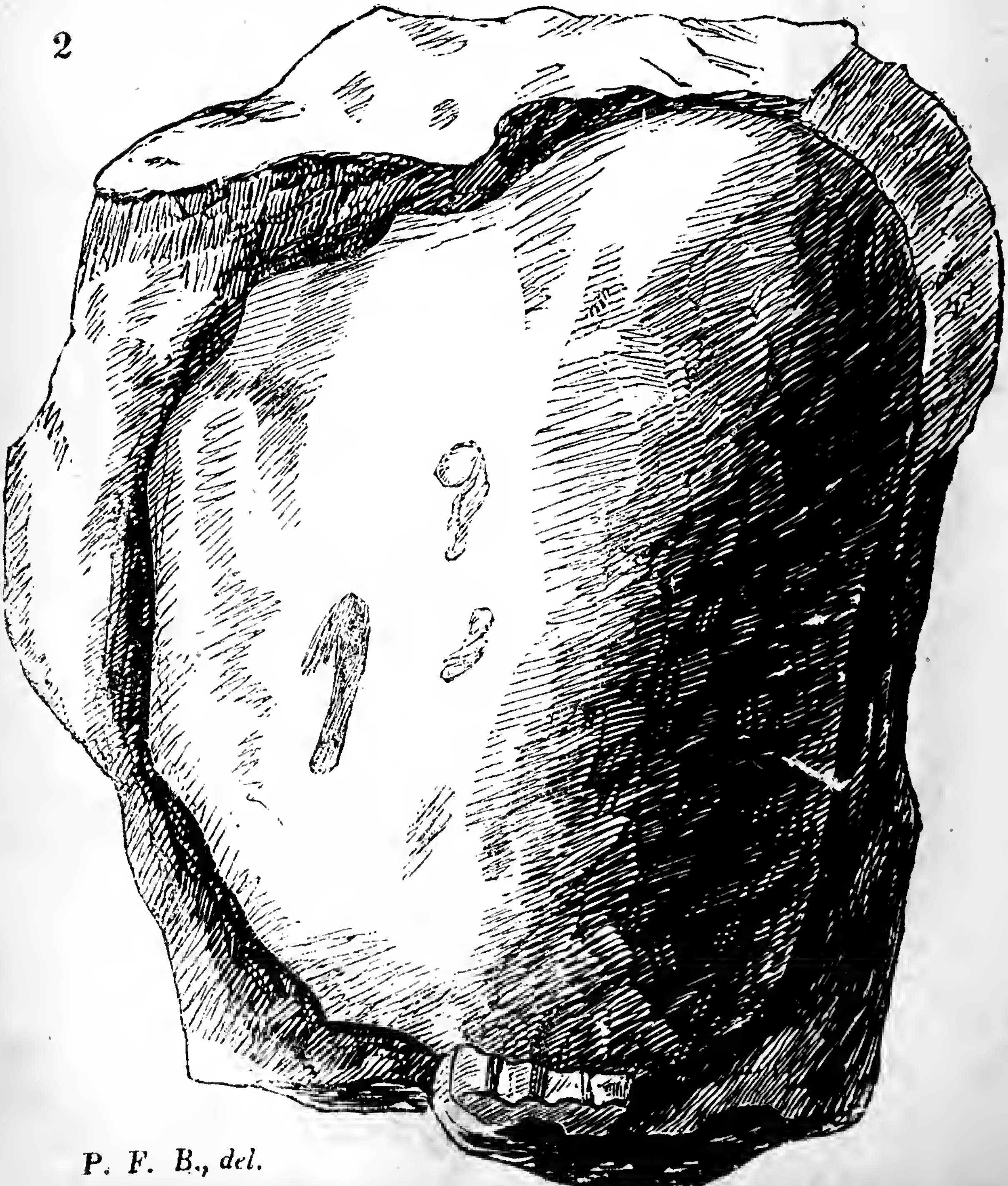
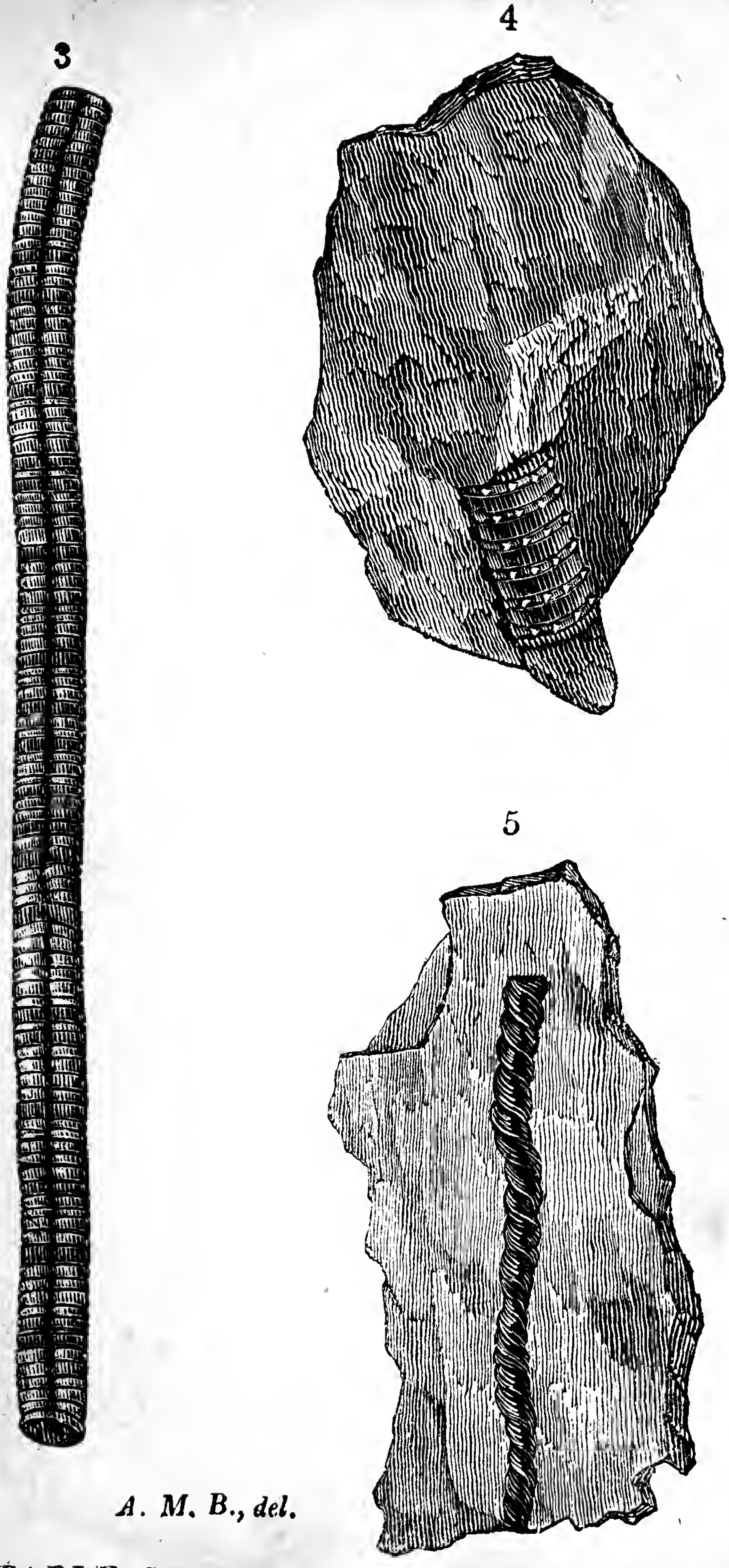


P. F. B., del.



A. M. B., del.

TABLE 6.

