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The atlas of nature : being a graphic display of the most interesting subjects in the three kingdoms of nature, for study and reference. [1823]

London: Printed for Sir Richard Phillips and Co. by J. and C. Adlard , [1823]

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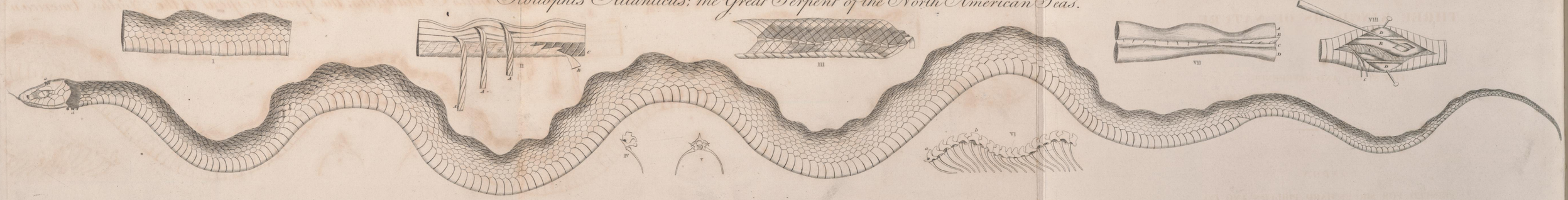
THE FALLS OF NIAGARA.

Scoliophis Atlanticus; the Great Serpent of the North American Seas.



London Published April 4th 1821 by S.R. Phillips & Co.

THE

ATLAS

OF

NATURE,

BEING A

GRAPHIC DISPLAY

OF

THE MOST INTERESTING SUBJECTS

IN THE

THREE KINGDOMS OF NATURE,

FOR STUDY AND REFERENCE.

LONDON:

PRINTED FOR SIR RICHARD PHILLIPS AND CO.

BY J. AND C. ADLARD, 23, BARTHOLOMEW CLOSE;

AND TO BE HAD OF ALL BOOKSELLERS.

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PREFACE.

THE Plan of an ATLAS of NATURE arises from the effective manner in which the Graphic Arts have been exerted, within the last century, to display Nature in all its parts. Such a work could not have been meditated till within the present generation, as the materials were not sufficiently abundant for its completion with taste and effect. The labours of men of science have co-operated to produce the results exhibited in this volume, which could never have had existence without the modern system of uniting artists with voyagers and travellers, and without the combined labours of those literary and scientific institutions with which the civilized world has for many years been filled.

At the same time these combinations would remain useless to the bulk of mankind, without such a selection and union as is presented in the present volume. The labours to which we have alluded, and which are here arranged in an economical form, are scattered through expensive works and voluminous series of Transactions of Societies. Many of them also have become scarce and almost unattainable. Such an assemblage, therefore, as is presented in this volume, confers practical utility on the labours of a century; and, without such an assemblage, those labours would have been merely objects of isolated curiosity or luxurious gratification.

By means of such an accumulation of materials, it has therefore become as practicable to exhibit the interesting details of Nature in the compass of an Atlas, as to exhibit plans of countries in the same form; and hence an ATLAS of NATURE, which seizes on its most interesting features, becomes synonymous to an Atlas of Geography, and possesses similar uses for study and gratification. As an object of study, its pretensions are so high, that any person previously unacquainted with the wonders of Nature will, in a few hours, acquire more accurate knowledge than can be obtained by the study of years in the usual manner. In this respect its utility applies to all ages, for all are interested in the study of Nature: but to young persons of both sexes, such a volume, as a means of enlarging their minds, is above all price. These conclusions are so obvious, and a moment's inspection of the book will so fully justify them, that to insist on them by formal argument would be a waste of time. It is calculated, therefore, that, as soon as the plan of the work is understood by the public, it will be anxiously received in all families desirous of being distinguished for good intelligence, will be adopted in every seminary of liberal education, and be considered as an essential part of every library.

The Plates were executed in the first instance to illustrate a comprehensive popular work, under the title of **NATURE DISPLAYED**; wherein are given exact and copious details of the several objects in genera and species, and in the pages of that work the whole have been inserted. The series of Engravings thus prepared, proving to be one of the most extensive which had been made for the illustration of Nature, and an **ATLAS of NATURE** appearing to be a legitimate design, considered merely as a collection of Engravings, the whole have been printed in their present separate form. As, however, many persons who possess themselves of this Atlas may desire the illustrative letter-press, it has been prepared in three volumes, without a duplication of the plates, and may in that form be purchased, with or without this Atlas.

Nevertheless, in the hope of rendering the Atlas complete, as a substantive work, such descriptions of the plates have been introduced as will render unnecessary any reference to the text by persons who have no desire to pursue their enquiries further; while, if an inspection of this volume should stimulate further enquiry, the letter-press will satisfy the utmost range of curiosity: but this Atlas stands alone, and has no greater connexion with the three volumes of letter-press, than a collection of maps has with books of illustrative geography.

For the more precise information of the public, it may not be improper to describe the form of the work, and the prices at which it may be purchased of any Bookseller.

I.

This Atlas, by itself, at Two Guineas.

II.

The Letter-press, done up by itself, in three Volumes, at One Guinea and a half, in boards.

III.

The Letter-press with the plates, done up in Six Volumes, forming a complete work of NATURE DISPLAYED, at Three Pounds.

In the arrangement of these terms, the Publisher has been governed by the expectation that the work will become one of general currency, the prospect of which alone justifies so moderate a scale of price. The great cost of books of Natural History, particularly with coloured Engravings, has hitherto operated as an obstruction to its study; and, in the present volume, the most interesting objects have been introduced which are to be found in works that would cost at least One Hundred Guineas. Of this fact, every one will be sensible who is acquainted with books on these subjects; and it may therefore be presumed that the publication of this Atlas will tend greatly to promote the study of Nature.

LONDON: June 16, 1823.

ATLAS OF NATURE.

DESCRIPTION OF THE ENGRAVINGS.

1. THE SOLAR SYSTEM.

The centre of the engraving represents the system of the Sun and Planets, in which an approximation is made to exhibit the relative distance of their orbits, from Mercury the nearest, to Herschel the most remote, that has yet been discovered. The several orbits are designated by the hieroglyphic characters used by astronomers, and, for the purpose of making the references accurately, those characters are explained, and the distances and bulk of each planet given:—

	Miles distant from the Sun.	*Diameters.*	*Periods.* *d.*	*h.*	*m.*	*s.*
☿ Mercury	36,774,320	3,130	87	23	15	44
♀ Venus	68,716,569	7,700	224	16	49½	
⊕ Earth	95,000,000	7,914	365	6	9	12
♂ Mars.....	144,760,806	4,200	686	23	30	39
♃ Jupiter.....	494,265,155	91,000	4,332	14	19	
♄ Saturn	906,183,000	77,680	10,758	23	17	
♅ Herschel	1,822,413,975	34,170	30,688	17	6	

The four small planets, or asteroids, are introduced between Mars and Jupiter, and their great ellipticity is rendered apparent, by their orbits crossing each other. The earth's satellite, the four of Jupiter, the seven of Saturn, and the six of Herschel, are also introduced.

The twelve signs of the Zodiac are affixed round the whole for completeness; but, as the planets are always progressing in their orbits, their signs, and the position of the planets, have no relation to each other, as expressed on the plate. The diffusion of the solar light, and of its power on the planets, is indicated by the radiation, and are every where inversely as the square of the distance from the sun in the centre.

The corners of the plate are indicated by figures, as seen through a telescope, of Venus, in two positions from the Sun; of Jupiter, and his belts; of Saturn, and his ring; and of Saturn's ring, as it appears in various parts of the orbit.

2. VARIATIONS OF DAY AND NIGHT, AND THE SEASONS.

This engraving represents the effects which arise on the earth, from the Sun being at one season perpendicular over the Northern Hemisphere, as in our Summer; and at another season, being perpendicular over the Southern Hemisphere, as in our Winter: the upper and lower figures indicating the equal effect on both Hemispheres, when the Sun is vertical in the equatorial parts. It is the same thing whether we consider the axis as inclined to the orbit, and always parallel to itself; or whether we suppose the axis to be perpendicular, and the orbit to ascend and descend 23½ degrees.

To render this subject at once more picturesque and familiar, we have introduced a finished engraving, in which the axis of the earth is represented by S, S, and the equator by T; and by following the earth from the spring in the northern hemisphere at March, and going round the zodiac to June, September, and December, observing the effect of the axis being always inclined the same way, the reader will obtain a clear idea of the cause of the inequality of day and night, and of the alternation of winter and summer in both hemispheres.

If we take a globe or round ball of any kind, and carry it round a candle in the same plane or level, with the axis perpendicular, it is evident that the candle will uniformly shine directly upon the central parts, and its light will just reach the top or bottom of the globe during the entire circuit; but, if we want to light and warm the two polar parts, or top and bottom successively, then we must do one of two things—we must either make the globe ascend or descend in its orbit round the candle, or we must turn the axis a little on one side, and carry the globe round, with the axis always inclined exactly towards the same parts; and by either means we shall alternately cause the top and bottom to incline from and towards the candle.

3. THE EARTH'S ELLIPTICAL ORBIT.

A, B, C, D, represents the annual orbit of the earth. R is the perihelion, the nearest point to the sun; and, Z, the aphelion or most distant point; Y is the centre of the elliptic; S, L, is the earth's mean distance from the sun; and S, Y, measures what is called the eccentricity of the orbit. The unequal direction of the shadows on the earth, as it moves round the ellipsis, produces an inequality of the length of the day, which occasions the clock to be sometimes before the sun, and sometimes after.

4. THE SPOTS IN THE SUN.

When we look at the sun through a telescope, even of a moderate power, we discover on his surface many black, or rather less bright, spots of various sizes and shapes.

1. These spots will sometimes vanish in a very short time after their first appearance; sometimes they travel over his whole disc, or *visible surface*, from east to west, when they disappear, and in twelve or thirteen days re-appear again, so as to be known, by their magnitude and figure, to be those that had disappeared before. Those, however, which are of the longest continuance, do not appear to have much solidity of consistence, for after some time these also vanish, or become bright like the rest of the surface.
2. Every spot which has a nucleus, or dark part, has also an umbra, or fainter shade, surrounding it.
3. The boundary between the nucleus and umbra is always distinct and well defined.
4. The increase of a spot is generally gradual, the breadth of the nucleus and umbra dilating at the same time.
5. In like manner the decrease of a spot is always gradual, the breadth of the nucleus and umbra diminishing at the same time.
6. The exterior boundary of the umbra never consists of sharp angles, but is always curvilinear, how irregular soever the outside of the nucleus may be.
7. The nucleus of a spot, while on the decrease, often changes its figure, by the umbra encroaching irregularly upon it, insomuch, that in a short space of time new incroachments are discernible, whereby the boundary between the nucleus and the umbra is perpetually varying.
8. It often happens, that, by these incroachments, the nucleus of a spot is divided into two or more nuclei.
9. The nuclei of the spots vanish before the umbra.
10. Small umbræ are often seen without nuclei.
11. A large umbra is seldom seen without a nucleus in the middle of it.
12. When a spot, which consisted of a nucleus and umbra, is about to disappear, if it be not succeeded by a facula, or spot, brighter than the rest of the disc, the place it occupied is, in a very little time, not to be perceived.

5. RELATIVE SIZES OF THE PLANETS.

This engraving represents not merely the relative sizes, but the phases of the planets as they are usually seen through a telescope. The belts of Jupiter and the wonderful ring of Saturn are conspicuous. Taken in round hundreds of miles, the diameter of Mercury is 31; Venus 77; the Earth 79; Mars 42; Jupiter 910; Saturn, 777; and Herschel, or Uranus, 342.

The forces which occasion the several parts of the masses to keep together, or fall towards their centres of motion, occasion the polar diameter of the earth to be shorter than the equatorial, as 331 is to 332; that of Mars, as 15 to 16; that of Jupiter, as 13 to 14; and Saturn, as 10 to 11.

6. TELESCOPIC APPEARANCE OF VENUS.

As this planet is nearer the sun than the earth, its dark side is presented to us when it is between the earth and the sun, and its entire illumined side when it is beyond the sun. Hence, as it passes through its orbit the intermediate phases are assumed by Venus just as in the moon. If Venus moved in the same plane as the earth, we should see

her pass across the sun every time she is between the earth and sun; but this can only happen when she is in or near the point where the plane of her orbit crosses that of the earth, and then we have a *transit* of Venus. Under like circumstances, we have also occasional transits of Mercury. These transits, viewed from different parts of the earth enable us to determine the angle at which the earth is seen at the sun or the parallax, and therefore calculate the distance of the sun, and, by Kepler's Law, that of all the planets.

Venus, in the form of a crescent, and at her brightest times, affords a more pleasing telescopic view than any other of the heavenly bodies. Her surface is diversified with spots, like those of the moon: and by the motion of these we ascertain the time which she takes up in revolving upon her axis. With good telescopes, mountains, like those in the moon, may be seen.

7. TELESCOPIC APPEARANCE OF MARS.

The red aspect of *Mars*, as seen with the naked eye, is proved by the telescope to arise from the density of his atmosphere. His surface appears also to fluctuate in such manner as might be produced by clouds like those on the earth. We behold, however, the whole at once in combined forms, which have been represented by different observers, like those in the engraving.

Mars appears always round and full, except at the time of quadrature, when its disc appears like that of the moon about three days after the full. By the spots which are seen on its surface, its diurnal revolution has been ascertained. From its characteristic ruddiness and other phenomena, it has been supposed that its atmosphere is nearly of the same density with that of our earth. The luminous circles surrounding its poles are supposed to arise from the accumulation of snow about those parts.

8. THE COMET OF 1811.

This beautiful comet was visible from 25th of March to January, 1812, with an interval of three months, or from May to August, when it was in conjunction with the sun. Its orbit being inclined to the plane of the ecliptic 72° during the latter period of its appearance, it formed a grand object in the northern part of the heavens, till it became too distant to be further seen, either with the naked eye or telescope. Herschel determined its solid nucleus to be only 428 miles in diameter; but the conglomeration of its vapours he made 120,000 miles, and its tail, or luminous refraction of the solar rays through its atmosphere, was 100,000,000 miles long. It was in its perihelion, or nearest point to the sun, on the 12th September, distant 97,000,000 miles.

The following were its distances from the sun and earth on the days specified, in millions of miles.

	From Sun.	*From Earth.*
September 23d	99	132
October 2	103	120
——— 12	108	114
——— 22	116	116
——— 25	119	118
November 1	125	126
——— 17	141	156
——— 26	151	176
December 5	161	198
——— 14	171	219
January 1, 1812	191	260

It now became too faint to be visible, except through powerful telescopes. It will be seen by the table that it was nearest to the earth on the 12th of October. Its mean rate of motion, while visible, appears to have been 100,000,000 miles per day. The philosophy of comets is involved in great difficulty: nothing, however, can be less probable than the notion of their attracting the earth: such inert masses can have no effect on each other, except so far as they affect the intervening medium of space; the reflection of which medium is what is called a comet's tail, proving the universality of its existence.

This is a very exact representation while it appeared among the stars of the Great Bear. The tail was palpably nothing more than the solar rays refracted through the atmosphere of the comet, and divided in the middle by the denser nucleus: it is vulgarly called the tail, but in truth it was projected *before* the comet, and in a right line from the sun.

9. CLUSTERS OF FIXED STARS.

Herschel, by means of his powerful or space-penetrating telescopes, discovered that certain faint points in the heavens were not single stars, but clusters of innumerable stars, too distant to belong to our system or cluster of the Milky-way; but evidently separate systems of suns, distinct from the vast system which we see with a naked eye from the earth. These clusters are represented as they were drawn by Herschel, and published in the Philosophical Transactions. They subtended angles of from 8″ to 15″. Although the stars on the outside of the mass could be counted distinctly, yet the centre of the group was condensed into an indistinct clusters of stars.

10. MECHANICAL PHILOSOPHY.

Fig. 1, 2, 3, represent the various conditions of an heterogeneous aggregate in motion, or globular mass, consisting of bodies of various density, without general adhesion; the darkest parts being supposed to be the most dense; or the dark parts may be considered as solids, and the light parts as fluids.

Condition 1. *When such a mass is projected forward in a right line;*—it will presently assume the shape of a meteor, the dense parts moving foremost and nearest the line of motion, and the light parts being left behind.

Condition 2. *When the mass is revolved in the same part of space;*—it will assume the form of the annexed figure, *i. e.* the dense parts, as in fig. 1; will perform the swiftest motion; and revolve in the circumference; while the rare and fluid parts will perform the smallest motions near the centre.

Condition 3. *When the mass is impelled in a right line, and also revolved round its centre;*—the motion in the right line being greater than the rotatory motion. The rectilinear being greater than the rotatory motion, the phenomena of Condition 2 will be reversed, because the heavy parts will seek the line of greatest motion; while the train in Fig. 1 will be wrapt round by the simultaneous rotatory motion, and the masses will be at a distance from the centre proportioned to their rarity; and all dense bodies will, in such condition, be forced towards the centre. Such are the phenomena by which planetary masses aggregate, and heavy bodies fall towards the centre.

Fig. 4. This figure represents the effects of two forces acting on bodies on various parts of a planet's circumference; the one towards the axis, B, C, D, from the rotatory motion, and the other towards the plane of the orbit, A, C, E. Thus, if the bodies M and *m* are directed towards the axis at N and *n*, and towards the plane of the orbit at P and *p*, the two forces will cause them respectively to move in the diagonals, M C, and *m* C. So, also, with bodies at *a* and E *e*, and *d* and *g*; and, it is proved, by calculation, that, on the earth, these two forces or motions will cause the several bodies to fall to the earth at *b*, *f*, *c*, *h*, with a velocity of 16.1, in a second of time.

Fig. 5. *The radiation of motion in gas.* If we suppose a large surface, as a tambourine, to be moved rapidly from A towards B, it will urge the whole body of air in that direction with a diverging force, or with a force inversely as the square of the distance from the surface; and such is the law of all forces propagated through a gaseous or fluid medium.

If, at the same time, a globe of silver-paper, *a*, be suspended in the moved medium, and another small globe, 1, be also suspended, both globes will be moved by the action of the tambourine, to B and 2, respectively; and it is obvious that the large globe, *a*, will also urge the small globe, 1, while 1 will re-act on *a*, their action and re-action being in proportion to their bulks.

This serves to convey a rough idea of the action of the sun on the planets, and of the planets on their satellites, and on one another. Of course, the energy of the sun is continuous and regular, while the effect in this experiment is but a sudden impulse. But such, in general, are our imperfect representations of the great motions of Nature.

Fig. 6. *Theory of the Tides.* The earth and moon are considered as a system of bodies, moving round a common fulcrum; which fulcrum is the centre of the solar force acting on the system of two bodies, which act and re-act on each other through the gaseous medium of space. The fulcrum is, of course, in the right line which joins the centres of the two bodies. The waters on the earth are its moveable parts, which, by their mobility, are capable of restoring any disturbed equilibrium in the system of the two bodies. In the figure, the fulcrum always continues in the earth's orbit, being the centre of the solar action. When the earth is at A, and the moon at B, or when the earth is at C, and the moon at D, or in its quarters, then the two bodies move in coincidence with the fulcrum; no equilibrium is disturbed; and the moving waters exhibit no phenomena. This is the period of Neap-tides, when the tides are mere remains of former oscillations. But, when the earth advances to Q, or to G, then a disturbed equilibrium takes place, owing to the earth being pushed, as it were, out of the line of its orbit, by the re-action of the moon, at H and I respectively, and the waters rise towards the fulcrum, or in effect towards the moon. But, when the earth advances to K and L, and the moon to M and N, the effect is still further increased, by the increased distance of the earth from the centre of force; and the waters rise still higher towards F, or, which is the same thing, towards the moon at M and N. But when the earth progresses to O and P, it approaches nearer the direction of the centre of force at F, and gives a decreasing tide, but still directed, through F, towards the moon, at S and R respectively. The rise of the waters is made, therefore, towards the fulcrum, by simple mechanical action; and, the fulcrum being in the right line which joins the centres of the earth and moon, there is an apparent connexion between the moon and the tides. The second tide, in twenty-four hours, is merely the returning oscillation of the first tide, owing to the two seas being intercepted by continents.

11. TELESCOPIC APPEARANCES OF THE MOON AT THE OPPOSITION.

Our terrestrial satellite, as seen through a telescope of any size whatever, presents one of the most curious objects in nature. It exhibits a surface of pits, prominences, and valleys, always exactly the same, at the same age of the moon, but very different in the shadows at different ages. No clouds ever obscure any part of its surface, and only one side is visible from the earth. The drawing of this representation occupied the artist for several years, and it is, perhaps, the most accurate that has been produced.

The first circle represents the Moon in its progress round the earth, its enlightened side being always towards the Sun; and the outer circle represents the appearances of phases of the moon, as it appears to an inhabitant of the earth, in each corresponding part of its orbit.

12. PHASES OF THE MOON.

The sun, the fountain of light and heat, illuminates the moon and earth, and, of course, has opake spheres; each has a dark half and a light half. In the orbit of the moon she is successively represented in the several parts, as at A, B, C, D, E, &c. When at A, it is apparent that the whole of her dark side is towards the earth; and her shadow would then fall upon the earth, and intercept the sight of the sun, causing an eclipse of the sun, provided she were in the same plane as the earth; but, as her orbit ascends and descends, her shadow generally passes above or below the earth, and an eclipse does not take place, unless when, at A, she happens to be crossing the plane of the earth's equator, or is within a distance of 15 or 21 degrees from that point, called her nodes.

But, when the moon is at E, the whole of her illumined side is then presented to the dark side of the earth, and then she appears a full moon as at *e*; and now she would be in danger of being eclipsed by the earth's shadow, if the shadow did not pass above or below her, owing to her orbit not being in the plane of the earth's equator. The earth's shadow is, however, so much larger than that of the moon, that an eclipse of the moon takes place, if the full moon happen when she is between 18 and 13 degrees from her node or point where her orbit crosses the plane of the earth's equator. Of course, to the inhabitants of the moon, if she has any, this produces an eclipse of the sun. The enormous velocities of the heavenly bodies is proved by the measured fact, that the moon's shadow during an eclipse of the sun moves above 2000 miles an hour over the earth's surface, or four times as fast as that of a cannon-ball.

As the earth moves from D to D, it is evident that some of her dark side becomes visible, and she then appears as at *d*; and at C the half of each side is shown, and she then appears as at *c*; but, when she arrives at B, very little of her light side is visible, and she then appears as at *b*. The same appearances from the same causes may be traced in the other parts of her orbit.

It merits notice that the same side of the moon is always towards the earth; so that her day and night is as long as $27\frac{1}{2}$ of our days and nights.

13. TELESCOPIC APPEARANCES OF THE MOON AT THREE PERIODS OF HER INCREASE.

This beautiful engraving represents one of the most striking wonders of the telescope. It exhibits the progress of the solar light, over the moon's surface, which, from the jagged or serrated appearance of the illuminated and dark parts, is evidently covered with mountains and rugged inequalities. Of the nature of these nothing can be satisfactorily ascertained; but it is fully believed, that, from the sterile and uniform appearance of these parts, and from no clouds ever interposing, that the moon is without water and atmosphere, and consequently without vegetable or animal life, similar in truth to the bare primitive mountains of the earth. The mechanical action of the earth on the moon would raise its tides to 64 times higher than those on the earth, and affect all its fluids in like manner, at least on the side next the earth. If the moon, therefore, be habitable, it must be on the side which never presents itself to the earth. Those persons who suppose that the moon ought to be inhabited because it is so large a body, forget that all existence is subservient to the general harmony and physical fitness of things; and that the northern and southern regions of the earth, the sandy deserts of Africa, and the mountainous regions of the Andes, Alps, and the Himmalayas, quite as large as the moon, are destitute of inhabitants.

14. THE GREAT SOLAR ECLIPSE OF 1820.

Fig. 1, represents the moon entering on the sun; fig. 2, the centre; and fig. 3, the passing off: the moon having a north latitude, and therefore not obscuring the entire disc of the sun.

15. COMPASS OF MUSICAL INSTRUMENTS.

This highly curious engraving, copied with slight variations from an Italian work, represents the compass of the principal musical instruments, or the highest and lowest tones which they are capable of producing, as exactly measured by the scale beneath. It cannot fail to be an amusing subject for the contemplation and comparison of every lover of music.

The scale of notes is given below both in the treble and bass cliffs running in ledger-lines through seven octaves; the lowest note being F, or an octave and a half below the bass cliff, and the highest C, or two octaves and a half above the treble cliff.

It appears, then, that the power of the guitar extends from G in the bass to B in the treble; that of the piano from A in the ledger-line in the bass cliff ascends to F in the ledger-line of the treble cliff, or may be extended *ab libitum* to G in the treble, down to F in the bass. The compass of the harp is still greater, and greater than that of any instrument, as it extends from A in the ledger-line of the treble cliff down to A in the ledger-lines of the bass cliff.

The compass of voices, it will be perceived, is not more than two octaves, and that in the treble and counter-tenor; but the bass voice extends from F in the bass to F in the treble inclusive.

At the bottom of the engraving the length of organ pipes is expressed. Thus, a pipe of sixteen feet is requisite to sound F in the ledger-lines of the bass cliff; while, to sound C in alt, a pipe of only an inch and a-half is requisite.

16. THE CLOUDS.

This engraving represents the classification of the clouds, according to the nomenclature of Mr. Howard. Clouds appear in these distinct forms, according to the state of the atmosphere; and it is, of course, very useful to be able to describe their varieties in some recognized language.

The meteor is one of those luminous phenomena which very often appears in the atmosphere, at heights varying from twenty to one hundred miles, and which often descend to the earth in the form of stones. They are believed to consist of small conglomerations of matter, generated in space, which get involved in the vortex of the earth's atmosphere, in its passage through space. Their luminosity is supposed to arise from the rapidity of the earth's motions, and to the resistance which they oppose in passing through the atmosphere.

17. WATERSPOUTS.

This drawing was made in the Grecian Archipelago, where, owing to the numerous islands, and consequently eddies and circular whirls of wind, these phenomena are very common. Every person who has seen a whirl of sand on a dusty road will readily understand the cause of a waterspout, clouds and water being the objects acted upon instead of dust and sand. A whirl takes place in the atmosphere, and, in the centre of its vortex, creates a sort of vacuum, into which the clouds rush, and, concentrating, form a column of water, which continues as long as the whirl lasts; and, if the atmosphere happens at the time to be electrically decomposed, they form conductors between the clouds and the sea, and are then accompanied by lightning. The three in the engraving were seen at the same instant; and the principle of firing at them is not erroneous, because the action of a ball passing through such a vortex would be likely to destroy it.

A, C, B, represent a gathering of the sea occasioned by the aerial vortex, and the gathering of the cloud at D arises from the same cause. H, I, K, in like manner, represent a gathering of the sea, and L, M, a cloud involved in a vortex driven forward by the wind. E, F, G, represent an affection of the sea, tending towards a fourth column; and N, O, P, represent the base of a column raised to R, where an involved mass of clouds is proceeding to meet it at Q. These phenomena are exceedingly striking, and, when not understood, have the appearance of enchantment.

18. FALLS OF NIAGARA.

This wonder of Nature has never before been duly exhibited to the European world. It was impossible to represent an object so vast, without an engraving of unusual dimensions, and we are indebted for this accurate representation to an original drawing, by Mr. Heriot, many years postmaster of Canada, who made it on the spot. The breadth of the principal cataract is 4,005 feet; the height 150; and the quantity of water precipitated from the falls amounts to 670,250 tons per minute. For an adequate description of it we have had recourse to three modern travellers:—

M. MONTULÉ informs us, that,—

"Being yet distant 12 miles from the Fall, we heard a tremendous roaring, without which noise, and the clouds of misty vapour rising gently through the air, no object would prepare you for the sight of the grandest spectacle nature can present to the eye. The soil is level, and the Niagara, which escapes from Lake Erie, runs in a tranquil current, till within about a hundred paces of its fall, when the rapids are perceptible. There, the stream meeting tremendous rocks, dashes along in white foam to an extent that tires the sight. The soil, covered with trees, here becomes more hilly, and at length, after a circuitous route by bad roads, we arrived at what is denominated *Table-Rock*, advancing to a considerable distance over the precipice. From thence the wondering gaze is saluted by the magnificent curtain which an immense stream presents, falling uninterruptedly from an elevation of 150 feet. After gazing awhile upon the *tout ensemble* of this magic spectacle, I was desirous of descending into the vast gulf excavated by the current, and through which the waters glide towards the lake Ontario. We with difficulty arrived at the spot where the stream falls. There a vapour, which may be compared to the thickest fog, driven by a powerful current of wind, drenched in an instant all our apparel. I immediately undressed myself, and began to advance along the space which, hollowed by the wind and the vapour,

forms a bended bow, leaving a space of nearly thirty feet between the rock and the precipitated torrent, having my footing on a projecting slant of the stone. You may easily imagine what a current of wind is ingulfed in this space, to which the perpetual motion of the water gives an incessant and stronger impulsion. The current of air, in short, is so violent, the rain which it drives against your face is so cutting, the fall of the torrent, which seems to attract you, is so rapid, and the noise so confused and stunning, that it totally bewilders the senses, and, if the footing was missed, you would be lost for ever. By resisting the wind which drove against me, and having recourse to my hands as well as feet in advancing, I had already gone to a considerable distance, when, blinded by the rain, I lay down, fearful of rolling into the horrible abyss.—All attempts to advance further were impracticable, and I found myself under the necessity of returning, moving backwards, nor was it without a sensation of delight that I once more beheld the sun, issuing from a situation where, at mid-day, nothing is discernible, and where it is so easy to make a false step, upon slippery stones, always ready to give way beneath your weight. An inhabitant of the neighbourhood, and M. Despares, saw me return with infinite pleasure, as they had begun to feel disquietude upon my account.

Having measured the elevation by means of a string with a stone attached to the end, which was lowered down from the height of *Table Rock*, I found that the fall is 151 feet; the cataract is divided into two parts; that to the left, being 800 feet in length, is called the American fall, because, in the line of demarkation passing between the two, it is on the side of the United States; being perfectly straight, it is only separated from the other by an island, which will probably some day disappear; which appears the more probable, as the water has began to penetrate a small partial cascade, about twenty-five feet in width. The other, called the English Fall, is the finest, and on the side of Canada. To all appearance, it formerly precipitated itself in a straight line, which formed an angle in the direction of the other; but the force of the water always directed towards the centre of the current has arched it, which renders the view more grand. The extent of this fall is full 1500 feet; the whole, comprising the island, about as large as the fall to the left, and the three falls, make about 1000 yards.

The water, precipitated from such an altitude, produces a vapour similar to the thickest cloud in the atmosphere, with which, rising gradually, it mingles. It mounts from the centre of the English Fall, and appears, according to the sun's position, either of a sombre black, or brilliant white: this vapour is in such quantities, that on approaching the Fall you would imagine the stream fell into a fiery gulf, from whence it immediately evaporated. Having long examined this matchless sight, and finished a drawing of the English Fall, we directed our course to a neighbouring inn, where, having refreshed ourselves, I returned to Table Rock."

Mrs. Wright, in visiting the same spot, observes,—

"Never shall I forget the moment when, throwing down my eyes, I first beheld the deep, slow, solemn tide, clear as crystal, and green as the ocean, sweeping through its channel of rocks with a sullen dignity of motion and sound, far beyond all that I had heard, or could ever have conceived. You saw and *felt* immediately that it was no river you beheld, but an imprisoned sea; for such, indeed, are the lakes of these regions. A mile farther, we caught a first and partial glimpse of the cataract, on which the opposing sun flashed for a moment, as on a silvery screen that hung suspended in the sky. Two foot-bridges have latterly been thrown, by daring and dexterous hands, from island to island, across the American side of the channel, some hundred feet above the brink of the fall: gaining in this manner the great island which divides the cataract into two unequal parts, we made its circuit at our leisure. From its lower point we obtained partial and imperfect views of the falling river; from the higher we commanded a fine prospect of the upper channel. It is but an inconsiderable portion of this imprisoned sea which flows on the American side; but even this was sufficient to fix the eye in admiration. Descending the ladder (now easy steps,) and approaching to the foot of this lesser fall, we were driven away blinded, breathless, and smarting, the wind being high and blowing right against us. The gloom of this vast cavern, the whirlwind that ever plays in it, the deafening roar, the vast abyss of convulsed waters beneath you, the falling columns that hang over your head, all strike, not upon the ears and eyes only, but upon the heart. For the first few moments, the sublime is wrought to the terrible. From this spot, (beneath the Table Rock,) you *feel*, more than from any other, the height of the cataract, and the weight of its waters. It seems a tumbling ocean; and you yourself what a helpless atom amid these vast and eternal workings of gigantic nature! The wind had now abated, and what was better, we were now under the lee, and could admire its sport with the vapour, instead of being blinded by it. From the enormous basin into which the waters precipitate themselves in a clear leap of 140 feet, the clouds of smoke rose in white volumes, like the round-headed clouds you have sometimes seen in the evening horizon of a summer sky, and then shot up in pointed pinnacles, like the ice of mountain glaçières. Caught by the wind, it was now whirled in spiral columns far up into the air; then, re-collecting its strength, the tremulous vapour again sought the upper air, till, broken and dispersed in the blue serene, it spread against it the only silvery veil which spotted the pure azure. In the centre of the Fall, where the water is the heaviest, it takes the leap in an unbroken mass of the deepest green, and in many places reaches the bottom in crystal columns of the same hue, till they meet the snow-white foam that heaves and rolls convulsedly in the enormous basin. But for the deafening roar, the darkness and stormy whirlwind in which we stood, I could have fancied these massy volumes the walls of some fairy palace—living emeralds chased in silver. Never surely did nature throw together so fantastically so much beauty with such terrific grandeur."

And Mr. Schoolcraft says,—

The breadth across, at the brink of the Fall, which is serrated and irregular, is estimated at four thousand two hundred and thirty feet, or a little more than three-fourths of a mile. The Fall on the American shore is one hundred and sixty-four feet, being the highest known perpendicular pitch of so great a volume of water. The fall of the rapid above, commencing at Chippeways, is estimated at ninety-feet, and the entire fall of Niagara river from Lake Erie to Lake Ontario, a distance of thirty-five miles, at three hundred feet. Goat Island, which divides the water into two unequal sheets, has recently been called *Iris*, in allusion to the perpetual rainbows by which it is characterized; and the descent at the present period, with every advantage arising from the labours of mechanical ingenuity, cannot be performed without feeling some degree of personal solicitude. It is in this chasm that the sound of the water falls heaviest upon the ear, and that the mind becomes fully impressed with the appalling majesty of the Fall. Other views from the banks on both sides of the river, and from the Island of Iris, in its centre, are more beautiful and picturesque; but it is here that the tremulous motion of the earth, the clouds of irridescent spray, the broken column of falling water, the stunning sound, the lofty banks of the river, and the wide-spreading ruin of rocks, imprint a character of wonder and terror upon the scene, which no other point of view is capable of producing. The spectator, who, on alighting at Niagara, walks hastily to the brink, feels his attention imperceptibly rivetted to the novel and striking phenomenon before him, and, at this moment, is apt either to overrate or to underrate the magnitude of the Fall. It is not easy to erect a standard of comparison; and the view requires to be studied in order to attain a just conception and appreciation of its grandeur and its beauties. The ear is at first stunned by the incessant roar, and the eye bewildered in the general view. In proportion as these become familiarized, we seize upon the individual features of the landscape, and are enabled to distinguish between the gay and the sombre, the bold and the picturesque, the harsh and the mellow traits, which, like the deep contrasted shades of some high wrought picture, contribute to give effect to the scene. It was some time before I could satisfy myself of the accuracy of the accredited measurements of the height of the Fall, and not until after I had made repeated visits, and spent a considerable time in the abyss below. There appears a great disproportion between the height and the width of the falling sheet, but, the longer I remained, the more magnificent it appeared to me; and hence it is, that, with something like a feeling of disappointment, on my first arrival, I left the Falls, after a visit of two days, with an impression of the scene, which every thing I had previously read, had failed to create.

20. THE RAINBOW.

The rainbow is a phenomenon arising from the reflection of the sun's rays in falling drops of rain, and is produced on the same principle as that by which various colours are reflected from the glass drops usually suspended from lustres and chandeliers. Every person is aware that such a piece of glass presents a different colour as he varies the position of his eye; and, of course, if there were a series of lustres placed one above the other, and the eye kept fixed, the series of glass-drops would present the same variety of colours to the fixed eye as on a single glass-drop presents when the eye changes its position. A drop of water has the same effect on rays of light as a glass lustre. On this principle a rainbow may be made by a garden engine, if the water be thrown high in the air, and the spectator stand between it and the sun.

The cause of the regularity of the rainbow arises from the circumstance that each colour leaves the drop of rain at a determinate angle; and, as the same angle is presented to the spectator all round his eye, so each colour forms its own circle, and the breadth of the bow is of course determined by the difference of the angle between the colour which makes the least angle, and that which makes the greatest, from the eye, which is about two degrees. To make this more intelligible, see fig. 3 in the plate. A ray of light is supposed to pass through a hole in a window-shutter; and, passing through a glass prism, it spreads when it emerges from the opposite side of the prism, and exhibits on an opposite wall the colours of the rainbow. In truth, it is found that the apparently white ray consisted of a mixture of colours, of which red, yellow, and violet, are the chief, the intermingling of which at their borders produces the intermediate colours of orange, green, blue, and indigo. The red or oxygenous rays, being the most powerful, are least diverted from their course, or least refracted; while the violet or hydrogenous rays are most refracted by the glass, and the intermediate colours lie between the violet and red. This discovery was made by Grimaldi, an Italian philosopher, and was applied by Descartes to solve the phenomena of the rainbow.

In the lower diagram of fig. 1, the line S and *d* is supposed to represent a ray of light proceeding from the sun, and the circle *d*, *n*, *e*, a drop of rain. The ray, on entering at *d* instead of proceeding to F, is refracted by the water to N, where it is reflected by the back of the drop to *e*: but, instead of proceeding to *f*, it is again refracted, and, passing out of the drop, presents a red ray of light to the eye at O; and, at the same instant, the violet part of the ray, S, D, being more affected by the refractions than the red ray, is carried somewhat above the eye to B. But, if we were to suppose another drop of rain situated a little lower, then it is evident the violet ray from that drop would

also enter the eye at O; consequently, while one drop is producing the red colour to the eye at O, another drop must be a little lower to produce the violet colour at O; and thus it is in nature, the lowest part of the rainbow is a violet colour, and the uppermost part is red. In the pictured diagram the same effect is shewn; rays proceed to the lower bow from S and S, to the drops at F and *d*. It is least refracted in F, and presents the red colour to the eye at O, and most refracted at *e*, and presents the violet colour; and so on for the intermediate colours; and all round the bow where the angles have forty degrees in the inner circle, and forty-two degrees in the outer circle, take place, as at A and B. A similar process takes place in the upper diagram of fig. 1, where an outer bow is formed at an angle of fifty-four degrees instead of forty-two degrees. But, in this case, the ray S, *d*, instead of entering the upper parts of the drop, C, as in the former instance, enters it at D, and then, instead of proceeding to M, is partly reflected from N within the drop, and partly proceeds to W: from N it is reflected to T, and partly proceeds to X, but is partly reflected towards Z, but again refracted at *o*, and then proceeds to the eye at O with a violet colour, appearing as at *v*; but the part which was red of the original ray, S, *d*, being less affected by the refraction than the violet part, proceeds towards A, and would be seen at *r*, or rather would not be visible to the eye at O: but, if we suppose another drop to be a little lower than the drop *c*, then the red ray also would proceed to the eye at O, and the upper drop would appear violet, and the lower drop red, which is the order of the colours in the outer bow. In the pictured diagram the same effect is shewn in the drop H and C, where it will be seen that the ray enters at *d*, is reflected twice within the drop, and then refracted again to the eye. Hence, in the inner bow, the light undergoes two refractions and one reflection; but, in the outer bow, C, D, two refractions and two reflections; and, consequently, as, in undergoing the operations, much of the light is lost, the outer bow is always fainter than the inner bow.

These diagrams will render the phenomena of rainbows familiar to the meanest capacity by a quarter of an hour's study. The resulting colours are expressed in the separate bows introduced to avoid confusion in the lines and references.

ELECTRICAL SPARKS.

This attempt to represent things so evanescent is copied from Dr. Young's lectures. The spark affords no evidence of any fluid, and is nothing more than the concentration into a single point of the disturbed surfaces of a stratum of air. Electrical phenomena in all cases arise merely from such disturbance, during which the oxygenous and nitrogenous principles within the air are accumulated on opposite surfaces.

INTERMITTING SPRINGS.

An intermitting spring will be understood by looking at the engraving: a channel of water descends into a cavity, and, when the cavity is full, it runs over to a lower level; but, when the cavity has become empty, it is some time before it fills again, so as to exhibit any discharge at the lower level.

C is a cavern; C, B, A, the outlet rising to B. Of course, it is only when C rises above the level of N, B, that any water can escape at A, or after great rains, which fill C.

ICE-ISLANDS.

When the sun passes the equator, either northward or southward, and the day becomes perpetual, or much lengthened at the north or south poles respectively, masses of frozen water and snow separate, which have accumulated either on the shores of land in the arctic or antarctic regions, or on the borders of the eternal masses of ice and snow. These masses, driven about in those seas, to the great terror of navigators, produce, by their occasional collisions, extraordinary phenomena; but winds from the north or south, respectively, frequently drive these masses into lower latitudes, and they are sometimes seen off Newfoundland and the Faro Islands, melting before the increasing sunshine. Three of these masses are represented in the plates, with their relative proportions to ships which happen to sail near them. Their enormous size may be conceived, when it is considered that several times the bulk above the water floats below it. The unequal action of the atmosphere between the ship and mass often carries the ship towards the mass, by the force vulgarly ascribed to their attraction. Bears are often conveyed upon these masses, and lost in the sea, when they dissolve. It is probable, that the notion of the existence of the *kraken* has originated in masses of this kind, nearly dissolved, and floating level with the surface of the water.

> Like burnished brass they shine, or beaten gold;
> And all around the pearls' pure splendour show,
> And all around the ruby's fiery glow.
> Their snowy-crested summits high, they show
> Their uncouth forms, portentous to our eyes.

Ice Islands, or huge solid masses of ice, float on the seas near the Polar circles. Many such islands exist on the coasts of Spitzbergen, greatly endangering the vessels employed in the Greenland fishery. In 1773, Lord Mulgrave was surrounded by the ice; which, when divested of the horrors associated with eventful expectation, was most beautiful and picturesque. After fruitless attempts to force their way through the fields of ice, the limits of these small spaces became so contracted, that the ships were immoveably fixed. The smooth surface soon altered: the pieces of ice, pressed by the violent swell, caused them to pack, fragment upon fragment, until many were higher than the main-yard.—The forms assumed by the ice are extremely pleasing. The surface of that congealed from the sea-water (for we must allow it two origins,) is flat and even, hard, opake, resembling white sugar, and incapable of being formed into slides like fresh-water ice. The greater pieces, or fields, are many leagues long; the lesser are like meadows, and the seals at times frolic on them by hundreds. The collision of the great fields was often attended with a noise which takes away the sense of hearing. The water which dashes against the mountainous ice freezes into an infinite variety of forms, and gives the voyager appearances of ideal towns, streets, churches, steeples, and almost every form which imagination can suggest.

The vast islands of floating ice in the high southern latitudes prove that they are visited by severer cold than equal northern latitude. Capt. Cook, in his second voyage, in lat. 50° 40′ S. fell in with a large cubical mass of ice, about 2000 feet long, 400 feet broad, and 200 feet high. Two days after, several other ice-islands were seen, some nearly two miles in circuit, and 600 feet high; yet such was the force of the waves, that the sea broke quite over them. At length, these ice-islands became as familiar to the voyagers as the clouds and the sea. They saw one solid ice-field of immense extent, with a bed of fragments floating around, raised several feet above the surface of the water; and ninety-seven ice-islands, on one occasion, were distinctly seen within the view, in addition to many large ones, like a ridge of mountains, rising one above the other until lost in the clouds. The most elevated and rugged were surmounted by peaks, and were from 200 to 500 feet high, with perpendicular cliffs.

> There Winter, armed with terrors here unknown,
> Sits absolute on his unshaken throne;
> Piles up his stores amid the frozen waste,
> And bids the mountains he has built, stand fast.

Icebergs fill the valleys between the high mountains in northern latitudes. Among the most remarkable, are those of the east coast of Spitzbergen; seven in number, and at considerable distances from each other, extending through tracks unknown, in a region totally inaccessible internally. The most distant exhibits, over the sea, a front three hundred feet high, emulating the colour of the emerald: cataracts of melted snow fall down in various parts; and black spiring mountains, streaked with white, bound the sides, rising in the back-ground, crag above crag, as far as the eye can reach. At times immense fragments breaking off, are precipitated into the water with a most alarming dashing. Lord Mulgrave saw a portion of this vivid green substance fall into the sea; and, notwithstanding it grounded in twenty-four fathoms water, it spired fifty feet above the surface. Similar icebergs are frequent in all the polar regions; and to their lapse, is owing the solid mountainous ice which infests those seas.

These icebergs are the creation of ages, and acquire annually additional height by falls of snow and rain, which latter often freezes instantly, and more than repairs the loss occasioned by the influence of the sun's heat.

THE RIVERS OF THE WORLD.

Comparative Chart of the principal Rivers in the World.

This plate enables the observer to comprehend at a glance the relative size of all the great rivers in the world. It points out their latitude and longitude at which they run into the sea, and at which they rise, with the name of the place. The Mississippi appears to be the king of rivers, being 4,443 miles long, and the Amazons 4,000; while the Obi in Asia is but 2,500; the famous Ganges but 1,500; the Danube but 1,600; and our Thames not more than 200. The great Lakes of the St. Lawrence are also exhibited in their natural dimensions, as well as the mouths of the several rivers. In short, this engraving is a little volume by itself for study and reference.

The reiterated action of the solar rays upon the ground, and the surface of the waters, warms them to a sufficient temperature to cause a radiation or evaporation of the aqueous atoms into the atmosphere, where, being lighter than the surrounding air, and wafted by the winds, they rise into regions not sufficiently warmed by the reflected rays of the sun, and, parting with their motion, are condensed into misty masses, called Clouds. These, carried by winds, are acted upon by cold, trees, and chains of mountains, and are precipitated to the ground in the form of rain. But, as the earth where they fall does not absorb the entire quantity, the water descends in masses on the inclined plane towards the earth's centre, by the ordinary laws of gravitation. Seeking every where the lowest levels, they form basins greater or smaller, which overflowing, outlets are formed till the current reaches the level of the sea. Such are rivers. Rivers are not constructed as such, but are simply the lowest levels through which the waters pass. The action of the water, however, in a series of ages, carries down the argillaceous and loose bodies, and scoops out a sufficient channel.

Rivers are necessarily proportioned in length and size to the continent and countries through which they flow; and their rapidity is governed not only by their fall from higher to lower levels, but by the laws of acceleration which govern all falling bodies, and which produce a sensible effect after a river has flowed down the inclined plane of its course, through many hundred miles. The forms of rivers are governed by the nature of the country

through which they flow: if the country be mountainous, the angles are sharp and frequent; if it be composed of gentle hills, the turnings are curvilinear; but, if it be a dead flat, the course of the stream is usually straight. The reflected action of water also produces peculiar phenomena, by raising banks, and thereby creating new directions. In truth, though to human apprehension nothing is more sublime, and often terrific, than the stream of a majestic river, yet the whole is in accordance with the ordinary laws of nature; and, if men often suffer by the flooding of rivers, it is owing to their own inadvertency in not keeping open the mouths by which they flow into the sea, or the outlets of small streams, by which they flow into principal branches. The engraving annexed exhibits in the most satisfactory manner, the comparative dimension of all the principal Rivers in the World, and the study of them cannot fail to prove an agreeable amusement.

American Rivers.

The Mississippi, with the Missouri, is in North America, and, for the length of its course, and the quantity of water it pours into the ocean, is the greatest river in the world. It receives in its course all the rivers which have their rise between the Rocky and Alleghany Mountains, and is subject to periodical inundations from the vast accumulation caused by the tributary streams pouring into its bosom the great body of water they collect: and this effect is greatly heightened by the flatness of the country, for at least one hundred miles from the Gulf of Mexico, into which it falls by six outlets, the west, south-west, south, main or north-east, also called the Balize, the north, and Passa Loutre, in which there is a depth of water varying from eight to twelve feet.

The breadth of this river is very unequal between the Falls of St. Anthony and the Illinois; it is from three hundred to nine hundred yards, and at some places exceeds two thousand yards; at the mouth of the Missouri it is about two thousand five hundred, and at New Orleans rather less than fifteen hundred. The Mississippi rises, during the inundations at New Orleans, about twelve feet; at Baton Rouge, twenty-five feet; at Fort Adams, and as far up as the Ohio, forty-five feet! The current, when the water it low, will float a boat from forty-five to fifty miles in twenty-four hours; in a middle state, sixty to seventy miles; and, in the time of inundation, from ninety to one hundred miles, in the same period of time. It is impracticable for boats to stem the current of the Mississippi above Natchez, which is four hundred miles from its mouth, by means of sails only; but since the invaluable invention of Steam Boats, which have generally been introduced in the navigation of the Mississippi and its tributary streams, the current can be stemmed at the rate of four miles an hour.

This noble river has its source in Upper Red Cedar Lake. Its length has been estimated, including its windings, at 3000 miles. The Missouri River falls into the Mississippi, a few miles above St. Louis, and, until Captains Lewis and Clarke explored it in 1804, 5, and 6, was little known; it is now, however, ranked one of the greatest rivers on the face of the globe. At the distance of 2858 miles from the confluence of the Missouri with the Mississippi, the former is divided into three branches, called Jefferson's, Madison's, and Gallatin's rivers. The navigation of this river to the falls, which is a distance of 2575 miles, may be generally deemed good. The Missouri affords the best route in that direction across the American continent; the total distance from the confluence of the Missouri and Mississippi to the mouth of the Columbia River, which discharges itself in the Pacific Ocean, is 3,155 miles.

The Amazon, Maranon, or Orellana, springs from the eastern slope of the Andes. The Ucayale or Paro is the longest, and it also contains the largest body of water. The upper part of this branch bears the name Apurimac, whose source is in a small lake in the 16th degree of south latitude. The Apurimac unites with the Beni, and other streams, which then form the Ucayle, which, after a course of upwards of 1,300 miles in a northern direction, a little inclining to the west, and nearly parallel with the Andes, unites with the Maranon and the western waters, and, turning round towards the east, takes the general name and direction of the river, which is from W. to E. inclining a little to the N. The swellings and freshes which come on with the periodical rains, are usually very great, and overflow an extensive tract of country for several hundred miles. It discharges itself into the Atlantic Ocean near the Equator.

The Columbia. A large river of North America, rises in the Rocky Mountains. The tide flows up the Columbia 183 miles, and within 7 miles of the great rapids; its banks are inhabited by savage tribes, who chiefly live upon salmon, which this river yields in immense quantities; the water is so clear that they can be seen at the depth of from 15 to 20 feet.