Hearder, sc.

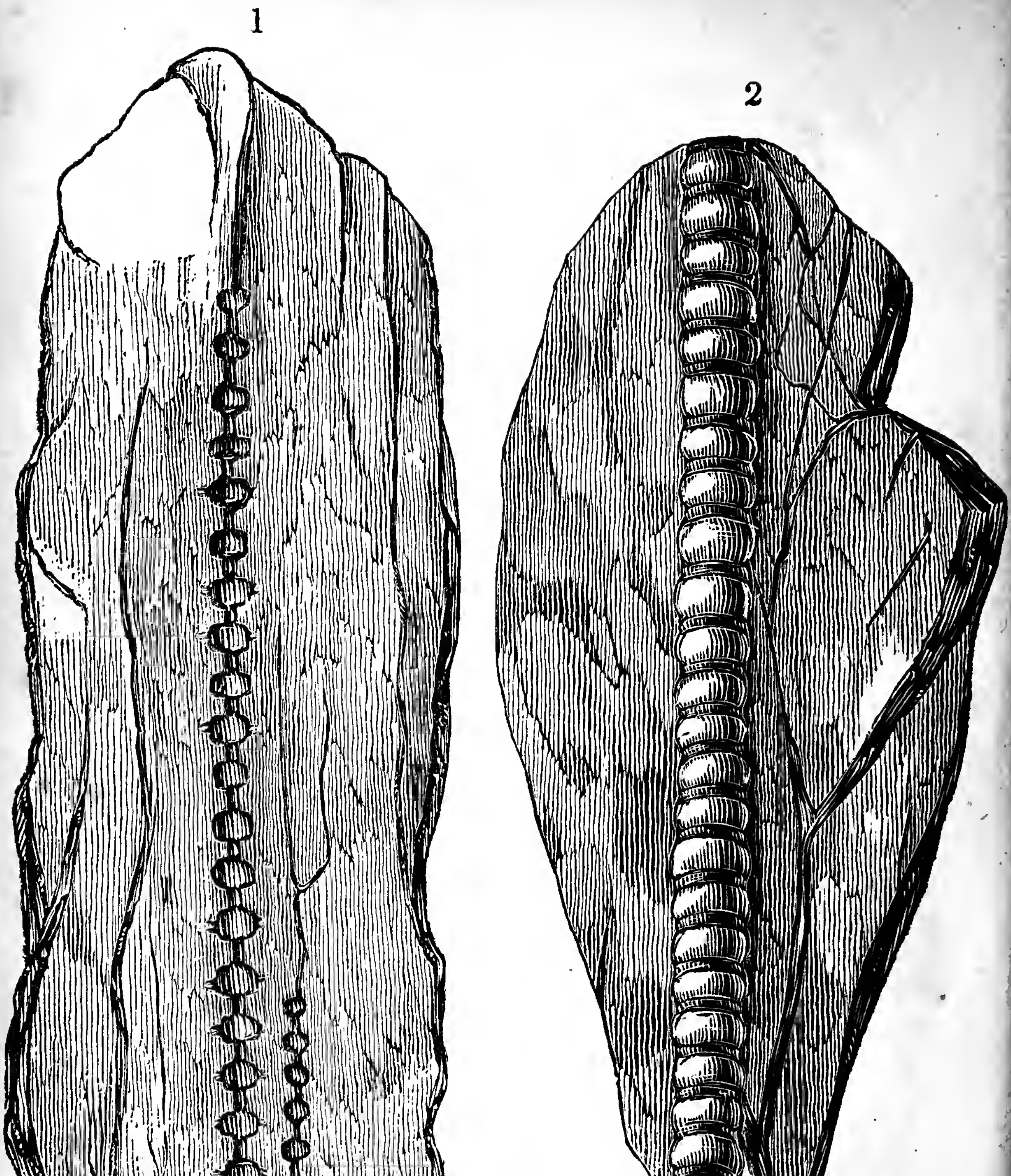
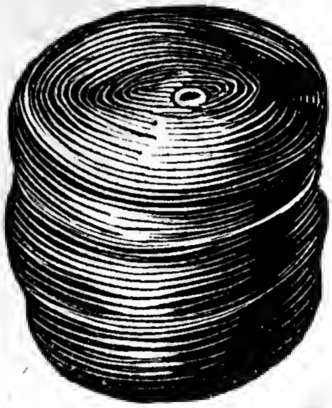


TABLE. 7

A. M. B. Del.

Hearder, sc.

3



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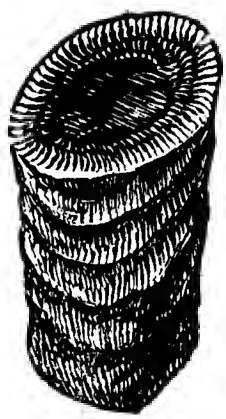

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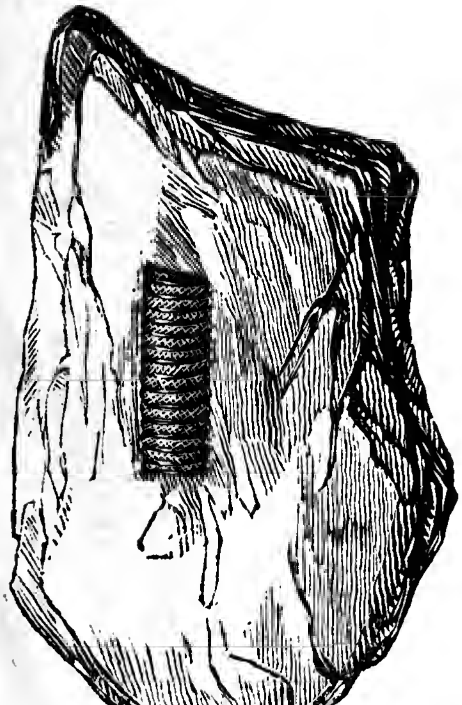

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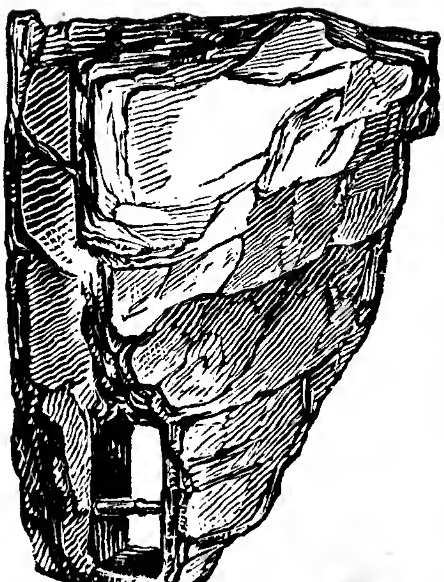

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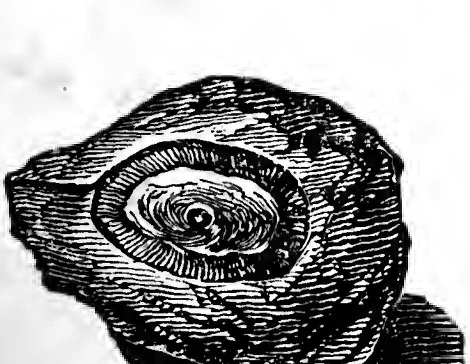