The source of this river is not more than a few miles from that of Unijah, or Peace River, whose waters communicate with that great succession of rivers and lakes which stretch across this part of the American continent and finally terminate in the great River St. Lawrence.

The Rio de la Plata, or River of Silver, is a name given by the Spaniards to a great river of South America, formed by the union of the Paraguay and the Parana, with those of the Uruguay, at which point the Plata commences, and almost immediately expands to an immense width, till it unites with the South Atlantic Ocean.

It is 150 miles broad at its mouth; at Monte Video 80 miles; and at Buenos Ayres, which lies above 200 miles from its mouth, it is above 30 miles broad.

The St. Lawrence issues from Lake Ontario, and is the outlet by which the waters of the great lakes Superior, Huron, Michigan, Erie, and Ontario, are discharged into the Gulf of St. Lawrence. It receives in its course nearly all the rivers that have their sources in the range of mountains, called "Land's Height," which separates the waters of Hudson's Bay, &c. from those that empty into the Atlantic. The St. Lawrence is 770 miles from Lake Ontario to the gulf of the same name, and passes through a fertile country; the towns of Montreal and Quebec are on its banks; the latter is built on Cape Diamond, which is 345 feet above the level of the water. The river at Quebec is two miles across, and continues gradually increasing in width until it enters the gulph of St. Lawrence, where, from Cape Rozier to the Mingan settlement on the Labrador shore, it is about 105 miles wide.

The Rio Bravo del Norte is a large river of Mexico, takes its rise in the Rocky Mountains. It runs S. E. and falls into the Gulf of Mexico, after a course of about 2000 miles. It is not, in any part, navigable for sloops, owing to the sand-bars in the flat country, and the mountains in the upper part, by which its course is interrupted. It is navigable for boats, however, and canoes, in various parts of its course.

The Orinoco of South America, according to La Cruz, has its source in a small lake called Ipava, in Guiana. In its course to the ocean, it receives the Maquiritari, Cunucunuma, Ventuari, Caura, Aruy, and Caroni, on its southern or left bank; and, on its right bank, the Cassiquiari, Guariari, the Meta, and the Apure, with their tributary streams, which vie in importance with the main river. At 200 leagues from the sea, its breadth is from 2,500 to 3,000 fathoms, without the interruption of a single island. The Orinoco, like most large rivers that flow through a flat country, makes its way to the ocean by innumerable channels, and, during the rainy season, inundates for a great extent the immense plains through which it flows. The inundation, during the highest flood, is calculated to extend on each side from 80 to 90 miles, presenting to the eye a boundless expanse of waters.

The Mobile, a deep, broad, and navigable, river of the United States. It is formed by the united streams of the Tombeckbee and the Alabama, and falls into the bay of the same name, in the Gulf of Mexico.

The Potomac is a river of the United States, which rises in two branches, the North and South, originating in and near the Alleghany Mountains, and forms, through its whole course, part of the boundary between Virginia and Maryland. It flows into the Chesapeake Bay, and is seven and a half miles wide at its mouth, and one and three quarters at Alexandria. The termination of the tide water is at George Town, about 300 miles from the sea, and the river is navigable for ships of the greatest burden, nearly the whole distance. Its junction with the Shenandoah at Harper's ferry, is regarded as a very great curiosity.

The Savannah, a river of the United States, is formed by the union of the Tugeloo and Keowee. It separates South Carolina from Georgia, and empties itself into the Atlantic Ocean.

The Susquehannah, a river of the United States, is formed by two branches that come from the east and west. The east rises in Otsego lake, New York, and the west in Huntingdon county, Pennsylvania. They unite at Northumberland. The river then runs south-east into the head of the Chesapeake Bay, Maryland. It is a mile and a half wide at its mouth, but is navigable only 5 miles above it.

The Hudson, or North River, is one of the largest and finest rivers of the United States, which is formed in the mountainous region to the west of Lake Champlain, and, after flowing through a very fine and populous country, empties itself into the Atlantic, below the city of New York.

The St. John's is a river of Florida, but its source is not at present known. It is probable, however, that it originates in the extensive swamps that exist in the lower part of Florida, and from which the water exudes, and gradually forms the river. It has been navigated as high as lat. 28° 30′ N. which is above Lake George, a distance of 150 miles from its mouth, and the depth found to be about 8 feet. It discharges itself into the Atlantic Ocean about 45 miles north of St. Augustine.

European Rivers.

The Volga, a great river of Russia, and the largest in Europe, rises in the Valday Mountains, in the province of Tver. It begins to be navigable a few miles above Tver. A navigable communication has been made between this river and those which fall into Lake Ladoga, from whence the navigation is continued to St. Petersburg, thus uniting the Caspian and Baltic seas. It enters the Caspian sea at Astrachan, by seven large mouths.

The Danube, a river of Germany, and, next to the Volga, the largest in Europe. It rises near Donan Eschingen; becomes navigable for boats at Ulm; and empties itself into the Black Sea by several mouths. It receives sixty rivers, great and small, in its course.

The Dneiper, a large river of European Russia, rises in a marsh, in the forest of Walchonski, in the government of Smolensko. It begins to be navigable very early, even above Smolensko; in the lower part of its course, however, it is impeded by islands, and at one place by cataracts. It falls into the Black Sea near Oczakov.

The Don is one of the largest rivers of European Russia. It rises in the government of Tula, and empties itself into the sea of Azoph, by two mouths. In summer it is so shallow and full of sand-banks, and its mouths are so choked with sand, that only flat-bottomed boats can pass into the sea of Azoph.

The Rhine, a river of Europe, which has its principal source in the highest part of Switzerland, the north side of the mountain of St. Gothard, and runs into the Lake of Constance, from whence it continues its course and flows into the German Ocean by Dort, Rotterdam, and Williamstadt. The northern, or less considerable, branch is farther divided, first above, and afterwards below, Arnheim; and the name of Rhine is finally retained by a small, slow flowing water, which passes Utrecht and Leyden, in its way to the sea, or rather to the sands near Catwyk. From its source to Mentz, this great river is called the *Upper* Rhine, and, from Mentz to Holland, the *Lower* Rhine.

The Dwina, a large river of European Russia, rises in a lake of the same name. It is navigable throughout the greater part of its course, and communicates with the lake of Ladoga, and with St. Petersburg, by a canal, which joins it to the river Louat.

The Vistula rises in the Carpathian Mountains, on the frontiers of Silesia, passes by Cracow, Sandomirz, Zarrichost, Warsaw, Wladislaw, Thorn, Culm, &c. and empties itself to the Baltic at Dantzic.

The Douro or Duero, a large river of Spain, rises on the borders of Arragon, and, flowing to the westward, traverses more than half the width of Spain, and the whole width of Portugal. It discharges itself into the Atlantic, a little below Oporto.

The Guadalquivir is one of the largest rivers in Spain; rises in the province of Granada, and, after traversing a very circuitous course, falls into the Mediterranean Sea about 20 miles N. W. of Cadiz.

The Thames, one of the most celebrated rivers of Great Britain. Large ships of war come up to Deptford; and merchant ships of 7 or 800 tons burden frequently lie at the quays close to London Bridge. The tide flows up to Richmond, a distance of above 70 miles, by the windings of the river, from the ocean.

The Shannon, the chief river in Ireland, takes its rise from Lough Clean. It is navigable nearly to Limerick for ships.

The Forth, a river of Scotland, rises on the north side of Ben Lomond, and discharges itself into the German Ocean.

Asiatic Rivers.

The Ob, or Obi, a great river of Asiatic Russia, rises on the southern side of the Altai mountains, from the lake, called by the Tartars, Altyr Noor. After receiving the waters of the Irtysch, it becomes very broad, sometimes extending several miles across.

The Hoang-ho, or Yellow River, a great river of China, rises from sources scarcely known in the west of Thibet, and from the summit, probably, of that loftiest portion of the Asiatic continent. Though broad and rapid, it is in many places so shallow as to be unfavourable for navigation. It is also liable to overflow its banks.

The Lena, a large river of Asiatic Russia, rises in the mountains to the north-west of the lake Baikal. The channel is broad and deep, and forms numerous islands, both in its course and in the sea, at its mouth.

The Amur, a large river of Asia, rises in Chinese Tartary, in the Kontaihan Mountains, and flows into the sea of Okhotsk. In its course, it receives the waters of the Argoun and Schilka. Its existence was first known to the Russians, in 1639.

The Jenissei, or Enisei, is a river of Asiatic Russia, rises in the borders of Chinese Tartary, and, taking a northern course, runs into the Frozen Ocean.

The Indus, a river of Hindoostan, is supposed to rise on the north side of the Himmalaya Mountains, enters the Arabian Sea by several channels. The higher part of its course is amidst immense mountains; but the lower is through a country peculiarly flat, and bounded by extensive sandy deserts.

The Euphrates is a celebrated river, the largest in Turkey, has its rise among the mountains of Armenia, from two principal sources. This river is made to communicate with the Tigris, by several artificial cuts; after which both rivers unite at the town of Korna, upwards of 100 miles from the sea. The Euphrates is navigable a great distance from the sea, and overflows and fertilizes the adjacent country at stated times of the year.

The Ganges is a celebrated river of Hindoostan, whose source, for a great length of time, was uncertain. A recent survey, however, made by order of the British Indian government, has succeeded in determining its position. It has been found to issue in a small stream from under a mass of perpetual snow, accumulated on the southern side of the lofty Himmalaya Mountains. At Hurdwar, it gushes through an opening in the mountains, and becomes navigable; afterwards flows through delightful plains, with a winding course, and in a south-east direction it enters the bay of Bengal.

The Jihon, or Amu, a great river of Central Asia, the principal part of whose course is through Independent Tartary. It has its rise in the high ridge and table land of Pamer, which, extending northward from Hindoo Coosh, forms the boundary between Thibet and great Bukharia. This river, the ancient Oxus, formerly emptied itself into the Caspian; it now falls into the sea of Aral.

The Ava, or Irawaddy, the principal river in the Birman empire. Its source has not hitherto been explored, but is supposed to be in the eastern quarter of Thibet. The water of this river possesses a strong petrifying quality.

The Godavery, a noble river of India, rises on the eastern side of the mountains called Bala Ghaut, 70 miles north-east of Bombay.

The Nerbuddah, a celebrated river of Hindoostan, forms the north boundary of the Deccan. It is navigable by boats for a considerable distance; and its waters are said to have a peculiar quality in bleaching cloths.

The Kistna, a celebrated river of the south of India, takes its rise near the fortress of Satarrah; empties itself by various mouths, into the Bay of Bengal; and, owing to the accumulation of sand at its mouths, is not navigable for ships.

The Sihon, or Sirr, a large river of Independent Tartary, rise on the western side of the mountains which separate that region from Cashgar, in Chinese Tartary; and, after a long course, chiefly to the north-west, it discharges itself into the Aral sea.

African Rivers.

The Nile, a great and celebrated river of Africa, traverses Egypt through its whole extent, and, by its inundation, produces all the fertility for which that country is distinguished. The cause of the overflow of this river is now perfectly ascertained, in the periodical rains, which fall from June to September, throughout the northern tropical regions. The rise begins to be felt about the 17th of June, and continues till August, when the river is at its height, and all the level parts of the country are overflowed.

The Congo, or Niger, a great river of Central Africa, has excited an extraordinary interest in modern geographers, by the remarkable nature of the region through which it flows, and still more by the various and contradictory rumours relative to its course and termination.

The name of Niger is not known in Africa. The name known to the negroes is Joli-ba, the last syllable being the generic term of a river. By the Moors, it is called Neel Abeede, or Nile of the Negroes.

24. THE DIVING BELL.

This apparatus belongs to nature as well as art: it is an exemplification of the principle that gas, however rare, will as gas maintain its own space. Thus the gas, filling the space of a bell, may have been generated by heat or atomic motion from substances only a 10,000th part the bulk of the cavity; but, while this motion continues in the atoms, they will occupy the cavity in spite of all pressure. The operator descends within the bell to make recoveries at the bottom of the water, and is as secure from the water as though he were in the atmosphere; but, as he would soon fix and absorb the oxygenous gas within the bell, a pipe is let down from without which keeps up a supply of fresh air, while another within is adjusted to let out the carbonic acid gas, which is compounded by breathing.

P, L, R, K, is the bell; M, L, seats for the operators; D, B, is the fastening; H is a valve to let out foul air; C is a reservoir of good air. Another operator is seen sending up a couple of cannon, with a water-tight glass-covering to his head, which is supplied with air by a tube from the bell.

THE GEYSERS AND HECLA.

This view exhibits some idea of the dreary perspective of Iceland, which, nevertheless, amidst its eternal snows, presents the singular aspect, at one and the same time, of a spring of water which raises the thermometer to the boiling point, and ascends in a column from 20 to 60 feet, the vapour and foam rising much higher; while Hecla, in the distance, never ceases smoking, and rages with terrible violence oftener than any known volcano in the northern hemisphere.

The Geysers are about 16 miles to the north of Skalholt, eastward of which are several hot springs, and others rise among the low hills, on the right hand in going to the Geyser. The hill, on one side of which are the Geysers, does not exceed 300 feet in height. On the east side of the hill there are several banks of clay, from some of which steam arises, in different places; and in others there are cavities, in which water boils briskly. The strata, or beds, seemed to have been broken by the shocks of earthquakes, particularly near the great Geyser. Within a space not exceeding a quarter of a mile, there are numerous orifices in the old incrustations, from which boiling water and steam issue, with different degrees of force. On the top of a mount is the basin of the great Geyser, extending 56 feet in one direction, and 46 in another.

Above the great Geyser, at a short distance, is a large irregular opening, and the water which filled it was as clear as crystal, and perfectly still, though nearly at the boiling point. Through it white incrustations are seen, forming a variety of figures and cavities, to a great depth; and carrying the eye into a vast and dark abyss, over which the crust forms a dome of no great thickness.

Following the channel, which has been formed by the water escaping from the great basin during the eruptions, beautiful and delicate petrifactions are found. The leaves of birch and willow were seen converted into white stone, and in the most perfect state of preservation, every minute fibre being entire. Grass and rushes are in the same state, and also masses of peat. On the outside of the mount of the Geyser, the depositions, owing to the splashing of the water, are rough, and have been justly compared to the heads of cauliflowers.

Sir George Mackenzie remarks, that, if the appearances were regular in duration, and the intervals between the jets always equal, it would not be difficult to construct an apparatus which would exhibit them with precision; but in both respects, as well as in the degree of violence, there is great irregularity. From whatever source the heat proceeds, whether from the combustion of beds of coal, the decomposition of pyrites, or any other cause, the wonders of the Geysers are caused by sudden productions of heat. A column of water is suspended in a pipe, by the expansive force of steam, confined in cavities under the surface. An additional quantity of steam can only be produced by more heat being evolved. When heat is suddenly evolved, and elastic vapour suddenly produced, we can at once account for explosions, accompanied by noises. The accumulation of steam will cause agitation in the column of water, and a farther production of vapour. The pressure of the column will be overcome, and the steam escaping will force the water upwards along with it. As long as the extraordinary supply of steam continues, these oscillations and jets will go on. But at every jet some of the water is thrown over the basin, and a considerable quantity runs out of it. The pressure is thus diminished; the steam plays more and more powerfully, till at last a forcible jet takes place, a prodigious quantity of steam escapes, and the remaining water sinks into the pipe.

GENERAL ORDER OF STRATA;—AND SECTION OF THE BROCKEN MOUNTAIN.

These two engravings afford a clear notion of the general order of the rocks and strata which compose the surface of the earth.—The granite is the lowest or central formation; but, in the structure of mountains, it is the highest, or the centre and nucleus, buttress or bulwark of the mountain, the other rocks and strata lying obliquely against and upon it. This would be intelligible if we were to consider the moon as formed entirely of granite, and that the earth was once like the moon, the surface being irregularly formed like that of the moon: some successive causes, about which various hypotheses have been raised by speculative men, have then produced the upper layers or strata, till we arrive at the most recent or uppermost stratum, called *alluvium*, which, according as the subdivisions and mode of numbering, may be considered as No. 1 or No. 17 in the two plates.

STRATA OF HEADEN HILL, ISLE OF WIGHT.

This hill, and its neighbouring parts on the right, exhibit a striking, but not uncommon, instance of the revolutions to which the materials of the earth's surface have been subject. The hill itself is composed of strata in the natural horizontal position; but the cliffs to the right in Allum Bay, though composed of similar strata, present them in a perpendicular direction, although like the others.

V on the extreme light consists of yellow and white sand with grey stripes.

W is formed of five beds of coal.

X is whitish sand, with stripes of deep yellow.

Z consists of layers of water-worn black flint pebbles, imbedded in yellow sand.

B is a stratum of blackish clay, containing green earth and fossil shells, worn down towards C by a stream of fresh water.

C consists of yellowish sand inclined 45 degrees.

D is also inclined when it is in contact with C, but afterwards stretches horizontally and forms a sandy base to the incumbent hill.

The whole have evidently been formed at the bottom of the ocean. The strata in the hill are indicated in the plate; but in the middle are three beds of coal, palpably of vegetable origin, as fruits and branches are still observed in it.

CURVED GNEISS IN LEWIS.

This remarkable specimen of gneiss in a curved state, copied from Dr. M'Culloch's work on the Hebrides, proves that it must once have been elastic; while the characters of this and other primitive mountains demonstrate that the change must have been produced by fire, previously to the formation of the secondary rocks.

Gneiss is the rock in which metals most abound, and is itself a compound of felspar, quartz, and mica, and of a slaty character, as is evident from the terminations of this enormous specimen. It would seem as though the action of water had in certain places carried off the alluvion, and left the primitive rocks bare; and that this specimen of gneiss must in some remote age have been covered with other strata.

SECTION OF THE LAND FROM DONCASTER TO MACCLESFIELD; AND ALSO FROM NEWCASTLE TO LONDON.

The writing upon this plate sufficiently explains the subjects. The first correct notions in regard to the successive battening or rising of different strata, by which a surface of country exhibits so regular a diversity of soils, were promulgated by Mr. W. Smith, and published in his geological map of England. These examples are copied from originals obligingly contributed to the editor for the use of this work. It would appear that the inclination of some primitive mountain has served as a basis to these strata, and governed their inclinations, and that they have been laid one over the other against the mountain by successive actions of the sea. To avoid confusion, the angles of the strata, as they rise to the surface, are, however, considerably too large. One great use of this knowledge is the certainty which it affords that, by digging to a certain depth, we shall arrive at certain desired strata.

THE GREAT ERUPTION OF VESUVIUS OF 1767.

This splendid engraving, perhaps the most effective which ever represented this great phenomenon of nature, was published by Sir W. Hamilton in the Philosophical Transactions. It represents the eruption of 1767, and the burning lava is seen rolling down the sides of the cone and the adjacent mountain towards cultivated and inhabited districts. This eruption is reckoned the 27th since that which destroyed the cities of Herculaneum and Pompeii, in the reign of the emperor Titus.

COLUMN OF SMOKE FROM VESUVIUS IN 1794.

This representation of a wonderful phenomenon was also published by Sir William Hamilton, in the Philosophical Transactions. It was determined by observation that the column of dense black smoke on this occasion ascended to the height of nearly thirty miles, darkening all the atmosphere behind it. Indeed, its ascent was so great that it seems to falsify the common theories in regard to the increased rarity of the atmosphere, which must at any rate have been greater than that of the smoke, to hold it in suspension; the smoke, being a conductor of electricity, evidently connected the electrified strata of the atmosphere, and hence lightning took place within the mass. On this occasion scoriæ were projected or carried by the wind to the distance of two hundred miles, and scattered over the country in the intermediate space. Nothing can give a more correct notion of the sublime character of a volcano than this engraving and the other which precedes it.

VESUVIUS AFTER THE ERUPTION OF 1794.

This is an accurate engraving, from a drawing made under the direction of Sir William Hamilton, of the actual appearance of the crater after the eruption of 1794.

SMALL VIEW OF THE ERUPTION OF 1794.

This engraving is also copied from Sir William Hamilton, and conveys a picturesque idea of the eruptions of this mountain as viewed across the bay of Naples.

INTERIOR OF THE CRATER OF VESUVIUS.

A View of the interior of the crater, as drawn on the spot after the eruption of 1805.

VIEWS OF ETNA.

Mount Etna, as taken by modern observations, is 11,000 feet high, though M. Gourbillon, a scientific traveller, asserts that it is double that height; but probably he meant the hypothenuse and not the perpendicular height. The crater is a vast aperture, having four summits of different heights, and is more than a mile in width, and about four miles in circumference. It is divided into two craters, by a cone

rising from its centre, and a small one which has probably been formed within a recent period, from whence smoke in great quantities constantly issues.

Although no great eruption has taken place at Etna for many years, yet its internal fires are not extinguished, and indicate great activity, causing concussions which have from time to time alarmed the inhabitants of Catania, and even overthrown some houses.

One of the views of the crater was recently taken by M. Montulé; the other is from Sir Wm. Hamilton; and another is from Brydone. We have multiplied them because the craters of volcanoes are objects of the highest mundane curiosity, and their changeable character renders different views necessary. All volcanoes appear to agree in having a large crater or cauldron of melted lava in the middle, with one or more orifices, round which accumulate a cone of ashes and lava; these we have variously depicted. Some travellers have paid the forfeit of their lives by the indulgence of their rash curiosity in seeking a peep into these gulphs of smoke and sulphur.

All they have been able to effect has been to describe the heat of the ground, the scorching of their boots, and the horrible desolation of the scene. Dr. Watson imitated them by burying a paste made of water, sulphur, and iron filings; and hence it has been supposed that the sea communicates with such materials in the bowels of Etna and Vesuvius. This hypothesis does not accord, however, with positions of the South American volcanoes, unless we are to suppose that the accumulated snow effects the same purpose as the sea in other cases. The earthquakes produced through the adjoining country during eruptions appear to prove that the explosions are deeply seated; but it continues to be a question whether they reach below the granitic formation; if they do so, their depth may exceed what has hitherto been imagined.

A VIEW OF THE CRATER OF ETNA.

M. Gourbillon, the last traveller who has published a description, states that the main gulph includes four distinct abysses or craters: the south crater (extinct); the eastern, or great crater; the northern crater; and the western crater, the nearest to the centre of the gulph. Besides the bank round the gulph, each crater has its own bank. The eastern crater is as large as that of Vesuvius, being above a mile round. Some pieces of lava were thrown down it, which sounded after a few seconds. M. G. descended 200 feet into the eastern crater, and with difficulty avoided falling into its abyss. The interior is covered with very fine, light, grey sand. From the northern crater smoke arose, and the heat was overpowering. The western crater is too dangerous for descent, and great noises are heard within it. A new crater was formed in 1819, which burnt with great fury during that year.

THE GREAT METEOR OF 1803.

This meteor, like all similar bodies, was seen in nearly all parts of the United Kingdom, and appeared to pass over each place at the same time; an unquestionable proof that its motions were connected with those of the earth; for, as the earth in its orbit moves 68,000 miles an hour, and 1000 by its diurnal rotation, so any independent body in space coming in contact with the earth like this meteor, would be seen over extensive regions at the same instant; while such a prodigious motion through the earth's atmosphere would necessarily create the combustion which accompanies it.

The plate gives a better idea of its appearances than could be afforded by any description. Its different aspects arose of course from the situation in which its tail was seen in reference to the nucleus. The spots in one drawing, and the stars in the other, appear to be mere coruscations from the body: a great noise followed it, arising doubtless from the collapsing of the air, as it passed onward through it. Of its height no accurate judgment could be formed; but other similar meteors have been determined to have 50 or 60 miles of elevation; and, as far as observations could be depended upon, this meteor moved over England at the rate of 500 miles in a minute.

VOLCANO OF STROMBOLI.

This is one of the Lipari Isles, lying north of Sicily. It is a mountain with two summits: the highest is about a mile high. The burning crater is about half-way up, on the NW. side of the mountain, and has a diameter of 250 feet. Burning stones are thrown up, at intervals of seven or eight minutes, ascending in diverging rays. The present crater has burned more than a century, without any apparent change of phenomena.

HECLA.

Hecla, one of the most active volcanos now known, as well as the most northern, is situated in a very desolate region of the earth; the approach to it is so impracticable that few travellers have had the hardihood to make the attempt. The engraving conveys some idea of the ruggedness of the district.

The cone of the mountain is 5000 feet above the level of the sea, by which the base is washed. The accumulated ice at its foot, and the noise which its crashing creates, united to the roaring of the mountain, lead the superstitious among the northern nations to regard Hecla as the mouth of Hell; and English seamen have been known to become the dupes of such fancies.

MARINE VOLCANO AT ST. MICHAEL'S.

Approaching the island of St. Michael's, (says Capt. Tillard,) on Sunday, the 12th of June, 1811, in the sloop Sabrina, we occasionally observed, rising in the horizon, two or three columns of smoke. Imagine an immense body of smoke rising from the sea, the surface of which was marked by the silvery rippling of the waves, occasioned by the light and steady breezes incidental to those climates in summer. In a quiescent state, it had the appearance of a circular cloud, revolving on the water like an horizontal wheel, in various and irregular involutions, expanding itself gradually on the lee-side; when suddenly a column of the blackest cinders, ashes, and stones, would shoot up in the form of a spire, at an angle of from ten to twenty degrees from a perpendicular line, the angle of inclination being universally to windward; this was rapidly succeeded by a second, third, and fourth shower, each acquiring greater velocity, and overtopping the other, till they had attained an altitude as much above the level of our eye, as the sea was below it. As the impetus, with which the columns were severally propelled, diminished, and their ascending motion had nearly ceased, they broke into various branches, resembling a groupe of pines!— These again, forming themselves into festoons of white feathery smoke, in the most fanciful manner imaginable, intermixed with the finest particles of falling ashes, which at one time assumed the appearance of innumerable plumes of black and white ostrich feathers surmounting each other; at another, that of the light wavy branches of a weeping willow. During these bursts, the most vivid flashes of lightning continually issued from the densest part of the volcano; and the cloud of smoke, now ascending to an altitude much above the highest point to which the ashes were projected, rolled off in large masses of fleecy clouds, gradually expanding themselves before the wind, in a direction nearly horizontal, and drawing up to them a quantity of water-spouts, which formed a most beautiful and striking addition to the general appearance of the scene. In less than half an hour a peak was plainly visible above the water; and, about three hours from the time of our arrival, a complete crater was formed above the water, not less than twenty feet high on the side where the greatest quantity of ashes fell; the diameter of the crater being apparently about 400 or 500 feet. The great eruptions were generally attended with a noise like the continued firing of cannon and musketry intermixed, as also with slight shocks of earthquakes. Now one of the most magnificent bursts took place which we had yet witnessed, accompanied by a very severe shock of an earthquake. In an instant we observed a large portion of the face of the cliff, about fifty yards on our left, falling, which it did with a violent crash. At night the volcano seldom emitted any lightning, but occasionally as much flame as may be seen to issue from the top of a glass-house or foundery chimney. On passing directly under the great cloud of smoke, about three or four miles distant from the volcano, the decks of the ship were covered with fine black ashes, which fell intermixed with small rain. On opening the volcano clear of the north-west part of the island, after dark, on the 16th, we witnessed one or two eruptions. On the 4th of July we approached the volcano, and perceived that it was still smoking in many parts; and, upon our reaching the island, found the surf on the beach very high. On landing, we found a narrow beach of black ashes, from which the side of the island rose in general too steep to admit of our ascending; and, where we could have clambered up, the mass of matter was much too hot to allow of our proceeding more than a few yards in the ascent The most extraordinary part was the crater; the mouth of which, on the side facing St. Michael's, was nearly level with the sea. It was filled with water, at that time boiling, and was emptying itself into the sea by a small stream about six yards over, and by which I should suppose it was continually filled again at high water. The island has gradually disappeared from October 1811, leaving an extensive shoal on the spot; but smoke continued issuing out of the sea through February 1812.

SUBTERRANEOUS CONFLAGRATION IN JAPAN.

The engraving conveys some idea of this catastrophe. 1. The mountain Asama. 2. Kousats-yama, where the fire commenced. 3. A post which marks the boundaries of the provinces Sinano and Koutsouki. 4. A village at the foot of the mountain, but ten miles distant from its summit. 5. The village of Orprake, where there are hot springs. 6. A mountain, twenty miles from Kousats-yama.

In September 1783, dreadful ravages were occasioned by the eruption of the volcano Asama-ga-daki, says M. Titsing, in his curious work on Japan. At eight o'clock one morning, there arose, in the province of Sinano, a very strong east wind, accompanied by a dull noise, like that of an earthquake, which increased daily. In four days there was a tremendous noise, and a shock of an earthquake: the walls of the houses cracked, and seemed ready to tumble. Each successive shock was more violent, till flames burst forth, with a terrific uproar, from the summit of the mountain, followed by a tremendous eruption of sand and stones. Though it was broad day, every thing was enveloped in profound darkness, through which the flames alone threw at times a red light. For three days the mountain never ceased to cast up sand and stones. The large village of Saka-

moto, and several others, situated at the foot of the volcano, were soon reduced to ashes, by the ignited matter which it projected, and by the flames which burst from the earth. The inhabitants fled; but the chasms, every where formed by the opening of the ground, prevented their escape, and in a moment a great number of persons were swallowed up or consumed by the flames. The water of the rivers Yoko-gawa and Carousawa boiled; the course of the Yone gawa, one of the largest rivers of Japan, was obstructed; the boiling water inundated the adjacent country; and there fell a shower of red-hot stones, each weighing four or five ounces. The bears, hyænas, and other beasts of prey, fled from the mountains, and flocked to the neighbouring villages, where they devoured the inhabitants, or mangled them in a horrible manner. The number of dead bodies floating upon the rivers was incalculable. Twenty-seven villages were swallowed up.

EARTHQUAKE IN CALABRIA.

This little engraving, copied from an Italian print, represents the extraordinary overturning of several fields in that country, during the great earthquake in 1783. They were thrown up into the oblique position represented, with all their trees and other objects upon them, exhibiting their strata to a considerable depth. This accounts for faults in strata, and such appearances as at Headon Hill, &c. &c.

SCALE OF THE NEWCASTLE STRATA.

This engraving accurately exhibits the successive strata from the surface of the earth to the depth of 135 fathoms in the Newcastle coal district. It indicates the progressive operations which have taken place on the surface of the earth at intervals of distant ages. For, as there seems no doubt that the coal consists of forests in a fossil state, so each bed of coal must have been a submerged forest; and the intermediate strata washed or rolled upon them, and formed into its peculiar character by chemical combinations, and exudations, from pressure, and lengthened pressure.

THE LEINSTER COAL DISTRICT.

This engraving will convey a more accurate idea of the strata of the earth than a hundred verbal descriptions. We are indebted for it to the interesting and scientific work of Mr. Griffith. The characters of the several strata are indicated by the lines in which they are engraved, as may be seen in the scale at the left-hand corner. The mountain stands on a basis of lime-stone, distinguished by the waving lines, and of course the whole of the upper strata have been formed since the lime-stone. Immediately above the lime-stone is a stratum of black slate-clay; then a stratum of sand-stone from 25 to 50 feet in thickness; then another of slate-clay; and these alternate with some mixtures, so that in the mountain there are no less than 16 beds of sand-stone and 11 of slate-clay; the others consisting, as may be observed, of seven of slaty sand-stone, of two of fire-clay, with one of coal lying over it.

But, by one of those caprices which belong to all formations, we have on the right two other coal formations, also upon fire-clay, and these formations appear as though they had extended higher, and joined the small bed of coal near Upper Firoda. The regular thickness of the strata in this mountain, the uniformity of the series contrasted with the serpentine directions into which they are thrown, and the extraordinary manner in which they are discontinued at the surface, as evident parts of continued curves, fill the mind with unsatisfied curiosity in regard to the original production, and the cause of its present broken condition.

CRYSTALLIZATION.

As all matter must consist of primeval atoms, so these, in combination, must assume determinate regular forms. If small enough, they may be spherical, and yet form regular bodies, as triangles, when ten, six, or three, are put together; when one is put upon three, a tetrahedron; and six would form an octahedron; while seven would form an acute rhomboid. Hence, all compounded forms, which may be the small bodies producing sensible phenomena, may consist of spherical atoms, provided these are sufficiently small; but, as such atoms would require cement, this hypothesis, for which Dr. Wollaston has taken credit, seems to be necessarily wrong. Better is it to conceive with Haüy, that primary atoms are in three different forms, as cubes, tetrahedra, and prisms; which three compounded form octahedra, hexangular prisms, dodecahedrons, and acute rhomboids; because herein we have that union of sides, which, when packed, are not easily disturbed, and exhibit the various phenomena of cohesion. Chemical action is then easily explained by the application of heat, or atomic motion in any form, as in gases or fluids; and then the introduction of an agent of a dissimilar form of atoms necessarily decomposes any mass of similar shaped atoms. Haüy illustrates his very ingenious theory, by supposing that the six secondary forms may arise from decrements of particles on different edges and angles of the three primitive forms. Thus, if a cube has a series of decreasing layers upon each of its six sides, it becomes a dodecahedron, as in fig. 1, if the decrement be upon the edges; but an octahedron, if upon the angles; while, by varying the decrements in different layers, an infinite variety of forms may be produced, as in fig. 1 and 2, which is ingenious and satisfactory. The nature of chemical action, or repulsion, will be evident, if, within such a mass of cubes as fig. 1 or 2, a number of tetrahedra were introduced, or made to insinuate themselves by heat or atomic motion. Of course, they would disturb the order of the layers, and decompose the whole mass. Fig. 3 and 4 exhibit the chemical and mechanical action of fluids and chemical agents on certain solids, in some ingenious experiments made by Mr. Daniell. Many analogies support the idea of three primitive forms of atoms, such as the three principal gases, oxygen, nitrogen, and hydrogen; the three colours,—red, yellow, and violet; and the three primary tones in music; while their combinations produce intermediate varieties of phenomena.

The figures in Plate I. represent the regular forms which the Abbé Haüy considers, and with apparent justice, as that of primæval atoms which constitute the basis of all solid matter, and which therefore are objects of the highest curiosity, in a philosophical point of view. One of the figures shows how solids may consist of an aggregation of little cubes, producing a figure in large similar to their own.

The Second Plate exhibits some experiments made by applying acids to solids, which, when examined by the microscope, appear to be separated in layers and regular forms, and not in the irregular manner which the cursory observations of the naked eye might lead us to imagine. The figures made up of balls are given in support of the hypothesis of Dr. Wollaston, who considers the primary atoms of matter as spherical, and that the regular forms of Haüy are necessary results of the primary atoms being spheres. —The idea is ingenious, but it suits the construction of fluids better than that of solids, and seems to require that the density of all solids should be similar, while it prevents the cohesion from contact.

THE MOUNTAINS ON THE EARTH.

The following enumeration serves as a Key to the interesting Engraving of the principal Mountains, &c. throughout the world:

WESTERN HEMISPHERE.

Explanation of the Figures and Letters.

Figures.	Mountains, &c.	Lat.	Country.	Feet above the sea.
1.	Town of Leon de Caraccas	10½°N.	S. America.	3,490
2.	The Intendency of Mexico, and parts of the adjoining provinces, lying on the high table land of New Spain	19½ N.	New Spain.	7,500
3.	Town of Riobamba		Peru.	11,670
4.	The lake of Toluca	19¼ N.	Mexico.	12,195
5.	Popocatepetl, the highest mountain in Mexico, a volcano	18½ N.	Mexico.	17,720
6.	Chimborazo, the highest peak of the Andes	1½ S.	Quito.	21,440
	*** In the text Humboldt speaks of 3000 yards—but he means from the elevated plain on which the cone is situated.			
7.	Cotopaxi, a volcano in the Andes, remarkable for the frequency and violence of its eruptions		Quito.	18,898
8.	Cajambe, a peak of the Andes		Quito.	19,480
9.	Antisana, a volcanic summit of the Andes		Quito.	19,150
10.	Tonguaragua, a volcano		Quito.	16,270
11.	Real del Monte, a mine	19¼ N.	Mexico.	9,125
12.	Cotocatche, a peak of the Andes	1½ S.	Quito.	16,450
13.	Imbabura, a volcano, which frequently ejects fish	1 S.	Quito.	8,960
14.	Mount St. Elias, the highest mountain in North America	60⅓ N.	N. W. Coast	18,090
15.	Height of Assuay, the ancient Peruvian road			15,540
16.	The city of Quito	0½ S.	Quito.	9,630
17.	Peaks of the Rocky mountains		N. America.	6,250
18.	The Farm House of Antisana, the highest inhabited place on the surface of the globe. It is elevated, according to Humboldt, 3,800 feet above the plains of Quito			13,500
19.	Pambomarca, a summit of the Andes	0½ S.	Quito.	13,500
20.	Jorullo, a volcano	19 N.	Mexico.	4,265
21.	La Souffriere, a volcano		Guadaloupe.	5,500
22.	The north peak of the Blue mountains in Jamaica	13¼ N.	W. Indies.	8,180
23.	The height attained by Humboldt and Bompland in June, 1802, and the highest spot of earth on which man ever trod. These enterprising travellers attempted to ascend to the top of Chimborazo, but were prevented by a chasm 500 feet wide. At the height to which they attained they found the air intensely cold and piercing, and, owing to its extreme tenuity, respiration was diffi-			

	cult. The blood oozed from the eyes, lips, and gums. One of the party fainted, and all of them felt extreme weakness			19,400
24.	The highest flight of the Condor			21,000
a.	The highest limit of the lichen plant			18,225
b.	Lower limit of perpetual snow under the equator			15,730
c.	The highest limit of pines under the equator			12,800
d.	The highest limit of trees under the equator			11,125
e.	The highest limit of oaks under the equator			10,500
f.	The highest limit of the Peruvian bark tree			9,500
g.	Lowest limit of pines under the equator			5,685
h.	Highest limit of palms and bananas			3,280

Mountains, &c. not referred to by figures.

Mountains, &c.	Lat.		Country.	Feet above the sea.
The peak of Orizaba, a volcano	19°	N.	Mexico.	17,370
Iztaccihuatl	19	N.	Mexico.	15,700
Nevada de Toluca	19¼	N.	Mexico.	15,165
Nauhcampatepetl	19½	N.	Mexico.	13,415
Highest peak	40¼	N.	Missouri.	12,500
James peak	38¾		Do.	12,000
Mount Fairweather, near Mount St. Elias on the N. W. coast of N. America	59	N.		8,970
The city of Santa Fe de Bogota	4½	N.	S. America.	8,615
Mount Washington, the highest peak in the United States	44¼	N.	N. Hampshire.	6,634
The city of Popayan	2½	N.	S. America.	5,825

EASTERN HEMISPHERE.

Figures. Mountains, &c.	Lat.		Country.	Feet above the sea.
1. The Dholager or Dhawalagiri, the highest summit of the Himmalaya mountains, which form the boundary between Hindostan and Thibet	29°	N.	Thibet.	27,677
2. Yamunatri or Jamautri, another peak of the Himmalaya range	29	N.	Thibet.	25,500
3, 4, 5, 6, and 7, are also summits of the Himmalaya mountains, varying in height from 22,400 to 24,600 feet.				
8. Mont Blanc, the highest summit of the Alps	46	N.	Italy.	15,665
9. Mont Rosa			Switzerland.	15,540
10. Mont Cervin, Pennine Alps			Switzerland.	14,780
11. Mont Pelvoux			France.	14,215
12. Mount Ophir, in Sumatra			Sumatra.	13,842
13. Jungfrau, a peak of the Alps	40½	N.	Switzerland.	13,735
14. Mount Ozon, a peak of the Alps			France.	13,465
15. Finsteraarhorn, Alps			Switzerland.	13,234
16. Sochonda mountains	49	N.	China.	12,800
17. Peak of Teneriffe	28½	N.	Canaries.	12,176
18. Mulahacan	37	N.	Spain.	11,670
19. Schreckhorn, a peak of the Alps	46½	N.	Switzerland.	11,490
20. Peak of Venletta	37	N.	Spain.	11,390
21. Mont Perdu, the highest of the Pyrennees	42¾	N.	France.	11,265
22. Le Vignemal	42¾	N.	Do.	11,010
23. Mount Etna	37½	N.	Sicily.	10,955
24. Mount Furca, in the Alps	46½	N.	Switzerland.	10,850
25. Pic Blanc, Alps	45¾	N.		10,203
26. Mount Lebanon	35	N.	Syria.	9,535
27. Mount St. Gothard			Switzerland.	8,930
28. Peak of Lomnitz, the highest of the Carpathian mountains	49	N.	Hungary.	8,640
29. Mont Velin, the highest of the Appenines	42½	N.	Italy.	8,300
30. Sneebutten	62½	N.	Norway.	8,295
31. Convent on Mount St. Bernard	46	N.	Switzerland.	8,040
32. A volcano in Bourbon	21½	S.	Ind. Ocean.	7,680
33. Pilatusberg, in the Alps			Switzerland.	7,080
34. Convent of St. Gothard			Switzerland.	6,810
35. Mount Cenis	45⅓	N.	Italy.	6,780
36. Mount Olympus	40	N.	Turkey.	6,500
37. Mont d'Or	45¼	N.	France.	6,190
38. The Cantal, in the same chain	45	N.	Do.	6,090
39. Mont Reculet, Jura chain			Switzerland.	5,590
40. Puy de Dome, in Auvergne	45¾	N.	France.	5,225
41. Hecla	64	N.	Iceland.	5,010
42. Mount Ida	35¼	N.	Candia.	4,960
43. Snoe Fiall	65	N.	Iceland.	4,560
44. Ben Nevis, the highest in Great Britain	56¾	N.	Scotland.	4,370
45. The town of Briancon	45	N.	France.	4,270
46. Cairngorm	57	N.	Scotland.	4,066
47. Mount Vesuvius	40¾	N.	Italy.	3,935
48. Palace of St. Ildefonso	41	N.	Spain.	3,790
49. Ben Wyvis	57¼	N.	Scotland.	3,720
50. Snowdon, in Wales	53¼	N.	Wales.	3,571
51. Ben Lomond	56¼	N.	Scotland.	3,250
52. Madrid	40½	N.	Spain.	2,276
53. Rock of Gibraltar, highest part	36	N.	Spain.	1,440
54. Arthur's Seat, near Edinburgh			Scotland.	809
55. London, at St. Paul's	51½	N.	England.	65
56. Dover Castle (in Kent)	51	N.	England.	469
57. Wrekin (Shropshire)	52¾	N.	England.	1,320
58. Holyhead mountain			Wales.	709
59. Dundry beacon (Somersetshire)	51½	N.	England.	1,668
60. Plynlimmon	52⅓	N.	Wales.	2,463
61. Paris	48⅚	N.	France.	115
62. Pyramids of Egypt	30	N.	Egypt.	500
63. Lake of Constance	47½	N.	Switzerland.	1,162
64. The highest flight of a balloon. Gay Lussac ascended to this height				22,900
65. Greenwich Observatory	51½	N.	England.	214
i. Perpetual snow in Switzerland, above the altitude of 8,000, or				9,000
k. Perpetual snow at this altitude, in			Norway.	7,000

*** Such are the admitted average heights of Mountains, but different Travellers report differently, and hence in every two tables and reports the elevation varies.

CHIMBORAZO AND COTOPAXI.

Chimborazo is 21,000 feet above the level of the sea, and 9000 above the elevated plains on which they stand; and Cotopaxi, 19,000. Till the discovery of the Himalayas, they were considered the highest points on the globe.

We distinguish, says Humboldt, three kinds of principal forms belonging to the high tops of the Andes: the volcanoes which are yet burning; volcanoes, the summits of which have sunk after a long series of eruptions, exhibiting ridges bristled with points, needles leaning in different directions, and broken rocks falling into ruins; and a third form of the high tops of the Andes, and the most majestic of the whole, is that of CHIMBORAZO, the summit of which is circular. The aspect of mountains of granite has little analogy with that of Chimborazo. Granite summits are flattened hemispheres, and the trappean porphyry forms slender cupolas: but Chimborazo appears like a cloud at the distance of 200 miles. It detaches itself from the neighbouring summits, and towers over the whole chain of the Andes, like that majestic dome produced by the genius of Michael Angelo, over the antique monuments which surround the Roman Capitol.

The bulk of Chimborazo is so enormous, that the part which the eye embraces at once, near the limit of the eternal snows, is 8000 yards in breadth. The extreme rarity of the strata of air, across which we see the tops of the Andes, contributes, too, greatly to the splendour of the snow, and the magical effect of its reflection. Under the Tropics, at a height of 6000 yards, the azure vault of the sky appears of an indigo tint. The outlines of the mountain detach themselves from the sky in this pure and transparent atmosphere; while the inferior strata of the air, reposing on a plain destitute of vegetation, which reflects the radiant heat, are vaporous, and appear to veil the middle of the mountain.

COTOPAXI is the loftiest of the volcanoes of the Andes, which at recent epochs have undergone eruptions; and, notwithstanding it lies near the Equator, its summits are covered with perpetual snows. The absolute height of Cotopaxi is 18,876 feet, or three miles and a half; consequently it is 2,622 feet, or half a mile, higher than Vesuvius would be, were that mountain placed on the top of the Peak of Teneriffe! Cotopaxi is the most mischievous of the volcanoes in the kingdom of Quito, and its explosions are the most frequent and disastrous. The masses of scoriæ and the pieces of rock thrown out of this volcano cover a surface of several square leagues, and would form, were they heaped together, a prodigious mountain. In 1738, the flames of Cotopaxi rose 3000 feet, or upwards of half a mile, above the brink of the crater. In 1744, the roarings of this volcano were heard at the distance of 600 miles. On the 4th of April, 1768, the quantity of ashes ejected at the mouth of Cotopoxi was so great, that it was dark till three in the afternoon. The form of Cotopaxi is the most beautiful and regular of the colossal summits of the high Andes. It is a perfect cone, which, covered with a perpetual layer of snow, shines with dazzling splendour at the setting of the sun, and detaches itself in the most picturesque manner from the azure vault above. This covering of snow conceals from the eye of the observer even the smallest inequalities of the soil; no point of rock, no stony mass, penetrating this coat of ice, or breaking the regularity of the figure of the cone.

GENERAL VIEW OF THE ANDES.

This view is taken from Humboldt, on the elevated plains near Quito, which are 3,300 yards above the level of the sea; above which Chimborazo and some other mountains are raised above another 3,000. The cones of burning volcanoes present themselves on every side in this sublime region.

GENERAL VIEW OF THE ALPS.

The tops of the Alps, like those of all high mountains, are continually covered with snow; and immense glaciers or mountains of accumulated ice fill their intervals, sometimes continued, in wonderful masses, from one valley to another, on the declivity of the summits. The view from Berne as exhibited in the engraving is very grand, and is

copied from the Berne Guide, and may be regarded as a faithful representation.

At the glaciers of Grindelwald and Bois, in the valley of Chamouni, these sublime horrors may be admired to advantage. From an insulated summit the eye beholds a sea of ice, whence arise crystalline blocks, transparent walls, and prismatic needles, confusedly intertwined, resembling the wrecks of a storm whose fury has abated. The brilliant reflections, the colours of the rainbow, and lights infinitely diversified, enrich this view.

MONT-BLANC.

This sovereign of the Alps is about 15,000 feet above the level of the sea; and, being perpetually covered with snow, and visible a hundred miles round, has acquired its name from its brilliant whiteness. Though surrounded by ridges of other mountains, and connected by Alpine tracks, yet, till within these few years, its ascent was deemed impracticable. M. Saussure has published the best account of the whole district; and we have copied his view of the mode adopted in ascending these dangerous precipices. At length, some adventurous English travellers reached its summit, by conveying with them three days' provisions, and conveniences for night-shelter; but, in a similar attempt made in 1822, some other adventurous travellers perished. Besides the difficulties presented by walls of ice and accumulated snow, unfathomable chasms and frightful precipices frequently arrest the course.

THE MIAGE.

This is one of those mixed mountains of ice and granite which surround Mont Blanc. Nothing can exceed it in peculiarity of objects, in desolation, and terrific grandeur. It affords no support to animals of any kind, and is therefore deserted by all. The masses of ice seem to have been accumulating since the Creation, and their bulk and splendour in the sunshine are indescribably wonderful.

CHAMOUNI.

The village of Chamouni is situated in a little valley, close to the immense glacier of Mont Blanc; and this, as well as other places of human habitation in the same vicinity, are frequently exposed to the destructive effects of slippings or falls of enormous mountains of ice upon them, which too frequently destroy men, cattle, and every thing in their course.

MONTSERRAT.

This Spanish mountain is famous for its serrated and pointed appearance, and in that respect is one of the most remarkable prominences in the world. It is, moreover, a noted focus of monkish superstition; a number of lazy anchorites residing in cells on its most inaccessible pinnacles, where they are fed by the bounty of the credulous.

SNOWDEN.

Although Snowden is only 3,500 feet above the level of the sea, and a mere mole-hill compared with the Himalayas or Andes, yet it serves to afford the inhabitants of England a specimen of mountain scenery, and is to them an imposing natural curiosity.

SAUSSURE ASCENDING THE ALPS.

M. Saussure passed several years among the Alps, exploring their recesses and examining their phenomena. This engraving, copied from his work, illustrates the ingenious means adopted to enable him with safety to ascend its crags and slippery precipices; and the engraving affords an idea of the similar means by which such mountains in general are explored by men.

GIANTS' NEEDLE ON THE ALPS.

This remarkable object consists of nothing more than a granitic or phophyritic projection towering above the snow. The contrast of colours render it conspicuous to a great distance.

THE DEVIL'S BRIDGE.

This view is introduced for the purpose of increasing the representations of the scenery of the Alps. This bridge was thrown over a chasm of an immense depth, which intercepted a road through the mountains; and, its construction being considered almost miraculous, it was ascribed by the vulgar to the devil, and hence its name. It fell a short time since, and has not, we believe, been replaced.

SOURCES OF THE GANGES AND JUMNA.

We have introduced this view from the grand work of Mr. Fraser, for the purpose of showing some of the sublime scenery of the Himalayas. The spot is held sacred by the Hindoos, as the seat of the principal source of the Ganges and Jumna; an object which, for several centuries, was a question of great geographical curiosity.

THE PHILOSOPHY OF MOUNTAINS.

This table assembles a most interesting number of facts relative to the phenomena of mountains, in addition to the other engravings. It leaves nothing more to desire on the subject. It is a study by itself, and merits the special attention of the reader. It is drawn up from materials furnished by M. Humboldt. United with the engraving of mountains, it renders the subject complete.

COPPER MINE IN SWEDEN.

The copper and iron mines of Sweden are the most celebrated and most valuable in Europe, and are of wonderful magnitude.

The exterior of this mine presents a vast chasm of a tremendous depth. The passage into the great chasm is by ranges of wooden steps. Here are to be seen the same caverned portico, the rocky, rough descent, the steaming sulphur, and all deadly stenches. The wretched inmates of this gloomy cavern appear like so many spectres. In one part the steam is so excessively hot as to scorch at the distance of twelve paces, at the same time that the sulphureous smell is intolerable. Near this spot a volcanic fire broke out some years ago, in consequence of which, strong walls were constructed, as barriers to its power, and several contiguous passages, which, had it spread, would have proved dangerous to the mine, were closed up. The depth is twelve hundred feet, and a full hour is required to reach the bottom. The mass of copper lies in the form of an inverted cone.