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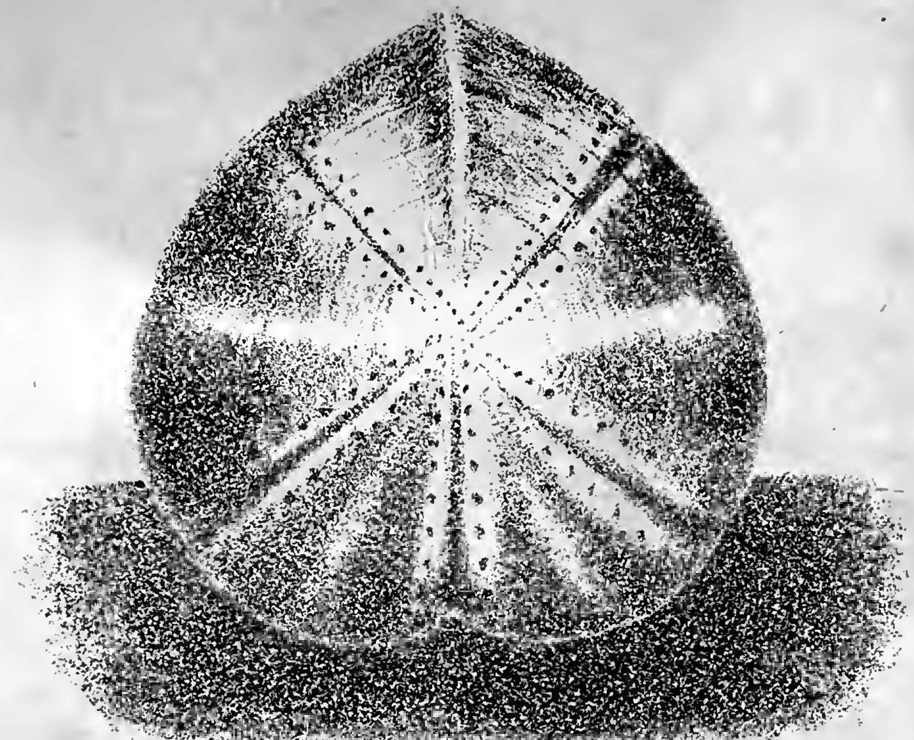
C. Jones.

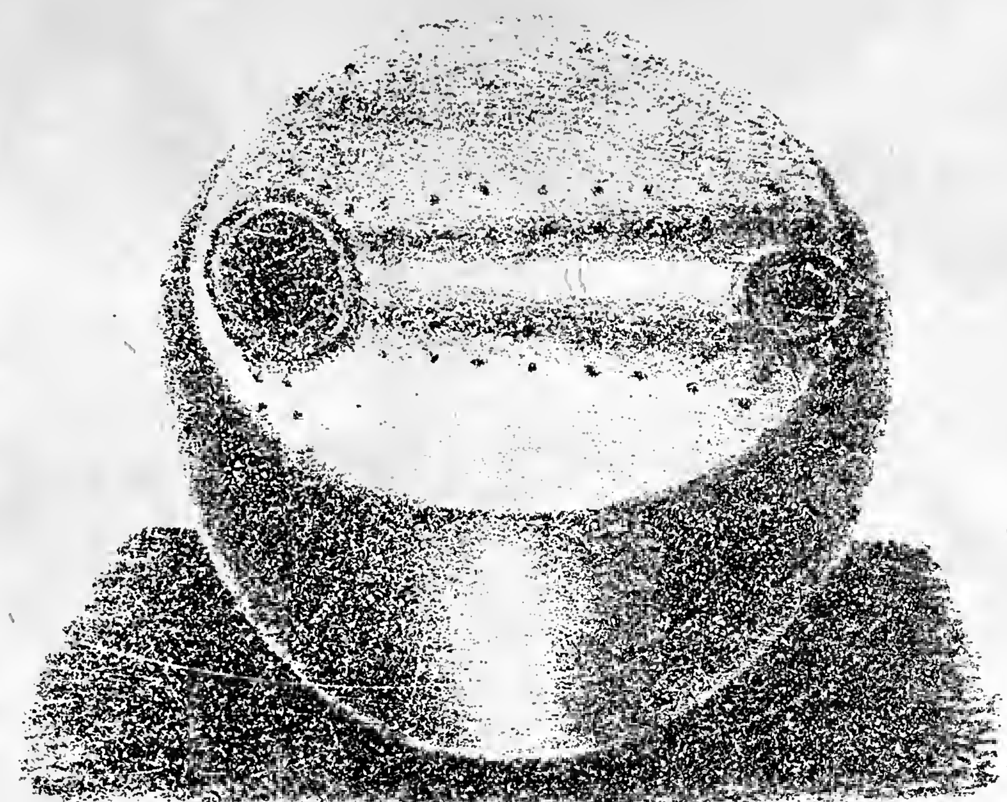
AMB



TABLE, 8

A. M. Bellamy

W. Braggs Lithog



TABLE, 9

A. M. Bellamy, del. W. Bridges, Sculp.

1

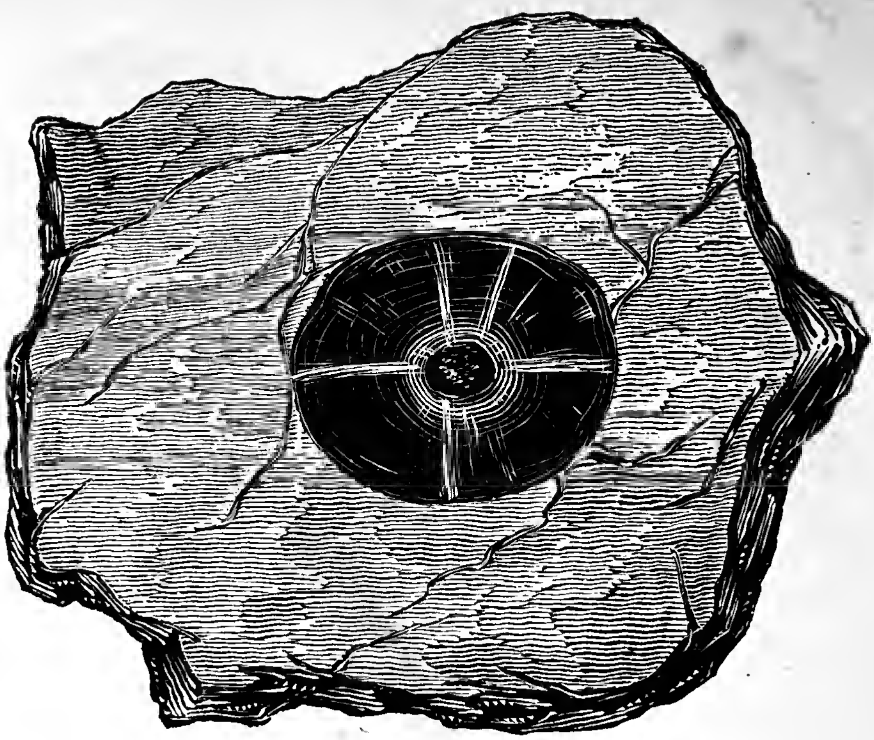


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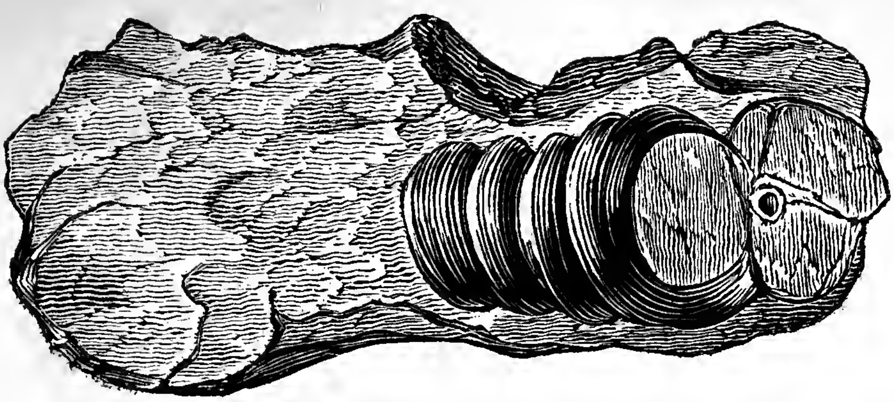
TABLE. 10