SILVER MINE IN POLISH PRUSSIA.

This celebrated silver mine is near Koningsberg, and is called in the country "God's Blessing." It yields many hundred pounds of rich ore per week, and is above 1,000 feet in perpendicular depth. At the bottom is an immense space filled with fires, to soften the stone, and with swarms of miners, making the most hideous appearance.

SALT MINES OF CRACOW.

The bowels of the earth, besides yielding metals and various stones, are found, in some situations, to contain strata of solid salt, called Rock-salt. Whether these salt strata have arisen from the drying-up of salt lakes, or whether the saltness of the sea arises from its contact with salt strata, has been made a question. Be this as it may, Cheshire and Poland present rich veins or strata of salt; and in some situations water is impregnated with salt, doubtless from passing through strata which produces a strong brine, from which salt is made by evaporation.

The mine at Cracow is very magnificent. It is 800 feet deep, 6000 feet long, and 2000 feet broad, filled with numerous passages, in which reside the miners with their families; many of whom never see the light of day. This salt-mine has, however, ceased to be wonderful for its magnitude, since the mines of Peru, Sweden, Britain, and the Low Countries, have been wrought to so much greater extent.

THE GIANT'S CAUSEWAY IN THE NORTH OF IRELAND.

This wonder of nature consists of a vast collection of basaltic pillars. The principal, or grand causeway, (there being several less considerable and scattered fragments of a similar nature,) consists of an irregular arrangement of many hundred thousand columns, formed of black rock, nearly as hard as marble. They are of unequal height and breadth; and several of the most elevated are of the height of about twenty feet.

This grand arrangement extends nearly two hundred yards, as it is visible at low water; but how far beyond is uncertain, from its declining appearance. The breadth of the principal causeway, which runs out in one continued range of columns, is in general from twenty to thirty feet, and in some parts it may be nearly forty. The figure of these columns is, with few exceptions, pentagonal, or composed of five sides; yet there are not two columns in ten thousand to be found which either have their sides equal among themselves, or display a like figure. The columns, or pillars, are composed of several short lengths, nicely joined, and articulated into each other like a ball and socket, or like the joints in the vertebræ of some of the larger kind of fish. The length of these particular stones, from joint to joint, is various: in general, from eighteen inches to two feet long; and, for the greater part, longer towards the bottom of the columns than nearer the top.

Notwithstanding the general dissimilitude of the columns, relatively to their figure and diameter, they are so arranged and combined at all the points, that a knife can scarcely be introduced between them, either at the sides or angles. At the depth of ten or twelve feet from the summit of the cape of Bengore the rock begins to assume a columnar tendency, and forms a range of massy pillars of basalt, which stand perpendicular, presenting, in the sharp face of the promontory, the appearance of a magnificent gallery

or colonnade, upwards of sixty feet in height. This colonnade is supported on a solid base of coarse, black, irregular rock, nearly sixty feet thick, abounding in blebs and air-holes; but, though comparatively irregular, it evidently affects a peculiar figure, tending in many places to run into regular forms, resembling the shooting of salts and many other substances during a hasty crystallization. Beneath this great bed of stone stands a second range of pillars, from forty to fifty feet high, more exactly defined, and emulating in the neatness of its columns those of the Giant's Causeway.

GENERAL VIEW OF STAFFA.

It appears by the view that Staffa is an entire basaltic formation, and its vicinity to the Giant's Causeway and to other basaltic islands seems to prove, if basalts are really of volcanic origin, that some great volcano exerted its energies in these seas, in some remote age of the world. Perhaps the Brahminical tradition of the great churning, as they call it, in this northern ocean, may refer to the period in question.

FINGAL'S CAVE, IN STAFFA.

This stupendous cavern is 371 feet long, and about 50 feet high, formed by an eruption of the sea, among a mass of grand basaltic pillars, themselves wonders of the world. It is supported by ranges of columns, and is roofed by the bottoms of such as have broken away. From the interstices of the roof, a yellow stalactic matter has exuded, which defines the different angles. The whole cave is so lighted from without, that the further extremity is plainly distinguishable. The highest range of pillars is to the north-west, and the surface of the stratum by which it is supported is rough, while the base is composed of heterogeneous parts, resembling lava.

FOSSIL REMAINS.

The subjects of Fossil Remains consist of parts of animals, plants, fishes, and shells, which either have been impregnated with silex, and become of stony hardness, with calcareous matter, and petrified, or imbedded in stones of various descriptions; and, in one case, we have given a specimen of marble, composed entirely of the visible remains of shells, a variety of which is so common in many districts, that it is used for ordinary purposes; and also various specimens of fish's teeth. These remains have evidently been entangled, during great changes, which have taken place on the earth's surface, in very remote ages; and they include an infinite variety of genera and species, no longer to be met with.

The five plates contain representations of 135 different species, classed under their respective names of various shells; remains of plants imbedded in stone; fish's teeth; and other organized productions living on the earth before the formation of the present strata.

In one of the larger specimens, various vegetables and their seed are assembled in one stone: the seed resembles coffee; and there is also a branch of Fern, with the vegetable of the verticillate tribe.

The fossil marble is so common in Sussex that the streets of Lewes are paved with it; and it consists entirely of shells united by cement. The fossil animal was published by Cuvier, and found near Paris.

All these objects are too interesting to be slightly passed over by the lover of antiquities or the student of Natural History.

SKELETONS OF THE FOSSIL SLOTH AND MAMMOTH.

Among other remains of quadrupeds, where continuance has become unfit or discordant with the state of the world, in other respects, are some varieties of enormous animals, whose remains are constantly found in exploring the strata of all countries.

One of these is the *American Mammoth*, whose bones are still exposed in great quantities on the banks of the Ohio, and a perfect specimen of which creature is to be seen in the Museum at Philadelphia. Its relative size to a man of middle stature is displayed in the engraving. When these animals became extinct is unknown; but the Indians have traditions that they were formerly so formidable as to drive men into caverns for safety.

The other specimen is of another genus, in which bulk is happily counteracted by awkwardness of structure. This creature is of the sloth kind, of the species called *Megatherium*, and its relative size to that of man is indicated by the figure. It was found in South America, and is now preserved in the museum at Madrid. Bones of animals, equally enormous, have been found in all parts of Britain; and the common existence of such creatures gives rise to interesting speculations relative to the state of the world when they flourished. The existence of enormous animals appears constantly to become more and more unfit. Thus, the rhinoceros, the elephant, the hippopotamus, the camel-leopard, &c. &c. are constantly becoming scarce, and wholly extinct, in countries where they formerly existed in great numbers.

The remains of this enormous awkwardly-constructed animal were a few years since found in Paraguay; and, being conveyed to Spain, were deposited in the Museum of Madrid. The difficulty with which a creature whose motions must have been so awkward could have found adequate subsistence must have led to the speedy extinction of the species, in spite of the prolific character of the country in which these remains were found. It is impossible to view these gigantic remains of creatures whose race is now extinct without feelings of mingled delight and astonishment.

MAMMOTH IN THE MUSEUM, PHILADELPHIA.

The bones of this animal abound in the vicinity of salt-springs near the Ohio, and are found also in other parts of North and South America. Its enormous dimensions are proved by M. Montulé's drawing, where he is represented reaching to touch the ribs. Its tusks distinguish it from those of the Siberian mammoth, which turn upward, and from the mammoth found in the Rio de la Plata, which was without horns; but the entire genus are of similar magnitude, i.e. twelve or fifteen feet high, and 20 or 30 long, their bones being massive in proportion to their bulk. The Indians have a tradition that they once were the terror of the woods, and that men were obliged to retreat to caves to escape from their ravages.

GROTTO OF ANTIPAROS.

Till the discovery of the great Cavern of Kentucky, this grotto was for ages regarded as the greatest natural curiosity of its kind. It consists of a series of chambers, whose roofs are covered with beautiful and transparent stalactites, or oozings from the superior ground of the very substance which, when strata are beneath, forms the solid cement of those strata, and converts loose matter into the hardest solids. The figured forms on the ground are composed of beautiful crystals, and icicles of white marble. The cavern is usually visited by strangers with torches, the reflection of the light of which, from the stalactites, produces an enchanting effect.

Derbyshire abounds in similar caverns, but the above is the finest specimen which could be given.

DEVIL'S PEAK, AND GRAND CAVERN, DERBYSHIRE.

The Peak of Derbyshire is famous for its subterranean, geological, and mineralogical wonders. Among these, the Peak Cavern, near Castleton, is very famous for its size and extent: it is 2250 feet in length, 620 feet below the surface, and in some parts 300 feet high. The Grand Cavern is a recent discovery; and doubtless others will be found on further examination, as the whole district is irregular, and full of cavities.

PLAN OF THE GREAT CAVE IN KENTUCKY.

Of other Caverns we have been able to give particular views, but this extensive and unparalleled range of galleries, of halls, and immense domes, would, if represented, furnish a picturesque work by itself. The figure at the side represents a human subject, probably the remains of some unfortunate Indian, who was bewildered in the Cavern.

A—Mouth of the cave, 40 feet high, and 30 wide.

BB—Hoppers, where saltpetre is made by the owners of the cave. Oxen are worked two miles in.

C—Pits, 175 feet deep in many places in this chamber.

D—This area contains upwards of eight acres, covered with one arch, at least 150 feet high in the centre. It is called the *Chief City*.

E—*Second City*, contains about six acres; the walls around at least sixty feet perpendicular height: one arch.

F—*Fourth City*.

G—This is called the *Fifth City*.

H—The bed of this chamber, which is 1800 feet in circumference, is forty feet above the level of the passage leading to it. You go up a passage like a chimney forty feet perpendicular.

I—At this place a cedar pole was found, twelve feet long, and perfectly sound.

O—No farther explored.

L—*Third City*. From the side of the cave issued a fine stream of water, which falls sixty feet.

R R R—Green River passes over three branches of this cave.

S—A long body of yellow ochre found here.

T—A very beautiful dome, at least forty feet diameter and sixty feet high.

X—Here are six or eight large columns of spar, standing upwards of sixty feet perpendicular height, the bases of which rest in elegant basins of water, as clear as amber. Soda is found in great quantities in and near these columns of spar.

Z—Found no end.

N—Ditto. Ditto.

THE GROTTO DEL CANE.

This is an inconsiderable cavern between Naples and Puzzuoli, situated in a volcanic district. It contains a small lake, over which hangs an atmosphere of carbonic acid gas, commonly called fixed air. If, then, a dog be plunged into this gas, he immediately loses all signs of life; but, on being drawn out, he speedily recovers again.

This was an object of great wonder among travellers and superstitious persons, till the density and deleterious character of carbonic acid gas were ascertained.

MICROSCOPIC OBJECTS.

It has been preferred to collect together in one series of plates, the various objects of microscopic observation, though they belong to different kingdoms and orders. The human eye is calculated to see objects distinctly at a distance not less than eight inches. The size or angle is inversely proportioned to the distance. Thus, at eight inches an object appears of certain standard dimensions, but at sixteen inches is only half those dimensions, while at four inches it is double, at two inches quadruple, and so on. In descending, however, to small distances, the object becomes indistinct. The purpose of a microscope is, therefore, to produce such a new disposition of the light, as enables the eye to produce a perfect image on the retina. For example, the eye can appropriate rays which flow into it parallel, or nearly so; but, if the eye is too near the object, the rays diverge too widely for its powers, and an indistinct picture is produced on the retina. In these circumstances, a convex glass enables the eye to become near-sighted, by rendering the rays parallel when they emerge from the glass, and the eye then sees as distinctly as at the distance of eight inches; but the object is as much larger as eight inches are proportioned to the distance of the glass lens from the object: such is a simple microscope. A combination of lenses increases the magnifying power, by first producing a magnified image, which magnified image another lens enables the eye to approach, and a multiplied power is the consequence. A simple microscope or single lens enables the eye to approach the object, and a compound microscope enables the eye to approach an image made by the single lens; and a solar microscope operates on the last principle, but improves the effect by increasing the quantity of light. The power of microscopes is usually estimated by the increasing bulk, which is the cube of the length and breadth. Thus, if we are enabled, by a lens, or combination of lenses, to view a cubic object within a quarter of an inch, its length is augmented in appearance thirty-two times, because we are thirty-two times nearer than at the distance we usually view it; but its superfices are increased thirty-two times thirty-two, or 1024 times, and its solidity or bulk thirty-two times 1024, or 32,768 times: such are the wonderful powers of the microscope. If the quantity of light could be augmented in the same proportion, we should thus see an object, only that small part of a cubic inch, as distinctly as we see a cubic inch at the usual distance of eight inches.

POLYPI.

These wonderful creatures, who appear to form a distinct branch of existence, and whose habits are totally unlike locomotive beings, present themselves in so many different shapes in the sea, that it would be endless to pursue them in all their protean forms and various structures; but enough is given in these engravings to fill the reader with delight and astonishment. We have traced them from their naked form in our ditches, to their surprising fortifications in various structures of substances as hard as ivory, where they set at defiance every enemy, yet are able to issue forth in search of their own prey. At the same time, such is their power of multiplication, and such their industry, that they fill up the bottoms of the vast ocean, and thereby appropriate to themselves perhaps as large a portion of the surface of the globe as is occupied by the land itself. In this manner Divine Wisdom humbles the pride of man, by means apparently the most insignificant.

Fig. 1 represents a polypus sticking to a twig, A, B; its body very slender. From A is expanded several horns, A, C, which serve it instead of legs and arms, and are more slender than the body. The mouths of the polypus are at C. The stomach occupies the whole length of the body, which is a pipe, or sort of gut, open at both ends. They can stretch themselves to the length of an inch and a half, but they are generally about three-quarters of an inch long; and they can contract themselves to the twelfth of an inch, or to any intermediate length. One species can extend its arms seven inches, or contract them at pleasure; and the number of the arms are seldom fewer than six. They are capable of assuming all manner of forms. They do not swim, but crawl upon all bodies they meet with in the water; and their common position is to fix them to their posterior end, B, and stretch their body and arms forward into the water. As soon as an insect touches one of the arms, it is caught, and carried to the mouth by contracting or bending the arm; but, if the prey make resistance, other arms are brought into action. Thus a polypus can master a worm twice or thrice as long as itself. He draws it to his mouth, and swallows it whole, and the stomach extends so as to receive it; he then sucks it, and voids the remainder at B. They eat more in hot weather, and grow in proportion to what they eat; yet they can fast for months. Each individual produces young ones from all the exterior parts of its body, which are stems, from which issue the young ones as branches. The young ones themselves sometimes bring forth others before they are severed from the parent. If they are kept warm and have plenty of food, they multiply prodigiously. If the polypus be cut into two parts transversely, each becomes a complete polypus, and the end at A lengthens itself, creeps, and eats on the same day. On the part which has no head, one grows, a mouth forms itself, and shoots forth arms, in summer, in twenty-four hours; and the new head is perfected in a few days; both the polypi being as complete in all their functions as though they had not been cut. Even if a single one be cut into fifty pieces, each of them shoots out into perfect polypi. It may also be cut into two, lengthways, when the edges of the half-pipes close, and the animals become perfect in an hour; additional arms growing in a few days. Most ditches, where water is stocked with small insects, produce them.

Fig. 2. A polypus magnified.

—— 3. The same insect, when it has contracted itself, magnified.

—— 4. A polypus with a young one growing at its side.

—— 5. The polypus swallowing a worm endways, grasping the remainder to push it into its stomach.

—— 6. With its mouth extended to receive the remainder of a worm.

—— 7. After it has swallowed the worm.

—— 8. One of the arms of the polypus very much magnified.

—— 9. Represents the clustering polypus considerably magnified; a species which unite in this manner to one stem, and then separate.

—— 10. Represents another of the clustering polypus, drawn in two or three days after it began to form itself. It is much magnified; and one of the branches at little *a* is represented as partly contracted from some external cause.

—— 11. A clustered polypus, of its natural size, extending itself. This specimen was brought up from 236 fathoms, in lat. 79° north, about eighty miles from Greenland, and was at first taken for a fine full-blown flower.

—— 12. Represents the same polypus, with the tentacula laid straight. M is a stem of ivory, six feet long; N is the muscular base where the bodies of the polypus unite.

The polypus appeared to reside at the top of the stem, as on a branch of coral, and even united to it by a membrane like a bladder. Their disposition on the top of the stem is represented at Fig. 13, where ten occupy the upper circle, nine the next, and four in the centre.

THE BELL-FLOWER POLYPI.

These extraordinary creatures dwell in colonies, as they are called, or as a family in a common receptacle, and adhere to duck-weed and other aquatic plants. When the weeds are put for three or four hours in glass vessels in a strong light, the polypi will beautifully extend themselves out of their transparent cases, as in Fig. 1 and 2. A colony never exceeds fifteen; and, when it has increased above that number, the bell or case splits gradually, as in fig. 3, and it afterwards constitutes two separate colonies.

a, the head, resembling a horse-shoe.
b, *c*, the arms.
c, the neck.
d, the œsophagus.
e, the stomach.
f, the intestine.
g, the anus.
h, *i*, that part of the common bell which surrounds the animal, and closes upon it when it retires downward.

Fig. 5 represents what is called a colony of these animals, standing erect, with the animals out of the common envelope.

Fig. 6 represents the extraordinary process of a colony splitting or dividing into two parts, when it has become too numerous.

EGGS OF THE PHALÆNA NEUSTRIA.

Fig. 7 represents the eggs of the moth or phalæna neustria, as taken from the tree to which they adhere, and magnified. The strong ground-work, visible in many places, is the gum by which they are glued together; and strengthened by a very tenacious substance interposed and filling the vacant spaces between the eggs. Fig. 8 shows a vertical section of the eggs, exhibiting their oval shape. Fig. 9 an horizontal section through the middle. These eggs appear beautiful through the microscope: *a*, *b*, *c*, represent the objects in their natural state.

CORALS.

Coral is a marine production, in shape resembling a shrub stipt of its leaves, as in fig. 13. It has no root, but is supported on a broad foot, which adapts itself so firmly that it is impossible to disengage it, as N, N, fig. 14; and the thickness seldom exceeds an inch. Fig. 15 represents a branch of coral with its coating taken off, to show its tubular structure. The coral derives no nutriment from the root; for, if broken off, it grows equally well. Its greatest height is about twelve inches. When the bark is broken off, a small worm enters the body of the coral, which makes itself roundish cells, and others pass through it in straight cylindrical holes. On the bark appear small tubercles, as S, fig. 13, or S, S, fig. 14. The bark of the coral ends at the extremity of these parts. From these tubercles proceed hollow cells, extending to the foot of the coral, in which are lodged polypi, visible at S, through a microscope, having eight equal rays like a star, and nearly conical. These may be seen when the coral is just taken from the sea, and placed in sea-water; otherwise the polypus draws itself in, as a snail draws in its horns, when it resembles a drop of milk.

CORALLINES.

Of these beautiful and extraordinary productions of nature, it is difficult to convey an adequate idea by an engraving. They are extraordinary, because the productions of extremely small insects, which in these forms construct rocks dangerous to navigation, and, ultimately, islands, which

in time become habitations of men; such being the origin of most of the islands in the South Seas. The specimens represented are of the genera *madrepora* and *millepora*. The 4th figure in the plate represents the celliferous or fleshy coralline; each cell of which affords habitation to a polypus.

Fig. 19, is the tubular coralline, in effect the same as a coral, but carried up in different branches by polypi, whose arms are seen stretching from the apex of each tube.

—— 20, represents the small branches which attach to oyster-shells, but which, in truth, are the productions and residence of polypi; as may be seen in fig. 21, where a branch is magnified, and the arms are seen extended; and fig. 22 further illustrates the same fact, by showing the tubular construction of the base of the same coral, where it attaches to the oyster-shell.

THE CAMPANULATED TABULARIA.

This is one of the most beautiful of the polypus congregations. It is found in clear stagnant waters, and lives in a congregated manner, several animals, to the number of ten, twelve, or fifteen, inhabiting a common receptacle. It is generally attached either to the small fibres of roots projecting into the water, or to the stems of aquatic plants. The body is transparent, of a sub-cylindric tubular form, and is included in a larger or exterior tube, from which the head or upper part is at pleasure protruded. When disturbed, the animals withdraw into the larger or exterior tubes; they, however, seem impatient of confinement, and are commonly seen with their heads expanded. They are found in various parts of the metropolis.

THE RED SEA-PEN

Forms a genus of loco-motive zoophyte, and swims in the manner of a fish. It is generally of a very beautiful appearance, and is found on the British coast. The animal consists of a flattened stem or body, which is furnished with an internal bone, and dilates into an expanded part, consisting of several pinnæ, or lateral branches, which are divided on their inner edges into a number of tubular processes, through each of which is protruded a part of the animal, resembling the head of a hydra or polype: the whole animal may, therefore, be considered as a very compound or ramified union of polypi, the bodies of which are contained in the naked part or stem, and from thence ramify into a vast number of processes, each furnished with its particular head. The animal emits a very strong phosphoric light, and it is even so luminous, that it is no uncommon circumstance for the fishermen to see the fish which happen to be swimming near it merely by the light of the pennulata. Its colour is a bright red or crimson, and the general size that of the figure.

THE SILVER SEA-PEN.

Of all the pennulata yet known, this is one of the largest and most curious in its appearance; being of a beautiful silvery white, elegantly striated on each of the feather-like processes, with lines or streaks of the deepest black. It is extremely rare, and is a native of the Indian Seas. The accompanying engraving is copied from a fine specimen in the British Museum.

WHEEL INSECTS AND ANIMALCULÆ.

Fig. 1. *The Eel in Paste magnified.* Paste turned sour becomes full of these insects in the manner represented in the adjoining division of the plate. Similar insects also appear in vinegar. They flourish for a considerable time in the paste if it is kept moist.

The Wheel Animal. This animalcule appears in rain-water, which stands in contact with lead, and is remarkable for its various forms, its vivacity in the water, and its tenacity of life out of the water, in a completely torpid and dry state, when it assumes the form of a sphere, as in Figs. 2 and 3.

Fig. 4, 5, is its maggot state; and all the other figures in the plate represent its various extraordinary changes between the globular and the maggot state. When it has been several months out of water in the globular state, it becomes the size of a grain of sand; but, on being put into water, in half an hour it begins to move, and assumes the maggot form, pushing out its wheels, and swimming through the water, or fixing itself by the tail and working its wheels. This wheel-work, which is represented at the crown of several of the figures, is a most curious piece of mechanism, and assumes a great variety of forms, sometimes of entire circles, formed with small teeth or cogs; sometimes like the battlements of a tower, and others like a gothic crown or clublike mallets; the assemblage of which make regular rotations, and their forms seem to be connected with the animal's pursuit of prey. They appear very sagacious; for, on touching the water, they instantly draw in the wheels: yet, small as they are, other insects infinitely smaller may be seen in the water, on which they prey. The heart of the animal may be seen through the back in regular action, and the abdomen, stomach, and intestines, are distinguished in action. The abdomen is capable of stretching, as in the three last figures, and receiving the upper parts of the body.

COSSUS CATERPILLAR.

To convey a just and accurate notion of the most wonderful economy of the meanest insect, we have selected as a specimen of the whole the development of the internal structure of the small caterpillar which harbours on the willow.

Fig. 1-2, exhibit the anatomy of the cossus caterpillar, which lives on the willow.

The body of this caterpillar consists of twelve rings, marked 1, 2, 3, &c.: each is distinguished from the preceding and following, by a neck or hollow; and the boundaries to the rings make twelve other divisions: to the first the word *ring* is affixed, and to the second *division*.

Fig. 1-3 show the muscles, arranged with the most wonderful symmetry and order, especially when taken off by equal strata on both sides, which exhibit astonishing and exact form and correspondence. The figure shows the muscles of two caterpillars opened at the belly, and supposed to be joined at the superior lines. The muscles of the back are marked by capitals; the gastric muscles by Roman letters; the lateral ones by Greek characters; and those marked θ are dividing muscles.

The muscle A in the first ring is double; the anterior one thick at top, and, on the upper side, divided into different muscles, but without any such appearance on the under side. One insertion is at the skin of the neck towards the head; the other a little above; and that of the second muscle, A, a little below the first spiraculum, near which they are fixed to the skin.—The muscle α is long and slender, fixed by its anterior extremity under the gastric muscles *a*, *b*, of the first ring, to the circumflex scale of the base on the lower lip. It communicates with the muscle *c* of the second ring, after passing under some arteries, and itself introduced below the musle θ.—The muscle β is so tender, that it is scarcely possible to open the belly of the caterpillar without breaking it. It is sometimes double, and sometimes triple. Anterior it joins the posterior edge of the side of the parietal scale, the lower fixture being at the middle of the ring near the inferior line.

Three muscles are marked ξ: the first affixed at one extremity near the lower edge, higher up the parietal scale; the other end divides into three or four tails, fixed to the skin, under the muscle δ. The anterior part of the second is fixed near the first; that of the third a little under the first and second, at the skin of the neck under the muscle A; and these, passing over the cavity of the first pair of limbs, are fixed by several tails to the edge opposite this cavity. In this subject two muscles are marked δ, but sometimes only one is anterior, fixed to the lower edge of the parietal scale, the other ends inserted in the first fold of the neck. Fig. 20 best represents the muscles β and δ; as they do not appear injured by any unnatural connexion.

In the second and four following rings, we discern two large dorsal muscles, A and B. In the 7th, 9th, and 10th rings are three, A, B, and C; in the 11th are four, A, B, C, and D; and in the anterior part of the 12th ring are five, A, B, C, D, and E. All these, however, as well as the gastric muscles *a*, *b*, *c*, *d*, appear only as a single muscle, running nearly the whole length; but, when detached, consists of so many distinct muscles, each the length of only one ring, their extremities being fixed to the division of each ring, except the middle muscle, *a*, which, at the 6th, 7th, 8th, and 9th rings, has its insertions rather beyond the division. Each row appears as one, because closely connected at top by some fibres from one ring to the other.

The muscles A, 12 in number, gradually diminish in breadth to the lower part of the last ring; at the 8th and three following divisions, they communicate with the muscles B, and at the 11th with D. The lower part of the last ring, A, is much broader that in the preceding ring; one extremity is contracted, and communicates with B: the lower insertion being at the membrane I, the exterior skin of fæcal bag. The muscles A and B, on the lower part of the last ring, cannot be seen until a large muscle is removed, which on one side is fixed to the subdivision of the ring, and on the other to the fæcal bag.

The right muscles B, also 12 in number, begin at the second ring, and enlarge to the seventh, and are usually narrower to the 12th; the deficiency in width being supplied by the six muscles C, from the 7th to the subdivision of the 12th ring. The muscles B and C communicate laterally with the 8th, 11th, and 12th divisions. C is wanting at the subdivision of the 12th, being supplied by B, which there becomes broader.

The first of the three floating muscles, V, originates at the first ring, thence introduced under N, and then subdivided and hidden under other parts. The second, at the second division, fixed to the anterior extremity B, directing itself towards the stomach, after communicating with the case of the *corpus crassum*, divides, and spreads into eight muscles along the belly. The third, at the third division, originating at the skin, and the junction of the muscles B, directs itself obliquely to the belly near the third spiraculum, and, branching, forms the oblique muscles of some of the viscera.

The thin long muscle θ is single at the subdivision of the last ring, and covers the anterior insertion of the muscle *a*, where the ring terminates. It begins at one extremity of the muscle *c*; at the fore-part of the ring runs along the subdivision round the belly to the extremity of a similar muscle C.

Fig. 2, shows the dorsal muscles of the cossus: to be viewed advantageously, observe the following mode of preparation:

Take out all the 35 dorsal muscles, and the seven lateral ones.

Take away all the straight muscles of the belly, the muscular roots, *c*; and the ends of the gastric muscles, *c*, at the third and fourth divisions; and remove at the second division the muscle θ, leaving only the extremities to show where it was inserted.

Begin at the third ring, where are four dorsal muscles, C, D, E, and F. The first, C, is inserted at the third division, under the muscles θ and α, where it communicates by some fibres with the muscle, *f*, of the second ring; proceeds obliquely to the intermediate superior line, and is fixed at the fourth division. When C is retrenched, the muscle D is seen wider from the anterior extremity, in a contrary direction to C, and inserted into the third and fourth divisions. The muscle E lies in the same direction as C, but less obliquely: the lower insertion is at the fourth division; the other at the third

immediately under C. The muscle F is nearly parallel to D, which joins it; the first insertion is visible, but the other is under E and G at the fourth division.

In the eight following rings are only two dorsal muscles; and D only is completely seen, very large, and diminishing from one ring to the other to the last, sending off some branches. E is one of the straight muscles of the back, inserted under the dividing muscles θ, at the divisions of its own ring.

On the anterior part of the 12th ring are three dorsal muscles, D, E, and F. D is similar to that of the preceding ring, (marked also D,) only half the length; terminating at the subdivision of its own ring. E is of the same length, and differs only in direction from the muscle E of the preceding ring. F is parallel to E, and shorter, its anterior end not reaching the twelfth division.

The posterior part has only one dorsal muscle, fastened by some short ones to the subdivision of the last ring, traversing the muscle α, as if to strengthen them and vary their direction.—α is a single muscle, the anterior insertion visible, the other fixed to the bottom of the foot of the last leg to move the foot. The anterior part of the muscle β branches across the superior line obliquely, and is fixed to the skin a little above. The other end is fastened to the membrane T.

Fig. 2 and 4 show the muscles when the insect is opened at the back.

The first ring has only two gastric muscles, *c* and *d;* the former is broad, with three or four little tails; the first fixture is at the base of the lower lip, whence it descends obliquely, and is fixed between the inferior and lateral line. The small muscle *d* is fastened on one side to the first spiraculum; on the other, lower to the intermediate inferior and lateral line, and seems an antagonist to the muscle P, which opens the spiracula. The posterior fixture of δ is under the muscle C, near the skin of the neck; β is fixed a little on the other side of C, at the middle of the ring. In the second ring are three gastric muscles, *g*, *h*, and *i;* but only the anterior part of *i* seems fixed at the folds which terminate the ring. The muscle *h* is triple, and, in one division, in two parts; that marked *i* comes nearer the inferior line, fixed beyond the middle of the ring, where the corresponding muscle of the opposite side is forked to receive it. In the third ring, the muscle *h*, triple in the foregoing ring, is double here, that nearest the inferior line being broadest; it has three tails, and is exactly similar to the preceding ring, crossed by the muscle from the opposite side.

Through all the eight following rings, the muscle *f* is very broad and strong. The anterior part is fixed at the intermediate inferior line, on the fold of the first division; the other part is fixed beyond the lower division, but at the 10th and 11th rings and at the last fold; whereas, in the others, it passes over that ring, and is inserted into the skin of the following one. In all, the first extremity of *g* is fastened to the fold which separates the ring from the preceding one, parallel to *f*, and at its side. The six muscles marked *g* are forked; that of the fourth ring more than the rest, and unites only near its anterior insertion. The longest tail holding the following inserted near the inferior line; the other near the same line about the middle of its own ring. These two do not branch out; but terminate at the divisions. The muscle *h*, at the side of *f*, has nearly the same direction, and finishes at the folds of the ring.

The anterior part of the 12th ring has only one gastric muscle marked *e*, placed on the intermediate inferior line; and inserted at the folds of the upper division and subdivision of this ring. The lower part has a larger muscle *e*, with several divisions; one under *b*, with one extremity fixed near the lateral line, at the subdivision of its ring; the other to the fæcal bag, a little lower than the muscle *b*.

In fig. 2, the gastric muscles described in fig. 4 disappear, and those lateral and dorsal ones of which the letters are not found.

In the first ring are the gastric muscles, *e*, *f*, *g*, best seen here: the first is narrow and long, passing under and crossing *f:* one insertion is at the lower line, the other at the lateral, between the spiraculum and neck: *f* is short, broad, and nearly straight, along the intermediate line; but passing between it and the lateral under *e*, and fixed to the fold of the skin which goes from one bag to the other; the lower insertion is near the second division. There are sometimes three or four muscles of *g;* the lower parts fixed about the middle of the ring, and the anterior at the fold of the skin near the neck, with the muscles *i* and *h;* the other end of *h* being fixed under the muscle I, I, near the spiraculum. Above the upper end of *f*, is a muscular body, *g*, formed by the separation of two floating muscles.

The second ring has six gastric muscles, *k*, *l*, *m*, *n*, *o*, *p*. The first is large and oblique, with three or four divisions at the anterior part of the ring; the head is between the inferior and intermediate lines at the fold of the second division, whence, crossing the inferior line and its corresponding muscle, it terminates right and left of the line. I is narrow, the head fixed to the fold of the second division; the tail lying under *n*, and fastened to the edge of the skin that forms the cavity for the leg. The two muscles *m* have the some obliquity, placed one on the other; the head inserted in the skin under β, communicates by fibres with the tail of γ; the other end is fixed to the intermediate inferior line at the fold of the third division. The large and broad muscle *n* covers the extremity of the tail of *l*, and the lower edge of the cavity of the limb: fixed first at the skin, near the intermediate line, from whence it goes perpendicularly towards *m*, and under *o* and *m* it is fixed. The muscle *o* is narrow, bent, and covers the edge of the cavity of the leg a little; one end terminating there, and the other at the third division near *m*. That marked *p*, also bent, runs near the anterior edge of the cavity of the leg; one end meets the head of *o*, the other terminates at a raised fold near the inferior line. There is a triangular muscle on the side of the lateral muscle *o*, similar to that marked *g* in the following ring.

The third ring has no muscle similar to *m;* that marked *k* differs from that of the second ring only in being crossed by the opposite muscle: *l*, *n*, *o*, *p*, are similar to those of the preceding; *q* is triangular, the base fastened to the last fold of the ring; on the lower side it is fixed to *o*, the top to the skin at the edge of the cavity for the leg.

The eight following rings have the gastric muscles, *i*, *k*, *l*, and *m: i* is straight, and at some distance from the inferior line, broad at the fourth ring, but diminishes gradually to the 11th. At the fourth it divides into two heads, which divaricate in the following rings. In the six next rings these heads are fixed nearly as *a* and *f;* and the others terminate at the fold of the ring. The anterior insertion of the first and last is at the fold where the ring begins: that of the six others is lower, under where *i* terminates. The lower part of *k* is in the skin near *i;* the upper part at the intermediate interior muscle upon the fold which separates the following ring, but is wanting in the 11th. The muscle *l* is large, and co-operates with M; in opening and shutting the spiraculum, one fixture is near the intermediate inferior line, at about the same height as *i*. The tail terminates a little below the spiraculum.

The twelfth ring has only *d*, which is a bundle of six or eight muscles; the first fixture is at the subdivision of the ring near the inferior line: one or two cross this, and likewise the similar muscles of the opposite side. Their fixture is at the bottom of the foot, to assist the muscle *a* in bringing back the foot, and to loosen the claw from its hold. One of the insertions is near *d*, the other near the subdivision of the ring.

Fig. 5 and 6 show imperfectly the organization of the head. Lyonet employed *twenty* figures to explain it fully, as it appears separated from the fat, and disengaged from the neck. H H are the two palpi. The truncated muscles D belong to the lower lip, and assist in moving it. K shows the two ganglions of the neck united. I I are the two vessels which assist in spinning the silk. L, the œsophagus. M, the two dissolving vessels. The Hebrew characters דכבא show the continuation of the four cephalic arteries. In fig. 5, S, T, V, and Z, the ten abductor muscles of the jaw. Four occipital muscles are seen in fig. 6, under *e e* and *f f; a k* is a nerve of the first pair, belonging to the ganglion of the neck; *b* a branch of it.

Fig. 7 exhibits the nerves seen under: but, except two or three easily distinguished, only one of each pair is drawn. The nerves of the first ganglion of the neck are marked by capital letters, those of the ganglion (a) of the head by Roman letters; the nerves of the small ganglion by Greek characters. Those of the frontal ganglion by numbers.

The muscles of the cossus differ in colour and form from those of larger animals. They are soft, of the consistence of jelly; in colour, a greyish blue, which, with the silver-coloured appearance of the pulmonary vessels, form a brilliant spectacle; but, when soaked in spirit of wine, they lose their elasticity and transparency, become firm, opaque, and white, and the air-vessels disappear. This number is very great. The head is almost composed of them, and there is a vast number about the œsophagus, intestines, &c. the skin is lined by different beds placed one under the other with great symmetry. Lyonet distinguishes 228 in the head, 1,647 in the body, and 2,066 in the intestinal tube: in all 4,041.

At first sight, the muscles might be taken for tendons, as having the same colour, and near the same lustre. They are generally flat, and equal throughout, the middle seldom differing from either extremity. When separated by very fine needles, in a drop of some fluid, they seem composed of fibres, membranes, air-vessels, and nerves; and, from oil seen floating on the fluid, they seem furnished also with many unctuous particles. Their ends are fixed to the skin, but the rest is generally free and floating. Several branch out, and sometimes so far, as not to be easy to discover whether they are distinct or separate muscles, or parts of another. They are moderately strong; and soaked in spirit of wine, when examined by the microscope, are covered with a membrane, and appear to consist of several parallel bands longitudinally, which, when divided by fine needles, appear composed of still smaller bundles of fibres in the same direction, which, with a powerful magnifier twisted like a small cord. The muscular fibres of the spider, much larger than these, consist of two substances, one soft, and the other hard, twisted round the former spirally, and giving it the twisted appearance.

Nothing in the caterpillar is similar to the brain in man. There is, indeed, in the head a part from which all the nerves seem to proceed, but it is entirely unprotected, and so small as not to occupy one-fifth part: the surface is smooth. As this is called a brain, the caterpillar has *thirteen*, there being twelve other such parts in a straight line, all of the same substance and size, from which the nerves are distributed through the body. The spinal marrow along the belly is very small, forking at intervals, nearly equal throughout, except at the ganglions, and not inclosed. It is less tender than in man, has great tenacity, and only breaks with considerable tension. Its substance differs from that of the ganglions, as no vessels can be discovered in it, but they are full of very delicate ones. There are 94 principal nerves, having innumerable ramifications.

The cossus has two large beautiful silver-coloured tracheal arteries under the skin close to the spiracula, each side of the insect communicating with the air by nine spiracula. They are almost as long as the whole caterpillar; beginning at the first spiraculum, and extending beyond the last, and some branches to the extremity of the body. Round each spiraculum the trachea pushes many branches, again divided, and these further subdivide through the whole body. The tracheal artery, with its ramifications, are open elastic vessels, which may be pressed close, or drawn out, but return immediately to their usual size when the tension ceases. This artery, and its principal branches have three coats; the outmost is thick, with various fibres, which describe numerous circles round it, communicating by many shoots. The second is thin and transparent, without any particular vessel distinguishable. The third is scaly threads, of a spiral form; and so near as scarcely to leave any interval. They are curiously united with the membrane which occupies the intervals, and form a tube, always

open, notwithstanding the flexure of the vessel. Its structure has many other peculiarities. The principal tracheal vessels divide into 1326 branches.

The heart differs from that of other animals, being almost as long as the animal itself. It lies immediately under the skin of the back, entering the head, and terminating near the mouth. Near the last rings of the body it is large and capacious, diminishing much from the fourth to the twelfth, as it approaches the head. On both sides an appendage partly covers the muscles of the back, but, growing narrower as it approaches the lateral line, it forms irregular lozenge-shaped bodies. This tube, however, performs none of the functions of the heart in larger animals, as no vessel opening into it answers either to the aorta or vena cava. It is called the heart, because generally filled with lymph, which naturalists suppose to be the blood; and because, in all caterpillars with a transparent skin, are seen alternate regular contractions and dilatations along the superior line, but begin at the eleventh ring, and proceed from ring to ring, to the fourth; hence this vessel is supposed to be a string or row of hearts. Two white oblong bodies join the heart near the eighth division, and are called *reniform* bodies, from their resemblance to a kidney.

The most considerable part of the whole caterpillar is the corpus crassum, the first and only substance seen on opening it. Like a sheath, it envelopes all the entrails, and, introduced in the head, enters all the muscles, filling the greatest part of the empty spaces. It much resembles the configuration of the human brain, and is of a milk-white colour.

The œsophagus descends from the bottom of the mouth to about the fourth division. The fore-part in the head is fleshy, narrow, and fixed to its crustaceous parts; the lower part passes into the body, is wider, and has a membranaceous bag covered with small muscles; near the stomach it is narrower, and confined by a strong nerve at distant intervals. The ventricle begins where the œsophagus ends, a little above the fourth division, and finishes at the tenth: it is about seven times as long as broad; and the anterior part, which is broadest, is in folds, which diminish with the bulk on approaching the intestines; the surface is covered with aërial vessels, and opens into the large intestine, one of three large tubes, each so different from the others as to require a particular name.

The two vessels from which the cossus spins its silk are often above three inches long. The body is divided into the anterior, intermediate, and posterior parts. It has likewise two other vessels, supposed to prepare and contain the liquor for dissolving the wood on which it feeds.

Globe Animal and Water Flea.

The Globe Animal abounds in water, revolving in all directions.

The Water Flea is a lively and curiously formed creature, found in all stagnant waters, neglected water-butts, &c.

LARVA OF THE MUSCA CHAMÆLEON.

Fig. 1 represents the larva of the *musca chamæleon*, an aquatic insect. Viewed by the naked eye, it appears composed of twelve annular divisions, separating it into an head, thorax, and abdomen; but it is not easy to distinguish the two last parts, as the intestines lie equally in both. The tail has a fine crown or circle of hair, *b*, by which it is supported on the surface of the water, the head and body hanging down, in which posture it will remain a considerable time; to sink to the bottom, it closes these hairs. Fig. 2 forms an hollow space, including a small bubble of air; by enlarging or diminishing which, it can rise or sink in the water. When the bubble escapes, the insect can replace it from the pulmonary tubes, and sometimes much air may be seen escaping from the tail into the atmosphere, when the worm is placed in a glass of water. The snout is divided into three parts, the middle one immoveable; the others from its sides moveable and vibratory, like the tongues of lizards or serpents; in which lies most of the creature's strength; for it walks upon them when out of the water, appearing to walk on its mouth, and to use it as the parrot does its beak in climbing.

Fig. 3 is its appearance through a microscope. It grows narrower towards the head, is largest about the thorax, converges along the abdomen, and terminates at length in a sharp tail surrounded with hairs. The twelve annular divisions are now very visible, and marked by numbers. The skin appears hard and resembling shagreen, thick set with grains equally distributed. It has on each side nine holes, or spiracula, for breathing, but none on the tail division *a*, nor any easily visible on the third from the head. The latter has some very small holes under the skin, near the place of the embryo wings of the future fly. Caterpillars, in general, have two rings, without these spiracula, perhaps because they change into flies with four wings; whereas this worm produces a fly with only two. The skin of the larva is adorned with oblong black furrows, spots of a light colour, and orbicular rings, whence there generally springs a hair; but only those hairs which grow on the insect's sides are represented in the figure. There are also some larger hairs, as at *c c*. The difference of colour arises only from the quantity of grains in the same space: for where they are in numbers the furrows are darker, and paler where they are less plentiful.

The head, *d*, is in three parts, and covered with a skin having scarcely any discernible grains. The eyes are rather protuberant, and lie near the snout, which has two small horns, *i i*. It is crooked, and ends in a sharp point *f*. The legs are near the snout, between the sinuses of the eyes. Each leg consists of three joints, the outermost covered with stiff hairs like bristles, *g g*. From the next, composed of a black substance, of a hardness between bone and horn, springs a horny bone *h h*, used as a kind of thumb, and the third joint is of the same nature. To distinguish these parts, the upper sides of the mouth and eyes must be separated; after which, by the microscope, we may perceive the leg articulated by some particular ligaments, with the portion of the insect's mouth which answers to the lower jaw. We may also discern the muscles which move and draw the legs up into a cavity between the snout and those parts of the mouth near the horns *i i*. The insect walks upon these legs, in the water and on the land. It also uses them in swimming, keeping its tail on the surface, and hanging down the rest of the body; when its only perceptible motion is in its legs, which move in a most elegant manner.

The snout is black and hard; the front, *f*, sharp and hollow; and the back part quite solid, somewhat globular; and three membranaceous divisions may be perceived on it; by means of which, and the muscles in the snout, the creature can contract or expand it at pleasure. The extremity of the tail is surrounded with thirty hairs, and the sides adorned with others smaller; here and there the large hairs branch out into smaller ones. All have their roots in the outer skin, here covered with rough grains, observed when cut off and held against the light upon a slip of glass. At the extremities of the hairs are grains, like those on the skin; and in the middle of the tail is a small opening, with minute holes, for the insect to take in the air it breathes. These hairs, however, are disposed in the regular order represented in the figure, only when the insect floats with the tail and its hairs under the surface. The least motion of the tail downward produces a concavity in the water, and it resembles a wine-glass. It answers the double purpose of swimming and breathing, and through it the insect receives the principle of life and motion.

These creatures are found in shallow standing waters in June. They crawl on the grass and other plants which grow in such waters, and often float on the surface, the head and thorax hanging down; in which posture, in search of food, commonly a viscous matter, they turn over the clay and dirt with their snout and feet.

The Wing of an Earwig.

Fig. 4. The wing of the earwig magnified. When the earwig uses its wings, which is not often, and closes them again, they fold them back in parts, and shut up the ribs like a fan.

The other objects on this plate represent three insects of extraordinary structure.

Fig. 5. The *stick phasm*, a singularly shaped creature, and one of the sportive varieties of nature.

The Praying Mantis.

Fig. 7 and 8. The Praying Mantis, or Soothsayer, is an object of much respect among the superstitious eastern nations, who consider its uplifted fore-legs, when standing upright, as an attitude of forewarning, and hence its name. We have introduced the animal at large, and another in a standing posture and praying attitude.

This extraordinary insect is named from the Eastern notion that it possesses supernatural powers. This idea has originated in the peculiar manner of its holding its fore-legs when sitting, which superstition has construed into an act of prayer; so that the bewildered traveller supposes that he will be guided into the right path, according to which leg the animal first stretches out. The Hottentots hold this animal in such veneration, that they consider themselves blest if it alights on them, and they accordingly pay it a species of adoration. The animal represented is much magnified.

THE POINT OF A NEEDLE, A FULL-POINT, AND FLAKES OF SNOW, MAGNIFIED.

This plate represents *the Point and Surface of a fine Needle magnified; the Crystallizations of Snow;* and *the Full-Point used in Printing*. The exactness of nature, compared with the coarseness of art, are well worthy of attention.

THE MITES IN CHEESE MAGNIFIED.

After viewing these creatures, there are few persons who will not be disgusted at the thought of eating them, or not shocked at the unthinking practice of roasting them alive.

A FLEA MAGNIFIED.

The power of this creature to leap in its surprising manner, is evinced by the length and number of joints in its legs. The hooks at the end of its claws, and other circumstances of construction, are worthy of notice.

The head is small and shelly; a quick, round, and beautiful black eye on each side, K; in the middle is a round black spot, the pupil, encompassed with a greenish glittering circle or iris, as bright and vivid as the eye of a cat.

Behind each eye is a small cavity, at L, with a certain thin moving film, beset with many small transparent hairs; probably the ear.

From the snout proceed the two fore-legs, between which are two long small feelers, M,M, each having four joints, and much hair below; and almost between these is the proboscis, or piercer, N, N, O, consisting of a tube, N, N, and a tongue or sucker O, protrusive or contractile at pleasure. It has also two chaps or biters, shaped and opening like the blades of a pair of round-topped scissars; with which, it penetrates the skin of living creatures, and leaves a round red spot, commonly termed a flea-bite.

The parts A,A, of the fore-legs, lie within the parts B,B; and those again within the upper and stronger parts, C,C, parallel to each other. The parts of the two next legs are disposed contrariwise; the parts D,D, are placed without the parts E,E, which are yet more outward than those parts F, F. In the hinder legs the parts G, H, and I, bend one within another, like the limbs of a double-jointed rule; or like the foot, leg, and thigh, of a man. To leap, the flea folds up these six legs, and extends them all at the same instant; and, its whole strength being thereby exerted at once, the little body is carried to a considerable distance.

A LOUSE MAGNIFIED.

The head A, is rather conical, but little flatted: on each side where whitest, is a large black shining eye, B,B, very protuberant, and encompassed with small hairs, situated a little behind the head, where are the ears of other creatures; and, where one might expect to find the eyes, a couple of horns protrude, as C, C, extending so as to defend the eyes from being injured by the surrounding hairs; each horn has four joints, fringed with small bristles.

The head tapers from the horns to the snout D, which ends in a sharp point, and seems a tubular instrument; the louse sucks the blood, on which it feeds and lives.

There seems a resemblance of chaps or jaws, at E, E, yet in another view those appearances are not discernible.

There appears, at A, some contrivance like a pump, a pair of bellows, or heart, which, by a very swift and alternate dilation and contraction, draws up the blood, and forces it into the body. When viewed attentively while sucking, it cannot be perceived that any more of its nose is thrust into the skin than the tip of the snout, D; nor does it cause the least pain, although the blood runs through its head quickly and freely; which proves that blood-vessels are dispersed through every part of the skin, even into the cuticula; for, was its whole snout thrust in from D to C, C, it would not amount to the supposed thickness of that tegument; the length of the whole nose not exceeding the three-hundredth part of an inch.

The louse has six legs, strongly jointed to the thorax: on which, for each pair, a kind of division appears, as *e*, *e*, *e*. They are covered with a transparent shell, and jointed like the legs of a crab or lobster. Each is divided into six parts, with several small hairs issuing, and end with two unequal claws, adapted to the particular exigences of the animal, to walk either on the skin or hair. The lesser claw, *a*, being much shorter than the other claw, *b*, when it walks on the skin, the shorter claw does not touch, and then the feet are like those of the mite and many other insects: whereas, when among hairs, the longer claw bends round by its small joints, and, meeting with the shorter, both together can take hold and grasp a hair, as with a thumb and finger, after the manner represented in the figure, where F, F, F, a human hair, is so grasped and held by this creature that it is in no danger of falling.

The belly is very transparent; but its covering resembles a skin rather than a shell, being grained like the skin of a man's hand, and, when the belly is empty, very flaccid and wrinkled. The white spot I, I, may be the liver or pancreas, which, by the intestinal peristaltic motion, is moved a little to and fro, with a thronging or justling motion.

After one had fasted two days, all the hinder parts appeared lank and wrinkled: the white substance I, I, scarcely moved; most of the white branches disappeared, as did also the redness or sucked blood in the intestines; the peristaltic motion was scarcely discernible; but, upon being suffered to suck, the skin of the belly, and the six scalloped embossments on either side, were quickly filled out; the stomach and intestines seemed quite crammed, and multitudes of white vessels appeared, full and turgid; the peristaltic motion quickened, as likewise the justling motion of the substance I, I.

Near the bottom of the belly, beset with hairs or bristles, appears the anus, K, whose aperture is occasionally closed by two parts, L, L, below. At the extremity of the tail, two bodies, M, M, resemble the rump of fowls, whence issue a number of sharp hairs.