A. M. B., del.

3



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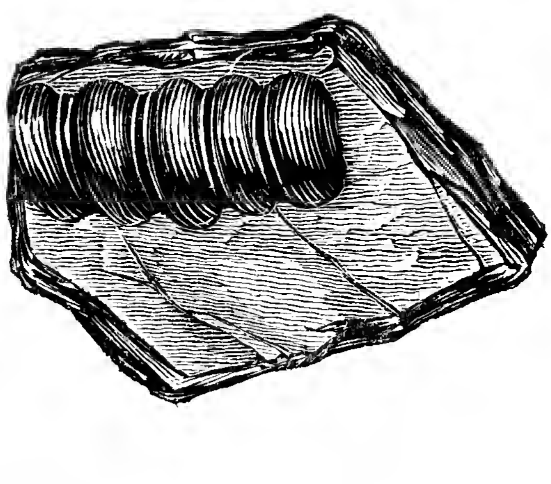

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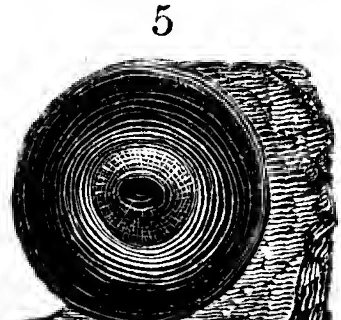


Hearder, sc.

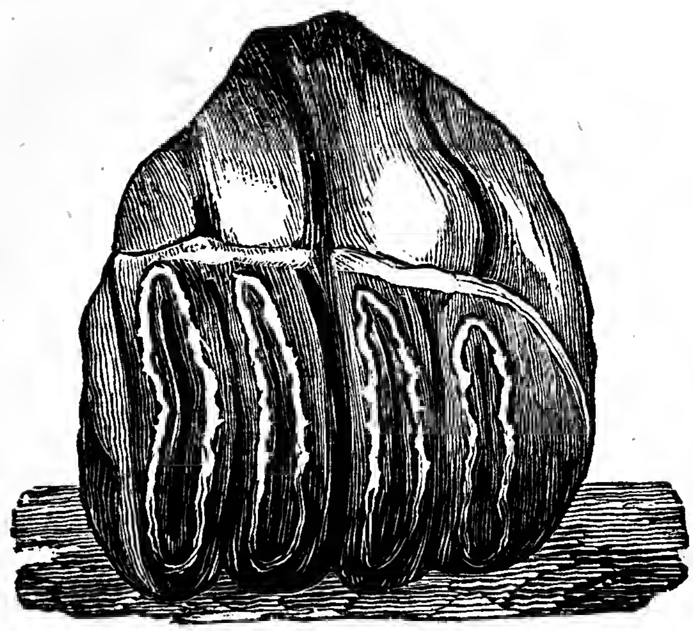
ELEPHAS.

1

TABLE 11.

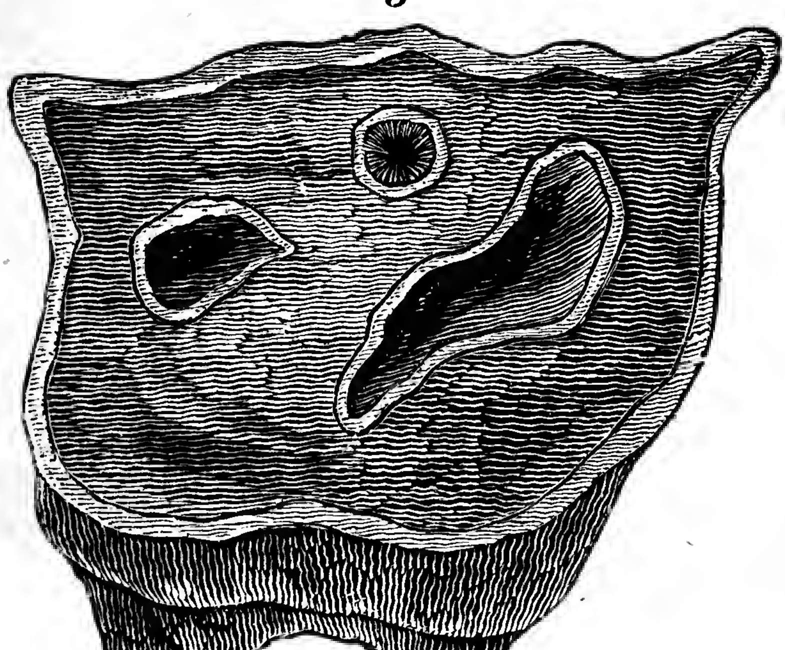
ELEPHAS.

2



A. M. B., del.

3

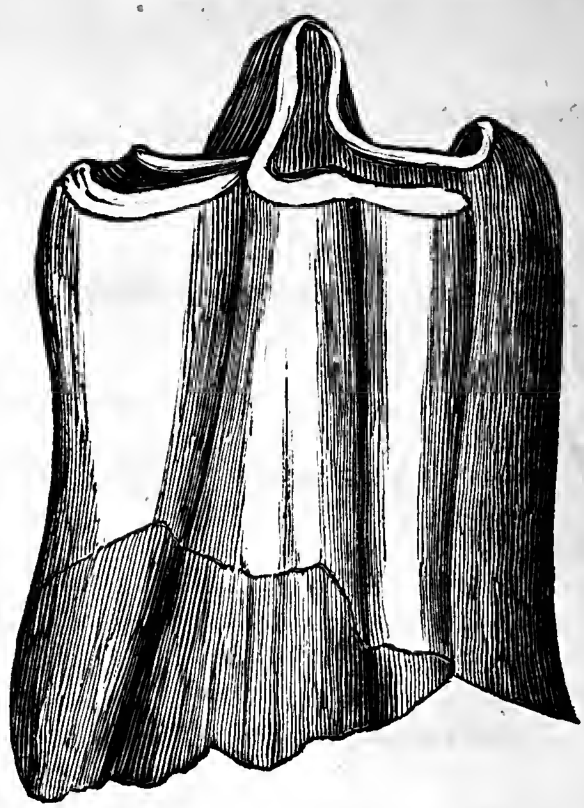


RHINOCEROS.

Hearder, sc.

RHINOCEROS.