THE BLUE-BOTTLE, OR COMMON FLESH FLY.

Fig. 3. *The Blue-Bottle, or common flesh-fly*, enlarged by the microscope, so as to show distinctly all its particular and minute members and ornaments. A,A, are its protuberant and pearled eyes, or hemispheres, ranged in triangular order, which make a considerable part of the head, though smaller than those of the drone-fly. A scaly prominent front between the eyes, adorned and armed with large tapering sharp black bristles, growing in rows on each side, and bending towards each other near the top, form an arch of bristles, that almost covers the front B, C, a projecting part at the anterior end of this arch, and about the middle of the face, two little oblong bodies, D,D, like the apices or pendents in lilies, each having one small joint to C, and another to the front part, B. These, in the head of the drone-fly, are called horns, from their resemblance to the horns of some kinds of beasts. E, E, are brushy bristles or feathers, like the tufts of a cock-gnat, growing from the upper part and outsides of the horns D, D. F, F, are four strong bristles, placed two and two, and bending towards each other, just above the opening of the mouth. G, H, I, is the fly's proboscis or trunk from the middle of the mouth. It seems hollow, and by several joints is moved, thrust out, or pulled in, at pleasure. At H is a knee, or bend from thence to the extremity, slit into two lips, H G, H I, on their outer sides covered with large hairs; though those on the upper part of the proboscis are very small. These lips easily open or shut, and hold or take in little pieces of solid food; but, when the fly sucks any thing, she spreads them open, and applies their hollow part perfectly close to the surface; thus they serve to pump up the juices of fruits or other liquors. K, K, are two little hairy oblong bodies, in the mouth, growing from each side of the proboscis. These parts are differently shaped, and much larger in the head of the drone-fly, marked G, G. Hooke imagines these may be the organs of smelling.

The middle part or thorax, is crustaceous, strongly made, rounded on the top, and covered with large, long, black bristles, in parallel order, like the quills of a porcupine, all pointing towards the tail. From the hinder and under part grow three large legs on each side, covered with a strong hairy shell, and resembling the legs of a crab or lobster. Each leg is jointed, and of eight parts, 1, 2, 3, 4, 5, 6, 7, 8; on the eighth grow the soles or spunges and claws. Of these six legs, the fly seldom employs more than four to walk with; the two former serve instead of hands, to take up any thing to eat, to clean her mouth, eyes, wings, and body, and for many other purposes. L, L, are the two wings fastened with strong joints to the upper part of the thorax.

The Foot of a Fly.

Fig. 1. The *Foot of a Fly*, magnified.

The two talons are handsomely shaped, as A, B, A, C, and very large in proportion to the rest of the foot. The larger part, A to *dd*, is bristled all over; but thence towards C and B, the tops and points which turn downwards and inwards, are smooth and very sharp. Each talon moves on a joint, A, and can be shut or opened at pleasure; so that, the points B and C, having entered the pores of an object, and the fly endeavouring to shut its talons, they not only draw against and so fasten each other, but also pull forwards all the parts of the foot; and the tenters, or sharp points, G,G,G,G, run into the pores, where there are any; or, on a soft place, make their own way.

Something similar may be discerned by the naked eye in the feet of a chaffer; and, if suffered to creep over the hand, or any tender part of the body, its manner of stepping will be as sensible to the feeling as to the sight. But, as the chaffer, notwithstanding its contrivance to fasten its claws, often falls in attempting to walk on hard and close bodies; so likewise would the fly, had not nature furnished its foot with a couple of pattens or spunges, D,D.

From the under part of the last joint of the foot, K, proceed two small, thin-plated, horny substances, each consisting of two flat pieces, D,D. These, about F,F, *f*,*f*, seem flexible, like the covers of a book, by which the two sides *ee*, *ee*, do not lie always in the same plane, but sometimes shut closer, so that each can take a little hold. But the bottoms of these spunges are also beset with small tenters, like the wire teeth in a wool-card, their points inclining forward; by these the two talons draw the foot forwards, and the spunges being applied to the surface of the body upon which the fly walks, with the points of all their bristles standing forwards, and outwards, as *o*, *o*, *o*, *o*, *o*, if that surface has any irregularity, or gives way, the fly can suspend itself, or walk on it easily and firmly. And its ability to walk on glass proceeds partly from some little ruggedness thereon, but chiefly from a tarnish, or dirty smoky substance, adhering to the surface; so that, though the sharp points on the spunges cannot penetrate the surface of glass, it may easily catch hold of the tarnish contracted. *y*, *y*, *y*, are some very long, stiff, sharp-pointed hairs or bristles.

Fig. 2. What a wonderful complication of admirable contrivance and divine wisdom and goodness is thus displayed in the structure of so simple and inconsiderable a thing as a fly's foot! Is it to be supposed that so much wisdom was exerted for the convenience of an animal for the mere purpose of being wantonly destroyed by man? Are we not bound by our homage to the Creator to respect all his works, by allowing them to fret out their little hour upon the stage of life unmolested; except so far as they unquestionably militate against our own existence?

The Wing of a Fly.

A whole wing, consists of a fine, thin, transparent skin or membrane, variously folded, plaited, and distended over the whole area; and several bones, ribs, or stems, with great regularity and contrivance, disposed so as to strengthen and support the wing, and determine its proper figure.

The ribs of the wing are covered with little scales; but the fore edge is armed with little bristles, all whose points are directed towards the tip; and even the whole edge all round the wing is covered with a small fringe, of shorter and more slender bristles.

SECTION OF AN ELM BRANCH.

Fig. 6 represents the section of a *small elm-branch*, the variations of which, from the ash and oak, given in the subsequent plates, merit special notice.

Scales of different Fish.

Fig. 1 shows the *Scale of a Sea-perch*, found on the English coast; the natural size is exhibited at *a*.

Fig. 2 is the *Scale of a Haddock* magnified; its natural size is within the circle *b*.

Fig. 3, the *Scale of a Parrot-fish* from the West Indies magnified; *c*, the natural size.

Fig. 4, the *Scale of a kind of Perch* in the West Indies magnified.

Fig. 5, part of the *Skin of a Sole-fish*, as viewed through an opaque microscope; the magnified part, in its real size, is shown at *e*.

SECTION OF AN OAK BRANCH.

Fig. 6. *Section of an Oak-branch*, worthy of being compared with that of the ash and elm, in which the differences are considerable, and interesting; although, at a rough glance, they present the appearance of structures very similar.

Cornea of the Libellula.

Fig. 1 shows part of the *Cornea of the Libellula* magnified. In some positions the sides of the hexagons appear of a fine gold colour, and divided by three parallel lines. The natural size is at *b*.

Lobster's Cornea.

Fig. 2 shows the part *c* of a *Lobster's Cornea* magnified. As these animals have no muscles to turn their eyes in different directions, they are provided with an immense number of separate lenses, by means of which, a distinct figure of the object is produced on the retina, by some one of them, whatever be the direction of the eye; and they are consequently enabled to see distinctly on any side. Such is the opulence of their structure, despised and abused as they are by the pride and cruelty of man.

One Arm of the Barnacle Shell-Fish.

Fig. 3 shows one arm or horn of the *Lepas antifera*, or barna-

cle shell-fish, magnified. Each horn consists of several joints, and on the concave side of each joint are long hairs: the arms appear rather opaque, but may be rendered transparent and most beautiful by extracting from the whole length of the interior cavity a bundle of longitudinal fibres. Needham thinks that the motion and use of these arms may illustrate the rotatory motion in the wheel-animal.

Apparatus of the Gad-Fly.

Fig. 4 shows the apparatus of the *tabanus*, or gad-fly, by which it pierces the skin to suck the blood of horses and oxen. The whole is in a fleshy case; the feelers of a spongy texture and grey colour, covered with short hairs, are united to the head by a small joint. They defend the other parts, being laid side by side whenever the animal stings, and thus prevent external injury. The wound is made by the two lancets, of a delicate structure, but very sharp, like the dissecting knife of anatomists gradually thickening to the back. The two jagged or toothed instruments appear intended to enlarge the wound, by irritating the parts round it: their hard and horny texture may also serve to defend the softer tube, being of that form to admit the blood and convey it to the stomach. This part is totally inclosed in a line, which entirely covers it. The natural size of this apparatus is inclosed in the small circle.

Skin of a Lump-Fish.

Fig. 5 shows a bit of the *Skin of a Lump-fish, cyclopterus*, magnified. When a good specimen is procured, it forms a most beautiful object.

SECTION OF AN ASH BRANCH.

Fig. 5. *Section of an ash-branch.* The power of the microscope is evinced, by comparing the natural size and indistinct forms of this object, with the beautiful results of the microscopic object in large. Nothing can be better calculated to display the wonderful economy of vegetation, and the surprising variety of tubes and mechanism, essential to the growth and support of a tree or plant.

The exterior circle represents the cuticle, or epidermis, which serves to protect the delicate vessels of the cellular membrane within, and also to transmit exhalations. Beneath this cuticle lies the cellular integument, and the bark or cortex lies below the cellular integument, varying the number of its layers, according to the years of the plants. Next to the bark comes the wood, which consists of concentric layers, which are hardest near the pith; its tenacity arising from the innumerable vessels which pass from one part to another in an horizontal direction, and a cellular substance binds the whole together.

In the middle is the pith, or medulla, a light, spongy, and soft substance, composed of tubes in the manner represented.

The entire substance, from the pith to the cuticle, is composed of cells and tubes, which form a continued series of central and alburnous vessels, terminating in the leaf; and from the leaf, a series of cortical vessels return through the bark.

The Bug.

Fig. 1 represents the most ornamented of the bug genus, of which Linnæus enumerates 121 species; but that most known in England, and the pest of our bed-furniture, is called the *house-bug*, and its thirst for human blood is but too well-known in most large cities. The species represented is the *Cimex striates*, or *elm-bug*; on which tree it is found in June; and its natural size is represented at (*a*). The larvæ of bugs differ only from the perfect insect by their want of wings, and they change to *chrysalis* without undergoing any material difference, except having their wings unfolded. The larvæ are very voracious, and spare nothing they can overcome; but, in their perfect state, they glut themselves with blood, and destroy caterpillars and small flies. The house-bug, or *cimex lectularius*, is, however, in his turn, devoured by spiders, and by those of his own genus known by the name of wood-bugs.

Asparagus Insect.

Fig. 2 shows the *Chrysomela asparagi*, or asparagus insect. Of this genus Linnæus enumerates 122 species, distinguished by their colours. They abound in woods and gardens, and the species represented is found on asparagus after it has run to seed. They are slow in motion, and emit a disagreeable oily liquor. They feed on leaves. Another species is the *turnip-fly*, which infests turnips and other tender leaves of plants, of which they destroy whole fields and beds. The natural size is represented at (*b*).

The Meloe, or Cantharides.

Fig. 3. This insect is famous under the name of Cantharides, and used for blistering-plasters in medical practice. The most powerful are those which come from Spain. They are so acrimonious and corosive, that persons who pick them up without gloves have been dangerously affected in the urinary passages. Applied to the skin as a plaster they excoriate the part, raise a blister, and occasion a copious discharge of serum. If taken inwardly, they create dangerous and violent inflammations of the intestines. The natural size is at (*c*).

Wing of the Hemerobius Perla.

Fig. 4 represents the wing, magnified, of the *Hemerobius perla*, an insect which seldom lives above three days. The wings are nearly of a length, and exactly similar, composed of delicate nerves, regularly and elegantly disposed, beautifully adorned with hairs, and lightly tinged with green. The body is of a fine green colour, the eyes appear like two burnished beads of gold, hence it is named *golden eye*. This insect lays its eggs on the leaves of the plum or the rose tree, of a white colour, and each fixed to a little foot-stalk, by which they stand off from the leaf, resembling the fructification of some mosses. The larva from these eggs resembles that of the coccinella or lady cow, but is more beautiful. Like that, it feeds on aphides, or pucerons; sucks their blood, and, forming itself a case with their dried bodies, it changes into the pupa state, whence it emerges in the form of a fly.

SHELLS.

Nature is nowhere more lavish in the display of regular forms of beauty than in the construction and colouring of shells.

It cannot be supposed that such alternations of colours, stripes, and varied figures, are results of chance; nor that they have been introduced without some design and some use. It would indeed appear, from human conceptions of such things, that the creatures who inhabit them must have perceptions of beauty, and that these displays are calculated to excite in them feelings of mutual affection, and, perhaps, of pride, necessary to the conservation of their species. The specimens given in the plate are intended to represent some of the chief varieties; but those who seek to gratify themselves still further in this branch of natural history may consult the elegant work of Mr. Mawe, or any other of the books which are specially devoted to the study of conchology.

According to the Linnean system, Testaceous Animals are divided into three classes: multivalves, with more than one piece, or valve; bivalves, with two valves, or pieces; and univalves, composed of one valve, or piece. The animal inhabiting shells, is a soft, fleshy, bloodless substance, without bones, but generally furnished exteriorly with a muscle, by which it adheres to the shell, occasioning certain indentations, thence called muscular impressions. Like other animals, it is endued with lungs, heart, mouth, and organs, peculiarly adapted to its nature. The inhabitants of multivalves and bivalves are viviparous; but, of univalves, some are oviparous. They may be considered as one of the sports of nature; the shell, which is exterior to the animal, being equivalent to the bones of most other animals, so that here are the same parts, though arranged in a totally different manner; the bones, in general, conferring strength in the interior of the animal; whereas, in testaceous creatures, the bony matter serves for strength and shelter. They are a class of subjects difficult to represent graphically, because their beauty consists in their involutions, and in irregularities, which cannot be well depicted on a plain surface, and the variety of their colouring is much heightened in its effect by the high polish of their surfaces. Of the habits and passions of the animals, of which the shells have been their tenements, little or nothing has been observed. The most brilliant shells are brought from the coasts of Hindoostan.

FOSSIL SHELLS, &c.

Independently of the shells at present found in the sea, and occupied by living animals, many varieties resembling these, but often very dissimilar, are found in a fossil state, bedded in rocks, and often forming entire strata of vast extent by themselves.

Pectines. These include the whole of the oyster or scallop classes. The shell is bivalve, generally with unequal valves, and slightly eared. Their form is usually regular, and their surface is adorned with elevated divergent ribs, varying in number from five to forty, which proceed from the tip of the beaks to the extremity of the margins, there terminating in a scalloped outline. The ribs are variously diversified with beautiful colours and delicate checquer-work. The margins of the interior are mostly crenated, and are often beautifully coloured. The scallops have the faculty of leaping out of the water, and are enabled to effect a very rapid motion, by opening and closing their valves. In the plate, ten beautiful varieties of fossils of this order are exhibited.

Coni or Cylindri. The numerous species of the cones are very similar in form. Their colour and markings are extremely beautiful and much diversified: in some species they are elegantly disposed in dots, stripes, bands, and reticulations; and in others, delicately blended in cloudings, veins, and marbling.

The Tubulus Marinus belongs to the tubular family, first pointed out by Langius.

The Concha Margaratifera belongs to the order of bivalves, and is still found in several rivers of Britain. The shell is ovate-oblong, and is covered with a black epidermis. The length is two inches and a half; and the breadth, five inches. It often produces pearls of a considerable size, and of a good colour.

Dentalia. The shells of this genus resemble an elephant's tusk in miniature, and the principal distinctions are in magnitude, curvature, and the number of ribs and grooves. The Dentalia are now principally found in the Indian and European Oceans; and a few in the Mediterranean and Northern Seas.

Ostracites, a beautiful specimen of the genus Ostrea, or Oyster.

Helicites, the Snail or Spirak. This extensive genus

consists principally of land or fresh-water shells, a very few only being the produce of the ocean; but in fossil remains they are found in prodigious quantities.

Nautili. The most striking character of this genus is that the whorls are divided into separate compartments or chambers, which are connected by a slender syphon running spirally through the shell. The general form of the shell is spiral or scrawl like. Fine specimens of the Pompilius genus are often converted by the inhabitants of the East into drinking-cups, on the surface of which they engrave various devices and ornaments. Some species of the Nautilus are found adhering to coral rocks on the Sicilian shores. The American and Indian Oceans, as well as the Mediterranean, Adriatic, and Red Seas, produce species of Nautili; but the greater number are found on the European and British coasts.

Buccina or Whelks. This genus derives its name from some of its species, resembling a trumpet *(buccinum.)* The African, American, Indian, European, and Southern Oceans, produce the greater number of buccina, and many are found in the British and Mediterranean Seas.

Trochi. The leading characteristic of the Trochus, or Top Shell, is the conical shape of its species. A few species have their surfaces almost smooth; but the greater number are covered with knobs, spines, or undulations. Many, when uncoated, present a brilliant mother-of-pearl appearance; others have only a pearly appearance, and a few exhibit a bronze-like hue. The Trochus derives its name from the resemblance of its species to the form of a top, and is found in almost every part of the world.

Neritæ, or Hoof Shells. There is a considerable variation in the form and markings of these shells. This genus received its name from its species having been supposed by ancient naturalists to have the power of swimming in the ocean.

Orthoceralite, is a genus of the Nummulite family, so abundant as to fill whole tracts of country, and so ancient that they abound in the lime-stone of which the pyramids of Egypt are built. They are of the shell kind.

Gryphites, are a species of bivalve shells, often found petrified in lime-stone.

Ammonitæs, are another tribe of fossil shells, of which no less than 300 different species have been described. They are vulgarly called snake-stones, from a notion that they were petrified serpents. They are found in vast abundance.

Asteriæ, or Star-stones, are fossil or petrified remains of the Star-fish, but are rarely met with.

The subjects of plants found in stones speak for themselves, and are met with in great abundance; some of them like existing vegetables, but found in countries where they no longer flourish.

Madrepores, Tubepores, Corals, and other productions of polypi, are frequently found in a fossil state, and are known under the names of *porites* and *corralium*; and even sponges are often found in a fossil state in flint and chalk.

Entrochites, are fossil remains of the Radiaria, a family now scarce, but which appears to have been very abundant when the existing animals were converted into fossils.

Fossil Teeth, or Glosopetræ; so called from a vulgar notion that they were the tongues of serpents; whereas, in truth, they are the teeth of sharks and other fish.

Buffonitæ, another class of fishes' teeth, but which were once imagined to be parts of the heads of toads.

Ichthyperia, consist of fossil remains of fishes, and are often found in the earth in a mineralized state.

THE SAILING MEDUSA.

The *Sailing Medusa* appears floating on the water like a mere lifeless lump of jelly. It is whitish, with a blue cast, elevated into a convexity in the middle on the upper side, and furnished with a fringe of white or rigid filaments round the edge, resembling white hairs. This species is very frequently seen floating on the surface of the sea, or adhering to rocks; and, when the sun shines on them, they have a beautiful lucid appearance.

THE ARGONAUT, OR PAPER NAUTILUS.

This species of shell-fish is said to be named from a Greek word, which signifies both a ship and a sailor; the shells of all the Nautili having the appearance of a ship with a very high poop. The shell of the Argonaut, when out of water, is no thicker than paper. When it sails it expands two of its arms on high, and between these supports a membrane which serves as a sail, and the two other arms it hangs out of its shell, to serve as oars, and the office of steerage is generally served by the tail. When the sea is calm, numbers of them are seen thus diverting themselves; but, when a storm arises, or they are disturbed, they draw in their legs, take in as much water as makes them specifically heavier than that in which they float, and then sink to the bottom. When they rise again, they void this water by numerous holes, of which their legs are full. The other species of nautilus, whose shell is thick, never quits that habitation.

It is easy to conceive that the ingenious practices of this wonderful creature may have suggested to man the power of sailing upon the sea, and of the various apparatus by which that object is effected.

VARIOUS INSECTS.

Scarabæus Carnifex, or Bill-Chaffer.

The above species is common in America; and is so strong, though not much larger than a common black-beetle, that, if one of them be put under a brass candlestick, it will cause it to move backwards and forwards. It appears from April to September. It constructs a proper nidus for its eggs, by forming round pellets of dung, in the middle of each of which it deposits an egg. These, in September, the insects convey to the depth of about three feet into the ground; where they remain till the approach of spring, when the grubs burst their shell, and find their way to the surface of the earth.

The Beetle, or Scarabæus Hercules.

Of this genus there are eighty-seven species, all which have hard cases to their wings, which protect them in the earth, where they chiefly live, and which causes a humming noise when they fly. Beetles may be said to resemble shell-fish in their formation, their bones being placed externally, and their muscles within. Some are not larger than a pin; while others, as the Elephant and Hercules Beetle, are as large as a man's fist. The small ones go through the stages of their existence in a single season; while the large ones are four years in progression, and live as winged insects another year. The May-bug, or Door-beetle, or Cock-chaffer, lay their eggs in the ground, where a small grub or maggot is hatched, which continues in that state for three years, devouring the roots of plants: at length they grow to the size of a walnut, or thick white maggot, with a red head. In this form it lives for above three years in the worm-state under ground, blind, voracious, and every year changing the skin. At the end of the fourth year, it works itself much deeper into the earth, and there forms a capacious apartment, with smooth and shining walls. It then shortens itself, bursts its skin, and assumes the form of a chrysalis,—first yellow, and then red; the exterior discovering all the vestiges of the future winged insect. It continues in this state for three months, and in January the aurelia becomes a winged insect, completely formed. It now continues for three months in a sort of infant state, feeble and sickly, bright in colour, and soft in its parts. About the end of May these insects, after having lived four years underground, burst from the earth. Such is the preparation and wonderful birth of the May-bug, or cock-chaffer. They flourish during the warm weather, bore holes in the ground, lay about three-score eggs; and, on the approach of winter, those perish who have not previously been destroyed by birds or the wantonness of youth.

Scarabæus Hercules, or Elephant Beetle, is found on the northern coasts of South America, and is from four to five inches long, and two inches and a quarter broad. It is black; and the whole body is covered with a shell as thick as that of a small crab. The horns are nearly an inch, and the proboscis is nearly an inch and a quarter, long. It is the largest of this genus.

Fulgora, or Lantern Fly.

In the engraving this beautiful insect is represented with its wings closed.

The Vegetable Fly.

In some of the West-India islands, there is a fungus of the clavaria kind, that springs from flies, of the origin of which two accounts are published in the 53d volume of the Philosophical Transactions. One of them states that the fly buries itself in May, and in three months a fungus springs from it, three inches high, bearing pods which produce worms, and then turn into flies like the buried parent.—The other asserts that the fly, in the nympha state, merely perishes among dead leaves, and its remains afford a bed from which the seeds of the clavaria shoot and grow. The engraving represents the fungus attached to the fly.

The adjoining fly is the species common in our English fields.

THE EGYPTIAN LOCUST.

These elegant creatures are met with in immense swarms on the banks of the Nile, where they present the most brilliant display of colours in the whole range of nature's curiosities.

THE MIGRATORY, OR WANDERING LOCUST.

Many locusts, when minutely examined, are extremely curious, and very pleasing; but, considered collectively as destroyers of a country, they appear in an awful light. Desolation and famine mark their progress; and, where these destructive insects alight, not a leaf is left upon the trees, a blade of grass in the pasture, nor an ear of corn in the fields. Mr. Forbes saw, in India, a flight of locusts extending above a mile in length, and half as much in breadth: they appeared like a black cloud at a distance;

and, as they approached from the east, the density of the cloud obscured the solar ray, and threw a gloom over the country, like that of an eclipse. In short, the annals of most warm countries record devastations produced by locusts. They are bred in the warm parts of Asia and Africa, whence they have often taken flight; and, in 1748, some were seen in England; but, happily, our cold climate was unfavourable to their production, so that, being only animals of a year's continuance, they soon perished.

GREAT LANTERN OR FIRE FLY.

This nocturnal animal is wonderfully provided with a phosphorescent light in its head, which enables it to seek its prey by night. The light is so strong as to enable a person to read a newspaper by it; while the motions of the wings give the animal the appearance of emitting flashes of light. They abound in various tropical regions, particularly in the woods of Surinam, so rich in every kind of vegetable and animal existence; and they are so numerous on the South-American continent, as to present a peculiar night-feature to newly-arrived Europeans.

ATLAS MOTH.

We present this as a specimen of the gigantic size and exquisitely beautiful colouring of the largest species of moth. Of this genus Linnæus enumerates 1464 species; and the Atlas found in the East and West Indies is the largest. They fly chiefly by night, or towards evening. The chief part of them have no mouths, and pass through this state without food. It is their caterpillars which destroy cloth and furs. They remain in the chrysalis state much longer than butterflies; sometimes for years. The female of some species are without wings. The atlas is so large as to resemble a bird more than an insect; while the richness of their colouring equals that of the feathered race. The antipathy of moths to light is such, that they rush into candles, and in hot climates extinguish them, if the candle is not protected.—The *Peacock Moth* is a native of many parts of Europe, and measures six inches; and there is a smaller sort, a native of England, called the *Emperor Moth*. Its caterpillar, which is very beautiful, feeds on apples, pears, and other fruit. It is the caterpillar of the *Cloth Moth*, so called, which is so mischievous: it changes into a chrysalis in April, and the moth appears in May and June.

THE SILK-WORM, OR PHALÆNA MORI.

By the labours of this humble creature, the pride of man is more fostered than by any other animal. The moth lays its eggs, represented by the small dots near the moth: these, on the approach of warm weather, and in the sun's rays, are hatched into small caterpillars, which grow and feed on mulberry-leaves for a few weeks. When in a suitable situation, they enclose themselves in a cone of silk, where they turn into a chrysalis, represented in the plate; and from the chrysalis emerges a lively white moth, which, having laid its eggs, dies in a few days: the silk is wound off the cone, and furnishes materials for costly garments.

The bags or cones of silk generated by the worms weigh from three to four grains each, so that 2,300 worms produce a pound of silk. What an immensity of labour, therefore, is exerted to produce a few yards of ribbon or a silk gown!

TERMES ANT-HILLS AND PYRAMIDS.

These ant-hills, in the forests of Sweden, are truly wonderful. They consist of cones formed by the leaves and fibres of pine, some of them built even to the height of five feet.

As all countries abound in ants, and each of their hills, or nests, contain many thousands, they are, perhaps, the most numerous creatures in existence, and doubtless exceed the human race millions and millions of times; generally, and especially in the British Islands, they are so perfectly harmless, that their ingenuity entitles them to the respect and friendship, as well as the admiration, of man.

TERMES, OR WHITE ANTS.

There are eight species of these insects, the most remarkable of which is the *fatale*, or bellicosus, which is of a yellow colour above, and the wings also yellowish. Their works surpass those of bees, wasps, beavers, and other animals, as much as works of the most polished European nations excel those of the least cultivated tribes. Even the boasted pyramids of Egypt fall comparatively short, in size alone, of the structures raised by these insects; and, in the interior construction and the disposition of the building, they appear greatly to exceed that of any like work of human construction.

These ingenious insects are divided into three distinct ranks and orders, constituting a well-regulated community. These are, first, the labourers, or working insects; next, the soldiers, or fighting order; and lastly, the winged, or perfect insects, which may be called the nobility or gentry of the state. These are only capable of being elected kings or queens; and they emigrate within a few weeks after they are elevated to this state, and either establish new kingdoms, or perish within a day or two. In the engraving are represented the several orders:

Fig. 1 represents a labourer.
—— 2, a labourer magnified.
—— 3, a soldier.
—— 4, a soldier's forceps and part of his head magnified.
—— 5, a perfect termes bellicosus.
—— 6, the head of a perfect insect, magnified.
—— 7, a head, with a stemata magnified.
—— 8 and 9, a queen and king.

WHITE ANT-HILLS.

The hills of the white ants are most wonderful structures. They are composed of an exterior and interior part. There is a royal chamber situated near the centre of the building; the entrances to which admit only the labourers or soldiers. The chamber is surrounded by several others, all of them being arched either in a circular or elliptical form. The latter apartments are joined by magazines and nurseries. The magazines are stored with provisions, which, when examined by the microscope, are found to consist of gums or dried juices of plants. The nurseries are occupied by the eggs and the young ones.

This powerful community, considering the world as made for them, commit great devastations, and construct roads, or rather covered ways, in all directions from the nest, to every object of use within reach. The ravages they commit, though great, are probably counterbalanced to other animals by the good produced, in quickly destroying dead trees and other substances, which would, by a tedious decay, encumber the ground.

If any one wantonly makes a breach in any part of the structure, a soldier immediately appears, and walks about the breach, to see whether the enemy is gone, or to examine whence the attack proceeds. He is quickly followed by two or three others; and then a numerous body rush out as fast as the breach will permit, their numbers increasing while any thing continues to batter the building. During this time, they seem in the most violent bustle and agitation; some beating with their forceps upon the building, making a noise that may be heard three or four feet distant. On ceasing to disturb them, the soldiers retire, and are succeeded by labourers, who hasten in various directions towards the breach, each with a burden of ready-tempered mortar in his mouth. Though there are millions, they never embarrass each other; and a wall is raised to fill up the chasm. A soldier attends every 600 or 1000 labourers, seemingly as director of the work; for he never touches the mortar, either to lift or carry it. One, in particular, places himself close to the wall they are repairing, and frequently makes the noise above mentioned; which is constantly answered by a loud hiss from all the labourers within the dome; and, at every such signal, they evidently redouble their exertions. As a renewal of the attack constantly produces the same effects, the pleasure of seeing them come out to fight, or to work, alternately, may be obtained as often as unfeeling curiosity excites. The devotion of the soldiers is remarkable: they fight to the very last, disputing every inch of ground so well, as often to drive away the negroes, who are without shoes, and make white people bleed plentifully through their stockings.

It is indeed dangerous to approach these hills without suitable precautions, as the courage and patriotism of the ants render them indifferent to danger, and they inflict severe wounds.

FASCIATA, OR BARBARY SPIDER.

This frightful-looking animal inhabits hedges and thickets, where it spreads its snares for wasps, drones, and even locusts. The animal which it entangles is soon killed by the spider, and, if only partly eaten, the rest is concealed under some dry leaves, covered with a web and blackish glue. Its larder is plentifully stored. Its nest is about the size of a pullet's egg, divided horizontally, and suspended by the threads of the insect. It carries its eggs in a bag under its belly, from which the young ones come out, and for a time, in the same web, live in amity; but, when grown up, are mortal enemies. They never meet but they fight; and the battle generally ends with the death of one.

The engraving exhibits the Barbary spider in his web, at the moment of seizing his prey.

GREAT SCOLOPENDRA, OR CENTIPEDE.

This specimen possesses but forty-two legs, but some of the tribe have not less than 148 on each side. The species called *Wood-louse* has but fourteen. In hot climates the centipedes are from six to nine inches long; and they are common in England, though seldom above an inch long, and with 20 or 30 legs. Their bite produces inflammation, and in Jamaica is considered dangerous.

THE WHALE.

The whale, as found in the Polar Seas, is ninety feet in length, and twenty in breadth: but, in the seas of the Torrid Zone, many are seen a hundred and sixty feet long. The head is much disproportioned to the size of the body, being one-third the size of the fish; the eyes are remarkably small; and the under lip is much broader than the upper. The tongue is from eighteen to twenty feet long, and the gullet is only four inches in width. The tail is of an amazing size, and semilunar shape; and the animal employs it

very effectively in accelerating its enormous body, which, though so bulky, passes through the water with great rapidity, and leaves a track like that made by a large ship.

This fish varies in colour; the black of some being red, the belly generally white; others are black; some mottled; and others are quite white. They are gregarious, and feed on vegetables, and are perfectly harmless, unless attacked or wounded. There is a double pipe to the head, through which the whale spouts water to a great height. The females suckle their young, and their breasts contain a large quantity of milk. They are very affectionate, and have no enemies but man, the universal and unmerciful tyrant of the animal creation.

CAPTURE OF A WHALE.

This engraving conveys a correct idea of the scenery and practices of the Greenland seas. An unfortunate whale having been harpooned, and having bled to death in the water, is here represented, after being dragged on the shore; when the crew of the Greenland-man employ themselves in cutting up the body and extracting the blubber, with which nature had provided this warm-blooded fish, as a defence against the cold, because oil is a slow conductor of heat. The enormous proportions of the animal, compared with man, is rendered evident by this mode of display, while the powers of the human intellect, in enabling such small animals to overcome so large a one in his own element must strike every observer.

GYMNOTUS, OR ELECTRICAL EEL.

This animal possesses the extraordinary power of communicating an effect, on being touched, like that which is experienced on receiving a spark of electricity, or touching the prime conductor of a machine. It also affects the water in which it swims, so that, if one hand touches the animal, and the other is put in the water, a shock is felt like that from a Leyden phial; and several persons, joining hands, feel the same effect. The sensation is also felt when it is touched by conductors, as in electricity, and interrupted by non-conductors. On dissecting it, it is found that the whole of the space which is included within dots from the head to the tail, consists of a series of separated muscular plates, not unlike those in a galvanic combination, but very close together; and thus a strong natural electricity is accumulated, by a process somewhat similar to that in the galvanic series. This is a most wonderful structure; and a similar effect is experienced in the torpedo, the silverus electricus, and some other fish, although the structure of their electrical organs is somewhat different.

SCORPŒNA.

Head covered with spines or protuberances, destitute of small scales; one dorsal fin.

There are sixteen species of this genus. They have all a very uncouth appearance, and are armed with formidable spines. The subject of the plate is remarkable for two long tentacula, surrounded by several fibrous brown bars, seated immediately above the eyes. It is a native of Amboyna.

ANGEL FISH.

Body depressed; snout rounded; mouth terminal.

This genus contains only one species, the *squalus squatina* of Linnæus.

This is the *mermaid-fish* of Artedi, which, according to some naturalists, has given rise to those stories which we read and hear concerning mermaids.

CHÆTODON.

One dorsal fin; gill-lid destitute of processes; teeth small, flexible, and moveable; opening of the mouth small.

There are forty-two species of this genus. The one which we exhibit is a native of the fresh waters of India. Dr. G. Shaw, after informing us that its prey consists of the smaller kinds of insects, says, "When it observes one of these, either hovering over the water or seated on some aquatic plant, it shoots against it, from its tubular snout, a drop of water, with so sure an aim as generally to lay it dead, or at least stupified, on the surface. In shooting at a sitting insect, it is commonly observed to approach within the distance of from six to four feet before it explodes the water. When kept in a state of confinement in a large vessel of water, it is said to afford high entertainment by its dexterity in this exercise; since, if a fly, or other insect, be fastened to the edge of the vessel, the fish immediately perceives it, and continues to shoot at it with such admirable skill as very rarely to miss the mark."

HAMMER-HEADED SHARK.

This voracious animal has a remarkable obtuse head, with eyes fixed at its extremities, and its mouth in the centre, as exhibited in the plate. It grows to the length of six feet, and is chiefly found in the Mediterranean.

FROGS AND TOADS.

These belong to the genus Rana, of which there are seventeen species. Frogs appear first in the tadpole state; as soon as they are released from which, they leave the water, and cover the adjoining grass in multitudes. They live chiefly on insects and snails, and give no other offence to man than by their croaking, with which they fill the air in the neighbourhood of their ponds; but during one month their croaking entirely ceases. Both frogs and toads are torpid during the winter. The first figure represents the Pennsylvanian frog, variously coloured, which makes a roaring as loud as a bull, and hence is called the Bull-frog. They spring three yards at a leap, and equal a horse in speed. When in companies, their noise is deafening; and they make it in concert, apparently by mutual signal; and, if beaten, they cry out like children.

Toads, of the species Buffo, are much abhorred for their ugliness, though it has remarkably fine eyes, and is perfectly harmless, and in no degree poisonous, as the vulgar and credulous believe: so far from this, they are the common food of many birds, and of ducks and snakes. Their only offence is their not being handsome, according to human notions of beauty. They live an incredible time, a century or more; and it is no fable that they have been turned alive out of stones, in which they must have been inclosed some thousand years. Yet, with these providential endowments, a poor toad is never found by unthinking urchins without being exultingly stoned to death.

LIZARDS AND OTHER REPTILES.

This plate exhibits several varieties of chameleons, geckos, crocodiles, ignanas, turtles, and tortoises.

The Crocodile. Most of this species are inhabitants of the warmer climates; and are, in general, very active and voracious in pursuit of their prey. The back and belly are covered with large plates, and the head is broad and flat. All the species are capable of living both in water and on land; they generally inhabit the former, but move with ease upon the latter. The rivers of Guinea are infested with vast shoals of these animals; and on hot days great numbers may be seen basking on the banks. In the river Senegal, sometimes more than two hundred of them have been swimming in shoals, with their heads floating above the water, resembling a great number of trunks of trees floating down the river. One of them, taken at Siam, was eighteen feet and a half long, of which the tail was five feet and a half, and the head and neck two feet and a half; and he was eighteen inches in diameter. His hind legs were two feet two inches, and the paws nine inches; the fore-legs are like the arms of a man. Some of them measure twenty-five feet. The crocodile is a voracious and destructive animal, often seizing women who go to the Nile for water, and children playing on the shore. They frequently bask in the sun on the banks, and are fatally mistaken for trunks of trees. They will even enter cottages, and seize on the first animal they meet with; and will drag a man from his canoe. Dogs, bulls, tygers, and the human species, are his prey, which it seizes with a spring, and drags into the water with his teeth and claws. Its rapidity on shore in pursuing its prey is also frightful. Tygers maintain a desperate conflict with them, but, being dragged into the water, are overcome. Nevertheless, negroes venture to attack them even in the water, with a knife in their right hand, and their left arm wrapped in a towel, which they thrust into his mouth, while they stab him with the knife.

The Crocodile of the Nile has six large carinated plates on the neck. Except when pressed by hunger, or urged by the necessity of depositing its eggs, it seldom leaves the water. In the neighbourhood of Thebes, in Egypt, M. Sonnini's boat was often surrounded by these animals, on a level with the surface; but they allowed the boat to pass with apparent indifference.

There is also a false-bellied crocodile, which receives its young into a paunch for protection, like the opossum or the viper.

The Alligator is another species of crocodile, represented in the upper figure, with the tail serrated, and the skin covered with tubercles. It is seventeen or eighteen feet long. They abound in the rivers of Carolina, where they float like logs of wood, seizing dogs, hogs, and fish: they are torpid during the winter in dens, which they burrow under ground. The carrion vulture is their deadly foe in South America.

The Cayman of the Antilles is another animal of the same form and species.

Lizards. Many of this species inhabit woody situations, and seek their food in underwood. Others live about ruinous buildings, and feed on insects, fruits, and vegetables. A few are also found in ponds and marshes, where they prey on the smaller animals which inhabit them. Most of them are natives of the warmer climates, but more of this tribe than any other of the genus Lacerta are indigenous in the temperate countries of Europe.

The green Lizard is of a bright colour, marked with nu-

merous black or brown figures, and a verticillated tail covered with scales.

The spotted Lizard is blackish blue above, with a few round spots of a pale violet, and the belly is whitish.

The dark-brown Lizard, with a long tail, is entirely covered with scales. They are common in England, and live upon insects; and are timid and perfectly harmless creatures, though very disgusting to look at, and therefore suffer great persecutions from boys and vulgar men.

The dwarf, common, and *cloven-footed Chameleon.* These animals are natives of India, Africa, and parts of South America. From the earliest periods, this extraordinary reptile has been metaphorically employed to denote fickleness and versatility, on account of its peculiar property of changing colour. It is susceptible of many shades, particularly three very distinct ones, Saxon green, deep green, and a blue and yellow green. When provoked in the open air, and well fed, it becomes blue green; but, when feeble or deprived of free air, the prevailing tint is yellow green. Attempts have been made to account for these changes, by the remark that the blood of the animal is of a violet blue, while the natural colour of the skin is yellow: hence, when the skin is most transparent, and the animal in greatest vigour, the shade of green is darkest, or assumes most of the blue tinge; while, when the skin is least stretched, and the circulation languid, the colour becomes paler, and verges towards yellow white, or even brown. Chameleons are generally of a diminutive size, the largest not exceeding two feet from the muzzle to the tip of the tail, of which the tail occupies one half. It is also remarkable of them, that they are able to look two ways, and able to move one eye at a time. They live chiefly on trees, and their food is insects, which they eat with their tongues; and they are capable of undergoing very long abstinence.

Geckos. These animals are found in South America, in Africa, and the East Indies. They live about walls and in trees, feed chiefly on insects, and have so little dread of mankind, as familiarly to enter their houses. The body is covered with very small prominent scales; the tail is generally cylindrical, but in a few species flattened, as in the flat-headed gecko; the feet have each five broad toes, covered with small scales, concealing glandular pores, from which exudes a very corrosive fluid. They are ranked by some naturalists amongst salamanders, whom many people weakly suppose can live in fire; for which vulgar opinion there is no foundation.

The flat-headed Gecko has the head, body, and legs, flattened at the sides, and bordered with a membraneous fringe. The tail is broad and compressed, with a simple membrane on each side. The *striped or Surinam Gecko* has a tail as long as the body, with brown bands; a yellowish band, bordered with brown, running from the eyes to the thighs. The *banded Gecko* is of a reddish colour, with the body and tail marked with dark bands.

Ignanas. These animals are found chiefly in Africa and the Bahama Islands, and inhabit the woods, sporting among the trees. The tail is surrounded with numerous small rings of minute scales: a high crest of pointed scales extends from the neck to the tip of the tail; and the feet are very strong, each having five toes ending in claws. It is said that the negroes are very expert in catching this animal, amusing it by whistling, and, when it suffers them to approach, tickling it with the end of a rod, they secure it by a cord with a running noose. In the plate are represented five beautiful varieties of this tribe. One of the nations on the coast of Africa consider them as *fetiches*, or guardian genii, and they cherish them in every possible manner. In the Bahamas they are called Guianas, and serve as food to the natives.

The common or green Turtle. The body of this animal is enclosed within a shelly covering, consisting of two parts, one covering the back, and usually called the shield; the other supplying the place of a sternum, and called the breast-plate. The legs are very short, but so strong, that one of the larger turtles has been known to walk with apparent ease, while several men stood on his back. The plates of the shield are thirty-four in number, and the fore feet are furnished with two nails. In their motions these animals are slow and awkward; and, with few exceptions, they are inoffensive, and submit without resistance to the most cruel treatment. Some species have the power of withdrawing their limbs within the shell, where they lie encased, safe from the attacks of almost every animal but man. A gigantic species, with long legs, is found in the Galipagos, some of which weigh five hundred pounds.

Tortoises. These animals have all the toes furnished with claws, but not distinct in all species. The shell is generally hard and horny. They feed on vegetables, insects, worms, &c.; some of them reside on the borders of lakes and rivers, and others live entirely on land.

The Mud Tortoise inhabits the lakes and muddy rivers in the south of Europe. It is very plentiful in France, especially in Languedoc and Provence. Its whole length, from the snout to the tip of the tail, seldom exceeds eight inches, and about three or four in breadth. The young, when first hatched, are not an inch in diameter. They continue to grow for a long time, and are known to live for at least twenty-four years.

The Rough Tortoise has the upper part of the shield yellowish, and irregularly spotted. The marginal plates are twenty-five, the feet are palmated, and one hind toe is without a claw.

The Figured or Manuscript Tortoise has the plates marked above with characters, and spotted on the lower part.

The Yellow Tortoise is variegated with spots, but in its habits chiefly resembles the other species of the tortoise tribe.

The Land Tortoise, known in England, is torpid during the winter, and sleeps much even in summer. They are docile, and even affectionate to those who feed them. It is a fact well ascertained, that one of them lived in the precincts of the cathedral of Peterborough from the reign of James I. to that of George IV., or about 200 years.

THE FLYING DRAGON, OR DRACO-VOLANS.

This harmless creature, with a body four inches long, and a tail of six, has been magnified by poetry and superstition into a tremendous monster. Its colour is an elegant pale blue or bluish grey, and its wings are very elegantly spotted. It inhabits woods in warm climates, where it is seen flying from tree to tree, feeding on various insects. It has four legs, like the lizard; and is about ten inches long.

TWENTY-SEVEN VARIETIES OF SNAKES.

In this class of amphibia there are six genera, as under:

1. The Crotalus, or Rattle-snake.
2. The Boa, of which there are ten species.
3. Coluber, or Viper.
4. The Anguis.
5. The Amphisbæna, with annular segments.
6. The Tentaculated Snake, with a wrinkled tail and body without scales.

They have very wide mouths, and can swallow substances three times as large as their own head, because the jaws are not inserted in each other, but are connected by a stretching muscular string, and the throat stretches like Indian rubber. The teeth are capable of being erected or depressed at pleasure; their tongue is long and forked, and in some of the viper kinds are a fifth of the length of their bodies, which they dart out, and terrify the ignorant. The joints in their back are very numerous, being 145 from the head to the vent, and 25 from thence to the tail, and the bones play into each other like a ball and socket. There being two ribs to every joint, they are 290 in number. The skin is composed of scales, which is generally cast twice a year. They grow larger as they grow older, and, though voracious, can live a long time without food. They live in hostility with most other animals; and there are few or none which they are not able to overcome. Their contests are chiefly on the banks of rivers.

Thus the neighbourhood of a rivulet, during the drought of tropical countries, is generally the place where all the hostile tribes of nature draw up for engagement. On the banks of this envied spot, thousands of animals of various kinds are seen venturing to quench their thirst, or preparing to seize their prey. The elephants are perceived in a long line, marching from the darkest parts of the forests: the buffaloes are there, depending upon numbers for security; the gazelles, relying solely on their swiftness; the lion and tyger, waiting an opportunity to seize; but chiefly the larger serpents are upon guard there, and defend the accesses to the lake. Not an hour passes without some dreadful combat; but the serpent, defended by its scales, and naturally capable of sustaining a multitude of wounds, is above all others the most formidable. It is the most wakeful also; for the whole tribe sleep with their eyes open, and are consequently for ever on the watch; so that, till their rapacity is satisfied, few other animals will venture to approach their station.

The Boa.

This is the most formidable genus of serpents. The species called *Constrictor* sometimes grows to the length of thirty or forty feet, and by twisting round another animal is able to crush it to death, and afterwards swallow it whole.

The *Spotted Boa*, another species, is as formidable as the Constrictor, and found in South America.

The *Boa Cannina* and *Boa Phrygia* are remarkable for the beauty and variety of their colouring.

Of the *Coluber*, 97 species are enumerated, among which is the Berus, a common British viper found in dry situations. It is from two to three feet long; its colour is a dirty yellow, and the back is marked with square black spots touching at the points, the sides with triangular ones, and the belly is black, and some are entirely black, though marked like the others; the tongue is forked, and the teeth small. They have four canine teeth, capable of being raised or

depressed at pleasure; and through these they instil their poison. Sir Thomas Browne asserts that, when alarmed, their young seek shelter in the throat and belly of their parent. They live chiefly on frogs, toads, lizards, and mice, but endure long abstinence, and remain torpid throughout the winter. Their bite is venomous; but salad oil immediately applied is a certain remedy. In India they chew the root of the *lignum colubrinum*, and apply it to the wound. Many of this species are quite harmless, and some of them are six feet long. The water viper of Carolina catch fish with great dexterity, and often suspend themselves from the branches of trees to surprise birds. It has a horny substance at its end, as may be seen in the plate.

The Crotalus, or Rattle-snake.

The *Crotalus Horridus*, or American Rattle-snake, grows sometimes to the length of eight feet, and weighs between eight and nine pounds. The colour of the head is brown, the eye red, the upper part of the body of a yellowish brown colour, transversely marked with irregular broad black lists. The rattle is of a brown colour, composed of several horny membraneous cells, of an undulated pyramidal figure. These are articulated within one another in such manner that the point of the first cell reaches as far as the basis of the protuberant ring of the third, and so on; which articulation being very loose, gives liberty to the parts of the cells that are inclosed within the outward rings to strike against the sides of them, and so to cause the rattling noise which is heard when the snake shakes its tail. It is the most inactive and slow-moving of all the snakes, and is never the aggressor except in what it preys upon. Its bite is mortal, and no remedy has yet been discovered for it.

It is said that this animal has the power of fascinating its prey before it commences the attack; but, no doubt, this arises from the terror of the victim; the power of fascination being a chimera of superstition, like suction, attraction, repulsion, and the like.

Of the *Anguis* there are fifteen species, two of which, the eryx and blind or slow-worm, are found in England. They are about a foot long, and about the thickness of the finger; their motions are slow, and their eyes small. The belly of the eryx is of a light lead colour, marked with white spots, and a greyish brown, with three dusky lines. The slow-worm has a blunt tail; the back is a dark lead-colour, marked with black specks in lines; the sides reddish, and the belly dusky, marked like the back: it lives on worms in gardens. This is considered as the most venomous snake in England.

The *Amphisbæna* are so called because they move with either end foremost, from an erroneous opinion that they have two heads. They are but a foot long; but are divided into 200 segments and many longitudinal streaks: their colour is black, variegated with white. They live chiefly in the earth on worms.

The Egyptian Viper

Is abundant in Egypt; and is found in other parts of Africa, as well as in Asia.

Cerestes, or Horned Viper,

Generally grows to the length of about a foot or fifteen inches, and is distinguished by a pair of horns, or curved processes, seated and projecting from above the eyes. It is a native of Africa, and is chiefly found in sandy deserts and dry places. It closely resembles the common viper: its bite is perhaps still more to be dreaded, since it possesses a propensity of springing with great suddenness to a considerable distance, and assailing, without provocation, those who approach it.

Pambou-Rajah, or Royal Serpent,

Is about 50 feet long, with its body much thicker than that of a man. It is found on the rivers of the western African coast, and in eastern India.

In the engraving the popular names have been for the most part adopted, as most intelligible to the general reader.

COBRA DI CAPELLO, OR HOODED SNAKE,

Is common in many parts of India. Its general length is three to nine feet, and its thickness in proportion. It is usually marked on the top by a very large and conspicuous patch, resembling a pair of spectacles. The usual colour of this snake is a pale rusty brown above, and beneath a bluish white yellow.

When it is irritated or preparing to bite, this animal erects its body, bends down its head, and seems, as it were, hooded by the expanded skin of the neck: hence its name of Cobra di Capello, or Hooded Serpent. It is reckoned the most deadly of all the serpents in the East Indies; but, on account of its sagacity, is considered an emblem of prudence, and held in great veneration by the natives. The engraving represents his position when he is about to strike an object. Death follows its bite within two or three hours.

SCOLIOPHIS ATLANTICUS, OR THE GREAT AMERICAN SEA-SERPENT.

The evidence of numerous mariners proves that there exists in the sea, serpents of extraordinary length. In 1817, one was seen off New England by different persons. One made oath it was 100 feet long, and two feet in thickness; another 90 feet; another 70 feet; and another 120 feet; and all certified in regard to its unparalleled velocity through the water! A few days afterwards a small one, and evidently the progeny of the large one, was taken on shore; and from this the present engraving has been made. In the general disposition of its colours, in the number, form, and arrangement, of the scuta and scutellæ, this animal approaches most nearly to the Coluber Constrictor.

a. a. represent portions of the head and throat so far destroyed that their structure could not be ascertained.

Fig. 1. Section of the body.

Fig. 2. Dissection of the same on the opposite side A.A.A. Muscles of the back. B. Lateral muscles. C. Intercostal muscles.

Fig. 3. Inside view of the cavity of the ribs and spine, with the internal muscles crossing the ribs.

Fig. 4. Side view of a vertebra.

Fig. 5. Front view of the same.

Fig. 6. Portion of the spine, shewing the varieties of the vertebræ, and the direction of the ribs.

Fig. 7. Portions of viscera of the first section. A. The lungs, their inequalities corresponding to the cavities in the spine. B. The mesentery, which is attached on each side to the ribs. C. The great vein. D. The Œsophagus.

Fig. 8. Represents an opening in the throat. A. The trachea. B. The Œsophagus, with a blowpipe inserted into its cavity. C. Elastic retractile filaments of the tongue. D.D. Extremities of the ribs.

THE OURANG-OUTANG.

This animal has a flat face, with a deformed resemblance of the human; ears like those of a man; the hair on the head is longer than on the body. The body and limbs are covered with reddish and shaggy hair; longest on the back, thinnest on the fore parts. The face and paws are swarthy. They grow to the height of six feet; have prodigious strength, and are able to overpower the strongest man. They sleep in trees; and form rude shelters from the inclemency of the weather. They are of a grave appearance and melancholy disposition, and even when young not inclined to frolic. They walk erect, and are very swift.

THE GREAT BABOON.

This animal is from three to four feet high; very strong built; with a thick body and limbs, and large callosities behind, which are without hair, and red. Its tail is crooked, and about seven or eight inches long. Its snout is long and thick; and on each cheek is a pouch, for receiving its superfluous provision. It is covered with long thick hair, of a reddish brown colour; and walks more commonly on all-fours than erect. Its hands, as well as its feet, are armed with long sharp claws.

THE RIBBED-NOSE BABOON.

This singular creature is no less remarkable for its great size and strength, than for the variety of beautiful colours on different parts of its body. His head is very large, and his muzzle long. Its nose is marked with broad ribs on each side, of a fine violet blue-colour; a vermilion line begins a little above the eyes, and running down on each side of the nose, which is somewhat similar to that of a hog, spreads over the tip of it; the insides of the ears are blue, which gradually soften to a purple, and terminate in vermilion; the body is squat; the rump is also of a vermilion colour; and the beautiful colours on the hips are gradations from red to blue; the hair on the forehead is long, turns back, and forms a sort of pointed crest.

THE GIBBON, OR LONG-ARMED APE.

This animal is distinguished by the extraordinary length of its arms, which reach to the ground, when its body is upright, and give it a disgusting appearance. Its face is flat, and of a tawny colour, surrounded with a circle of grey hairs, which add to the singularity of its aspect; its eyes are large and deep sunk; its ears round and naked; and its body covered on all parts with black rough hair, except its buttocks, which are quite naked. It is of a mild, gentle, and tractable disposition; feeds on fruits, leaves, and the barks of trees; and is a native of the East Indies, Sumatra, and the Molucca isles; and measures from three to four feet in height.

THE BARBARY APE.

This species is very common in Africa, and is very untractable. Its head is large, and nose prominent; its face long, and not unlike that of a dog; its ears round like the human; the body is covered with hair of a brown colour, inclining to green; but lighter on the belly. It is from two feet and a-half to four feet high when standing erect.

THE GREEN MONKEY

Has a black and flattish face, the cheeks bounded by long white hairs, falling backwards, and almost covering the ears, which are black, and like the human; head, limbs, and whole upper part of the body and tail covered with soft hair, of a yellowish green colour at their ends, cinereous at their roots; under side of the body and tail, and inner side of the limbs, of a silvery colour: tail very long and slender; size of a small cat.

THE SLOTH.

The appearance of this animal is so helpless as to excite compassion. It has three claws upon each foot, and a short tail; its fur resembles dried grass; the mouth wide; the eyes heavy; the legs and feet so awkward, that it requires a week to walk a short distance. When this animal makes a step forward, it scrapes on the back of the nails against the surface, and seldom moves more than three feet in an hour; it rarely changes its place, but when impelled by hunger. It is about the size of a cat, very ugly, and has claws extended like fingers; it feeds upon vegetables, and requires a considerable portion of provision.

THE ANT-EATER.

This creature is a native of Brazil and Guiana. It is nearly four feet in length, exclusive of its tail, which is two and a half, and serves to cover the body when it rains; it is remarkable for its long snout, which is cylindrical, and serves as a sheath to its long and slender tongue, which always lies folded double in its mouth, and is the instrument by which it finds its sustenance; it lives wholly on ants, which it collects by thrusting its tongue into their nests, and withdrawing it loaded with prey.

THE RHINOCEROS.

This animal is of a peaceful disposition, but, when hungry or injured by any one, he springs forward and attacks them furiously with his head, transfixing them with his horn. These animals never assemble together in troops like elephants, and never attack men except when provoked or first attacked; their skin is so extremely hard as to resist javelins, sabres, and even leaden musket-balls. They inhabit various parts of Asia and Africa, frequenting the banks of rivers and marshy places.

ELEPHANT.

This animal is one of the most striking among quadrupeds, as well for its bulk as his sagacity and usefulness; its strength is so great, that he is competent to bear a load of nearly two thousand pounds; he will draw a carriage which six horses are scarcely able to move; and he will travel when trained, on an emergency, more than thirty leagues a day. The elephant is not only the most tractable, but the most intelligent, of animals, sensible of benefits and resentful of injuries. They are natives of Africa and India, and were formerly attached by Eastern monarchs to armies, and used in battle; but have been found more injurious than useful since the invention of gunpowder. They live to the age of two or three hundred years, and continue to grow for nearly a century. Next to the human hand, their proboscis is the most useful implement attached to any animal; they can pick up a pin with it, or twist it round a horse and his rider, and thrown them into the air.

ARCTIC WALRUS, OR SEA-COW.

This amphibious creature is a species of seal, but much larger, being sixteen or eighteen feet long, and differing in the shape of its head, and in having two tusks, which she can use for various purposes. They are very sagacious, gregarious, and affectionate, and subsist entirely on shell-fish and marine plants, within the polar circles.

WOLF.

The Wolf is one of those quadrupeds, whose appetite for animal food is the most vehement, and whose means of satisfying it are various, as nature furnishes him with strength, cunning, and agility. He is naturally dull and cowardly; but, when pressed by hunger, he ventures to attack animals under the protection of man. These ferocious animals are natives of almost all the temperate and cold regions of the globe, but, happily, have long ceased to roam in the British Islands. The present subject is from RIDINGER.

LION.

The Lion's external appearance is not only majestic, but his gait proud, and voice terrific; he is a perfect model of strength, associated with agility. The Lion whose figure accompanies the present account, was one of the most beautiful animals ever seen in captivity; he was caught between Constantine and Bonne, in the dominion of Algiers, after a chase of three days; was presented to the French republic, and kept many years in the Garden of Natural History at Paris.

A LIONESS AND HER WHELPS.

The Lioness is equally terrific with the Lion, and, when her cubs are endangered, will attack every species of animal. She has recourse to stratagem, and conceals herself by laying on her belly, and there waits till her prey or enemy comes within her reach, when she suddenly springs on her victim. This individual was also kept in the French Museum.

TYGER.

This animal is of the most ferocious nature, and it partakes of the noxious qualities of the Lion, without possessing any of his good ones; is fierce without provocation, and destroys every thing that falls in his way indiscriminately; and such is the malignity of his disposition, that he not unfrequently ventures to attack the Lion itself: so great is the strength of this creature, that, when it kills an animal, such is his thirst for blood, that he will leave it, and seize upon a new prey with equal fury. He often devours his own young, and tears the mother in pieces for endeavouring to defend them; his usual method of taking his prey is, by concealing himself, and springing suddenly on his victim. The female produces four or five young at a litter, and is as furious as the male.

BEARS.

In a native state, Bears are found in most of the Northern districts of Europe, Asia, and America, and in some parts of Norway. There are four species; the Black, the Brown, the White, and the Kamtschatka. The Black or American Bear inhabits chasms and precipices, and often chooses for his abode the hollow of some tree; there he lives for months in the winter without provisions, and seeming to exist on the exuberance of its former flesh, which it had acquired in the summer. The female generally prepares a bed in the hollow of a rock, and brings forth in winter: they subsist entirely on vegetables. The Brown or Alpine Bear is solitary, and is the species usually led about the streets by Savoyards, by whom they are in a cruel manner taught to dance. The White or Greenland Bear measures from ten to thirteen feet in length, and is the largest animal of the polar regions, where they range on the ice and snow, and are very ferocious. The females are remarkable for their affection for their young.

PORCUPINE.

This animal is a native of Africa, India, and the Indian Islands; it sleeps during the day, and makes its excursions for food in the night, and always eats with a voracious appetite. The Porcupine is harmless, and never the aggressor; but, when pursued, it climbs into a tree, until the adversary's patience is exhausted; at the approach of an enemy they gore him with their erected prickles. When the Porcupine meets with serpents, he closes himself up like a ball, then rolls upon, and kills them with his bristles, without any risk of being wounded himself.

KANGAROO.

These animals sometimes measure seven feet in length, from the tip of the nose to the end of the tail, and weigh one hundred and fifty pounds; the fore-legs are seldom more than nineteen inches in length, while the hind ones are three feet and a half; and of such prodigious strength as to be able, when used as a weapon of defence, to break a man's leg at a single blow. From its general form and structure, its chief progressive motion is by leaps, and in these exertions it has been seen to exceed twenty feet at a time, bounding over obstacles nine feet or more in height, so as to elude the swiftness of a greyhound.

THE JERBOA.

This animal, remarkable for the singular construction of its legs, is found in Egypt, Barbary, and Palestine.

It is somewhat less than a rat; its eyes are large and full; the fore legs are only one inch in length, and are used as hands to convey victuals to its mouth; the hind legs are naked, and very much resemble that of a bird, having only three toes on each, the middle one longest; its tail is much longer than its body, and terminated with a black tuft, the tip of which is white; its hair is long and soft, of a reddish colour on the back; the under parts of the body are white: across the thighs there is a large black band, in the form of a crescent.

Its motions are similar to those of the kangaroo, going forward very nimbly on its hind feet, and taking leaps of five and six feet from the ground. It is a lively, harmless animal, lives entirely on vegetables, and burrows in the ground like a rabbit.

CAMEL.

Camels in hot climates are universally employed as beasts of burden, and perform the same offices as the Horse in Europe; their pace is usually slow, but they are able to sustain themselves on long journeys with a very small portion of food, and undergo privations of water for many days, a reservoir of which they carry in a fifth stomach. They have four other stomachs, so that they live not only on vegetable food, but ruminate the cud. There are two species of Camels, one the Bactrian or Taurida Camel, which has two hunches on its

back; and the other, the Arabian Camel or Dromedary, which has but one hunch, and is smaller, lighter, and more alert: both animals are represented in the engraving; and, as the recumbent position of these animals is peculiar, one of the figures has been given in that position.

HIPPOPOTAMUS.

These animals inhabit the rivers of Africa, and are the same as described by Job under the name of the Behemoth. They are perfectly harmless, living entirely upon vegetables, though the wantonness of man occasion them to be frequently wounded and destroyed. They walk at the bottom of the water, but are often seen presenting their enormous heads above its surface to respire air. When attacked, they have been known to rise under a boat and upset it, or tear out its sides with their teeth, and sink it. This animal belongs to the sixth order of Linnæus called Belluæ, which have cutting teeth in each jaw, and is also known under the name of the River Horse.

THE BOTTLE-NESTS OF THE BAYA, OR AFRICAN ORIENTAL SPARROW.

The Baya, or Bottle-nested Sparrow, is remarkable for its pendent nest, brilliant plumage, and uncommon sagacity. The head and breast are of a bright yellow, and in the rays of a tropical sun have a splendid appearance; they make a chirping noise, but have no song: they associate in large communities, and cover extensive clumps of palms, acacias, and date trees, with their nests, which are formed in a very ingenious manner, by long grass woven together in the shape of a bottle, with the neck hanging downwards, and suspended by the other end to the extremity of a flexible branch, by which they effectually secure the eggs and young brood from serpents, monkeys, squirrels, and birds of prey.

RED-THROATED HUMMING-BIRD.

Humming-birds are chiefly remarkable for their diminutive size, being the smallest objects in ornithology. The plate represents the exact size of this species, which appears to be about two inches long; but the smallest species, called the *fly-bird*, is not more than an inch and a quarter long, and when dead weighs but twenty grains.

THE TAILOR BIRD.

This is one of the most pleasing objects in the whole compass of natural history, and exhibits so much design, ingenuity, and purpose, that no person who contemplates it can question the reasoning powers of the interesting artists who effect the construction. Two leaves are sewed together with vegetable fibres, and the beak performs the office of drilling the necessary holes, and passing the fibres through them with the dexterity of a tailor. Even such parts in the rear as are not sufficiently firm, are sewed in like manner, and when two growing leaves are not conveniently situated, these ingenious creatures sew a dead leaf to a living one, and thus effect their purpose. The birds which display such dexterity are somewhat smaller than the English wren, and they are to be found in various parts of India. Nevertheless, though we feel the more surprised at contemplating this novelty to our climate, yet the whole system of building their nests by different birds, as well in the tailor bird as in the swallow, the bottle-nested sparrow, &c. &c. evinces so much deliberate design and choice, as to baffle every attempt to explain it on the principle of mechanical instinct.

THE PAINTED OR ARGUS PHEASANT,

So called from the number of eye-like spots with which its wing-feathers are covered, is found in the northern parts of China, and in several of the interior districts of India and Sumatra. They are nearly as large as peacocks, and rank among the most beautiful of the feathered creation.

THE OSTRICH.

The ostrich is the largest of all birds; it frequently attains the height of seven or eight feet. Its long and slender neck is clad only with a kind of down. The head is small in proportion to the body; but the eyes are large and vivid. The beak is short, blunt, and flattened horizontally. The wings are extremely short, when compared with the size of the body; and they are furnished only with those waving and flexible feathers, used as ornaments in dress. The thighs and legs are of astonishing strength. The feet have only two toes each, of which the outer one is much shorter than the other, and have no nail or claw.

The male is generally of a brown black colour, the plumage intermixed with white feathers. The female is entirely of a uniformly greyish brown.

They are the swiftest footed animals known, using their wings only to assist their legs, like a man in running. In Africa, they are occasionally used to carry burthens, and even to ride upon, being strong enough to carry two men upon their backs with great celerity.

FLAMINGO.

This bird resembles the heron in shape. Its colour is entirely red, except the quill-feathers, which are black. A full-grown bird, when erect, stands five feet high. The feet are webbed. These birds make their nests on hillocks in shallow water; on which they sit with their legs extended down. They breed on the coasts of Cuba and the Bahamas, and frequent salt-water only. By reason of the particular shape of its bill, this bird, in eating, twists its neck from side to side, and makes the upper mandible touch the ground.

SCARLET IBIS.

The ibis was formerly held in great veneration in Egypt, on account of its utility in freeing the country from serpents. They still continue to frequent the great stagnant pools common in Ethiopia.

THE PELICAN.

This bird is much larger in the body than a swan. Its toes are webbed; and its neck resembles that of a swan; but its bill is fifteen inches from the point to the opening of the mouth, which is far back behind the eyes. The underchap is very extraordinary; for to its lower edges hangs a bag, reaching the whole length to the neck, and capable of containing fifteen quarts of water; and, when this bag is empty, it is not seen; but, when the bird has fished with success, its extent is then incredible.

The pelican has strong wings, furnished with thick plumage, with the feathers over the body of an ash-colour. Its eyes are small, compared with the size of its head; its countenance sad, and its whole air melancholy. It is slow in flight, and rises to fly with difficulty and labour.

THE NUMIDIAN, OR BALEARIC CRANE.

The *demoiselle* of Numidia has been celebrated, by all ornithologists, as a most elegant bird. It has all the proportions and shape of the crane, only on a smaller scale; its port, its garb, are the same; and the same distribution of colours on the plumage, only the grey is purer, and more pearled. This beautiful bird received the name of *demoiselle*, or *miss*, on account of its elegant form, its rich plumage, and its affected airs: it makes repeated gesticulations; it walks with sprightly ostentation, and it often leaps and springs from gaiety, as if it were preparing to dance.

CRANIOLOGY.

The modern science of phrenology or craniology, though carried too far, yet being a study which has obtained a considerable share of public attention, the plate of the usual divisions of the cranium has been introduced, and the following are the passions or subjects assigned by the system to the several parts.

Organs of the Brain, according to the System of Drs. Gall and Spurzheim.

1. The organ of sexual instinct. Fig. II. III.
2. The organ of parental and filial love. Fig. II. III.
3. The organ of susceptibility for instruction, *memoria realis.* Fig. I. II.
4. The organ of finding and remembering places. Fig. I. II.
5. The organ of recollecting persons (in the eye-hole). Fig. I. II.
6. The organ of comparing colours. Fig. I. II.
7. The organ of music. Fig. I. II.
8. The organ of arithmetic. Fig. I. II.
9. The organ of finding and remembering words (in the eye hole). Fig. 1.
10. The organ of philosophy (in the eye-hole). Fig. I.
11. The organ of mechanical arts. Fig. I. II.
12. The organ of friendship and attachment. Fig. II. III.
13. The organ of fighting. Fig. II. III.
14. The organ of murder. Fig. II. III.
15. The organ of cunning. Fig. II. III.
16. The organ of thieving. Fig. I. II.
17. The organ of loftiness and high-mindedness. Fig. III.
18. The organ of thirst for glory, and of vanity. Fig. III.
19. The organ of reflection. Fig. II. III.
20. The organ of ingenuity. Fig. I. II.
21. The organ of philosophical judgment (includes No. 20.) Fig. I. II.
22. The organs of wit. Fig. I. II.
23. The organ of induction (includes the organs Nos. 20, 21, and 22.) Fig. I. II.
24. The organ of meekness or good-nature. Fig. I. II.
25. The organ of religious fanaticism. Fig. I. II. III.
26. The organ of constancy. Fig. II. III.
27. The organ of imitative power (includes No. 24.) Fig. I. II.

PHYSIOGNOMY.

This engraving exhibits a classification of the human countenance, as found in different nations and particular families.

Man, being endowed with intelligence, presents the impression of them by his exterior form; and by features which distinguish him from all other animals. Accordingly, the form of his face is the more beautiful the more it is peculiarly his own, and less resembles any other; it is the more disgusting, the more sensibly it recalls that of any beast.

The 2d and 7th figures in the plate represent the human face in its perfection; the 11th and 14th, inclusive, represent it debased and approaching that of some other animal. Among the vast variety presented by the countenance of animals, the hu-

man is distinguished by its regularity. In front, it forms an exact oval, the parts of which are regularly divided, and preserve a symmetrical relation to each other. It is in this front part that animals principally differ from each other and from man; nature appearing to have established this visible correspondence between its exterior form and the quality of the faculties. The human head presents in its front part, as we have just observed, the exact shape of an egg; that is to say, of an oval, wider above than below. In dividing this oval into two diameters, the largest, marked A and B, will part into two equal portions, the forehead, the nose, the mouth, and the chin.

The smallest will divide the head into two equal portions, at the origin and extremity of the eye-brows, or sometimes to the middle of the orbilary cavities. See the same Fig. line C D. These two parts, divided again into halves, will give, one the origin of the hair, the other the extremity of the nose. The fourth part divided into three gives the place of the mouth and the origin of the chin.

The base of the nose forms, with its most prominent part, an equilateral angle, which ought to be of the size of the mouth, or of the eye; there is between the two eyes, the space of an eye or a nose. The nose and the forehead will only be separated by a slight and almost imperceptible inflection. The upper part of the forehead, and the lower part of the chin, will be a little depressed, to soften the oval, and give it a more regular form. This may be perceived in the regular profile, Fig. 18. In Fig. 15, 16, 17, 25, and 26, the beauty is injured, because the face is constructed on a line too convex or concave, too flat, too long, or too wide. Figures 21, 22, 23, and 24, are caricatures taken from *Leonardi da Vinci*.

PLATES OF ANATOMY.

FRONT OF THE HUMAN SKELETON.

Head and Neck.

A Os frontis, or frontal bone
B The parietal bone
C Temporal process of the sphenoid bone
D Squamous part of the temporal bone
E Mastoid process of that bone
F Malar, or cheek bone
G The nasal bone, behind which is the nasal process of
H The superior maxillary bone
I The lower jaw.

Trunk.

A The sternum
B The seventh, or last true rib
C The cartilages of the ribs
D The twelfth, or last false rib
E The lumbar vertebræ, with their intervertebral cartilages and transverse processes
F The os sacrum
G The os innominatum, composed of
a The os ilium
b The os pubis
c The os ischium.

Superior Extremity.

A The clavicle
B Inner surface of the scapula
a The acromion of the scapula
b The coracoid process of that bone
C The os humeri
c The head, or ball of the os humeri
d Internal tubercle of the os humeri; and, farther out, the groove for lodging the tendon of the long head of the biceps muscle
e The inner, and
f The outer condoyle of the os humeri. Between *e* and *f*, the hollow for lodging the coronoid process of the ulna in the flexion of the fore-arm
D The radius
f The head of the radius
E The ulna
h The coronoid process of the ulna
F The bones of the carpus
G The metacarpal bone of the thumb
H The metacarpal bones of the fingers
I The two bones of the thumb
K Three phalanges of the fingers.

Inferior Extremity.

A The os femoris
d The ball, or head of this bone, lodged in the acetabulum
e The cervix of the bone
f The large trochanter
g The small trochanter
h The inner condyle
B The patella, placed upon the trochlea of the os femoris
C The tibia
k The head of the tibia, between which and the condyles of the os femoris, the semi-lunar cartilages appear
l The tubercle of the tibia
m The malleolus internus
D The fibula, the upper end of which is connected with the tibia
n The malleolus externus
E The bones of the tarsus
o The projection of the os calcis
F The metatarsal bones
G The phalanges of the toes.

BACK OF THE HUMAN SKELETON.

Head and Trunk.

A The parietal bone
a The sagittal suture and parietal hole
B The occipital bone
b b The lambdoid suture
C The joining of the temporal and parietal bones
D The cheek bone
E F The inner or back part of the jaws, with the teeth
G The first cervical vertebræ
H The second cervical vertebræ
I The seventh cervical vertebræ
c The spinous processes of the cervical vertebræ
k The first dorsal vertebræ
L The twelfth dorsal vertebræ
d The spinous processes of the dorsal vertebræ
e Their transverse processes
M The first lumbar vertebræ
N The fifth lumbar vertebræ
f Their spinous, and
g Their transverse processes
N The os sacrum
h The uppermost spinous process. Farther out are seen the superior oblique processes of this bone, joined to the inferior oblique of the last lumber vertebræ
i i The lateral parts of the os sacrum, joined to the ossa innominata. Between *i* and *o*, the posterior foramina of the os sacrum
k An opening in the under and back part of this bone, covered in the subject by a ligamentous membrane
P The os coccygis, joined by its shoulders to the os sacrum at the lower part of the opening *k*
Q The os ilium
R The os pubis
S The os ischium
T U The seven true ribs
v v The five false ribs.

Superior Extremity.

A The clavicle
B The dorsum scapulæ
a The spine of the scapulæ
b The acromion of the scapulæ
c A fossa for lodging the supra-spinatus muscle
d An irregular surface, occupied by the infra-spinatus muscle
C The os humeri
e The ball of the os humeri
f The external tubercle of the bone
g The external condyle
h The internal condyle
i Cavity for lodging the olecranon of the ulna
D The radius
k The head of the radius articulated with the trochlea of the os humeri
l The under end of the radius, grooved by the tendons of the muscles
E The ulna
m The olecranon of the ulna
n The under end of the ulna, with its styloid process
F The bones of the carpus
G The metacarpal bone of the thumb
H The metacarpal bone of the fingers
I The two bones of the thumb
K The three phalanges of the fingers.

Inferior Extremity.

A The os femoris
a Part of the ball of the os femoris
b The cervix of the bone
c The trochanter major
d The trochanter minor
e The cavity for lodging the popliteal vessels and nerves
f The external condyle
g The internal condyle
h The semi-lunar cartilages
B The tibia
i The head of the tibia
k The malleolus internus
C The fibula
l The head of the fibula
m The malleolus externus
D The bones of the tarsus
n The astragalus
o The os calcis
p The fore-part of the tarsus
E The bones of the metatarsus
F The phalanges of the toes.

THE SKULL, CUT PERPENDICULARLY.

A The os frontis
B Sinus Frontalis
C C Os bregmatis
D Os occipitis
E Os petrosum
F The seventh foramen, through which the auditory nerve passes
G The ninth foramen
H Processus clinoides
I Sella turcica
K Crista galli
L L Sinus sphenoidalis
M Os nasi
N A process of the os ethmoides, that makes part of the septum nasi
O Part of the os sphenoides, that makes part of the septum nasi
P Os vomer
Q The suture of the upper jaw
R Processus pterygoides
S Maxilla superior
T The styloid process
U U Sutura sagittalis
V The spongy substance of the os sphenoides
W Part of the diploe of the os occipitis.

THE UNDER SIDES OF THE BONES OF THE FOOT.

A The os calcis
B C D Three protuberances of the os calcis

E The smooth part of the astragalus which joins the os naviculare
F The upper side of the astragalus which articulates with the tibia
G Os naviculare
H Os cuboides
I A sulcus in the os cuboides
K Os cuneiforme majus
L Os cuneiforme maximum
M The metatarsal bone of the great toe
N The part upon which the sesamoid bones are moved
O The first bone of the great toe
P The last bone of the great toe
Q Q Q Q The metatarsal bones of the four smaller toes
R R R R The first bones of the four smaller toes
S S S S The second bones of the four smaller toes
T T T T The last bones of the four smaller toes.

THE BACK OF THE HAND.

1 2 3 5 6 7 8 Seven of the bones of the carpus
A A A The three bones of the thumb
B B B B The metacarpal bones of the fingers
C C C C The second bones
D D D D The second bones
E E E E The third bones.

THE BRAIN,

In a perpendicular direction.

a a A section of the cranium
b Part of the right frontal sinus
c Part of the right sphenoidal sinus
d The septum narium, composed above of the nasal plate of the athmoid bone, below of the vomer, and before of cartilage
e The opening from the left nostril into the throat
f The roof of the mouth, and teeth of the left side of the upper jaw
g The cancelli of the cuneiform process of the occipital bone
h The root of the falx, the rest being removed to shew the convolutions of the inner side of the left hemisphere of the brain
i Part of the tentorium cerebelli, and the situation of the torcular herophili
k The termination of the superior longitudinal sinus
l A section of the corpus callosum
m The septum lucidum, and situation of the right lateral ventricle
n The body of the fornix
o The two anterior crura of the fornix, one of which is cut and turned forwards
p A section of the anterior commissure of the brain
q The passage by which the two lateral ventricles communicate with each other, and with the third ventricle
s The infundibulum, at the bottom of the third ventricle
t The glandula pituitaria, lodged in the sella turcica
u A section of the right optic nerve
v A section of the right corpus albicans
w Part of the choroid plexus
x A vein running upon the right side of the septum lucidum, to terminate in the choroid plexus
y The pineal gland, at the root of which is a section of the posterior commissure of the brain
z A section of the nates
1 A section of the testes
2 The valve of vicussens
3 3 The arbor vitæ of the cerebellum
4 A passage to the fourth ventricle
5 The cavity of the fourth ventricle, the under end of which is shut by the choroid plexus and pia mater
6 A section of the tuber annulare
7 Of the medulla oblongata
8 Of the spinal marrow
9 The basil artery.

The base of the Brain.

a a The anterior lobes of the brain
b The division of the anterior lobes, on each side of which is a groove, where the first pair of nerves were situated
c c The lateral lobes, separated from the anterior by the fissures of sylvius
d d The posterior lobes
e The infundibulum, placed behind the union of the optic nerves, and before the corpora albicantia
f f The cerebellum divided into its two lobes or hemispheres
g g The superior and anterior lobules, called also the superior and anterior vermiform processes of the cerebellum
h h The crura cerebri
i i The crura cerebelli
k The tuber annulare, in the middle of which is an impression made by the basilar artery
l The medulla oblongata composed of two lateral portions, with a fissure between them
m m The corpora pyramidalia
n n The corpora olivaria.

Contents of the Thorax and Abdomen, after removing the Parts which cover them.

A The right lung, part of which is cut off from *B* to shew the large blood-vessels
B The left lung
C The right ventricle of the heart, with the point of the left ventricle
D The right auricle of the heart
E The vena cava superior
F F The subclavian veins
G G The internal jugular vein
H The aorta ascendens
I The pulmonary artery
K K The diaphragm
L L The right and left lobes of the liver, with the vestige of the ligamentum latum between them
M The ligamentum rotundum
N The fundus of the gall bladder
O The stomach, pressed by the liver towards the left side
P The spleen
Q Q The situation of the kidneys behind the intestines
R R R The convolutions of the small intestines.

FIG. I.

The Head in the region of the Ear.

A The external carotid
B The internal carotid
C The auricularis posterior
D The pharyngea ascendens
E The internal maxillary artery
F The porlio dura of the auditory nerve
G The malleus
H The incus
I Part of the membrana tympani
K The upper ganglion of the sympathetic nerve
L Nervus vagus
M The facial branch
N The styloid process.

FIG. II.

The Ear.

A The helix
B The antehelix
C The tragus
D The antitragus
E The lobe
F The cavitas innominata
G The scapha
H The concha
I Meatus auditorius
K The eustachian tube.

FIG. III.

Fallopian Tube.

A The fallopian canal
B The labyrinth.

FIG. I.

THE RIGHT EYE,

With its Muscles viewed obliquely from its Upper and Outer Side.

a The eye-ball
b Parts of the upper eye-lid
c The tunica adnata adhering to the edge of the cornea
d The integuments of the right side of the nose
e e The optic nerve
f The four straight muscles with the levater palpebræ superioris and obliquus superior embracing the optic nerve, where it enters the orbit
g The levater palpebræ superioris drawn aside
h The levater oculi
i The abductor oculi
k The adductor oculi
l The depressor oculi
m The obliquus superior or trochlearis
n The trochlea of the superior oblique
o The insertion of the tendon of the obliquus superior in the eye-ball
p The inferior oblique muscle taking its rise from the superior maxillary bone
q The insertion of the tendon of the inferior oblique muscle in the eye-ball.

FIG. II.

THE COATS OF THE EYE.

a The optic nerve
b b The sclerotic coat cut and turned outwards
c The sclerotic coat cut and turned forwards, with
d The cornea
e e Half of the iris in its place, the other half being removed
f The pupil with the crystalline lens in its place
g The ciliary circle
h h The choroid coat
i The ciliary processes seen in their places, by cutting off a portion of the iris
k A portion of the iris cut and turned back
l The floating points of the ciliary processes also turned back
m The middle smooth part of the retina seen by cutting a hole in the choroid coat
n The roots of the ciliary processes of the retina to which the black part of the ciliary processes of the choroid coat adheres
o The ciliary processes of the retina inserted into the capsule on the crystalline lens.

FIG. III.

The Passages of the Tears.

a The lacrymal gland; shewing its natural situation with respect to the eye-lids
b b The eye-lids widely opened
c The situation of the pometa lacrymalia
d d The ducts continued from the pometa lacrymalia
e e The angles the ducts form after leaving the pometa
f The termination of the lacrymal ducts in
g g The lacrymal sac
h The nasal duct continued from the lacrymal sac.

FIG. IV.

Longitudinal Section of the Left Eye and Orbit.

a The upper eye-lid shut
b The cornea
c c The cut edge of the iris
d The pupil

e e The cut edge of the sclerotic and choroid coats with the retina
f The crystalline lens
g g The ciliary processes continued from the choroid coat
h The optic nerve running in a waving direction to the ball of the eye
i The lavater palpebræ superioris
k The lavater oculi
l The depressor oculi
m A section of the obliquus inferior
n n A section of the blood vessels and nerves, with a large quantity of fat surrounding the optic nerve.

CHART *shewing the* NUMBER *of* DEATHS *arising in one Year from different Diseases, within the London Bills of Mortality during the Years* 1796, 97, 98, 99, *and* 1800, *on an Average.*

Connected with the history of man, it is curious to see at one glance the proportionate diseases which terminate human life in the British metropolis. The longest line is *consumption*, while no less than fifty-five generic diseases, of which there are numerous species, contribute to the destruction of our race. Of the average of life we have a melancholy exhibition in the fact that six times as many die under five years of age as exceed eighty. Taken altogether, the table is a moral lesson.

TATTOOED SOUTH-SEA ISLANDER.

Nothing connected with human practice and character can be more striking than the mode of ornamenting their skins, practised by many semi-barbarous tribes. It corresponds with the love of finery, showy colours, and extraneous ornaments, which is indulged in by the whole human race. The historian and antiquary cannot fail to be struck with the similarity in effect which exists between the decorations of the South Sea islanders and the armed warriors of antiquity. The process by which the effect is produced is tedious, laborious, and highly painful.

THE BEE AND ITS ECONOMY.

The history of these insects would fill many volumes: the accompanying engraving, however, exhibits a luminous view of the structure and economy of the bee.—*Fig.* 1, is the queen-bee. 2, The drone. 3, The working-bee. 4, Represents the bees hanging to each other by the feet, taking their repose. 5, The proboscis or trunk magnified, with which they gather the honey and take their nourishment. 6, One of the hind-legs of a working bee loaded with wax. 7, A comb, in which the working bees are bred: the cells are the smallest of any: a royal cell is suspended on one side. 8, A comb in which the drones are bred, being larger than the former; the young drones being included in several of them: with two royal cells suspended on the side. 9, A similar comb, in which the royal cell is fixed in the middle, and several common cells are sacrificed to serve as a basis and support to it: in general, the royal cells are suspended on the side of a comb, as in *fig.* 7, 8. At the side of *fig.* 9, two royal cells are begun; they resemble pretty much the cup in which an acorn lies: the other royal cells have the young queens included in them. *Fig.* 10, exhibits the sting and all its parts, magnified: the sting is composed of a sheath or case, and two shanks, united to each other, and terminating in a sharp point, so as to look like a single part: *b*, the poisonous bag; *c*, the tube that conveys the poison to the sting; *dd*, the two shanks of the sting; *ee*, the sheath of the sting; *ff*, the thickest end of the sheath, where the tube opens into it with the poison; *g*, the point of the sting; *h*, the beards or jags with which the sting is armed; *i*, the tube that secretes the poison; *kk*, extremity of the tube; *llll*, cartilages which are articulated with the shanks of the sting; *mm*, two other cartilages, less than the former; *nnn*, places where the foregoing cartilages are articulated; *oooo*, four muscles serving to move the sting different ways; *pp*, two muscles which draw the shanks of the sting into its sheath; *qq*, two appendages of the sting, which are moved along with it, and seem to answer no other purpose than that of ornament. *Fig.* 11, The ovary. 12, Six eggs drawn after nature, and placed on their ends. 13, An egg viewed with a microscope: it resembles the skin of a fish, divested of its scales, but still retaining the marks of their insertion. 14, Worms of bees, of different sizes, drawn after nature: *a*, a worm newly hatched; *b c d e*, four worms that have received more nourishment, and are more grown; *f g*, two worms still larger than the former, having had more nourishment provided for them: they are represented as they lie doubled in their cells; *h*, a worm placed in its belly, so as to show on its back a black line, which denotes the stomach; *i*, a worm lying on its back, beginning to draw in the hinder part of its body, and move its head. *Fig.* 15, A full-grown worm viewed with a microscope: *aa*, its fourteen annular incisions or divisions; *b*, the head and eyes, &c.; *ccc*, ten breathing holes. 16. The worm forming its web; *aa*, the sides of the cell that contain it; *b*, bottom of the cell; entrance or door of the cell: the worm is here represented as making its web to shut up this entrance. *Fig.* 17 A worm taken out of the web, and just ready to cast its skin. 18, A cell containing the worm changed into a nymph, and perfectly lined with the worm's web: likewise the web entire, with the nymph contained in it, as they appear on opening the cell; *aa*, the sides of the cell, lined with the worm's web; *b*, the mouth of the cell, closed by the web; *c*, the bottom of the cell; *d*, the web entire, as it appears on opening the cell, which it greatly resembles in form; *e*, the upper part of the web, of a convex form: this part shows its filaments pretty distinctly; *f*, the inclosed nymph appearing through the transparent sides of the web; *g*, the bottom of the web answering to that of the wax cell. *Fig.* 19, is a worm changed to a nymph, of its natural size and form, yet so as to exhibit its limbs, which are folded up in a curious manner. 20, The nymph of the bee viewed with the microscope, displaying all the parts of the inclosed insect, and the beautiful manner in which they are laid up: *a*, the head bloated with humours; *bb*, the eyes projecting considerably; *cc*, the horns, or antennæ; *d*, the lip; *ee*, the teeth, or jaw-bones; *ff*, the first pair of joints belonging to the proboscis; *h*, the proboscis itself; *ii*, the first pair of legs; *kk*, two transparent little parts, lying against the lowest joints of the first pair of legs; *ll*, the second pair of legs; *mm*, the wings; *nn*, the blade-bones; *oo*, the last pair of legs; *pp*, the abdominal rings; *q*, the hinder part of the body; *r*, two little parts accompanying the sting; *s*, the anus. *Fig.* 21. *a*, A cell full of bee-bread, placed in layers; *b*, little grains, of which the said substance, viewed with a microscope, appears to consist.

THE FALLOW-DEER.

Deer are now the only race of forest animals surviving in Britain. The fallow-deer, of which an engraving is given, are of a reddish brown colour, spotted with white, with noble branching antlers. The colour of the fallow-deer varies more than that of the stag, and its tail is longer; but, in other respects, the affinity is very close.

The young deer in his first year is called a *fawn;* in his second, a *pricket;* in his third a *sorel;* in his fourth, a *sore;* and in his fifth, a *buck.* The female in her first year is called a *fawn;* in her second, a *teg;* and afterwards a *doe.*

The varieties of this noble species now ornament the parks of our nobility and gentry.

THE BULL-DOG.

The bull-dog has altogether a fierce and unpleasing appearance; a large thick head, short nose, and the under jaw shorter than the upper. His courage in attacking the bull is well-known; his fury in seizing, and invincible obstinacy in maintaining his hold, are equally ferocious. This variety is almost peculiar to England: the genuine breed, however, is becoming scarce.

THE HEDGE-HOG.

This harmless creature is about a foot long. Its colour is a greyish brown: the head, back, and sides, are covered with sharp-pointed prickles. His body is an oblong mass, convex above, terminated on the fore-part by a very sharp muzzle, and mounted on four short legs, of which nothing appears but the feet. When disturbed, it rolls itself up in a globular form, and thus presents an invulnerable ball of prickles.

THE OTTER.

There are two species of this animal, the sea otter and the common otter, which latter is the kind represented in the engraving. It is about two feet long, and covered with fur of a deep brown colour. It frequents rivers and lakes containing fish, among which it is very voracious. Its habitation is very curious: the entrance is in a hole under the water, and it afterwards works upwards, nearly to the surface of the bank, forming several apartments, and making a very small orifice at the top for the admission of air, contriving that the hole shall be under a bush for concealment. They are capable of being tamed, will follow and seize fish for their master. When chased by dogs, they defend themselves with courage; and are particularly obnoxious to beavers, who drive them from their haunts.

THE FOX

Is at present the only predatory animal in Britain. He is, however, timid and shy, and his attacks are confined to the poultry in farm-yards. These larcenies are, however, punished by extermination wherever he is found: under pretence of avenging the public, but in reality for want of a more worthy employment, scores of men and dogs are engaged during a considerable part of their lives in hunting this puny animal. Many are even bred and kept for the purpose, and thereby occasions are created for this extraordinary pursuit.

The fox has a broad head, sharp snout, flat forehead, brilliant and expressive eyes, sharp erect ears, and bushy tail: his colour is a brownish red.

THE CUR-FOX.

The cur-fox is a variety of the common fox, described above. His habits and disposition for craft are the same.

THE CAT.

The cat has been too long under the protection of man to need any particular description.

HOGS.

A rude and brutal character proverbially attaches to the swinish tribe: their habits are gross; they are so voracious that they devour every thing indiscriminately. There are many varieties of this tribe, all very prolific; and they live from twenty to thirty years.

THE POLE-CAT.

The pole-cat commonly forms a subterraneous retreat beneath the roots of large trees. It preys on poultry and

small animals, and is a cruel enemy to rabbits. It is also fond of milk and honey, and will occasionally prey on fish. The smell of the pole-cat, like most of the weasel-tribe, is very offensive. The fur, however, is beautiful, and much sought for as an article of dress.

THE CLYDESDALE HORSE.

This race is strong, hardy, active, and calculated for hilly districts. They can live upon coarse food, and are well suited for the cart or plough.

The colour is brown or grey; the head and body light and well formed; and the height from fifteen to sixteen hands and a-half.

THE SUFFOLK-PUNCH.

The Suffolk-Punch Sorrels have large bodies, short legs, and ill-formed heads; yet, notwithstanding their awkward appearance, they exceed every other race for draught and agricultural purposes.

THE ASS.

The value of this ill-treated quadruped is overlooked in the superior qualities of the horse: in this country especially, he falls to the lot of the lowest hucksters. He is of an affectionate disposition; for, although so ill-used, yet he seems partial to his owner, scents him at a considerable distance, distinguishes him from others in a crowd, knows the road he has passed, and the place where he sojourns; and, when he is so fortunate as to meet with a humane master, he well repays his tenderness.

The ass, like the horse, is three or four years in growing, and lives also like him twenty-five or thirty years.

Extreme temperance, both in quantity and quality of provisions, is a striking feature in the character of the ass. He is satisfied with the most neglected weeds, making his humble repast on what the horse, cow, and sheep, refuse. He sleeps less than the horse, and his constitution is stronger.

THE SQUIRREL

Is remarkable for its vivacity, celerity of motion, and general beauty and neatness. It inhabits woods, and lives entirely on vegetables. It seldom descends from the trees, except during a storm, but continues leaping from one branch to another.

Though naturally wild and timid, the squirrel is soon reconciled to confinement, and becomes docile and frolicsome. The beauty of its form, the vivacity of its motions, and the various amusing tricks it acquires, render it a favorite with young persons.

THE BADGER.

This inoffensive animal is an object of the brutality of the lowest people, who glory in his helplessness, indulge their drunken propensities by digging into his retreats, and bait him to death with dogs not more brutal and ferocious than their masters.

THE SPANIEL.

Of all animals the dog is the only one which, leaving his fellows, cultivates the friendship of man. To man he looks, in all his necessities, with a speaking eye for aid; for him exerts all his best services with cheerfulness and pleasure, and bears famine and fatigue with patience and resignation; injuries cannot abate his fidelity; nor distress induce him to forsake his benefactor. Studious to please, and fearing to offend, he is a humble, stedfast, dependant; and, in him alone, fawning is not flattery.

The spaniel was originally a native of Spain, (whence its name,) but is now so completely naturalized, that it may be considered a British animal. Dogs of this kind vary in size.

When an eminent painter was desired to represent a poor man's funeral, he drew the bier without mourners; but, by a happy thought, represented his dog following the bier, with his ears pendant and his tail depressed,—a noble and expressive compliment to the fidelity of the canine race. On a field of battle dogs have been known to set by the side of their murdered masters for many days without food. It lately happened that two farmers were imprisoned in the Fleet, and, their dogs not being allowed to enter the prison, the faithful creatures remained at the door by night and day, the one for ten months and the other for nearly two years.

THE GREYHOUND.

The greyhound is the swiftest of the canine race; but, not possessing the faculty of scent, it follows only by the sight.

THE GOAT.

Goats are distinguished from sheep, not only by their hairy covering, which varies with climate; but also by their horns, which are hollow, annulated, and gently inclining backwards. It delights in climbing the ridges of houses and precipices; its hoofs, being hollow underneath and with sharp edges, render its footing secure on the steepest ridges. The milk of the goat is sweet and restorative, and well adapted to stomachs of weak digestive powers, and is therefore often found more salutary than any medicine in consumptive cases.

THE MULE.

This useful and hardy animal is the produce of the horse and the ass. No quadrupeds are so sure-footed or convenient for large burthens; hence, in Spain, among the Pyrennees and the Alps, its services are highly estimated, as it will tread with the utmost security where a horse can hardly stand. Their manner of descending the most frightful precipices is interesting. When they come to the edge of a deep declivity, they stop; then place their fore-feet in the posture as if to stop themselves; they next put their hind-feet together, a little forward, as if in the act of lying down; and in this attitude, having surveyed the road, they slide down with the swiftness of a meteor, following exactly the different windings of the road. Droves of mules are chiefly seen in Spain.

THE RACE-HORSE.

By judicious mixture and superior management, the English race-horse excels those of Europe, or, perhaps, the whole world. For supporting continued violent exertion they are superior to the Arabian, the Barb, or the Persian; and for swiftness they yield the palm to none.

Horse-racing is of considerable antiquity in this island, and may be traced as far back as the eleventh century, but was not regularly pursued till the accession of the House of Stuart. It became a royal fashionable amusement under Charles II. and has so continued to the present time.

THE CART-HORSE

Is remarkable for its beauty, symmetry of form, and large size, possessing superior strength of constitution, hardness, and bone. They come into use at two years old. The English breeds are equal to those of Flanders, and superior to those of other countries. London furnishes horses able to draw on level ground, for a short space, three tons.

THE RABBIT.

The rabbit much resembles the hare, but is considerably smaller, and its fore-feet are furnished with larger and sharper claws, enabling it to burrow in the ground, and to form convenient retreats for concealment by day; like the hare, it feeds chiefly by night or very early in the morning.

The rabbit lives eight or nine years, is a prolific animal, being known to breed seven times in a year, producing eight young ones each time.

THE HARE.

The hare is one of the most innocent and most timid of quadrupeds. It frequently keeps all day in its form, and only feeds by night. Its eyes are prominent, to see behind and before; and, if disturbed, it will fly at the slightest alarm, but, after various doublings, it will return to the place from whence it set out.

The fore-legs of the hare being the shortest, it always runs swifter up hill than on even ground; hence, when pursued, it generally takes to rising grounds. The voice of the hare is never heard, except when seized or wounded, when it much resembles the cry of an infant.

The hare is preyed upon by foxes, wolves, eagles, hawks, and kites; which, together with the more destructive pursuits of mankind, contribute to reduce the number; else, from their prolific nature, they would multiply excessively.

The fur is employed in the manufacture of hats; but its flesh is forbidden both by the Mosaical and Mahommedan laws.

THE COMMON MOUSE.

This active, but timid and cautious, creature, is entirely domesticated. Fearful by nature, but familiar from necessity, it attends on man; and, only in searching for its food, quits its retreat. It may be tamed to a certain degree by music, to which the race are singularly attached, but never entirely loses its timidity.

There are several varieties, distinguished by their colour; but the most rare and beautiful are the white with red eyes.

THE RAT.

Of the forty-one species which this genus of animals comprises, three are natives of Britain, viz. the black rat, the brown or Norway rat, and the water rat. Each species is very prolific, and all are distinguished by their voracity.

THE LONG-HORNED OX.

The long-horned or Lancashire breed is an original species, of high antiquity, still found in considerable, if not entire, purity of form. The species, with few exceptions, are too slow and sluggish for labour; which circumstance has induced many persons to form erroneous conclusions on the subject of ox-labour. But other advantages, which this breed evidently possess, concur to render it worthy the extensive introduction it has obtained. The peculiar rotundity

of form and richness of milk has long established their superior character as dairy stock.

CHEVIOT SHEEP.

Of domestic animals, none is so extensively beneficial to man as the sheep kind. Others may excel in strength, docility, and dignity; but the sheep supplies both food and clothing, and is indispensable to our comforts, almost to our existence. The wool of the sheep warms every class of people from the monarch to the beggar; it employs thousands in its manufacture, and whole fleets in its exportation.

The Cheviot breed derive their name from the Cheviot Hills in North Britain. Their legs and faces are white, have a fine open countenance, with lively prominent eyes, a long body, largest on the hinder quarters, the fore-quarters being narrow and low, fine small-boned legs, the wool partly fine and partly coarse, each fleece averaging about three pounds.

SHORT-HORNED BULL.

The short-horns are an original species, but it cannot now be ascertained whether they are aboriginal or were imported in very early times.

This breed has long been in possession of the northern counties, and is esteemed the largest in England.

GALLOWAY BULL.

These cattle are a very valuable breed: they generally weigh from forty to sixty stone. The most essential difference in this to every other breed is in being without horns; though some few have two little horns, from two to four inches long, hanging loose from the parts where the horns of other cattle grow, and joined to the head by loose skin and flesh.

THE AYRSHIRE COW.

This breed is a mixed race between the Kyloes or Highland-bred and the Galloway breed.

THE BEAVER.

The beaver is a native of the northern parts of Europe, Asia, and North America; abounding most in cold regions, and gradually less common towards the south. It is distinguished from every other quadruped by its tail, which is oval, nearly flat, but with a slight convexity upward, devoid of hair, and marked by scaly divisions: this he uses as a rudder to direct his course in the water; its general length being nearly one foot, and that of his body about three feet. The colour of the beaver is a deep chesnut, and its hair is very fine, smooth, and glossy.

The beaver possesses great natural sagacity in constructing its highly-finished and commodious habitation, preparing, in concert with others of its species, arched caverns or domes, supported by strong pillars, plastered internally with neatness and accuracy, excelling the art of any other quadruped.

BEAVERS IN COUNCIL.

In places much frequented by man, Beavers neither associate nor build habitations; but in the northern regions, in June or July, they assemble from all quarters, for the purpose of concerting their building operations. The place of rendezvous is always on the banks of water. In lakes they make no bank or dam, as the water seldom rises above its level; but, in rivers or brooks, where the water is subject to rise or fall, they construct a bank like a sluice, often from eighty to one hundred feet long, and ten or twelve broad; but its solidity is more astonishing than its magnitude.

They make choice of a shallow part of the river, and where a large tree is growing on its banks. This they cut down with their teeth, so that the tree shall fall into the water. They then cut off its branches to make the trunk lie level: in the mean time other beavers cut down smaller trees, which they drag to the margin of the river, and then convey them by water to the place where they are building: these they sink firmly down as piles, interweaving the branches with the stakes. When this is accomplished, they bring earth in quantities to fill up the intervals, which they plash with their feet, and beat firmly down with their tails. The stakes that oppose the stream slope upwards to sustain the pressure; but the opposite side is perpendicular. To allow the surface-water to escape, they make three or four sloping holes; and, when any breaches are made in their bank by sudden inundations, they repair them when the water subsides.

This great object being accomplished by the united force and dexterity of the whole community, they separate into smaller societies, and construct their dwelling-places, which consist of cabins of one, two, three, or four stories, according to their families; they are either round or oval, and vary in size from four to ten feet in diameter. The walls, which are about two feet thick, are neatly plastered both within and without with a kind of stucco, their tails serving for trowels, and their feet for plashing. The situation of these cities are always on the banks of water, and have two openings, the one on the land-side, and the other into the water. The avarice of man frequently breaks up these interesting communities.

THE MOLE.

The mole is well formed for its subterraneous mode of life. Its fore-feet are naked and very broad, having large palms like a hand, with five toes on each, terminated with strong nails. The hind feet are small, with five toes, and a small thumb on the inside. Its skin is thicker and tougher than other quadrupeds of its size, and the fur surpasses in fineness and softness. This animal is supposed to possess an exquisite power of hearing, though its eyes are scarcely perceptible. It feeds on worms, insects, roots of vegetables, &c. but, generally, it is carnivorous, and in particular circumstance, very fierce and voracious.