1



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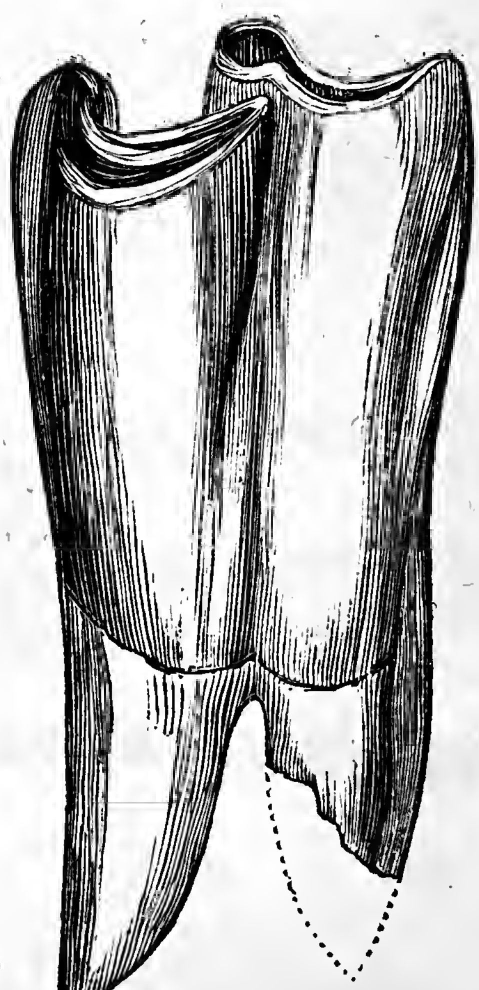
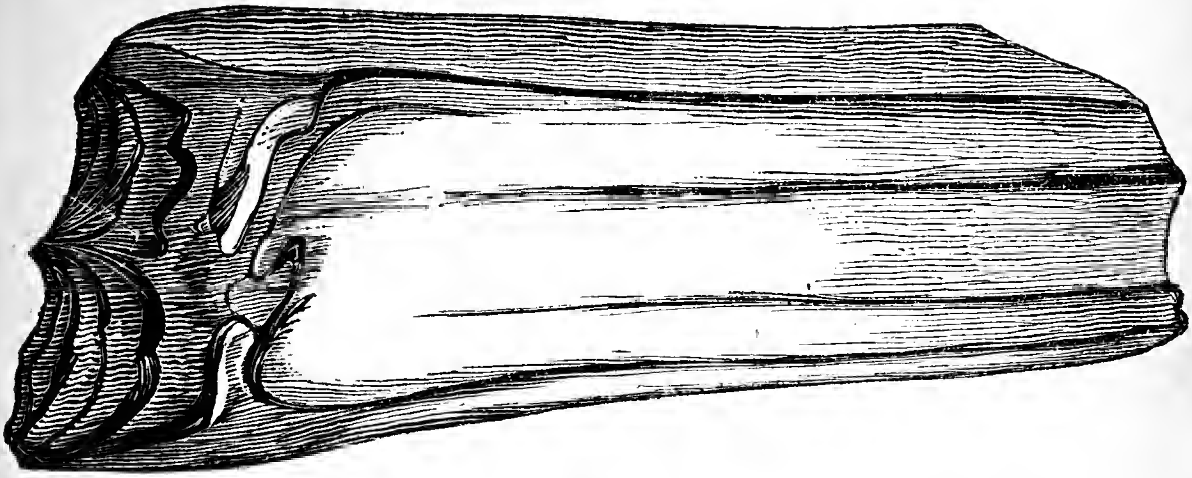


Hearder, sc.

TABLE 12.

EQUUS.

3



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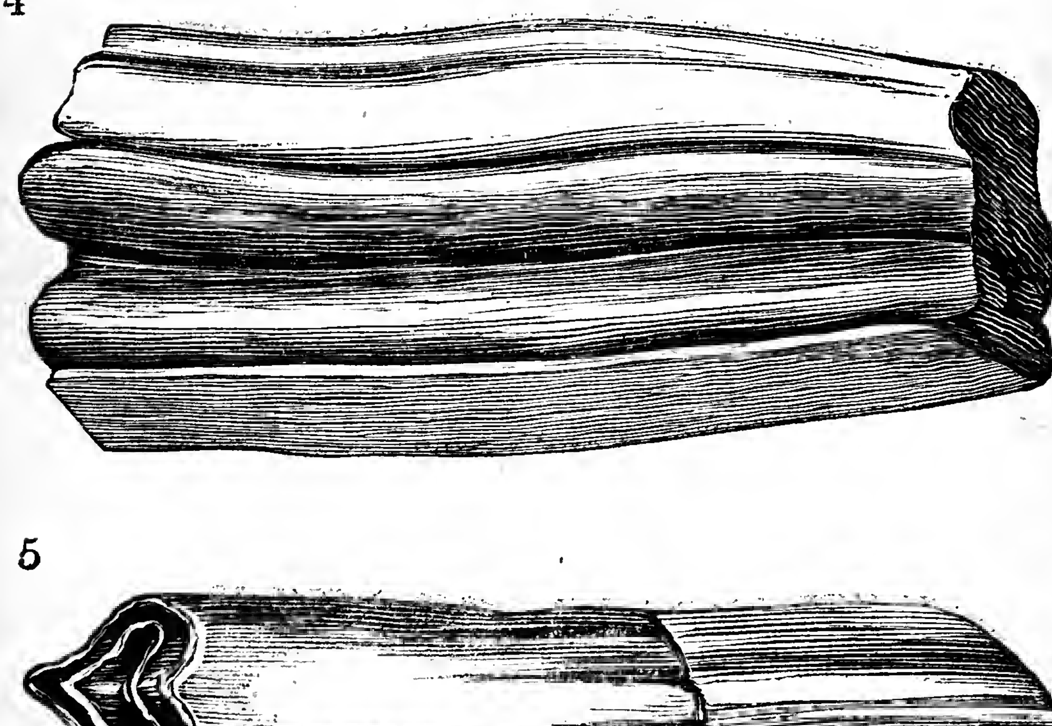

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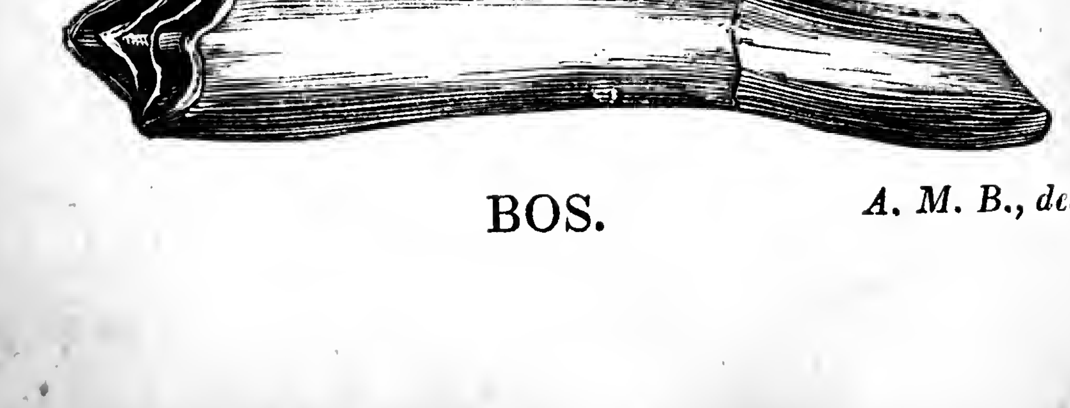


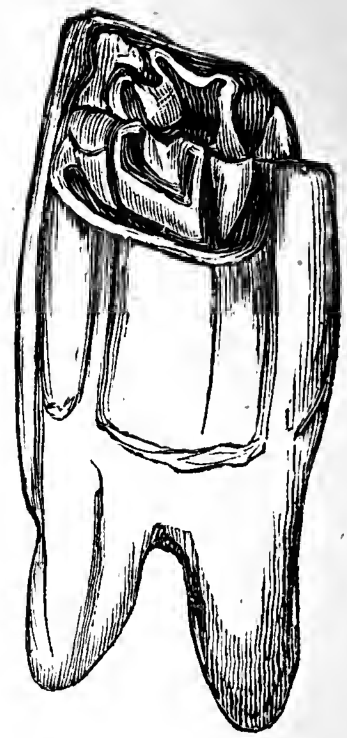
BOS.

A. M. B., del.

BOS.