THE MOLE-CATCHER.

Moles destroy and render useless the grass of meadows, by raising innumerable hills to form their nests, and destroying the roots for a considerable extent around. It therefore becomes an object of consequence to grass-husbandry to exterminate them. The practice pursued by some is to spread out the mole-hills in the spring, but the usual method is to employ mole-catchers, an important class in rural economy, one of whom is represented in his characteristic costume.

THE SOUTH-DOWN BREED OF SHEEP

Is one of the old varieties of sheep in this island, and has from time immemorial possessed the Sussex Downs and Kentish Hills. Of late years, however, they have been introduced into most parts of Britain and Ireland. The wool is very short and fine, from two to three inches long. They are quick feeders, and of a hardy and vigorous constitution.

THE DISHLEY, OR NEW LEICESTER BREED.

These sheep are distinguished from other long-woolled breeds by their clean heads, fine lively eyes, straight and broad backs, round bodies, small bones, and thin pelts. Their peculiar advantages are, fineness and length of wool, well adapted for combing, averaging eight pounds per fleece, and the facility with which they grow fat.

THE SEAL.

The common seal, even when taken old, is capable of being domesticated. One caught on the Welch coast was sent to London by water. During the voyage it became so familiar with the man who had the care of it, as to suffer him to play with it like a dog, and would lick his hands and face with great affection; and such was its attachment to him, that having left it at its place of destination, it emitted a melancholy noise, evidently bemoaning his loss, and died with apparent grief in the ensuing week.

The usual length of the seal is from five to six feet; the body is closely covered with short hair of various colours, smooth and shining; its tongue is forked at the end; it has two canine teeth in each jaw, six cutting-teeth in the upper and four in the lower, and five toes on each foot, furnished with strong sharp claws, for climbing the rocks, on which it often basks, and where it has been often mistaken by the vulgar for the fabulous mermaid.

SEAL CATCHING.

The immense caverns on the coast of Caithness are much resorted to by seals. About midnight, hunters, with torches and bludgeons, enter the caverns. Having roused the flock, and suffered the larger ones to escape, they despatch most of the young seals by a slight blow on the nose, which immediately destroys them.

THE GUINEA-PIG.

The Guinea-pig is tamed with facility, is inoffensive, timorous, and particularly cleanly. Their food consists of all kinds of herbs, but particularly parsley, apples, and other fruit. In a domestic state, they are very restless, and make a continued noise, similar to the grunt of a young pig.

THE EAGLE.

The eagle is the noblest and most splendid of rapacious birds. Its native fierceness renders it impossible to tame it; and even when deprived of liberty, it must be confined with a chain, or it would be dangerous to those who approach it.

Of all birds the eagle flies the highest; whence the appellation and character of the "bird of heaven" and "messenger of Jove." His sight being most exquisite, he chases by the eye, and darts on his prey with irresistible and unerring aim; easily carrying off geese, lambs, and kids. It is a long-lived bird, and no less remarkable for its abstinence than for its longevity.

THE SPARROW-HAWK.

The sparrow-hawk possesses great intrepidity and saga-

city, and is very destructive among young poultry, from which it is not to be deterred even by the presence of man. His courage is so great that he will attack turkeys and even game-cocks.

It has a green cere on the bill, yellow feet, white belly, undulated with grey, and the tail marked with black hairs. The male is about twelve inches long, and the female fifteen.

THE OWL.

Owls, being nocturnal birds, pursue their prey only by night, which is principally small birds and quadrupeds; but they do not reject insects, when they cannot procure more desirable prey.

Destined to seek their food by night, their eyes are so constructed that they see more distinctly in the twilight than in the glare of day. If, therefore, they are accidentally dislodged, or tempted by famine to venture abroad by day, they appear dazzled and distracted. Its appearance by day is sufficient to set the whole grove in an uproar. Legions of little birds flock round it, and, taking advantage of its confusion, treat it with insult.

The head of the owl is round, somewhat like a cat, which animal it strongly resembles in its general modes of life; the bill is hooked, and covered at the base with bristles: the nostrils are oblong; the head, ears, and eyes, very large; and the tongue cleft.

THE HORNED OWL

Inhabits inaccessible rocks and desert places, and preys on hares and feathered game. The horned owl sees better during the day than almost any other of the tribe; the body, which in size equals some of the eagles, is of a tawny red colour, elegantly varied with lines and spots. The wings are long, but the tail is short, and marked with transverse dusky streaks, legs thick, covered to the very end of the toes with a close and full down of a light brown colour; claws great, much hooked, and dusky.

THE CUCKOO.

This singular bird, familiar in most countries, has obtained a name in all languages from the sound of its voice. It is a bird of passage, or at least it disappears early in the summer, and is seldom seen or heard till the middle of April. It is an elegant bird both in form and colours. The cuckoo seldom builds a nest of its own, but deposits its solitary egg in the nest of some other bird, generally the hedge-sparrow, by whom it is hatched. No sooner, however, does the young cuckoo acquire a little strength, than it clears the nest of its young companions, and becomes the whole charge of its foster-mother.

THE FALCON.

The falcon is a species of hawk, and, before the invention of fire-arms, was much used in field-sports, being the only means of taking birds under flight; for which purpose, they used to be trained with care, and kept at great expence.

THE HOOPOE.

This bird is easily distinguished by a beautiful, though enormous, tuft of variegated feathers on the crown of its head, which it can raise or depress at pleasure. The back and wings are crossed with broad bars of white and black, the neck is a pale reddish brown, and the breast and belly white. The hoopoe feeds on beetles and other insects, and makes its nest of dung in the hollow of trees, laying two ash-coloured eggs. It is a bird of passage. It hunts after its prey on the ground, and seldom remains long on the wing.

THE COMMON THRUSH.

The common thrush, or throstle, is the finest singing bird of its kind, not only for the sweetness and variety of its notes, but for the long continuance of its melody. In song it is the nearest rival to the nightingale. It delivers its music from the top of some high tree; but, to form its nest, descends to some low bush or thicket. The nest is made of earth, moss, and straw, and the inside is curiously plastered with clay. It lays five or six eggs, of a pale bluish green, marked with dusky spots.

THE BLACKBIRD.

This bird receives its name from the colour of its plumage; it possesses no small reputation as a songster, though its note is too loud for any place but the groves. Nevertheless, it is often tamed; and, from the faculty of its imitating sounds of musical instruments, it may be taught any tune which is not complicated.

THE BULL-FINCH.

This bird, when tamed, becomes docile; its notes are harsh, but is susceptible of improvement, and by a regular education it becomes a proficient in music. But it is not in docility only that these birds excel, for they are also susceptible of personal attachment to their keeper.

THE SPARROW.

Few birds are more execrated by the farmer than the sparrow, and none perhaps more unjustly. They consume a considerable quantity of grain and fruit; but a pair of them will destroy three thousand caterpillars in a week. Sparrows build their nests under the eaves of houses, or in holes of walls, and lay five or six eggs, reddish white and spotted brown. The affection of the parent-birds to their young is very interesting. They will follow them a considerable way if removed from their nest; and, if opportunity presents, will continue to supply them with food.

THE GOLDFINCH.

Of the finch kind, none are equal to the Goldfinch for beauty of plumage, elegance of form, and melody of voice. This bird would be more the object of admiration were it more uncommon. It is fond of orchards, and usually builds its nest in an apple or pear tree, and sometimes has two broods in a year.

THE CANARY.

This bird is a native of the Canary Islands, where it still abounds, but is never seen in the yellow colour for which it is remarkable in a state of domestication in Europe. The song of the Canary bird is made up of a combination of the notes of the Titlark and the Nightingale, and is very rich and copious.

THE LINNET.

In point of external beauty the Linnet bears no comparison to the Goldfinch or Canary, but it is highly valued for the sweetness of its notes.

THE SKY-LARK.

The sky-lark commonly forms its nest between two clods of earth, and lines it with dried grass and roots. In this she lays four or five eggs. Her maternal affection is extremely interesting, both to the eye and to the heart. When her young are callow, she may be seen fluttering over their heads almost perpendicularly, and by successive springs into the air, frequently hovering over its nest at a vast height without once losing sight of her brood. When it begins to rise, its notes are feeble and interrupted; but, as it ascends, they gradually swell to their full tone, and delight every ear. In descending to their nest, they are so politic as to reach the ground at some distance, and then run concealed in the grass.

THE NIGHTINGALE.

This feathered chorister, so happily described by Milton as most "musical, most melancholy," transcends every bird in the richness of its tones and the variety of its expression. They visit England in April, and add charms to the evening's walk in Kent, Surry, Sussex, and other counties south of the Thames; but are seldom heard to the north of that river. The beautiful melody with which they fill the groves and valleys, arises from the apparent desire of the cock-bird to amuse the hen while she is setting on her nest; the tones are so strong that they may be heard at the distance of a mile.

THE REDSTART.

This bird generally appears in the spring, and is so fond of retirement, that it takes up its abode mostly in woods. Its notes are soft and pleasing.

THE ROBIN.

The name of the robin is a synonyme with innocence and confidence. When snow precludes him from obtaining food, he throws himself on the charity of the merciless tyrant of the feathered race, tapping gently with his beak against a window. If kindly received, he repeats his visits till the snow has disappeared, when, scorning any longer to be a beggar, he provides for himself.

THE WREN.

Although this bird is the most diminutive of English birds, yet she claims respect for her rich plaintive notes, which continue throughout the year. Though so small, it is most elegant in its symmetry.

SPONGES.

Sponges, according to Dr. Peyssonel, are said to be productions and habitations of small worms, being the first approach towards the elegant corals; and the same kind of animal forms the four principal species of sponge—the tube sponge, the cordlike sponge, the digitated sponge, and the honeycomb sponge; the interstices and tubes of which are labyrinths filled with these insects, and whose juices make the sponge increase or grow, just as bees, wasps, and wood-lice, increase their nests and cells. But Mr. Ellis, of the Royal Society, is of opinion that the sponge itself

constitutes the animal, and that the insects found in them only make use of the sponge as retreats. He considers the sponge as the lowest appearance of animal life, and as the link which connects vegetable with animal, the holes being so many mouths receiving nourishment, and discharging excrements. He states that the holes contract and dilate themselves, and that no polype or minute animals appear at their mouths, as would be the case if the sponge were merely their habitation.

The left-hand figure in the engraving is the branched English sponge; on the surface of which are rows of small papillary holes, through which the animal receives its nourishment. The small figure is the downy branch Sussex sponge. The third figure is of a firm but elastic texture, full of holes guarded by minute spines, and brought from Norway. The right-hand specimen, also from Norway, is called the sea-fan sponge, and all its pores are surrounded with spiculæ.

MADAPORES.

Fig. 16. This substance is as hard as coral, but white and wrinkled. In its centre is a cylinder, often pierced by two or three holes, and from this cylinder are detached seventeen radiated divisions which run to the circumference, and these again are intersected by divisions, so that the whole plant is filled with cavities, as in Fig. 17, where a part of the bark is taken off to shew the internal construction. The branches, G, G, Fig. 16, are conical, and the basis of the cone is formed by the summit of the branches, E, E, and every one of the summits has wrinkles on its outside, and each wrinkle answers to a division within In every one of these divisions is found a polypus, magnified in fig. 18. Three different parts compose this wonderful little animal. The feet are arranged all round, and on the outside are seen ten cavities, in which are lodged the animal's heads, which have prickly rays, as in the centre, where it has a continual oscillatory motion from right to left. It is extremely tender, transparent, and beautifully coloured. The entire of these plants appear the progressive production of these small insects, which includes the various vermicular tubes found in the sea, as Madrepores, Millepores, Lithophytes, Corallines, and the various shell-fish which inhabit the sea without changing their place.

BRANCHED ASTERIAS, OR MEDUSEAN STAR-FISH.

The several varieties of these zoophytes are found in the British seas. They are covered with a coriaceous coat, with five or more segments running out from a central part, and furnished with numerous tentacula. The mouth is in the centre, armed with sharp teeth, which convey the food into the body, and from this mouth goes a separate canal through many of the rays. These rays the animal, in swimming, spreads like a net to their full length, and, when he perceives any prey within them, draws them in again; thus catching it with all the dexterity of a fisherman.

ANIMAL FLOWERS.

The actinia, or animal flower, sometimes called Urtica Merina, has its claws disposed in regular circles, as represented in one of the figures; it presents lively colours, like radiated flowers; the bodies are of various forms, and some are stiff, while others are fleshy. They alter their shape when they extend their claws in search of food, and they can shift their situation, though their movement is very slow. They are found on rocky coasts fixed to some solid substance by a broad base, like a sucker. They have only one opening at the top, and round this are placed rows of fleshy claws, and they can swallow muscles, crabs, &c. sucking out the fish, and ejecting the shells. Through this opening they produce perfect young ones, which as soon as they affix themselves, extend their claws in search of food.

THE RICINUS, OR CASTOR-OIL TREE.

This tree is also known by the name of *palma christi*. It grows to its full height in a single year, being from fifteen to twenty feet. It yields a yellow blossom, and produces triangular and prickly capsules, each containing three seeds, from which castor-oil is obtained, from expression or decoction, but the latter method produces the best oil. It is used in medicine as a mild purgative; but it answers exceeding well for burning and painting, for which latter purpose it is used in America.

BEATING PTINUS, OR THE DEATH-WATCH.

This small insect is remarkable for its structure, which is exhibited in a magnified form, as well as of the natural size; the male specimen having wings. Superstition has attached a ridiculous importance to the unexplained beatings of the forehead of the male insect, and hence its name. If faith of this kind is entertained, these noises may actually kill some hypochondriacs; but the original idea must have sprung from some of those coincidences which often deceive the unthinking. If the average of human life is taken at thirty-five years, in a family of seven, one death must take place every five years, and, in a family of fourteen, every two years and a half: hence, if these insects harbour in any house, their noises must necessarily precede some death, though they have no other connexion with the death than any other circumstance.

THE MEDUSA.

The body of this animal is gelatinous, and the mouth is in the centre of the under part of the body. Many species, on being handled, affect with a nettle-like burning, and excite a redness: hence they are called sea-nettles, or medusæ. Their varied figure renders it difficult to assign them any determinate one; yet they mostly resemble a truncated cone, whose base is applied to the rock to which they adhere. Their colours are whitish brown, red, or green; the mouth is very large, and, when opened, appears surrounded with filaments resembling the horns of snails; which, being disposed around in three rows, give the animal the appearance of a flower; and through every one the animal can squirt the sea-water. These animals swim in large companies in search of food, with their tentacula in continual motion. They vary in size, the largest being generally about eight inches in diameter; they extend their filaments, and quickly entangle any small animals that come within their reach.

BUTTERFLIES.

The beauties of this elegant part of the creation are well known, and few can contemplate them without astonishment. The caterpillar informs us how it prepares for the lethargic sleep, the transition to its metamorphosis; the chrysalis being at once the tomb of the caterpillar and the cradle of the butterfly. Within a silken cell, or under a transparent veil, is this great miracle of nature daily wrought. But minute descriptions of various species of butterflies are tedious and uninteresting. In the engravings are given seven different species, in their three different states of grub, chrysalis, and fly; an inspection of which will teach more than several pages of verbal description.

In truth, there are no less than 273 species distinguished by the colour of their wings. The genus is characterized by four wings, body hairy, and the antennæ thicker towards the extremity, terminated by a head; while the wings, when setting, are erect, and touch one another above the body. In general, two generations of these insects pass through their three stages of caterpillar, chrysalis, and butterfly, in a season, but one very small species through these states ten times in a year, making ten generations, which would create an enormous increase if not checked by other causes. Barbut has divided papilios into five sections: 1, the Equites, or riders; 2, Heliconians; 3, the Danai; 4, the Nymphals; and 5, the Plebeians.

The following varieties of butterflies have been found near Epping, a situation highly favourable, owing to its vicinity to an extensive forest; and probably, therefore, affording as great a variety as any single situation in England.

Papilio Antiopa, Camberwell beauty. Very rare.
P. Polyclora, elm tortoise-shell. Rare.
P. Urtica, common tortoise-shell. Very common.
P. Io, peacock. Common.
P. Atalanta, scarlet admirable. Common.
P. C. Album, coma. Rare.
P. Cardui, painted lady. This was not uncommon in the year 1818, but has not been seen since.
P. Adippe, violet silver-spot, fratillary. Rare.
P. Paphia, silver-streak, fratillary. Common.
P. Euphrosyne, April. Common.
P. Euphrasia, May.
P. Janira, male } Meadow-brown.
P. Jurtina, female } Very common.
P. Ægeria, wood-argus. Common.
P. Hyperantus, ringlet. Common.
P. Megæra, wall-argus. Common.
P. Tithones, great gate-keeper. Common.
P. Pamphilus, small. Common.
P. Galatea, marbled argus. Common.
P. Brassicæ, large garden, white. Very common.
P. Rapæ, small ditto.
P. Napi, green veined.
P. Sinapis, wood ditto. Common.
P. Cardamines, orange-lip. Common.
P. Rhamni, brimstone-yellow. Common.
P. Argiolus, wood-blue. Rare.
P. Icarus, common blue. Common.
P. Machaon, common swallow-tail. Rare.
P. Electra, clouded yellow. Very rare.
P. Tages, dingy skipper. Not uncommon.
P. Thaumos, small skipper. Common.
P. Sylvanus, large skipper.
P. Idas, brown-blue. Not uncommon.
P. Phleas, small copper. Common.
P. Belulæ, brown hair-streak. Rare.
P. Quercus, purple hair-streak. Rare.
P. Rubi, green hair-streak. Rare.
P. Malvæ, spotted skipper. Common.

THE BAT.

The bat's nocturnal flight, with its general appearance, excites the idea of something hideous and dismal; and the larger animals of this species, in India and Africa, correspond with the description of the ancient fabulous harpies. The two most common species of bat in this country are the

common and long-eared bat; the former of which, represented in this engraving, is about the size of a mouse, and the extent of the wings, fully expanded, about nine inches. It never ventures abroad by daylight, or in rainy weather; but, when winter sets in, it becomes torpid, and remains till the return of spring.

THE VAMPYRE, OR SPECTRE OF GUIANA,

Called also the Flying Dog of New Spain, is a bat of monstrous size, which sucks the blood of men and cattle while asleep. It usually attacks the victim at the feet, by sucking the blood through a small orifice scarcely discernible. They generally bite cattle in the ear, but always in places where the blood flows spontaneously.

THE FLY.

The genus Musca is distinguished by transparent and naked wings, and the not having the powder which distinguishes the wings of butterflies, nor the cases or covers which distinguishes the beetle tribe. The parts are the head, the body, and corcelet, to which the wings are affixed, and to which the head is joined; and is the strongest and thickest part of the insect. The *formica leo* and some water-insects turn into flies, which have double corcelets; and flies themselves are divided into two classes, one having two wings, and others having four. Some have a trunk, and others have a mouth, from which they receive nourishment.

THE MUSQUITOE.

The knat of hot climates, where they exist in numbers, which almost darken the air, and subsist on the blood and juices of animals, which they suck by means of a sharp proboscis, and render life almost insupportable by their incessant attacks. In the larva state they exist in stagnant waters, as will be seen by the engraving. They are small in bulk, but powerful in their united numbers.

PROGRESS OF VEGETATION AT DIFFERENT ELEVATIONS.

M. Humboldt, for the purpose of exemplifying the heights at which various trees and plants will not flourish, has prepared this representation of a mountain, on one side of which he has represented the decrease of vegetation in a picturesque manner, and on the other has expressed the names of the several plants and trees which will flourish at the respective heights. It is a study at once most curious and useful. We have endeavoured, as often as possible, to give the common names of the plants. It appears, by examination of this engraving, that every plant has a determinate planet; and, as the mountains of the torrid zone afford every variety of climate between their base and their summit, so they are capable of producing all the vegetables of every climate; but, as the temperature diminishes as the latitude increases, so, generally speaking, the productions, as we proceed from the tropics northward or southward, correspond with the elevation at which the same plants will grow upon a mountain within the tropics. Every plant requires other circumstances alike: a mean annual temperature, for example. The magnificent plantain and useful sugar-cane require a mean annual heat of 82° to 73°; but 73° of mean annual heat is not found beyond the 27° of latitude; consequently, the plantain and sugar-cane will not ripen in the open air in a higher latitude: and this M. Humboldt has found to correspond with the altitude of 1000 yards under the equator. In like manner, the cotton-plant will not flourish without 68° of heat, which is not found beyond 34°; which corresponds with about 1200 yards' elevation at the equator. The same reasoning applies to all other plants, with the exceptions arising from warm valleys, moisture of air, and richness of soil; and, as the engraving exhibits several hundred plants, it may be regarded as a philosophical map of the vegetable world.

The mountain may be considered as divided into ten regions, as follows:

1. Region of Lichens and Umbiliferia, from 15,500 to 17,000 feet.
2. Region of Grasses, from 13,500 to 15,500 feet.
   The highest limit of arborescent plants.
3. Region of Gentian, from 7000 to 13,500 feet.
4. Region of Wintera and Escallonia.
   Superior limit of the Cinchona, or bark-tree.
5. Region of Barnadesia and Duranta Ellisia.
   Highest limit of large trees, and the Mimosa.
6. Region of the Cinchona, from 3000 to 10,000 feet.
7. Region of the Date, Palm, and fine Gum Tree, from 6000 to 10,000 feet.
8. Region of Ferns and Trees, from 1500 to 5000 feet.
9. Region of Palms, from 0 to 3,500 feet.
   Inferior limit of the Cinchona.
10. Region of Subterraneous Plants.

THE BRAZILIAN FOREST.

We are indebted for this accurate representation of a tropical forest to Prince Maximilian. These forests do not consist, as in Europe, of separated trees intermingled with underwood; but Nature is here so luxuriant, that these eternal forests consist of solid masses of the largest trees, which can only be penetrated by cutting paths through them with immense labour. The trees consist of gigantic mangoes, palms, bignonia, the cocoa-palm, and other forest trees of colossal magnitude; and, where any space interposes, it is filled up with creeping plants, which render the whole a solin mass. The prince remarks that no European can form any conception of their grandeur, and that it is impossible to give an adequate description of them. Being thus inaccessible to the great enemy of the animated creation, every species of birds and variety of insects and creeping things live in undisturbed security. As an embellishment of the engraving, a party of persecuted Indians called Puris, to whom the woods also afford security in common with lower animals, are represented in one of their family peregrinations.

THE LINNÆAN SYSTEM DISPLAYED.

This plate represents twenty-four classes of plants according to the system of Linnæus, and, as the names of the several classes are expressed on the plate, no verbal description is necessary.

The ancients gave popular names to plants, founded on imaginary qualities, and affixed adjectives to distinguish varieties of the same kind; but, as these names were not connected with the substantive character of the plants, they served no purpose of identification, and hence Botany made little or no progress. To obviate this difficulty, botanists adopted various modes of classification, founded on external appearance, and not, as at first, on imaginary qualities. At length it was discovered, about the eighteenth century, that the parts of fructification were always permanent in the same plant. This natural character was therefore ingeniously seized on by Linnæus, as a means of disseminating and fixing the classes and orders of all plants, while other parts determined the genera, and differences of leaves the species. An inspection of the plate will illustrate the principle of Linnæus, as far as regards the classes and orders; and, with the aid of a microscope or magnifying glass, any person may extend these illustrations by observations in his own garden.

MRS. IBBETSON'S MICROSCOPICAL OBSERVATIONS ON THE STRUCTURE OF PLANTS.

Plate I.

Division 1. Dissection of an *Elm Leaf.*

Fig. 1. First cuticle.
—— 2. Third cuticle, the second being impervious.
—— 3. The veins of the leaf, containing the spiral wire, or muscles.
—— 4. The pabulum of the leaf.
—— 5. The under cuticle, with the bubbles.
—— 6. A section of the leaf shown in thickness, with its successive parts one above the other.

Division 2. Dissection of an *herbaceous Plant.*

Fig. 7. First cuticle.
—— 8. Third cuticle, the second being impervious.
—— 9. The pabulum.
—— 10. The veins of the leaf, containing the spiral wire, or muscles.
—— 11. Section of the leaf in thickness.
—— 12. The same leaf shrivelled.

Division 3. Dissection of a *young Grass Leaf shrivelled.*

Fig. 13. First cuticle.
—— 14. Third cuticle.
—— 15. Pabulum.
—— 16. Thickness of the leaf. The leaves of the crocus, snowdrop, &c. have a glutinous liquor in their pabulum, which protects them from early frosts, with three cuticles above, and three below.

Division 4. Dissection of a *Leaf of an Evergreen.*

Fig. 17. First cuticle; whose shining appearance is caused by glutinous matter, which fills up the net-work of the exterior, and renders it lucid.
—— 18. Third cuticle: there are five upper and three under cuticles; and, in scented leaves, the second cuticle contains bladders of an oily compound.
—— 19. Pabulum.
—— 20. Veins and spirals.
—— 21. Sections of the leaf in thickness.

Fig. 22. The upper cuticle of a *Rock Plant;* this plant has not any impervious cuticle, but has millions of mouths in every leaf to receive moisture.
—— 23. The swellings in the upper cuticle of a rock plant.
—— 24. The holes or apertures which open into the swellings.
—— 25. One of the hairs on the leaf of a rock plant, showing its connexion with the three cuticles, through which it pierces to the pabulum. Young leaves have more hairs than old ones, but all are loaded with hairs, and often covered with a sort of net.
—— 26. Represents the edge of a young leaf, with its projecting hairs to increase the collection of moisture.
—— 27. Represents the edge of an old leaf, containing great additional appendages for the purpose of collecting moisture.
—— 28. Represents the edge of a young leaf, with all its ap-

pendages of hairs, &c. highly magnified, and forming a most extraordinary spectacle.

Figs. 29 and 30. *The formation of Pollen in Dioecious Trees.* The pollen is always formed in the top root, AA*a*, (the anthers and filaments are not produced till formed by the buds at the top of the plant,) when the anthers begin to form in the male bud. Fig. 30, the entering of the pollen into them is most evident, (B,) as they are then so stuffed, and filled to bursting, as to form a curious moving specimen for many minutes. Then the filaments are formed, and shoot forth from the male bud, to carry the anthers and pollen into the air, where they swing for some hours. Thus they absorb a quantity of gas by their motion, and soon become ripe; and, when the pistil indicates readiness to complete the seed, by the swelling of the bubble of liquid at the summit, the pollen again leaves the anthers, and flies to that nectarious drop, which attracts it to the pistil, remains fastened to the hairs to which the balls adhere; and are soon dissolved by the juices of the pistil, down which it runs in various gutters, till it has reached the seeds, which it enters mixed with the juice, and thus fructifies them.

The balls of the pollen are generally large, and run up the pith in different short vessels. Fig. 29, AA*a*, are all the same in their flowering; two stamens alone appear out of the bud; the others pass from the male bud to the female, and fructify all the seed. 4, is the nectary of the male bud of the willow; 3* of the female. The male is led up the spiral wire, the female by the alburnum; and so invariable is this law, that it passes through every class of plants.

Fig. 31, represents the stem of the tree, with the pollen ascending.

Fig. 32. *The Root of the Anther.* The threads which shoot from the anther after that it is filled with pollen, must be perfectly hollow the whole way; for so entirely does every ingredient, every nutriment, proceed from the root, that all must have free access to that part which appertains to it, and is intended to rise to the flower and the pistil. The anthers are little bags of exquisite workmanship, each sack divided into two or four partitions, always well filled by the pollen. They are highly curious, and the more they are magnified the more beautiful they appear.

Fig. 33. *Oblong Pollen.* The pollen, though it appears small, is not so in dioecious trees; and, though they seem like balls, yet, examined by the microscope, they differ in shape, some round, some square, triangular, oblong; and are equally various in colour, white, purple, blue, and red; but most pollen belonging to the same genera have the same form and shape,—an easy way of discovering the class of the flower. They have invariably two separate parts, and two different liquids: the outward part, as in fig. 33, is formed of a slight cuticle, sometimes crossed, or with circular apertures, which show the dark parts within, and which often exhibit vessels shooting from the exterior ball, and ejecting oil.

Figs. 34 and 35 represent views of the *Single Anemone*, to show how those sprigs found scattered in every part of the interior of the plant are also to be discovered in the corolla: in some they may be seen through the light, with a double microscope; in others, it is only by stripping off the upper cuticle. The cylinder to which the stamens are fastened passes between the numerous pistils and corollas: this shows that each ingredient, stamens, pistils, and corollas, have the same sort of cylinder in all flowers; but in the compound the cylinders pass, as in this, as low as *a*, *a*, *a*, where the mechanism *b*, *b*, is discovered in the plant, and where the different ingredients ascend.

Fig. 36, is a section of the same flower, but cut crossways.

Fig. 37, shows the instrument, or hair-like figure, in the *Sweet-Pea.* Hairs are not designed for absorption only, or one sort or form would have sufficed; whereas each vegetable has many different shaped figures, with valves and various species of curious mechanism. The sorts in the sweet-pea are, two in the *œnothera;* three in the *white antirrhinum;* three in the *lamium album;* and also one, admirable for its mechanism, nearly the same as in the nettle, but without its poisonous juices. The hairs change the colour of their juices, after entering a vapour, or sort of cloud, which becomes secreted between the valves; they afterwards admit another juice, and these coming in contact mix, explode, and produce the alteration required.

Figs. 38 and 39. Section of the leaf of the *Water Lily.* The first kind swim on the water. A double layer of air-vessels, and covered by an impervious skin, forms its surface in contact with the water; whilst the upper surface has a treble net, covered by a double skin, also impervious. The other leaf, fig. 39, is very different: when the corolla has fallen, and the seeds have dropped, the pericarpium decays, and a new germ, to contain the next year's fruit and flower, peeps above the mud, wholly covered with water, surrounded with very peculiar leaves, scalloped at the edges: they press the bud in every other part; the apex of the midrib just keeps above the water, by a large air-bubble, and by being full of air-vessels. There are none under the leaf, and few in the leaf-stalk; but the large opening for air between the skins of the leaf, at the top scallop, keeps it constantly upright.

Plate II.

Figs. 1 and 2 represent the *buds of the Alburnum*, as cut down with a sharp knife longitudinally, after a fortnight's formation of the bud. It exhibits a most beautiful representation of the nascent flowers, which are all arranged in regular order, previously to their bursting forth in bouquets, baskets, cornucopia, &c.

Fig. 3 is the perpendicular section of the same young tree: *a*, *a*, are parts whence flower-buds may flow through the wood, preceded by a juice; *e*, *e*, is the pith, the line of life being on each side; from which line flow the flower-buds, *d*, *d*.

Fig. 4 represents a horizontal section of a young tree, with buds, both old and young, running from the centre to the circumference, *a* to *b*.

Fig. 5 discloses the formation of *flower-buds* at the exterior of the wood, as at *d*, *d*, of the natural size.

Fig. 6 represents the same young buds highly magnified, which have not yet reached, but are approaching, the bark at *b*, *b*. At *a*, *a*, the aperture for the bud is seen to pierce the whole way to the line of life next the pith.

Fig. 7 represents a perpendicular section of the *common Furze*, when the buds are passing up the wood at *a*, *a*.

Fig. 8. This beautiful exemplification of *the progress of Germination* shows the manner in which the seed is filled up by the atmosphere, and afterwards by the earth. The atmospheric juices fill the bag more than one-third before the vessels from the root operate through the pith; the heart, *a*, enters the bag of the seed, and, as soon as it is fastened, a wonderful mechanism takes place to appropriate the atmospheric nutriment, which is effected by a feather arising from the stigma: the pollen spreads all over this feather, and, dissolving in the juice, it there encounters and runs down the feather, to impregnate the seed. This feather consists of a most extraordinary mechanism of small vessels, like pitchers, fixed along its branches, as is represented more at large in fig. 9; and the construction of which cannot fail to excite the highest admiration. When the impregnation is completed, the feather cleanses itself from the pollen, and the pitchers are empty to receive the atmospheric moisture, by which the bag of the seed is filled; the hairs, *b*, *b*, contribute at the same time to the same purpose, both supplying nutriment to the bag, *c*, *c*; but the liquid from the feather is thicker than that secreted by the hairs. This beautiful apparatus then decays, and the nutriment from the earth rises through *d*, *d*, *d*.—The first process appears to resemble the temporary sustenance of the fœtus of an animal.

Fig. 10. These represent a specimen of the *Gourd* cut horizontally, showing the different seed-vessels half filled by the atmosphere, and beginning to receive nourishment from the earth. The process is the same as in wheat: the vessels, *f*, *f*, contain the heart of the seed, *a*, *a*; and the powder nutriment is shown at *g*, *g*, *g*, pouring into the bottom seed-bag.

Formation of the Seed in its regular Progress.

Fig. 11. Natural size of the radicle.

—— 12. The same magnified.

—— 13. The vessels running through the root centered in the alburnum vessels, and proceeding up to the different buds, but not entering them; the buds are then seen to forsake them, and to pass up into the new shoot, just formed, by stalks growing under each bud, as in fig. 14; and then running up to their proper places in the new shoot.

Figs. 15 and 16. These represent the new shoot, round which the buds have arranged themselves; and the vessels formed to convey the balls from bud to bud, dropping so many at each perricarp, which then closes on them; while the collection from which they run at L, L, decreases hourly, till it is all exhausted. The seeds may be seen for the next hour to move into the different pericarps up the stem of the flower, at fig. 16, drawn in by the line of life at O, O, O; then those balls become fructified, which had moved from the root upwards, and the embryo grows in the ball.

Fig. 17. The seed, with its heart reaching from Z to W.

Figs. 18 and 19 disclose the manner in which the sap-vessels appear when the specimens are cut horizontally and perpendicularly; the hollow of the vacancies in which the sap runs at B, B, B; and the manner the spiral is carried round at D, D, D.

Plate III.

Fig. 1. *Fresh-grown Radicle of the Iris.*

When the seed is first formed in the extremity of the radicle, it soon (from powder) changes to balls, tied together by a line of life: the collecting of this powder, and the action of the line, is probably the first cause of its aggregating. The flowers then, which had spread from the first old seed, run down into the thread roots, and enter the radicle just where it is fastened to the root; and there each heart of the seed takes in its germ and female. AA, a fresh-grown radicle of the iris, where the powder first forms into seeds, of a pink colour, and easily distinguished. BB, where the powder forms into balls, still coloured. CC, where the female or flower first enters the radicle from the root and old seed, and, breaking off into shoots or separate germs, are drawn within the seeds. DD, a part where the pollen appears collected. The ball, when first formed at AA, consists of the heart of the seed only, an empty bladder, with a shoot below it: the vacuum is the part of the corculum first filled up, when the heart is fructified and brought from the root. When the seed is once fixed in the earth, it serves as a basis for the stripes of flowers in the wood, and as a commencement of those which entered the radicle. But, when the new-formed seeds are thus finished, they rise from the root, and pass through the alburnum; then

the flowers of the preceding year enter the flower-bud. The festoons and bouquets are alone forward enough to complete themselves, and rise up by the simple growth of their several peduncles, and burst into light and beauty. No tree, therefore, could flower the first year; and, in annual and herbaceous plants, seasons must stand in lieu of years.

DD has the appearance of pullen between the seeds, exactly like that which shows itself in the alburnum.

Fig. 2. The seed of the *Melon* just after fructification.

—— 3. A diminutive specimen of the part of the *Bean* surrounding the embryo.

Fig. 4. The seed of the *Buck-wheat*, and the embryo spreading around.

Fig. 5. The interior of a *Pea* before fructification.

—— 6. Specimens of the *heart of the Fir-seed*, now round, though afterwards a long oval, taken while in the root, before they enter the alburnum. They may be compared with the seed when it is first discovered in the seed-vessel, and afford proof that it was the seed in the root, since the same shoot may be discovered in both.

Fig. 7. *Heart of the Seed of the Fir* when divided, throwing out its germ or flower.

All these have the same regular process. The heart of the seed mounts with its germ from the root into the seed-vessel, and proves itself the seed, not only by its whole progress to fructification, but by having the same germ in the heart which it afterwards displays in the fructification: and thus not only the embryo, but the female flower, is also fitted for its increase, and fixes, by the various germs in the seed, the beginning stripe for each line in the wood. The flower, therefore, is continued from plant to plant, while the male is renewed and reproduced yearly in every tree.

FOURTEEN REPRESENTATIONS OF PRINCIPAL VARIETIES OF BRITISH FOREST TREES.

It may be proper to explain that these trees have been copied from a series of remarkable engravings published a few years since by an ingenious artist of the name of Coussens, and which have for some years been very scarce. They pourtray in the most effective manner the vertical section or physiognomy of the whole tree, and convey more accurate notions than if an attempt had been made to delineate the several leaves, in the usual manner; because in the present size, however laboured might have been the engraving, an accurate discrimination of the forms of the leaves could not have been made.

THE DATE TREE.

The method of cultivating this useful tree in Barbary, and the different uses to which it is applied, are thus described by Desfontaines: "All that part of the Sahara which is near Mount Atlas, and the only part of this vast desert which is inhabited, produces very little corn. The date-tree, however, supplies the deficiency of the corn, and furnishes subsistence. Forests of them may be seen here and there, some of which are several leagues in circumference. All these forests are intermingled with orange, almond, pomegranate, and especially vine trees; which last twist round the trunks of the dates, and thus ripen their fruits by the heat of the climate, though they are never exposed to the sun. But it is not the fruit alone which renders the date so precious among the inhabitants of the East; since there is scarcely any part of the tree which is not useful. The wood, though of a spongy texture, lasts such a number of years, that the inhabitants of the country say it is incorruptible. The substance which is found in the centre of the young date-trees is very nourishing, and has a sweet taste. The Arabs, who strip the bark and fibrous part off the tree, in order to obtain this food, call it the marrow of the date.

THE ALOE IN BLOSSOM.

As aloes seldom flower in our climate, an aloe in blossom is a curiosity; but it is a vulgar error that it blows but once in a hundred years, for in warm climates they flower much more frequently; but it is not merely the rarity which renders the blowing of an aloe an object of interest, for at that time it is one of the most elegant and stately objects in nature. The species in question is not the same as the medicinal aloe, which grows in eastern countries; whereas the aloe represented is a native of America.

THE COCOA NUT.

This famous tree flourishes in Asia, Africa, and America: it grows straight to the height of sixty feet, and there presents a bunch of ten or twelve leaves three or four yards long. Under the bunch of leaves issues a sheath, from which grows a panicle covered with yellow flowers, yielding cocoa-nuts. These, as is well known, afford food, oil, and milk. It produces fruit three or four times in the year; and, if the sheath be cut off, sweet and agreeable flavoured liquor flows from the wound, called toddy, a cooling liquor, but which after fermentation becomes intoxicating. Every part of this tree is rendered useful: it makes cloth, ropes, timber, and roofs for the houses. The cocoa-nut is the principal ornament of tropical scenery; but in America it is eclipsed in size by the less useful cabbage-tree, which grows to triple its height, and is the sovereign of the forest.

THE PALM TREE.

The Palm tribe are the glory of the forest. The species represented is called the Borassus, or Fan-leaved Palm; and flourishes throughout India, growing to the height of thirty feet. It surpasses other vegetables in the various uses to which it is applied: it furnishes articles of the most dissimilar nature—wine, oil, wax, flour, sugar, and salt. It generally blossoms in January and February, though some flower at other seasons: its fecundity is astonishing, not only in umbrageous foliage, with which men thatch their houses, but also in the multitude of its flowers and fruit. The leaves, produced every spring, originate always from the summit, the older ones standing below, the others gradually drying up, and leaving circular impressions, which mark the age of the tree. A considerable part of the inhabitants of Egypt, Arabia, and Persia, subsist almost entirely upon its fruit. Their camels feed upon the date-stones, while from the leaves they make couches, baskets, bags, mats, and brushes; from the branches, cages for their poultry and fences for their gardens; from the fibres of the boughs, thread, ropes, and rigging; and from the sap a spirituous liquor.

A beautiful species of this tribe grows in the West Indies, and with the leaves the houses are thatched; and these leaves, before they are expanded, are cut and made into women's plaited hats, and the berries are used for buttons.

THE LEMON TREE

Has an upright smooth trunk, divided upward into a branchy regular head, from twelve to fifteen feet high; large, oval, spear-shaped, pointed, slightly sawed leaves; and many flowers from the sides of the branches, succeeded by oval fruit, prominent at the top.

ORANGE TREE.

The orange, like the lemon, is of the genus *citrus*, of the order *polydelphia*, and classed *icosandria*. It is a dwarf, running in its different varieties from three to twelve feet high; and of such longevity, that some of those which grow in the gardens of the Tuileries at Paris were brought there in the time of Francis the First. In warm climates, where they flourish, there are as many varieties as of our common fruit-trees: the chief are the Seville, which produces an acid fruit; and the others, or sweet-fruited kinds, are the China, the great Shaddock, the Forbidden-fruit, the horned Orange, the Hermaphrodite, and the Dwarf.

SUGAR CANES.

There are three species of sugar-cane, which may be distinguished by the colour of the leaves; namely, the ancient Creole sugar-cane, the Otaheite cane, and the Batavia cane. The first has a leaf a deeper green, the stem less thick, and the knots nearer together.

The second is of a lighter green; and its stem is higher, thicker, and more succulent. The whole plant displays a more luxuriant vegetation.

The third species, the violet sugar-cane, called Cana de Batavia, is indigenous in the island of Java. Its foliage is purple, and it is preferred in Caracas for rum.

We have given two species,—the East India, or Batavian, with violet bark; and the common West India cane, both drawn after nature, and never before published.

COFFEE TREE.

The coffee, like the tea tree, is celebrated among all civilized nations for the refreshing drink made from its berries. It acquired its fame in Ethiopia, and is still cultivated and prepared in Arabia in the most delicate manner. It was afterwards transplanted to the West Indies, where it has become an article of immense commerce; but, from not being prepared with the same care as in Arabia, is much less esteemed than that which is brought from Arabia and the Levant. The specimen in the engraving represents a branch of the tree with its berries and flowers. The figure *a* represents the flower in detail; *b* the parts of fructification; *c* the entire berry; *d* its interior; *e* the kernel, with part of the rind taken off; *f*, *g*, and *h*, parts of the kernel. The natural height of the tree is from fifteen to eighteen feet; and, if left to itself, it would have the form of most other trees, i. e. a naked trunk and a branchy head. This is prevented by the top of the tree being cut off when it has arrived at its desired height.

TEA TREE.

This specimen will be viewed with interest, as its leaves furnish our most common beverage. It is little creditable to the policy of Europeans, that its cultivation was confined to certain provinces of China till after the commencement of the present century. Since that time, the Portuguese, with

laudable spirit, have transported numerous plants to the Brazils, and with the aid of some native Chinese have cultivated it with considerable success; but not in sufficient quantities to render it an article of commerce. The plant grows five or six feet high, and sometimes ten or twelve. The leaves are about an inch and a half long, narrow, indented, and tapering to a point, like those of the sweet-brier, and of a dark green colour. The root is like that of the peach-tree, and its flowers resemble those of the white rose. The stem spreads into many irregular branches; the wood is hard, of a whitish green colour, and the bark is green, with a bitter, nauseous, and astringent taste. The fruit is small, and contains several round blackish seeds, about the size of a bean: the plant is propagated by these seeds, which, being planted, grow without any care. The finest tea-plant known in England was raised in Kew Gardens; but the first that ever flourished in Europe belonged to the Duke of Northumberland, at Sion-House, from a drawing of which the engraving is copied.

The use of tea was first introduced into England in the reign of Charles II. and is now so general, that upwards of 25,000,000lbs. are annually consumed in the British dominions.

TOBACCO.

The two varieties of this plant, cultivated for common use, are distinguished by the names of Oronokoo and sweet-scented Tobacco; the leaves of the former being larger and narrower than the latter. They are tall herbaceous plants, growing erect, with fine foliage, and rising with a strong stem four to six feet high. The leaves are of a deep green, and grow alternately at two or three inches distance: they are oblong, spear-shaped, oval, and simple; the largest about twenty inches long, but decreasing as they ascend. The stem and branches are terminated by large bunches of flowers, collected into clusters of a delicate red. It is cultivated with success in the Netherlands and other European countries; but has been discouraged in England by the colonial policy of the government.

COTTON TREE.

Commerce and manufactures have within the last fifty years rendered this the most important tree in the whole vegetable kingdom. There are several species. The common Levant cotton, which is cultivated in several islands of the Archipelago, in six months becomes as large as an European quince. In China is cultivated that particular species which produces the cloth usually called nankeens in Europe. The Barbadoes Cotton-tree, with a stem from six to fifteen feet in height, is the species which is so much cultivated in the West Indies, and forms the chief branch of their exports. All the species of cotton are very tender, and will not grow in the open air in England. It is propagated in the West Indies, by seed, which is set in rows, about five feet asunder. The Indians use the leaves for cooling and healing wounds; the tree bears rich sulphur-coloured flowers, which are very large and beautiful. After the flowers, a head of seed follows, which, when it comes to maturity, bursts open, scatters the seeds, and discovers the white cotton.

FIG TREE.

This tree, now so well known in our English gardens, produces the figs of commerce on the shores and in the islands of the Mediterranean. It is little creditable to the horticulturist of France and England that it has not been more generally cultivated in both countries, as a single tree at a village near Worthing has for many years yielded its owner upwards of £25 per annum in the sale of its fruit. The first fig-trees introduced into England are those in the archbishop's garden at Lambeth. These trees are of the white Marseilles kind, and still bear delicious fruit. They are said to have been planted by Cardinal Pole, in the reign of Henry VIII. At Mitcham, is likewise a specimen of the same kind, which is asserted to have been planted by Cranmer. In a garden at Winchester, there was, in 1757, a fig-tree, whose fruit was of the small red sort; and on the stone wall to which the tree was nailed, was an inscription denoting that James I. partook of the fruit in 1623. At Oxford is a fig-tree, planted by Dr. Pocock in 1648. The trunk is perforated by insects, and much damaged, but the branches make vigorous shoots, and produce a great number of figs.

THE BANIAN TREE.

The Banian, or Bhurr-tree, is considered as one of the most curious and beautiful of Nature's productions in the genial climate of India. Each tree is in itself a grove, and some of them are of an amazing size, as they are continually increasing; and, contrary to most other animal and vegetable productions, seem to be exempted from decay; for every branch from the main body throws out its own roots, at first in small tender fibres, several yards from the ground, which continually grow thicker, until, by a gradual descent, they reach the surface; where, striking into the ground, they increase to a large trunk, and become a parent tree, throwing out new branches from the top. These in time suspend their roots, and, receiving nourishment from the earth, swell into trunks, which shoot forth other branches: thus continuing in a state of progression so long as the first parent of them all supplies her sustenance. A banian-tree with many trunks forms the most beautiful walks, vistas, and cool recesses, that can be imagined. The leaves are large, soft, and of a lively green; the fruit is a small fig, when ripe of a bright scarlet.

THE CLOVE-TREE.

The Clove-tree rises to the height of a common apple-tree; the leaves are like those of the bay-tree; the flowers are produced in loose bunches at the ends of the branches; are small, white, and have a great number of stamens, which are much longer than the petals. The flowers are succeeded by oval berries, which are crowned with the calyx, divided into four parts, and spreading flat on the top of the fruit. The young fruit, beaten from the trees before they are half grown, are the cloves used in Europe.

THE NUTMEG-TREE.

Fig. *a*, represents a sprig, with fructification. The drupa of the natural size, and bursting open.
Fig. *b*, the full-grown fruit cut lengthwise.
Fig. *c*, another section of the same.
Fig. *d*, the nutmeg enveloped with its covering, the mace.
Fig. *e*, the fatty membrane, or mace spread out.
Fig. *f*, the nutmeg of its natural size.
Fig. *g*, the same with its external tegument removed at one end.
Fig. *h*, The same with its outer tegument entirely removed.
Fig. *i*, a transverse section of the entire nutmeg.

Nutmegs flourish in a small group of islands in the Eastern Archipelago, known by the names of Banda, Terrate, and Amboyna; but, when these islands lately were held by the English, they conveyed plants to several English settlements, where they succeed. The tree grows thirty feet high, producing numerous branches; and there are three varieties,—the Male, or barren; the Royal; and the Queen. The royal produces the largest nut. The internal rind affords the delicate spice called mace; and such is the high price of these productions, that this tree may be considered the most valuable that grows. The internal fruit is about the size of a peach, and consists of the external covering, which is smooth, fleshy, and bitter. When the fruit ripens, this bursts, and discloses the mace; and within the mace is enclosed the nut. The fruit is gathered three times a-year; and, when the mace and nut have been dried in the sun, the nutmeg is steeped in lime-water and the mace in salt-water, to protect them from insects.

THE CINNAMON.

The *cinnamon* is a species of the *laurus*, of the *monogynia* order, and the *enneandria* class, and a native of Ceylon. It grows twenty or thirty feet high, and its bark at first is green, and afterwards red. The well-known spice is the under bark. This is separated in the spring, cut into thin slices, and on exposing to the sun curls up in drying. Trees about three or four years old yield in perfection. The trunk, when stripped, dies; but the root continues to throw up fresh shoots. The seed of this tree, when boiled, yields an oil, which swims at the top, and, when left to cool, hardens, and serves to make aromatic candles.

PIMENTO, OR JAMAICA PEPPER.

This plant is indigenous in Jamaica, and all attempts to propagate it, either by young plants or from seed, have proved abortive,—it must grow spontaneously. Soon after the trees are in blossom, the berries are fit to gather, the fruit not being suffered to ripen on the trees, as the pulp, being moist and glutinous, is difficult to cure, and, when dry, becomes black and tasteless.

THE BREAD-FRUIT TREE.

The Bread-fruit Tree is the size of a middling oak: its oblong leaves are frequently eighteen inches long, deeply situated, and like those of the fig-tree in colour. The fruit is the size and shape of a child's head; and the surface reticulative, not unlike a truffle; it is covered with a thin skin, and has a core as large as the handle of a small knife. The eatable part lies between the skin and the core, is as white as snow, and of the consistence of new bread; it is divided into three or four parts, and roasted before it is eaten: its taste is insipid, with a slight sweetness resembling that of the crumb of wheaten bread, mixed with a Jerusalem artichoke. It has been transported from the islands of the Pacific to the West Indies, but is not fancied.

THE PLANTAIN-TREE

Is cultivated in all the islands of the West Indies, where the fruit serves the Indians for bread. It rises with a soft stalk, fifteen or twenty feet high. The leaves are often eight feet long, and from two to eight feet broad. The flowers blow in bunches, each of which is covered with a sheath of a fine purple colour, which drops off when the flowers open. The fruit, or plantains, are about a foot long, and from one to two inches in diameter: it is at first green, but, when ripe, of a

pale yellow colour. The skin is tough; and within is a soft pulp, of a luscious sweet flavour. The spikes of fruit are often so large as to weigh upwards of forty pounds.

THE BANANA

Differs from the plantain in having its stalks marked with dark purple stripes or spots. The fruit is shorter, straighter, and rounder: the pulp is softer, and of a more luscious taste. The fruit of the banana is four or five inches long, of the shape and size of a cucumber; the leaves are two yards long, and a foot broad in the middle; they join to the top of the body of the tree, and frequently contain in their cavities a great quantity of water, which runs out, upon a small incision being made in the tree, at the junction of the leaves. This tree is perennial, and dies to the ground every autumn. As the fruit, when cut transversely, exhibits the figure of a cross, it is considered as forbidden by many superstitious Catholics.

THE MANGROVE.

This tree forms impenetrable forests on the banks of the rivers of Africa, and in many parts of Asia, chiefly near the sea,— the salt-water tide being apparently necessary to its duration. It is covered with extended branches and with large shining leaves. Like the banian-tree, it sends down shoots, which take root and form so many stems as to be impenetrable. The seed of this tree actually germinates before it falls from the tree, and the radical grows in that state a foot long; and the heavy part of the seed being on the opposite side of the radical, they always fall so as to stand erect. Oysters attach themselves to the roots, so that when the tide retreats oysters may be gathered like fruit from the branches of the roots, two or three yards high; a circumstance which has given rise to many marvellous relations.

THE RHUBARB.

This plant, whose root is so salutary to the human stomach, grows in several varieties, one of which is known to our English gardens, and yields us excellent spring pies for the table; and the root, properly prepared, is said to be of excellent medicinal quality; but the rhubarb of the shops is the Tartarian species, which grows with a stem six feet high. In Montgalia, the Tartars dig up the roots, and cut the large ones into pieces, to dry them more readily; while in the middle of each they scoop a hole, through which they pass a cord, to suspend them in their tents, or about the horns of their sheep, to dry.

PAPYRUS.

This beautiful engraving exhibits several specimens of the papyrus plant as it grows in marshy situations on or near the Nile. It is an object of curiosity, as having furnished the paper on which the ancients wrote; but is no longer useful for that purpose, as more perfect materials have presented themselves in the fibres of various plants, which are successfully manufactured into paper for every variety of purpose.

THE SENSITIVE PLANT, OR MIMOSA,

Is famous for the sensibility of its leaves, supposed to be a mechanical affection, and not to arise from nervous irritability conveyed to a censorium, as in animals.

THE BENZOIN, OR BENJAMIN TREE,

Is a native of Sumatra, where it furnishes the well-known balsam, which it exudes on being wounded, and which is of great importance in the Materia Medica for many purposes.

BRITISH GRASSES.

The reader is here presented with representations of sixteen of the principal grasses which adorn our fields, feed our cattle, and ultimately those who feed on them. We say principal grasses, because, little as it may be suspected by the cursory examiner of nature, nearly one hundred several varieties of grasses contribute to the verdure of these fortunate islands.

VINE LEAF MAGNIFIED.

This figure exemplifies the beautiful structure of leaves in general, as seen through high magnifiers. The circulations are made through the fibres and vessels which cover every part, and in general small insects may be seen roaming in the divisions like cattle grazing in enclosed fields, various leaves supporting different species of insects; and the same leaf, different species at different times and ages.

FLAX.

This is one of the most useful plants cultivated by man. It is a source of great wealth to the people of Ireland and the Netherlands. In the latter country it surrounds every cottage, and is a neat, clean, and elegant production. The cottager sows it, rears it, and prepares it, through all its stages, so as to fabricate from his own growth the linen used in his family, and even the fine laces with which Flanders supplies the rest of Europe. The species of *Linum* that is here figured is the only one that is used for the purpose of making flax in all nations: but varieties of this species, arising from culture and soil, are so different as to make the manufactures appear as though it were the produce of a different plant. The flax, for instance, which is sometimes imported from France is of so fine a texture as to resemble silk; while it would be in vain to attempt to make the fine lace of Flanders from any flax grown in England. The flax-plant grows about thirty inches high; but hemp, which furnishes a coarser fibre, grows from six or nine feet high, and should not be confounded with flax.

THE BETEL TREE.

This is one of the noble Palm tribe, and grows to the height of thirty feet, being a great ornament of eastern gardens. It produces a fruit in universal use in the east, of the size of a large walnut, with a kernel as big as a nutmeg. The natives chew it, mixed with the leaves of a pepper-tree, as the Europeans do tobacco, but more universally. The wood is used for a great variety of purposes.

SAFFRON CROCUS.

The stigmata of this plant yields the saffron of the shops, so useful in the materia medica as an aromatic cordial. It exhilarates the spirits, and is much used in hysteric affections. Spanish saffron is the most esteemed; but large quantities are cultivated in the unenclosed parts of Cambridgeshire. The flowers are gathered in the morning, carried in baskets, the stigmata or chives picked out, and the rest of the flower thrown away. These are then kiln-dried, and, as each acre produces three crops or pickings, the quantity of marketable saffron from an acre is considerable.

EUPHORBIA, OR SPURGE.

These are milky plants, the juice of which is so acrid that it corrodes and ulcerates any part of the body which it touches, and is therefore used to eat away warts and corns and the nerve in decayed teeth. It is also used by the Hottentots to poison their arrows, and sometimes to poison fountains of water at which wild beasts drink. One species produces a gum, by making incisions in the plant, and this also is poisonous.

THE COCCUS CACTI, OR COCHINEAL INSECT.

This insect is famous for the red dye which it communicates to wool and silk. The females yield the best colour, and are in number to the males as three hundred to one. They live on the plant represented in the plate called in New Spain Nopal or the Indian fig-tree. The magnitude of the insect is that of the tick found in dogs and other animals. The plants are cultivated for the sake of the insects. In May or June it is in perfection, and then the eggs are deposited among the leaves. In two months it grows to its full size, but is liable in its infant state to a variety of casualties, besides having enemies in birds and worms. The barbarous method is then adopted of gathering the insects into earthen pots, and killing them by millions, without compunction, either by pouring hot water on them, by exposing them to fire, or to the rays of the sun. There are few persons who, if they were themselves called upon to perform this operation, would not rather dispense with scarlet colours. These practices are chiefly carried on in New Spain and in the north of Peru, where they form the chief employment of many Indian tribes.

COMPARATIVE ANATOMY.

In these plates are represented the sculls of fifteen varieties of animals, from the European to the dolphin. The capaciousness of the scull and brain of the European will be palpable; while the declining form of that of the African and Ourang Outang affords evidence of their declining intellect. The elephant affords the next evidence of capacity of brain, while in that organ, so essential to the reasoning powers, the other animals appear to be very deficient.

The *skeleton of a cat* will enable the reader to compare the frame work of this animal with that of man.

PHYSIOGNOMY OF BIRDS AND QUADRUPEDS COMPARED.

The four subjects given have been taken at random, as indicative of similarity of structure, and, probably, of character. The subject might be even followed with great amusement through the entire tribes. In this plate are also introduced the legs or hinder paws of nine varieties of animals. The comparison of them, with reference to elegance of form, strength, and facility of motion, will afford an amusing contemplation.

CAUSES OF PHENOMENA.

As the consideration of Nature leads to enquiries into Causation, this work would be incomplete without some notice of the general causes of the wonderful phenomena which have been described in it.

It should be borne in mind, that, whenever we speak of phenomena, we mean such appearances and changes as are perceptible by our senses; and, as these have cognizance only of matter, so all phenomena with which we are acquainted through our senses relate to matter only, and are material. In examining material phenomena, or the accidents and changes of matter, as far as they are brought about by secondary causes, we must therefore search for such secondary causes in simultaneous operations of other matter sufficient to produce the effects.

Philosophers in general have taken a short road to this knowledge, by ascribing almost as many independent powers to matter as there appear various phenomena; but, as it must be evident, on the slightest consideration, that, as matter itself is essentially inert and passive, it cannot possess any original or innate powers of self-operation; such as an attractive power, a repulsive power, a calorific power, a sucking power, a sympathetic power, or any active power whatever. Power appears in matter only when in motion, and while moving; and then only has the capability of moving other matter, and producing material phenomena.

Action and reaction, too, are equal; that is, the motion imparted to one body must, before it returns to a state of rest, be received by some other body, or distributed to various bodies; or, by contact with other bodies, be again re-distributed by them; thereby producing constant successions of phenomena, and the well-known activity of Nature, in atoms and masses. Further, as action and reaction are equal, there must always be the same quantity of motion in the universe.

To ascribe powers of action to matter, and particularly the powers of attraction, which supposes that each body is acting on the contrary side of the other body, by pushing it towards itself in a place where it is not, is at once absurd and ridiculous. Yet this climax of error, admitted by Aristotle, Copernicus, Kepler, and others, in times when witchcraft, necromancy, luck, and astrology, were generally believed by mankind, still pervades all our books of science; and a generation must probably pass away before the powers called attractive, repulsive, and the like, are justly and correctly ascribed to the special motions and particular relations of other bodies, which produce all such appearances.

The two species of supposed attraction most observed are (1) the fall of heavy bodies towards the centre of the earth, and (2) the approach of light bodies floating on water. But the first has recently been proved to arise from the two great motions of the earth, which combined motions necessarily precipitate every part towards the centre of the moving mass; and the second arises from the circumstance that each of the floating bodies intercepts the pressure of the atmosphere in its own direction, so that the external pressure is greater than the internal pressure. Terrestrial gravitation has, therefore, a local and not an universal origin, and planetary aggregation is in every case local. In like manner, all other attractions may be explained by local and special affections of the bodies.

Nor is this a question about terms, as many would insinuate, for false premises lead to false analogies. Thus, if the absurd and impossible principle of attraction, or a force drawing towards the sun, is believed, we then raise upon it a false theory of the motions of the heavenly bodies. We are forced to invent a whimsical projectile force to prevent the fall of the planets to the sun; and then, to preserve this projectile force unimpaired, we require the extinction of the gas which fills space, and which is the operative lever that unites all parts of the universe. As there is no attraction, or central force, so there is no need of any projectile power, nor of a vacuum in universal space.

It is not indifferent, in adopting even a true law of nature, whether we ascribe that law to a true or false mode of action; for the law may be true, and yet the mode of action be very different from that assumed; and hence a continued train of errors will result. In like manner, by ascribing heat to caloric, instead of atomic motion, we involve chemistry in labyrinths of explications and false analogies, which render nature ridiculous. If the basis is defective, the superstructure must either fall, or become an object of derision when examined in relation to other phenomena.

In a word, all power which affects sensible and material bodies arises from matter multiplied (so to speak) by motion or velocity; and, in seeking for the causes of phenomena or changes, we must examine what is passing among the atoms in contact, or among the nearest masses. Of course, as matter can never originate its own motion, motion itself must commence independently of matter; and we hence arrive at the knowledge of the necessary existence of the sublime, eternal, omnipotent, and omniscient Creator, Contriver, and Continuator of the Universe!

THE SUN AND PRIMARY PLANETS.

	☉ The sun	☿ Mercury.	♀ Venus.	⊕ Earth.	♂ Mars.	⚴ Vesta.	⚵ Juno.	⚳ Ceres.	⚴ Pallas.	♃ Jupiter.	♄ Saturn.	♅ Uranus.
Diameter in English miles.	883,246	3130	7700	7914	4200			162	147	91,000	77,680	34,170
Mean apparent diameter.	′ ″ 32 3 3	″ 7	″ 17		″ 10					″ 38·2	″ 17·6	″ 4
Proportion of Polar to equatorial diameter.				as 331 to 332	as 15 to 16					as 13 to 14	as 10 to 11	
Time of performing one revolution round the sun.		d h m s 87 23 15 44	d h m s 224 16 49 1/6	d h m s 365 6 9 12	d h m s 686 23 30 39	d h m s 1335 4 55 12	d h m 1590 23 57	d h m 1681 12 56	d h m 1681 17 1	d h m 4332 14 19	d h m 10758 23 17	d h m 30688 17 6
Mean Velocity per hour in English miles.		109,442	80,062	68,092	55,166	44,202	41,170	40,932	40,930	29,866	22,050	15,546
Time of rotation on the Axis.	d h 25 10	h m s 24 5 28	h m s 23 21 7	h m s 23 56 4	h m s 24 39 21					h m s 9 55 50	d h m 10 16 19	
Mean distance from the sun in English miles.		36,774,320	68,716,569	95,000,000	144,760,806	225,435,000	253,380,485	262,903,570	262,921,240	494,265,155	906,183,000	1,822,413,975
Excentricity in English miles.		7,434,424	492,000	1,618,000	13,463,000	21,015,053	63,588,343	20,598,130	64,516,673	23,810,000	49,000,000	85,052,560
Places of Perihelion.		s ° ′ ″ 2 14 38 40	s ° ′ ″ 4 8 51 35	s ° ′ ″ 3 9 48 40	s ° ′ ″ 11 2 44 24	s ° ′ ″ 8 9 43 0	s ° ′ ″ 1 23 18 41	s ° ′ ″ 4 26 39 39	s ° ′ ″ 4 1 14 1	s ° ′ ″ 0 11 26 32	s ° ′ ″ 2 29 30 58	s ° ′ ″ 5 17 38 19
Inclination of orbits to the Ecliptic.		° ′ ″ 7 0 9	° ′ ″ 3 23 33		° ′ ″ 1 51 4	° ′ ″ 7 8 46	° ′ ″ 13 3 28	° ′ ″ 10 37 34	° ′ ″ 34 37 8	° ′ ″ 1 18 47	° ′ ″ 2 29 35	′ ″ 46 27
Places of the ascending Nodes.		s ° ′ ″ 1 16 10 30	s ° ′ ″ 2 15 1 57		s ° ′ ″ 1 18 9 40	s ° ″ 3 13 1 0	s ° ′ ″ 5 21 6 38	s ° ′ ″ 2 20 55 3	s ° ′ ″ 5 22 32 36	s ° ′ ″ 3 8 36 26	s ° ′ ″ 3 22 4 28	s ° ′ ″ 2 12 55 42
Axis inclined to the plane of its own Orbit.	° 82 30			° ′ ″ 66 32 27	° ′ 61 18					Nearly perpendicular.	° ′ ″ 60 0 0	

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28. Campanulated Tabularia.—Red and Silver Sea-pens.—Nautilus, &c. coloured.
29. Microscopic Objects.—Wheel Insects.—Cossus Caterpillar.—Bell-flower Polype.—Musca Chameleon, &c.
30. Mites in Cheese.—Point of a fine Needle magnified.—Flakes of Snow.—A Full-Point in Printing.—Section of the Ash-branch and various Insects.
31. A Flea as seen through a Microscope.
32. A Louse, ditto.
33. A Blue-bottle Fly.
34. Oak-Branch.—Elm-Branch, and various Scales of Fish.
35. Shells.—Capture of a Whale.
36. The Great Lanthorn Fly.—Atlas Moth.—Egyptian Locust.
37. White Ant-hills.—Banian Tree.—African Bird's Nest.
38. Barbary Spider.—Economy of the Bee.
39. Electrical Gymnotus.—Hammer-headed Shark.—Branched Asterias, or Star-fish.—Scorpasia.—Chætodon.—Angel Fish.

PLATE

40. Various Reptiles—Lizards, Crocodiles, Geckos, Tortoises, &c.—British and Foreign Frogs and Toads.—The Bat.—The Vampire.
41. Twenty-seven varieties of Snakes and Serpents.
42. Hooded Snake of Hindoostan.—Great Scolopendra, or Centipede.—Flying Dragon.
43. Barbary Ape.—Green Monkey.—Ribbed-nose Baboon.—Great Baboon.—Ourang Outang.—Ribbon Monkey.—The Fox.—The Cur Fox.
44. The Ant-Eater.—The Kangaroo.—The Sloth.
45. The Hippopotamus.—The Rhinoceros.—The Whale.
46. The Lion.—The Lioness and Whelps.—The Elephant.—The White Bear.
47. The Brown Bear.—The Wolf.—The Porcupine.
48. The Tiger.—The Camel.—The Camel recumbent.
49. The Tailor Bird.—Red-throated Humming-birds.—Beating Ptinus or Death-Watch.
50. The Migratory or Wandering Locust, (coloured.)
51. Chinese Painted Pheasant.—The Flamingo.—The Numidian or Barbary Crane.
52. The Scarlet Ibis.—The Pelican.—The Hoopoe.
53. Craniology,—Physiognomies of the Human Species.
54. Bones in front.—Bones of the Back.—Back of the Hand.—Human Skull.—Human Foot.—Tattooed South Islander.
55. Vertical section of the Brain.—Horizontal view of the Brain.—General view of the Ear.—Human Eye.—Viscera of the Human Body.
56. Chart, shewing the number of Deaths in One Year from different Diseases within the London Bills of Mortality during the Years 1796 to 1800, on an average.
57. The Fallow Deer.—The Pole Cat.—Rabbits.—The Hare.—The Mole.—The Hedge-Hog.—The Badger.—The Otter.
58. The Spaniel.—The Grey-Hound —Race-Horse.—Cart-Horse.—Suffolk Punch.—Clydesdale Horse.—The Ass.—The Mule.
59. The Seal.—The Beaver.—The Goat.—The Squirrel.—The Guinea-Pig.—Hogs.—The Cat.—Bull-Dog.
60. Beavers in Council.—Seal Catching.—Badger Catching.—Feeding Guinea-Pigs.—Mule-driving in Spain.—The Goat-Herd.—A Cow-Herd.—Drove of Hogs.
61. Ayrshire Cow.—Galloway Bull.—Short-Horned Bull.—Long-Horned Ox.—Cheviot Sheep.—Leicester Breed.—South-Down Breed.—Norfolk Breed.—The Rat.—The Mouse.
62. The Eagle.—The Sparrow-Hawk.—The Falcon.—The Owl.—The Horned Owl.—The Cuckoo.—The Social African Bird's-Nest.—The Pendulous Bird's-Nest.
63. The Thrush.—The Sky-Lark.—The Sparrow.—The Blackbird.
64. The Bullfinch.—The Wren.—The Canary-Bird.—The Nightingale.
65. The Linnet.—The Redstart.—The Robin.—The Goldfinch.
66. Various Butterflies.
67. Progress of Vegetation at different Elevations.
68. Dense Woods of Brazil, with a troop of Puris Indians.
69. The Twenty-four Classes of Vegetables, according to the Linnæan System.—Mrs. Ibbetson's Microscopic observations.
70. Mrs. Ibbetson's Microscopical observations on Plants.
71. Another Plate on the same subject.
72. Oak.—Pollard Oak.—Cedar.—Cypress.—Palm.—Italian Pine.—Elm.—Lopped Elm.
73. Aspin.—Pollard Aspin.—Lime.—Holly.—Ash.—Poplar.—Laburnum.—Laurel.
74. Elder.—Larch.—Fir.—Pollard Willow.—Weeping Willow.—Scotch Fir.—Norway Fir.—Pollard Weeping Willow.—Yew.
75. Beech.—Birch.—Sycamore.—Thorn.—Walnut.—Willow.
76. Lemon-Tree.—Orange Tree.—Sugar Canes.
77. Coffee-Tree.—Cotton-Tree.—Cinnamon-Tree.—Bread-Fruit Tree.
78. Fig-Tree.—Pimento Jamaica Pepper, or Alspice.—Tea-Tree.—Clove-Tree.
79. Date-Tree.—American Aloe.—Cocoa-Tree.—Palm-Tree. Plantain-Tree.—Nutmeg-Tree.—Banana.—Mangrove.—Silk-Worm.—Musquitoe-Fly.
80. Common Flax.—Virginian Tobacco.—Saffron Crocus.—Rhubarb.
81. Animal Flowers.—Castor-Tree.—Vine Leaf Magnified.—Sensitive Plant.—Benzoin.—Euphorbia.—Coccus-Plant and Insect.
82. The Papyrus.
83. British Grasses.
84. Comparative Physiognomies of Birds and Quadrupeds.—Skulls of various Animals.—Skulls of Men.—Skeleton of a Cat.

J. and C. ADLARD, Printers, 23, Bartholomew-Close.

THE SOLAR SYSTEM

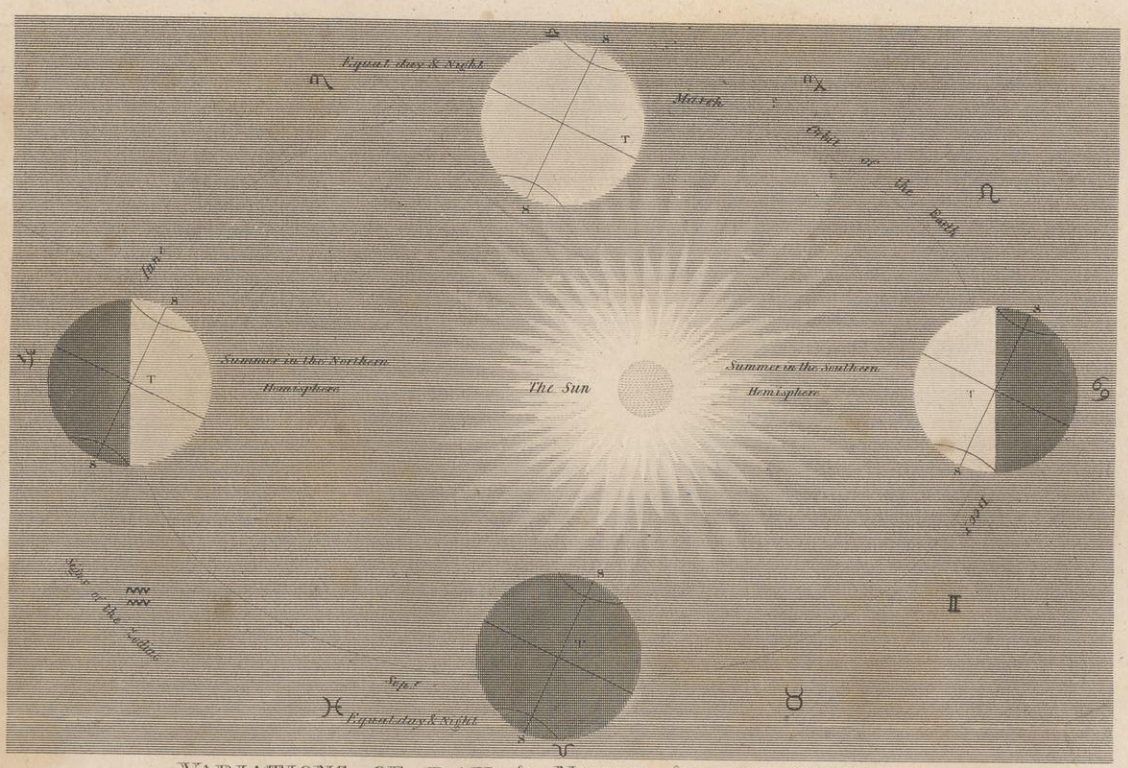
Jupiter & Belts.

Different appearances of Venus.

Saturns Orbit & Ring.

Saturn and double Ring.

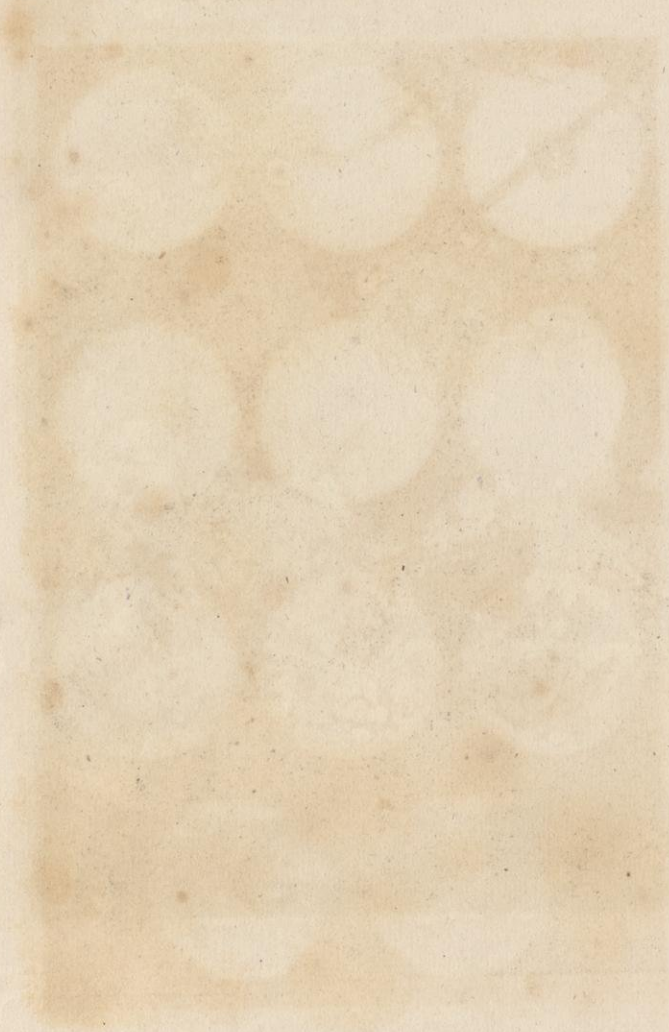
Engraved by W. Lowry.



VARIATIONS OF DAY & NIGHT & THE SEASONS.

The place of the Earth is opposite the apparent place of The Sun.

London, Published 1823, by Sir Richd. Phillips.



SOLAR SPOTS.

The Appearances of a solar spot in 7 successive days.

Sections of spots, with their variable formations of nuclei & umbrae.

THE COMET OF 1811.

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TELESCOPIC APPEARANCES OF VENUS.

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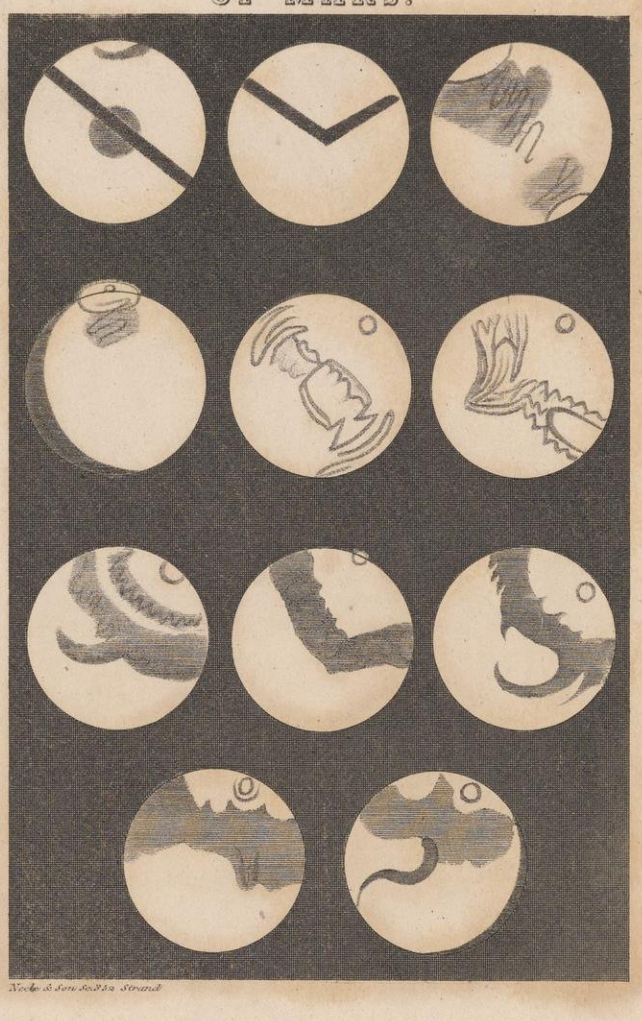
TELESCOPIC APPEARANCES OF MARS.



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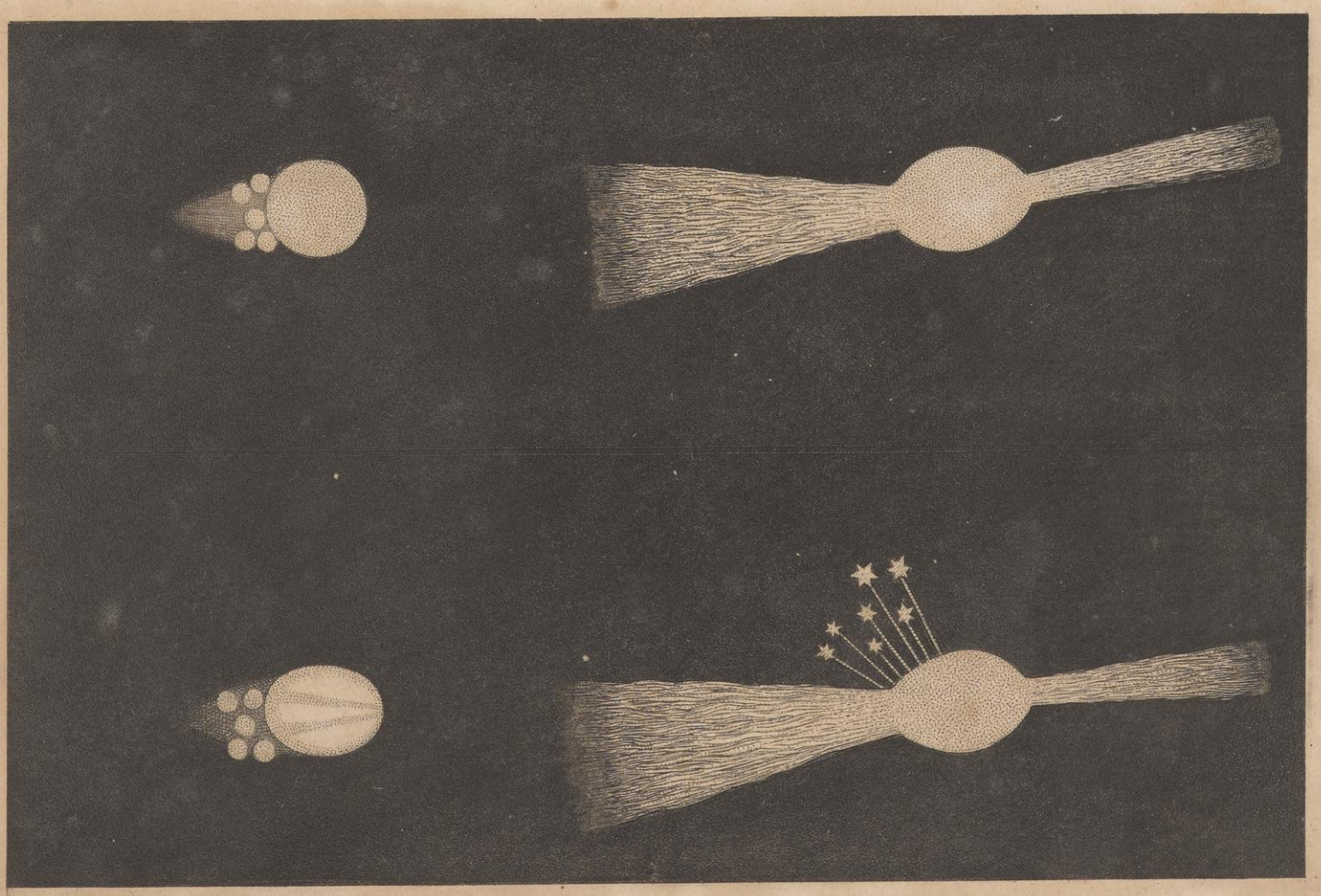
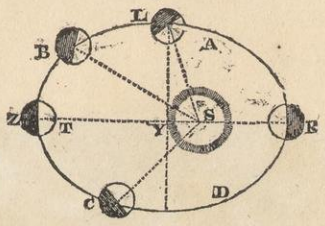
THE GREAT METEOR of November 13. 1803.



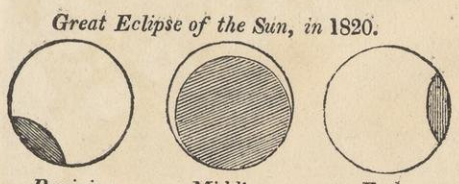
As seen at Greenwich.

As seen near Soho Square.

Orbit of the Earth.

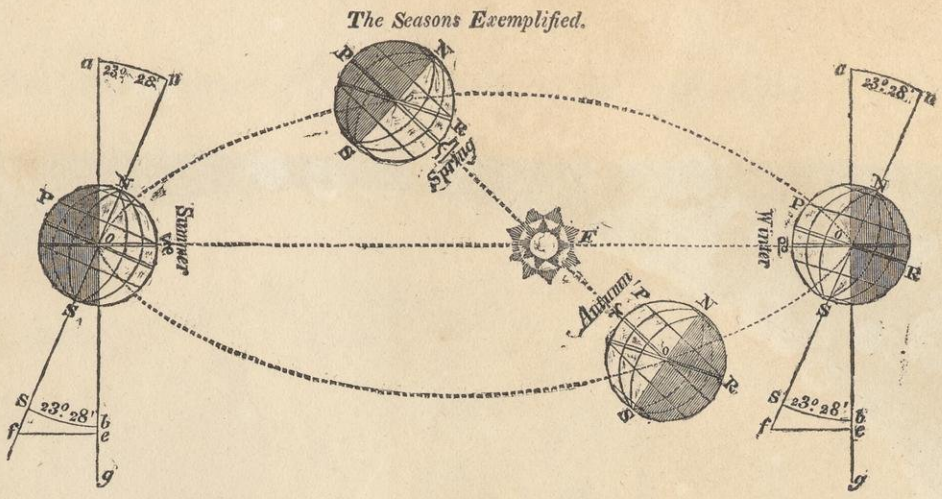


Great Eclipse of the Sun, in 1820.

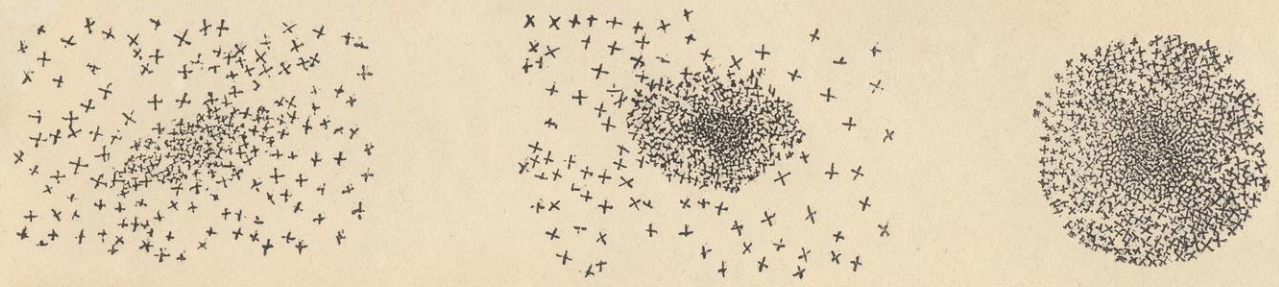


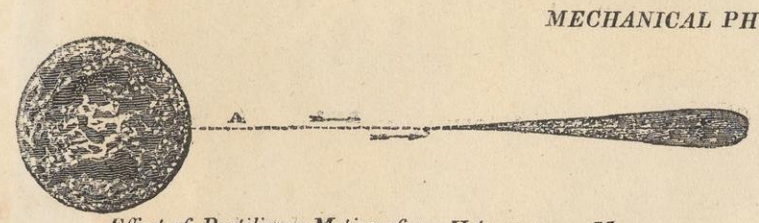
Begining. *Middle.* *End.*

The Seasons Exemplified.

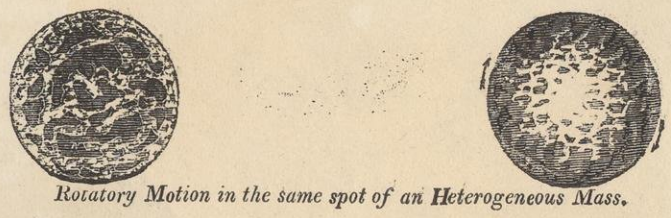


Clusters, or Systems of Fixed Stars.

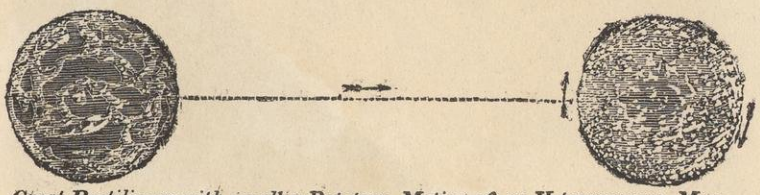




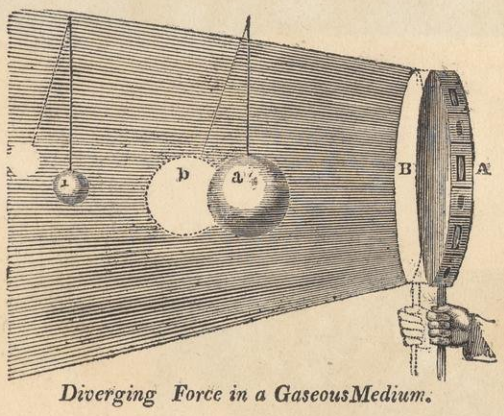
Effect of Rectilinear Motion of an Heterogeneous Mass.



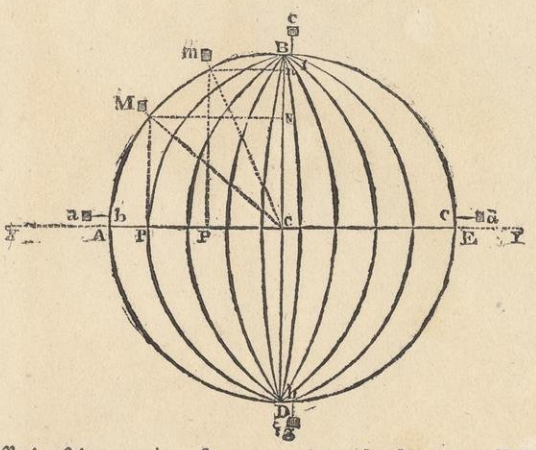
Rotatory Motion in the same spot of an Heterogeneous Mass.



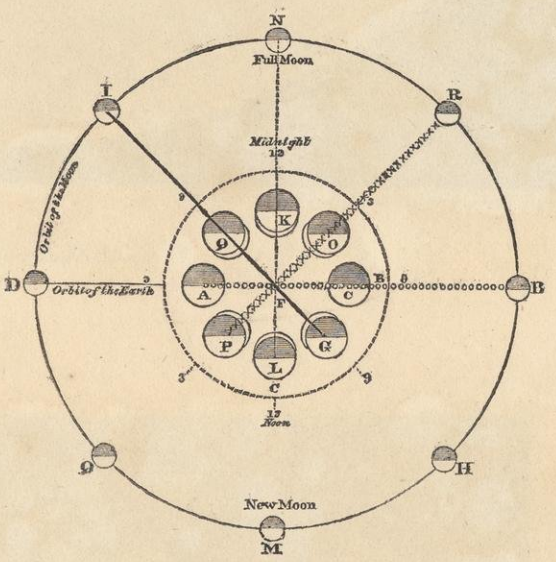
Great Rectilinear with smaller Rotatory Motion of an Heterogeneous Mass, like the Earth.



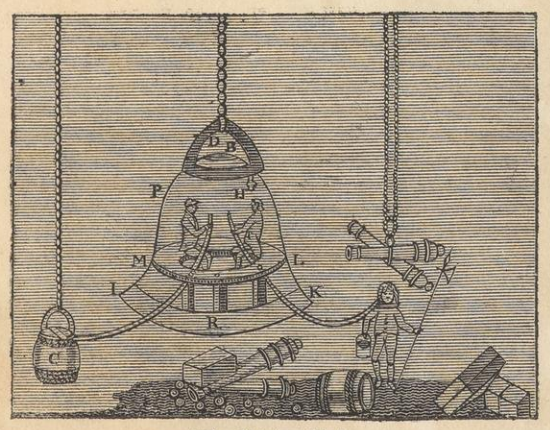
Diverging Force in a Gaseous Medium.



Effect of two moving forces, one towards the plane, X Y; and the other towards the axis, D B; in producing the fall of bodies to the centre C, through the diagonal.

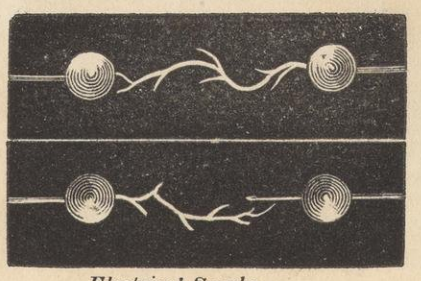


The Tides Illustrated.



The Diving Bell.

Intermitting Springs.



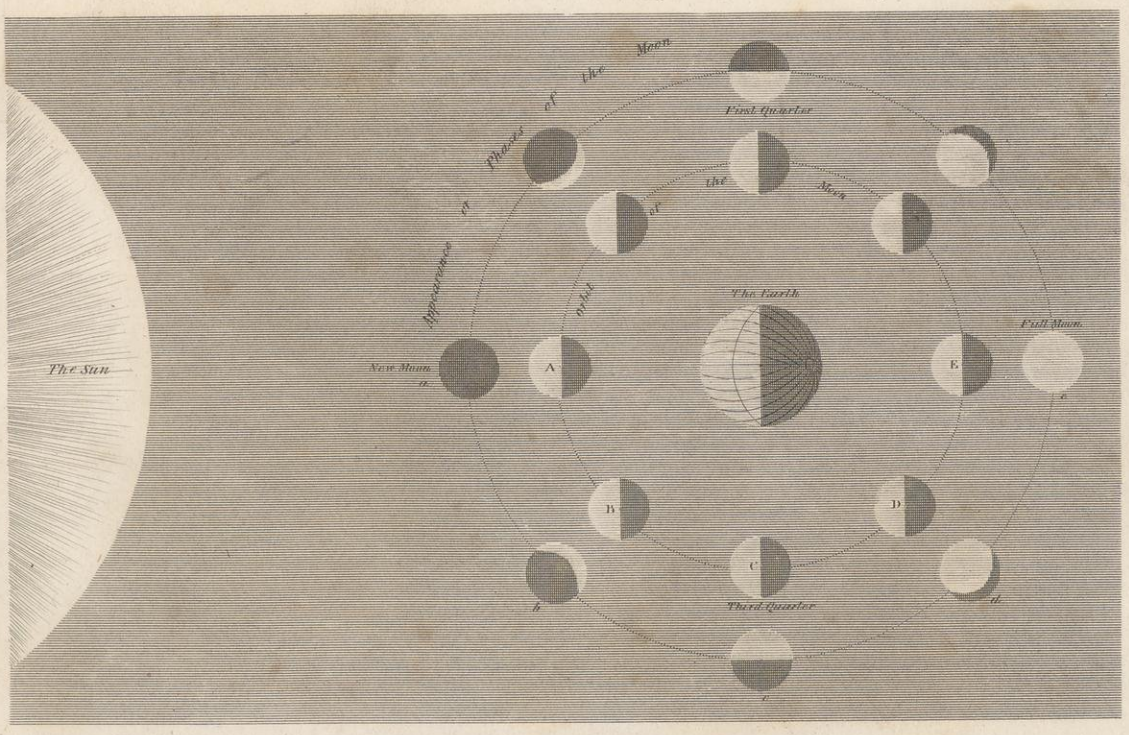
Electrical Sparks.

Telescopic appearance of the Moon at the opposition.

Drawn from observation, by John Blunt.

Engraved by W. Read, Maiden Lane, Covent Gard.n on his New Metallic Plate

London, Pub.d March 1. 1827. by Sir Rich.d Phillips & Co.

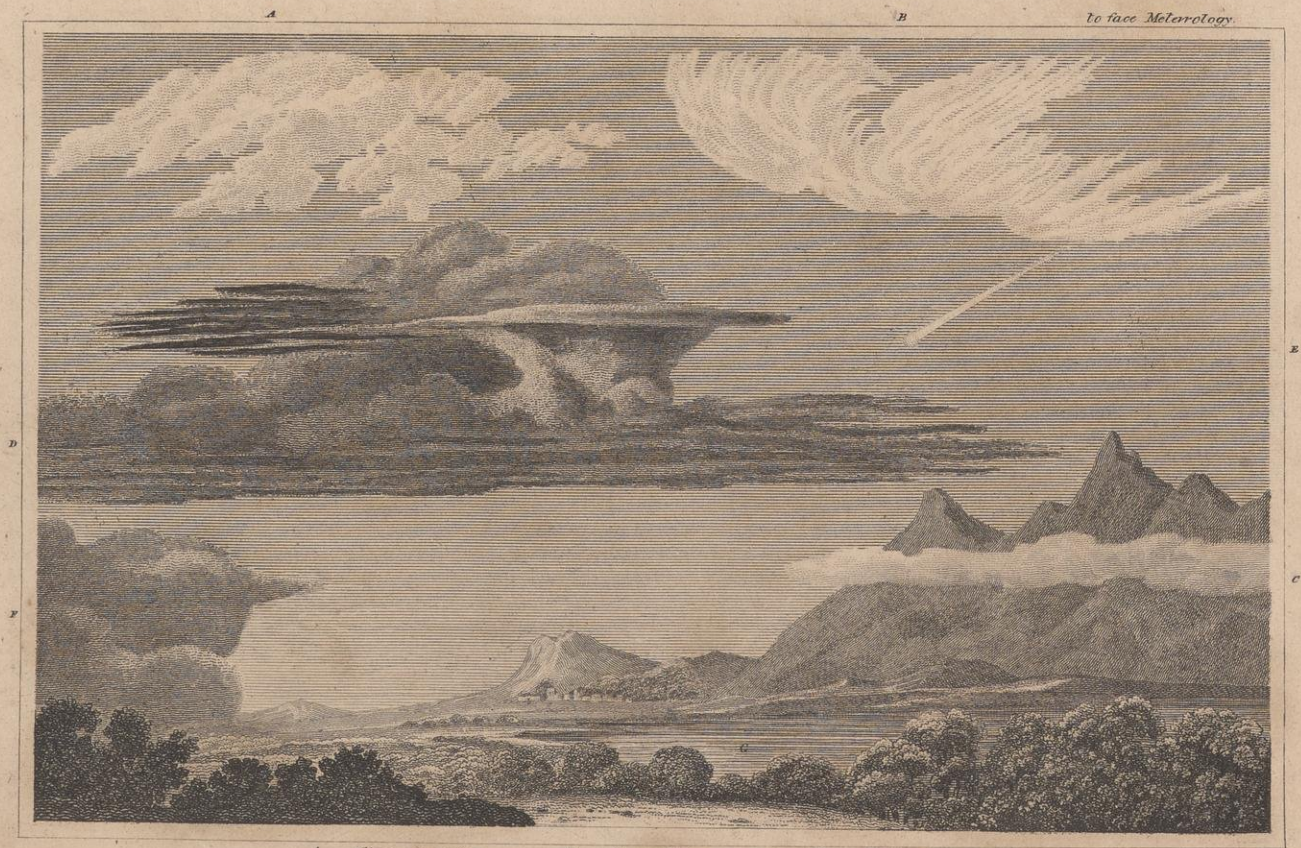


PHASES OF THE MOON.

C. Bhint. del.r

W. Read. Sc.

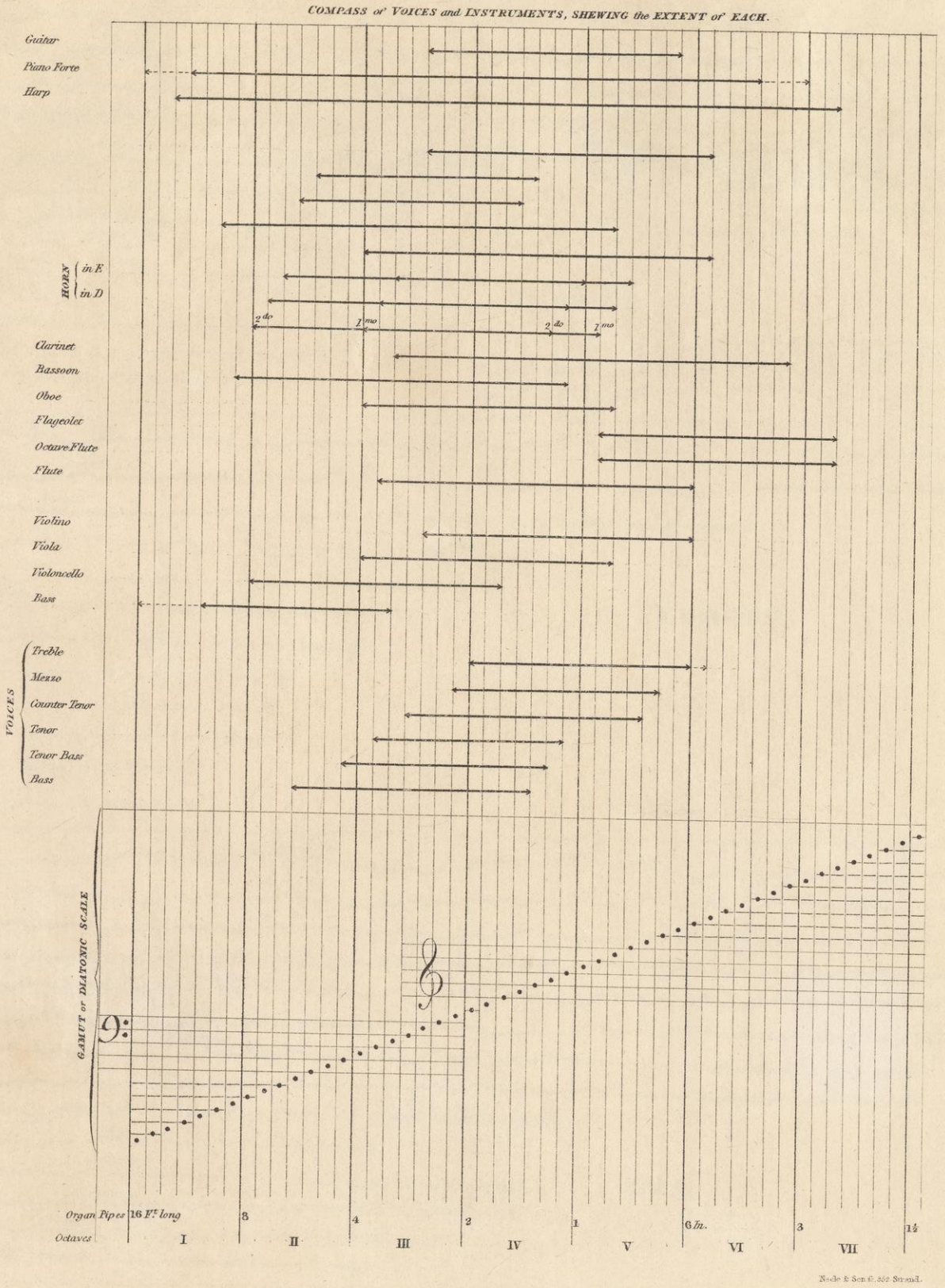
Telescopic Appearances of the Moon at three Periods of its increase.



A — Cirro cumulus.
B — Cirrus
C — Cirro Stratus.
D — Cirro Stratus. cumulus & Cumulo Stratus grouped
E — Meteor
F — Nimbus — G — Stratus.

SOUND.

COMPASS of VOICES and INSTRUMENTS, SHEWING the EXTENT of EACH.