1

2



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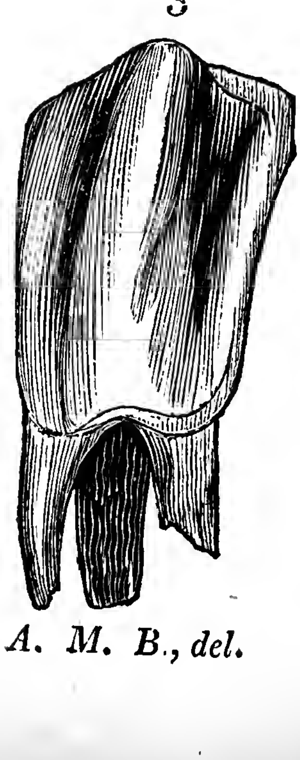

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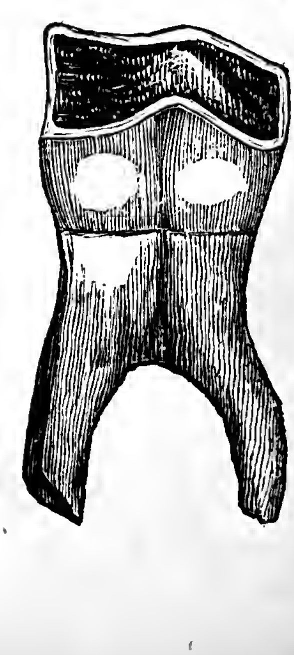
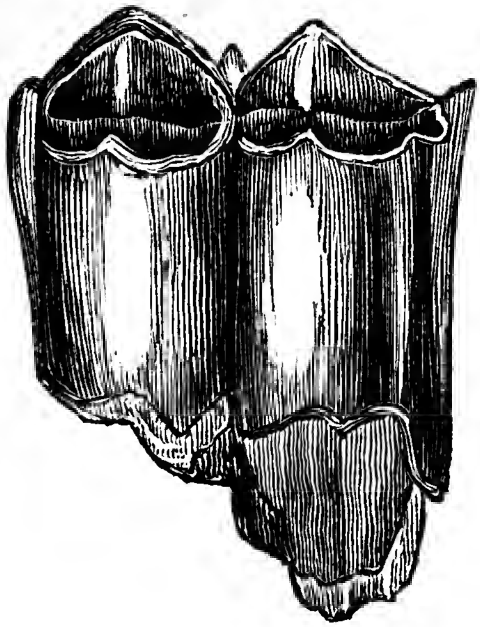


A. M. B., del.

CERVUS.

5



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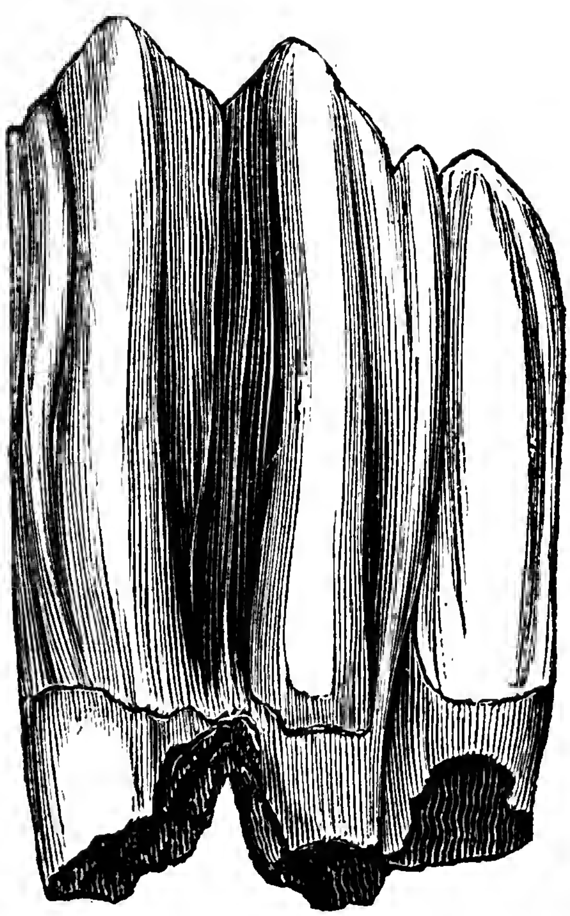
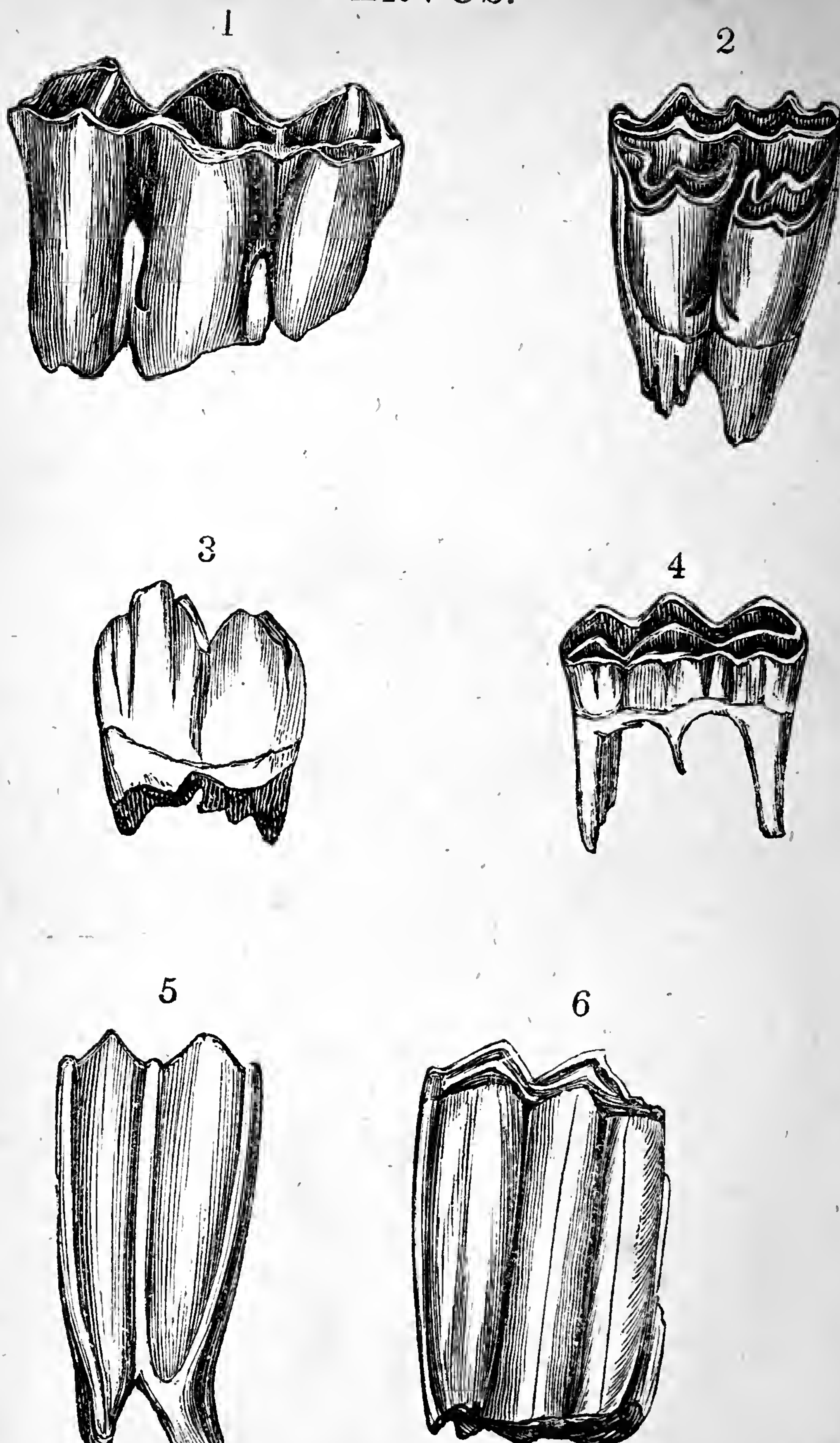


TABLE 13.

Hearder, sc.

CERVUS.



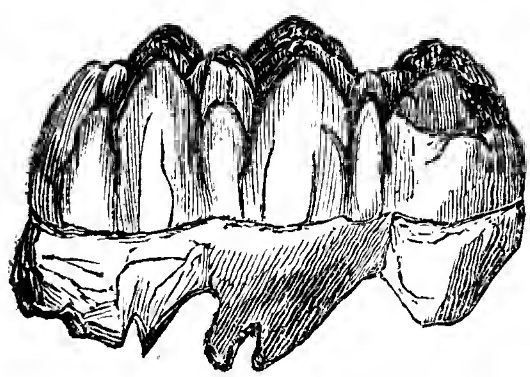
A. M. B. del.

OVIS.

SUS.

7

8



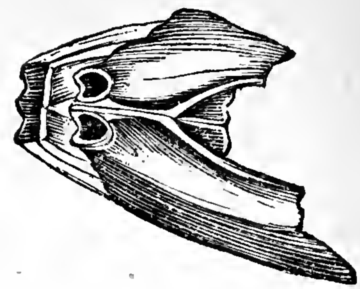
9

Hearder, sc.

TABLE 14.

LEPUS.

1



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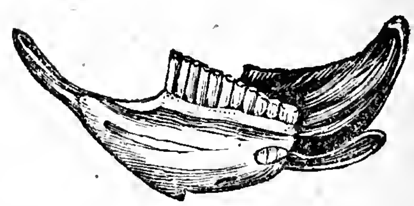


3

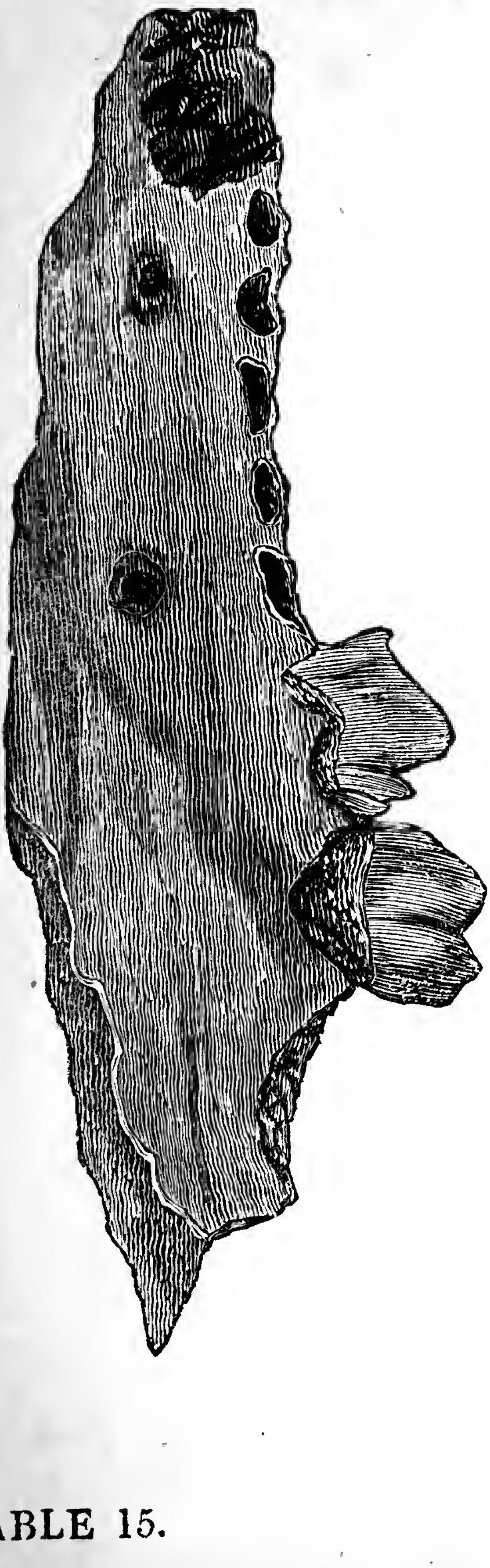
4

A. M. B., del.

ARVICOLA. *Lacep. Flem. &c.*
(Mus Linn.)

CANIS. HYÆNA.

5



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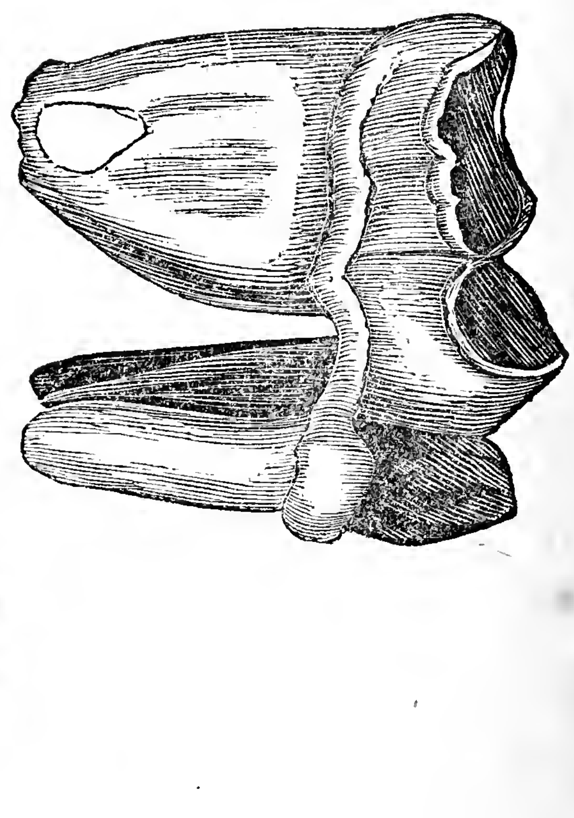


TABLE 15.

Hearder, sc.

URSUS.

1

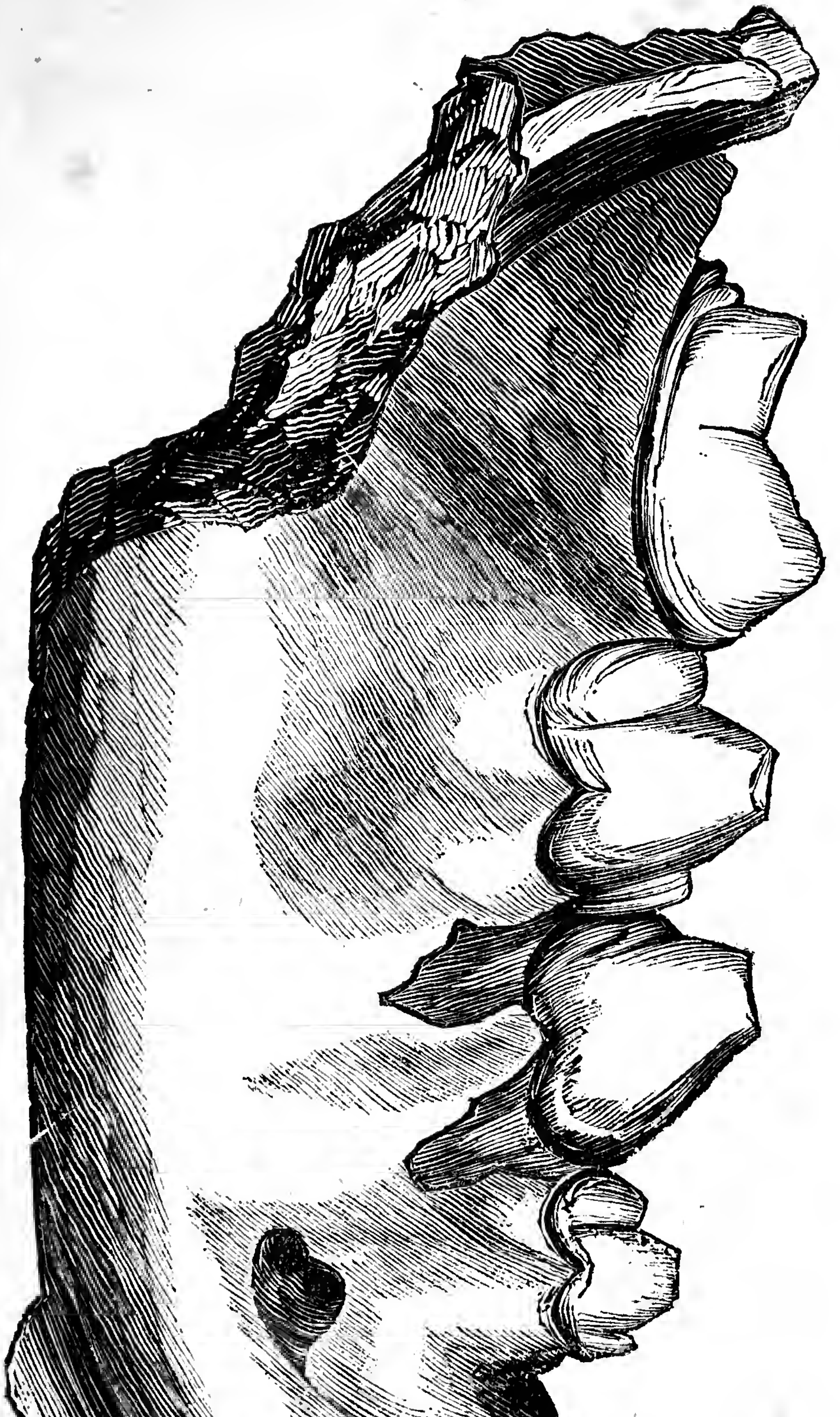
2

[Unascertained.]

A. M. B., del.

TABLE 16.

HYÆNA.



3

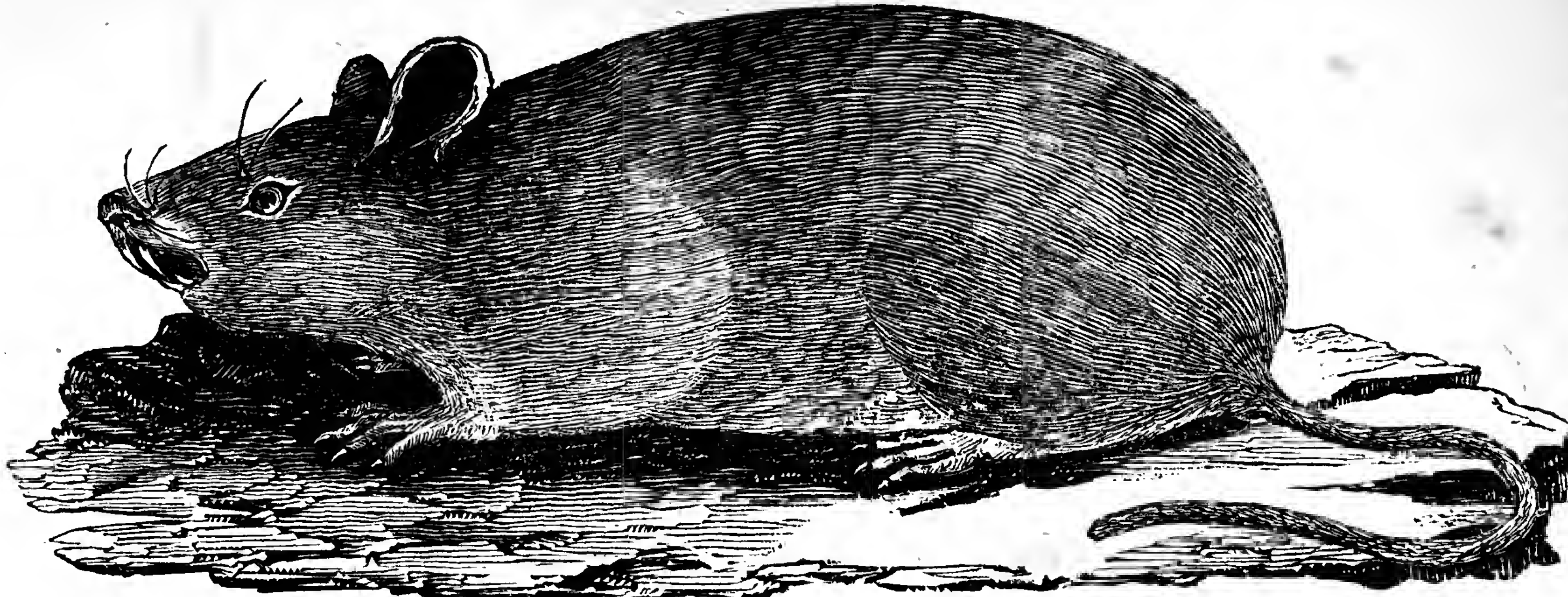
Hearder, sc.

TABLE 17.

T. E. GOSLING, DEL.

[Nat. Size.]

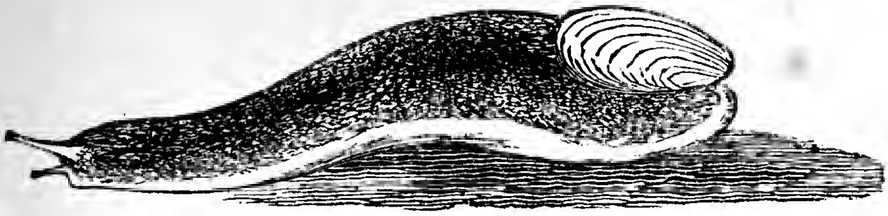
ARVICOLA HIRTA. (J. C. B.)



T. E. GOSLING, DEL. HEARDER, SC.

[Nat. Size]

MUS INTERMEDIUS. *(J. C. B.)*



T. Colley, del.

TESTACELLA MAUGII. (*Fleming.*) *vide p.* 246.

T. Colley, del.

HELIX SUBVIRESCENS. (*J. C. B.*) *vide p.* 418.

P. F. B., etched.

CARYOPHYLLEA SESSILIS. (*J. C. B.*) *vide p.* 330.

TABLE 18.

INDEX.

SUBSCRIBERS' NAMES.

Adams, Capt.	1
Avent, Esq. N. Surgeon	1
Bartlett, Esq. G. F. S. A.	1
Bayly, Esq. J.	1
Bedford, His Grace the Duke of	1
Beer, Esq. J. Solicitor	1
Bellamy, R. N. Lieut. J. H.	1
Bignell, R. N. Capt.	1
Blanckley, R. N. Capt.	1
Blewett, Esq. J. E.	1
Borwell, Rev. J. H. C. *Plymouth*	1
Boswarva, Mr.	1
Briggs, Miss, *Charles Place*	1
Brown, Rev. T. *Ivybridge*	1
Bulteel, Esq. J. C. *Fleet.*	1
Butter, Dr.	1
Codd, Esq. E. S. *Norley House*	1
Cole, R. N. Mr. *Woodside*	1
Colley, Esq. John L.	1
Colley, Esq. T.	1
Collier, Esq. William	1
Collins, Esq. W.	1
Cooban, Esq. G. Surgeon	1
Coppard, Rev. William J. *Plympton St. Mary*	1
Couch, J. Esq.	1
Creyke, R. M. Capt.	1
Cummings, Mr. Charles	1
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