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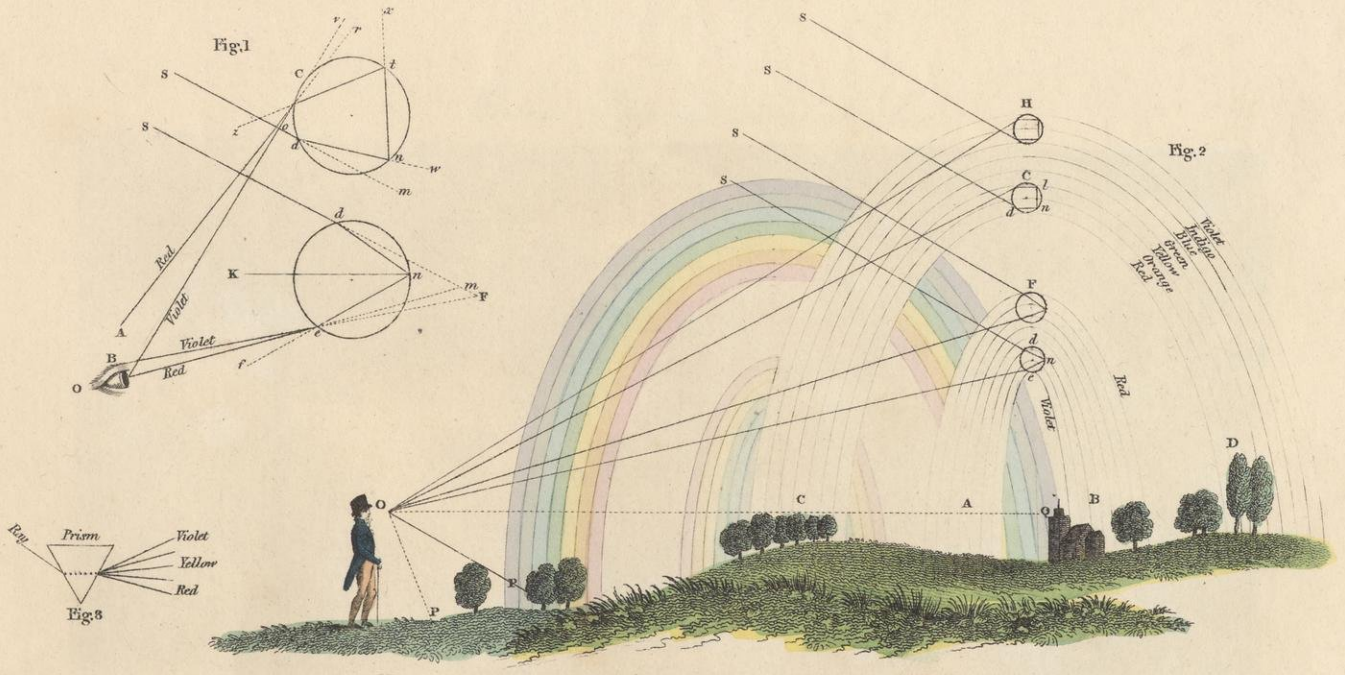
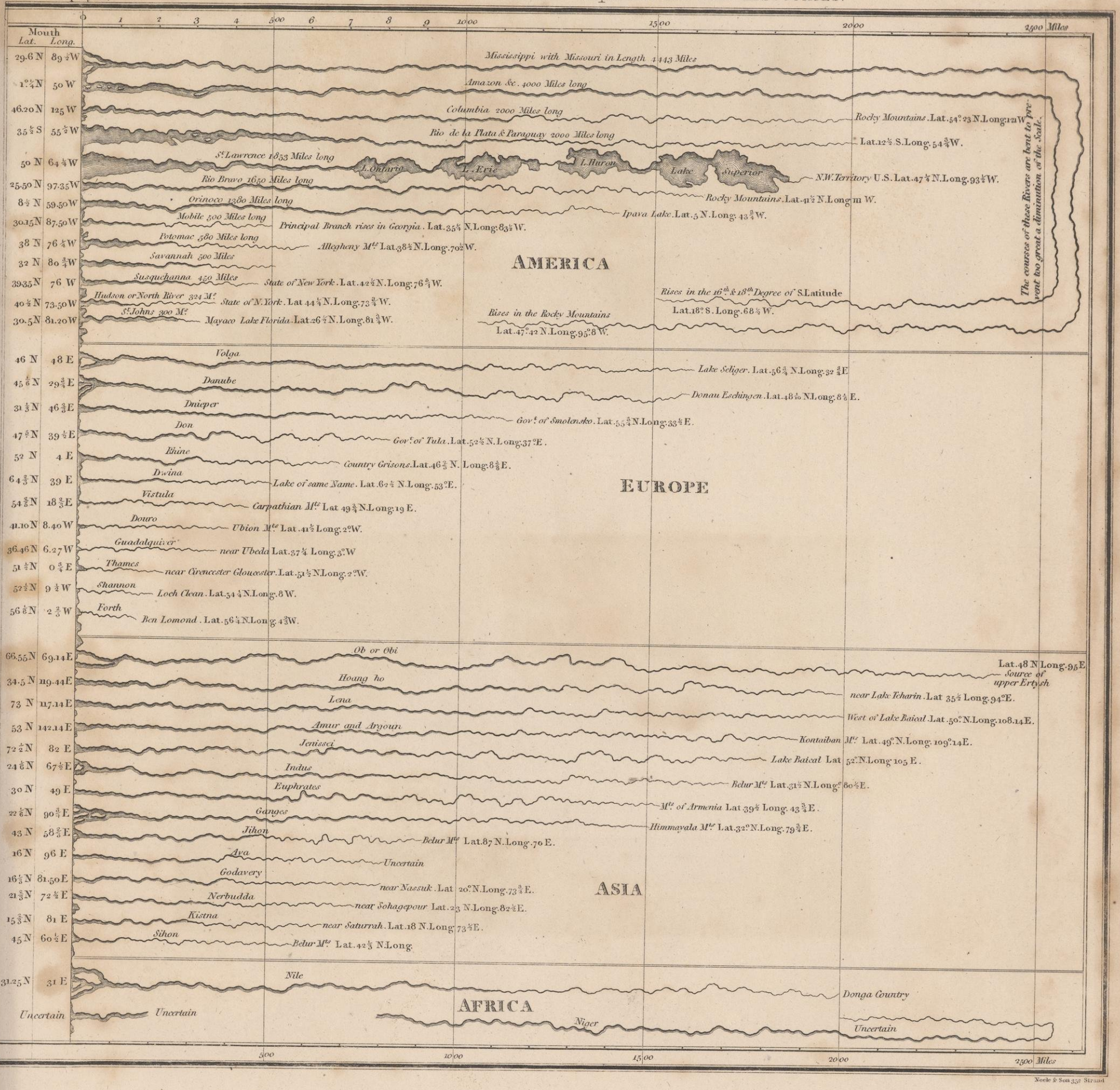
THE RAINBOW.



London Published, by Sir R. Phillips, & Co. Feb. 10. 1823.

Nature Displayed.

The RIVERS of the WORLD with their comparative *LENGTHS* and *SOURCES*.



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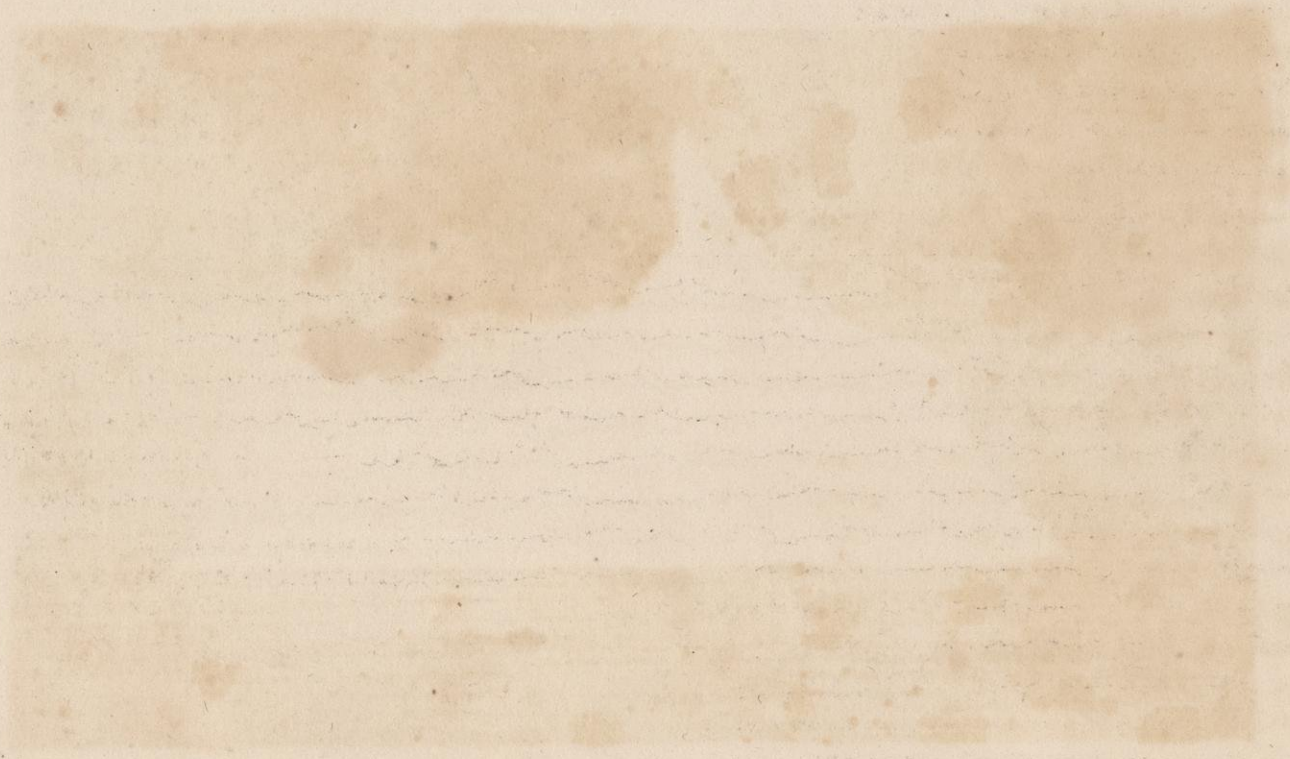
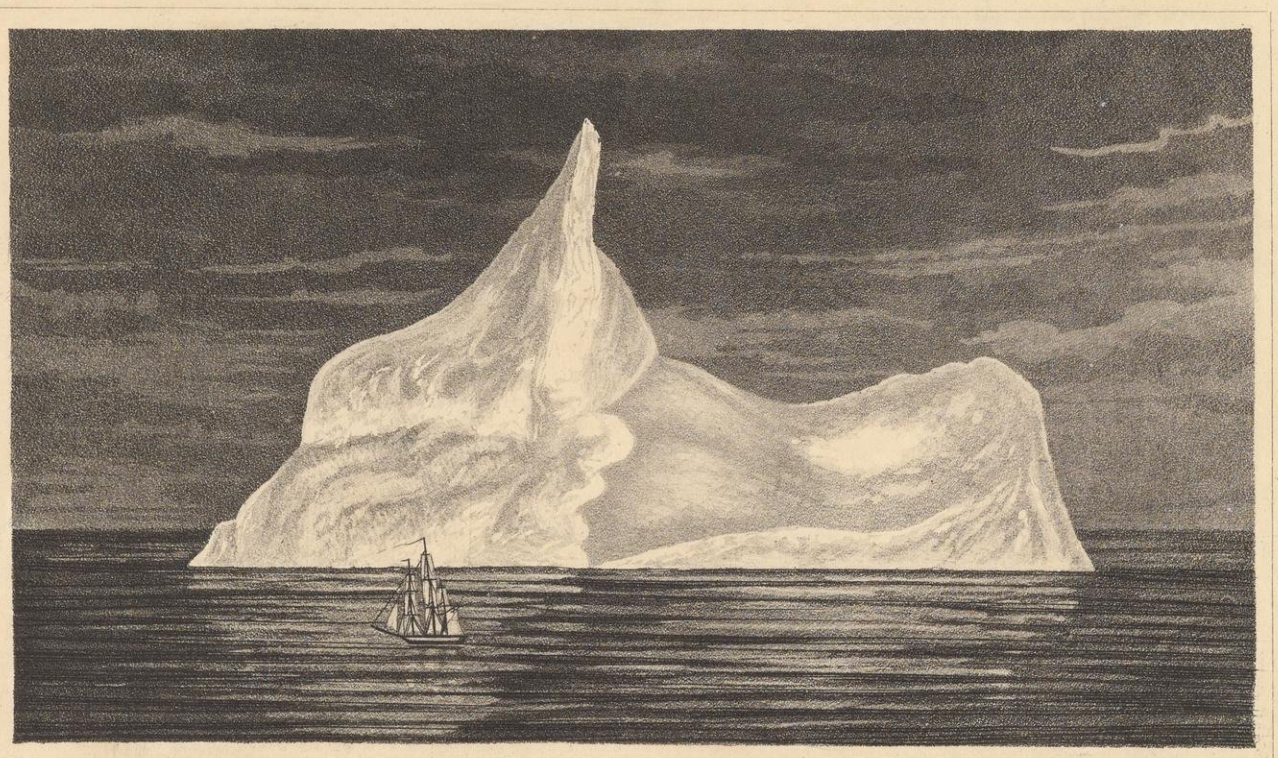
Water Spouts seen at Sea.

Neele sculp. 352 Strand.



ICEBERGS.



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ARCTIC WALRUS.

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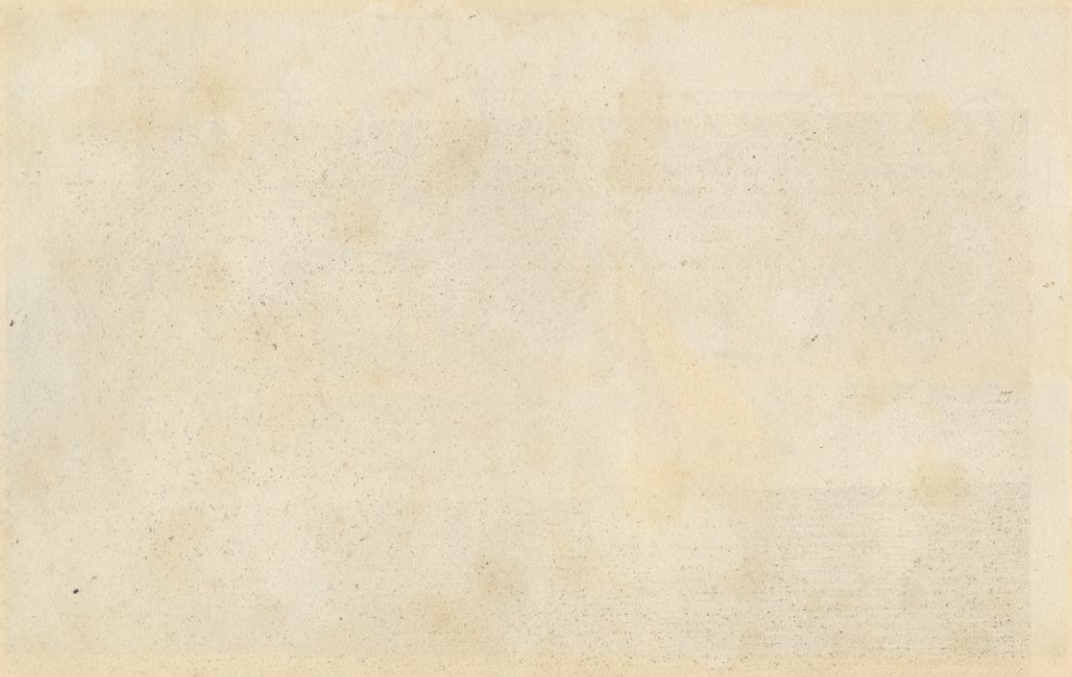
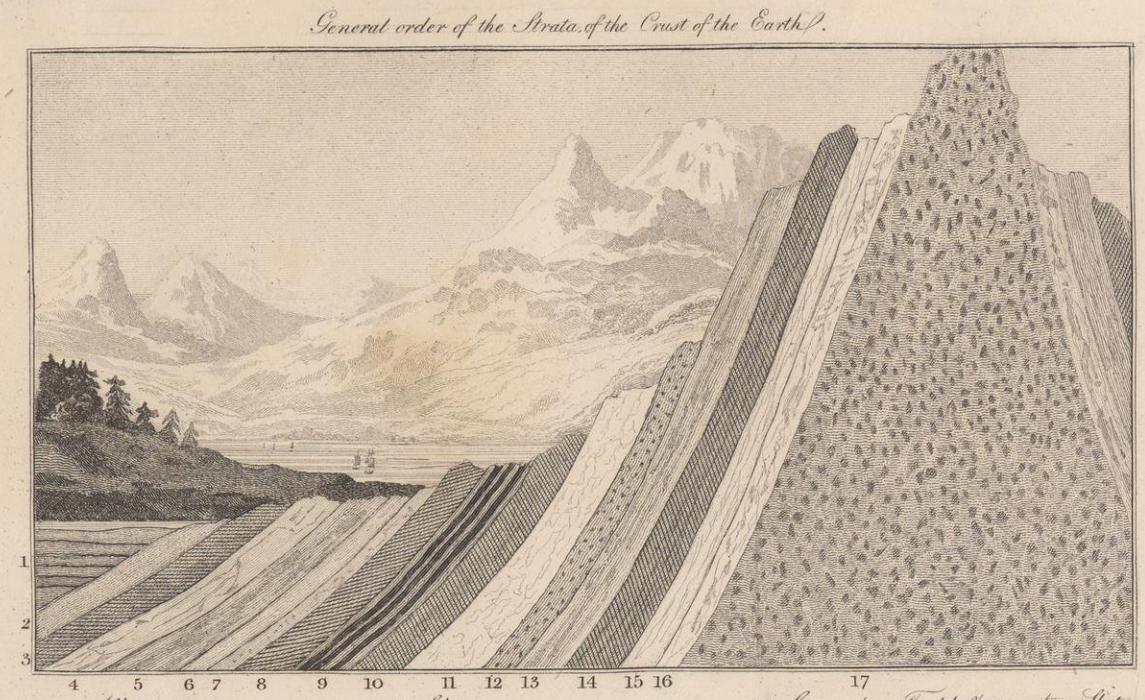
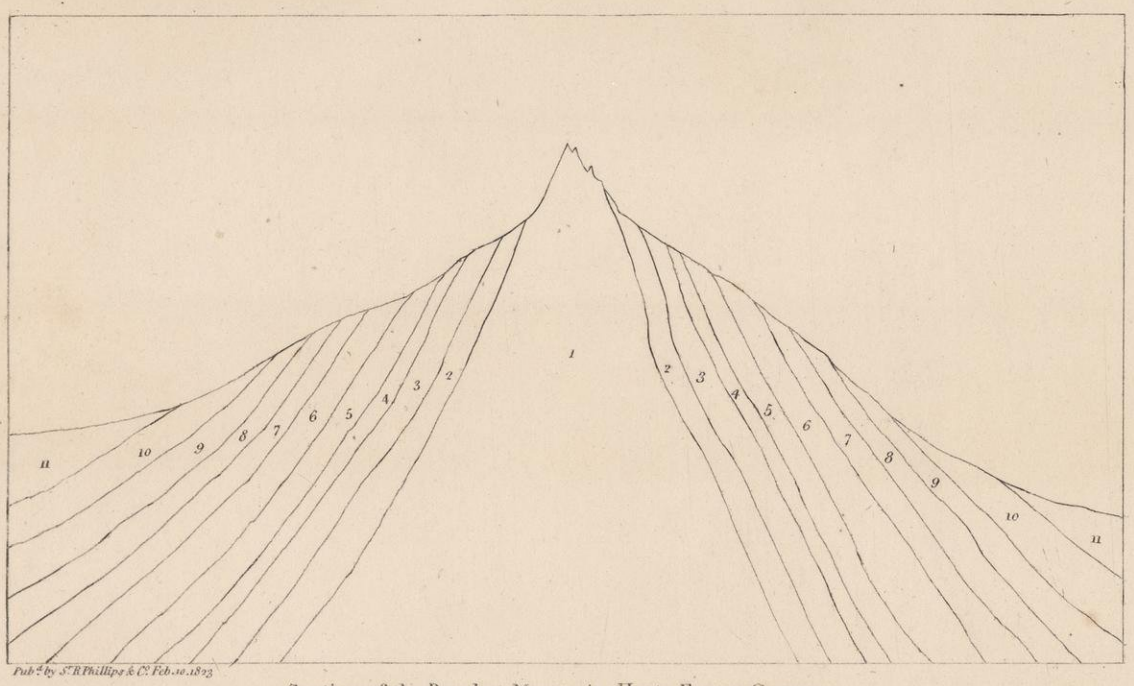


General order of the Strata of the Crust of the Earth.



1 *Alluvium*
2 *Fresh water formations*
3 *Clay & Sand*
4 *Chalk & Marle*
5 *Clay Sandstone &c.*
6 *Oolite*
7 *Lias*
8 *Various Clays*
9 *Coal formation*
10 *Red Marle & Sandstone*
11 *Mountain or Transition Limestone*
12 *Old Red Sand Stone.*
13 *Greenstone Trapp & greenstone Slate.*
14 *Clay Slate*
15 *Mica Slate with beds of Marble*
16 *Gneiss with beds of Granular or primitive Limestone called Marble*
17 *Granite.*



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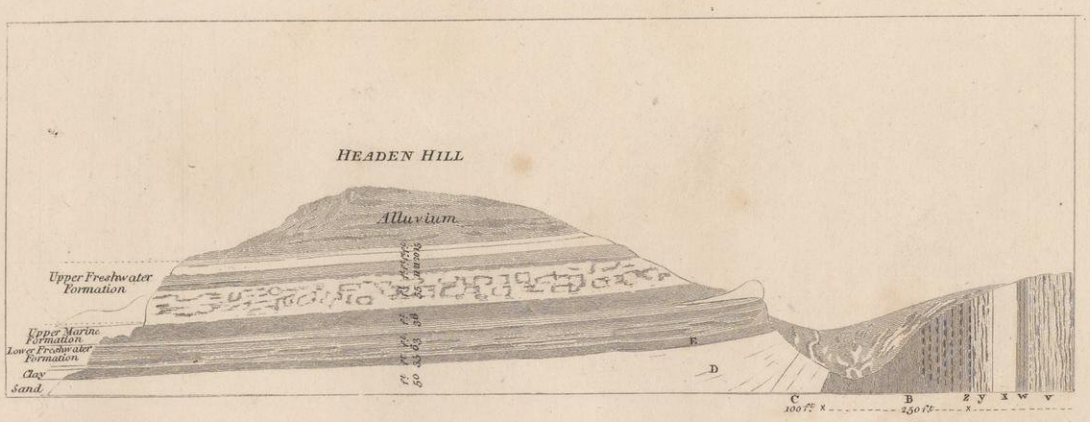
Section of the Brocken Mountain Hartz Forest Germany.

N.o 1. Granite; N.o 2 Claystate; N.o 3. Transition (or secondary Limestone) N.o 4. Greywacke & Greywack Slate; N.o 5 Old Red Sandstone; N.o 6. 1.st Flotz Limestone N.o 7. 1.st Flotz Gypsum; N.o 8. 2.d or variegated Sandstone; N.o 9. 2.d Flotz Gypsum N.o 10. 2.d Flotz Limestone. N.o 11 Alluvium deposite.



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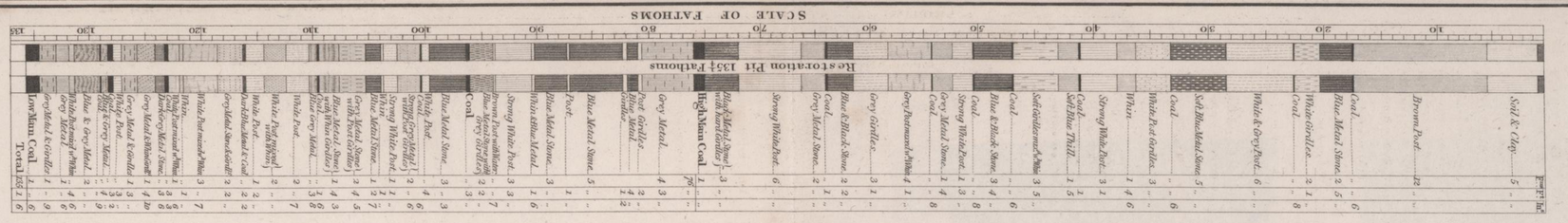
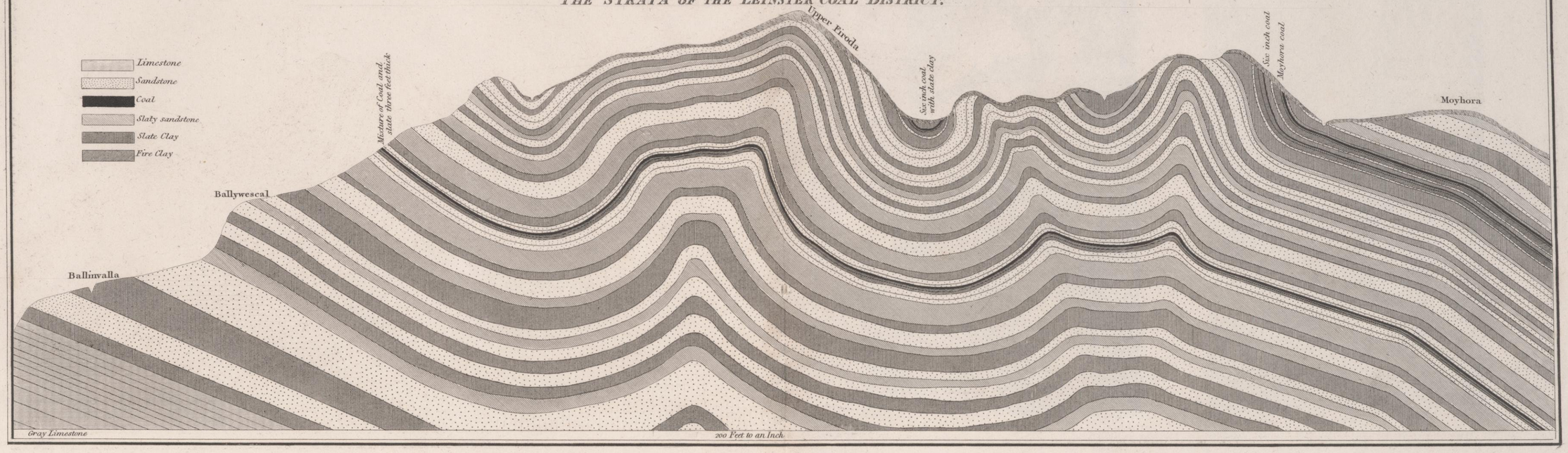
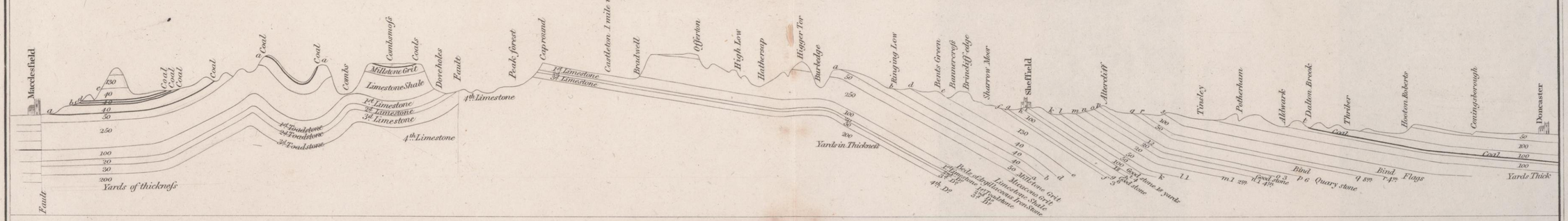
THE NEWCASTLE COAL-PIT STRATA.



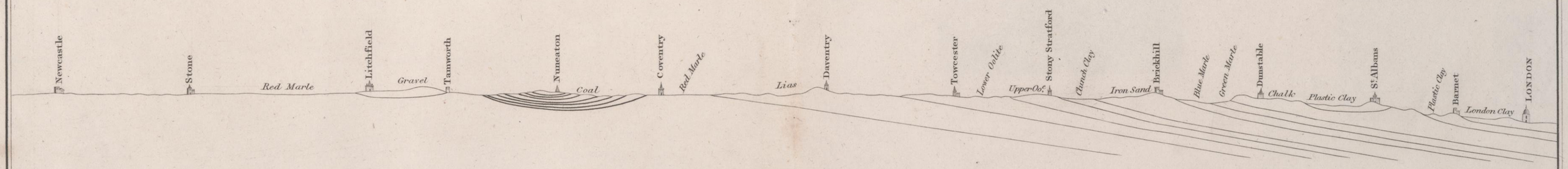
THE STRATA OF THE LEINSTER COAL DISTRICT.



A SECTION OF THE LAND FROM DONCASTER TO MACCLESFIELD.



A SKETCH OF THE LAND FROM NEWCASTLE TO LONDON.



Giants Causeway of Basaltic Pillars in Ireland.

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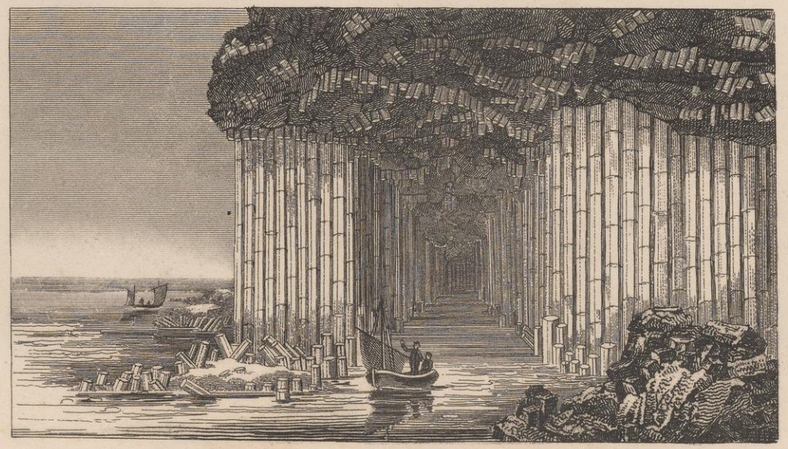
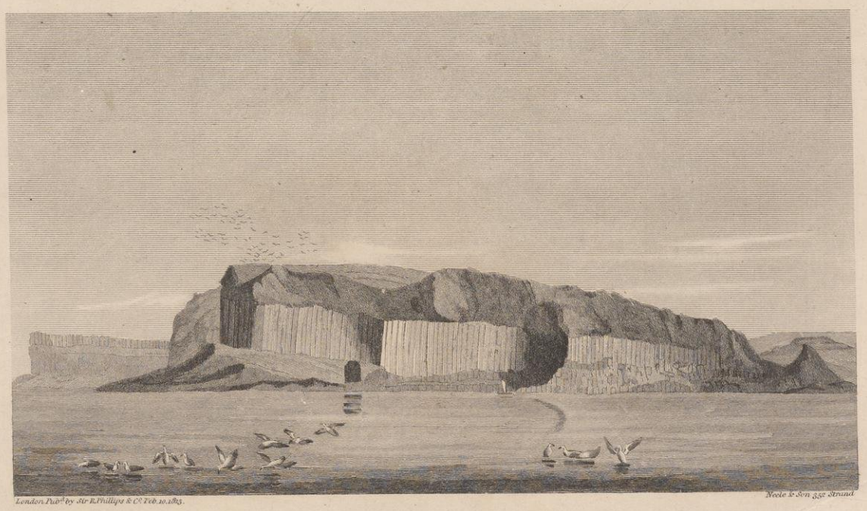
CURVED GNEISS IN LEWIS.



FINGALS CAVE IN STAFFA.



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VIEW OF STAFFA from the SOUTH WEST.

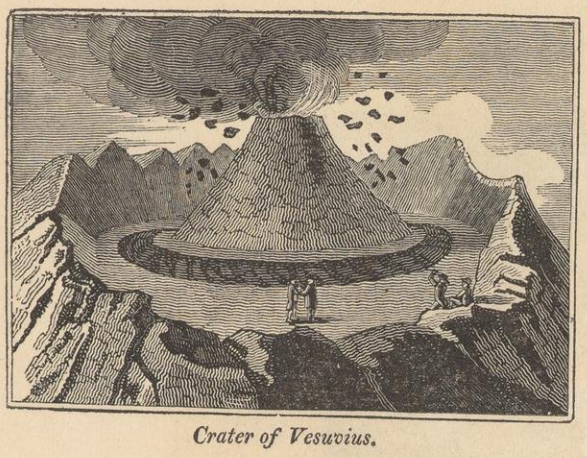
GRAND ERUPTION OF VESUVIUS 1767.

London Published by Sir R. Phillips & Co. Feb.10 1823.

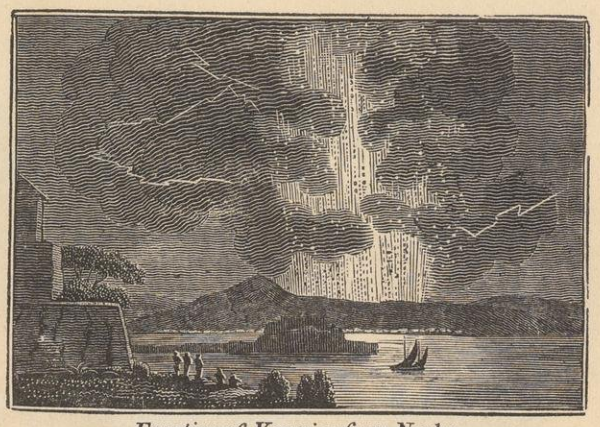
COLUMN OF SMOKE THIRTY MILES HIGH ISSUING FROM VESUVIUS.

London Published by Sir R. Phillips & Co. Feb. 10. 1823.

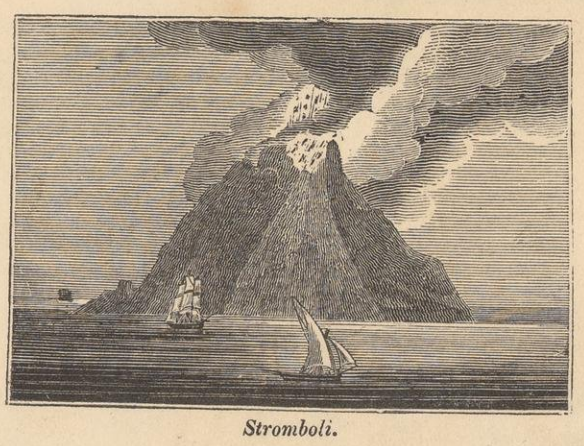
VOLCANOS.



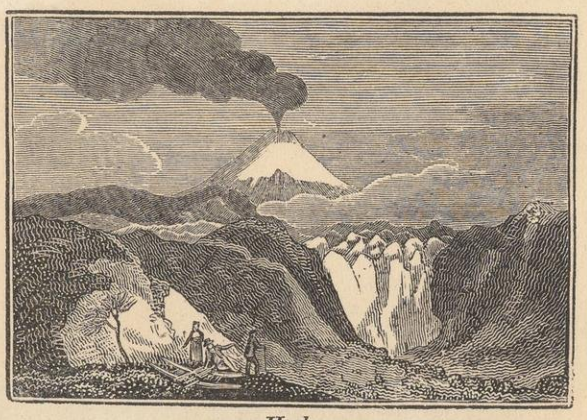
Crater of Vesuvius.



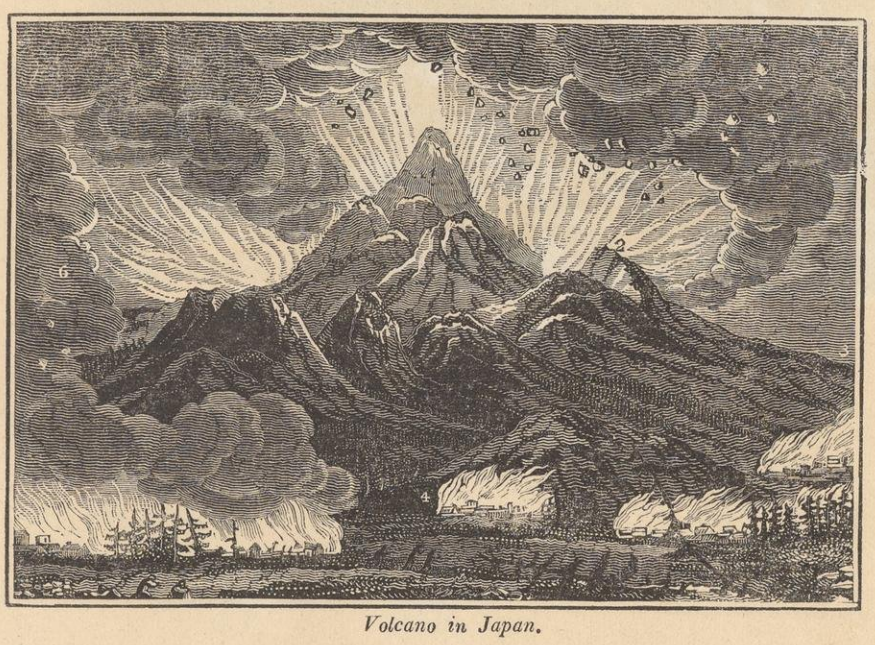
Eruption of Vesuvius from Naples.



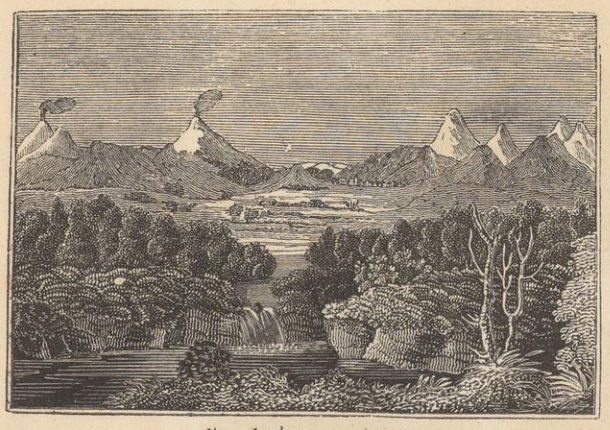
Stromboli.



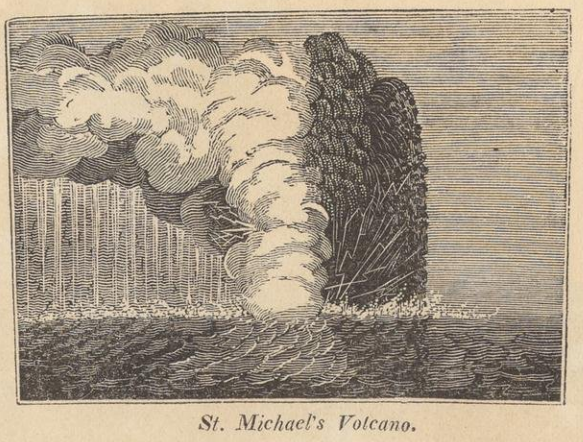
Hecla.



Volcano in Japan.



The Andes near Zuito.



St. Michael's Volcano.

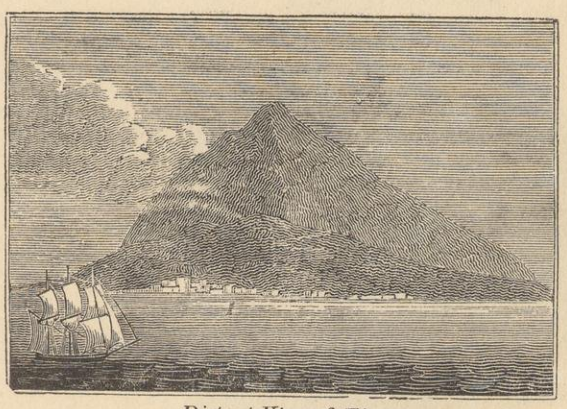
THE ALPS (from BERNE)

MONT BLANC from the Valley of CHAMOUNI.

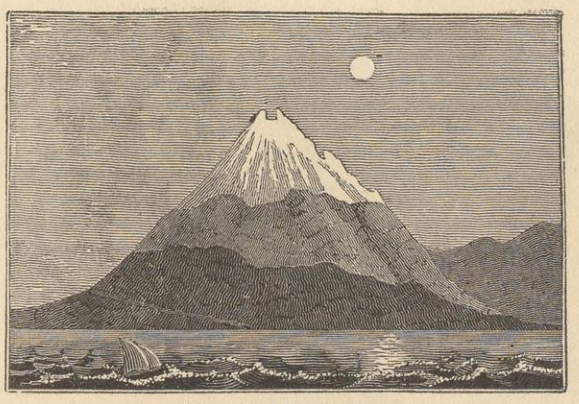
VESUVIUS IN 1794.

London Published by Sir R. Phillips & Co. Feb. 10. 1823.

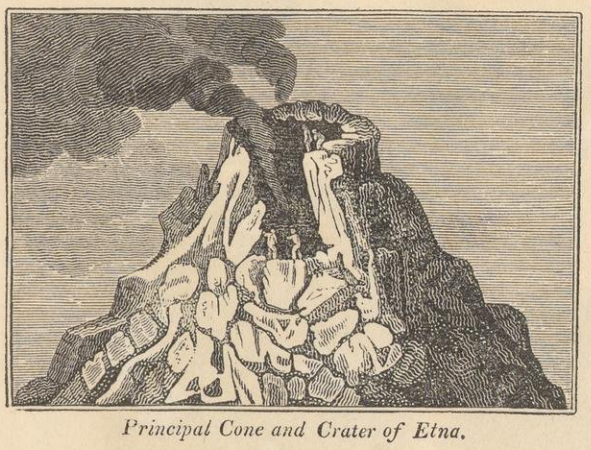
VOLCANOS.



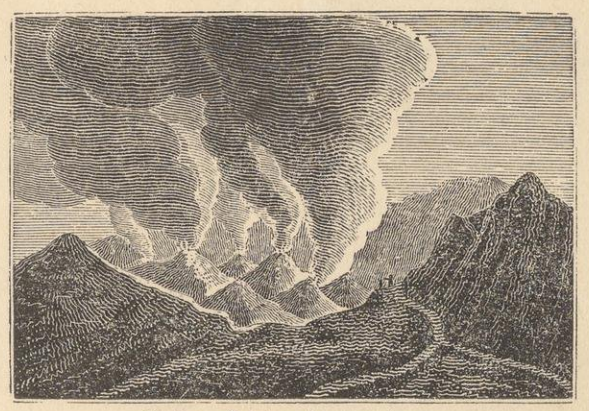
Distant View of Etna.



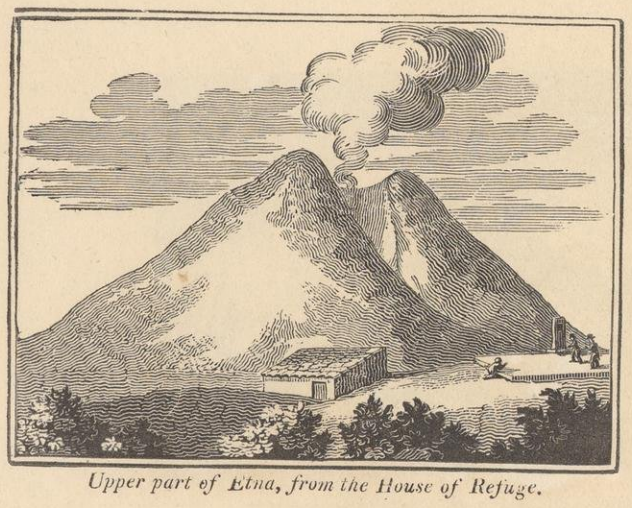
Etna by Moonlight.



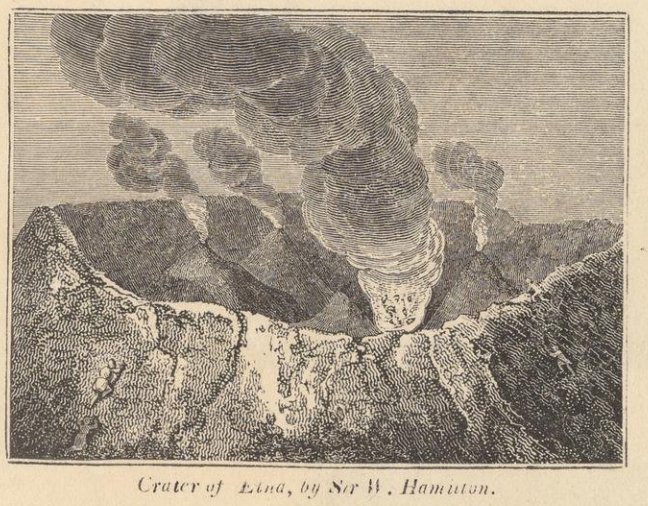
Principal Cone and Crater of Etna.



Crater of Etna, by Brydone.

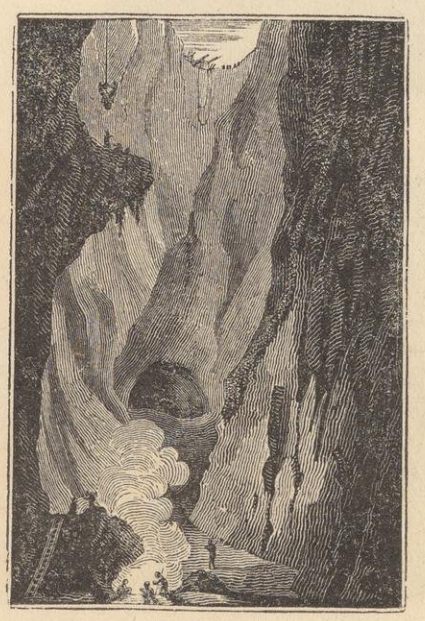


Upper part of Etna, from the House of Refuge.



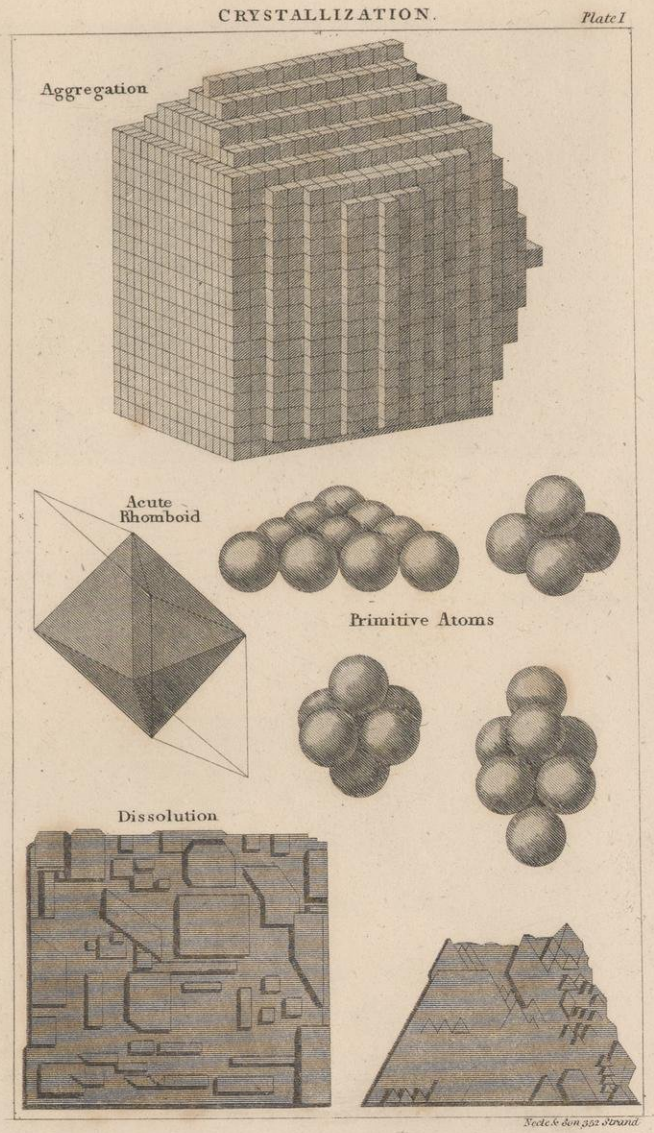
Crater of Etna, by Sir W. Hamilton.

Crater of Etna, by Montagné.



Copper Mine of Falkenstein Saxony

CRYSTALLIZATION. *Plate I*



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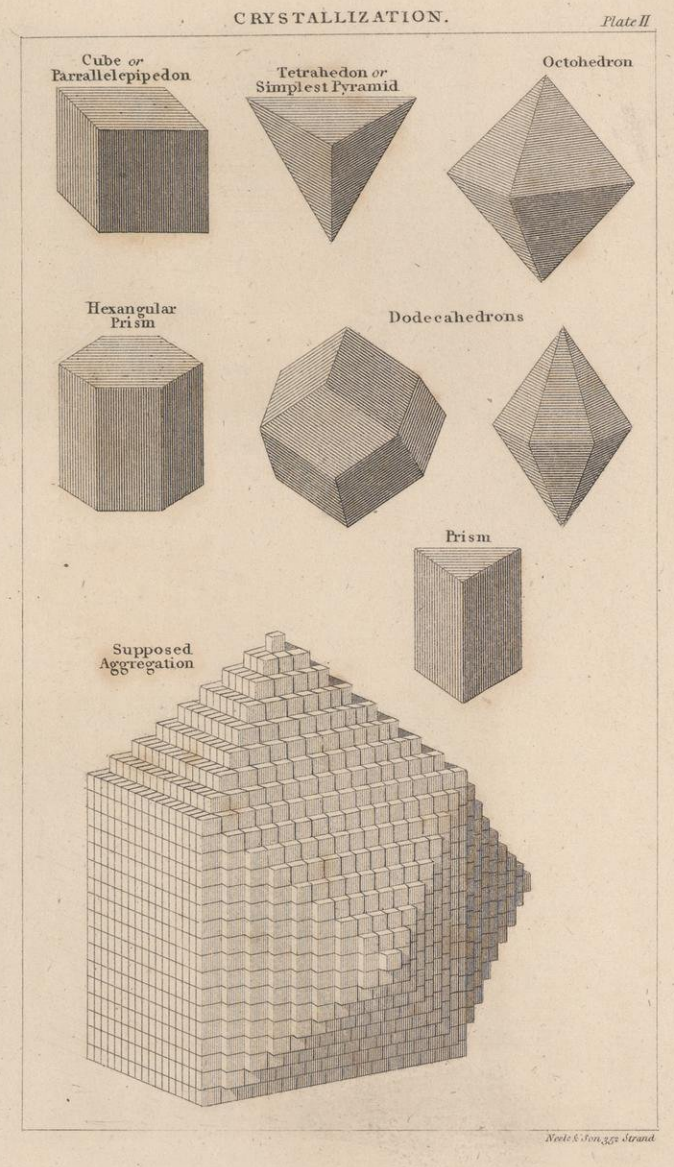
CRYSTALLIZATION. *Plate II*



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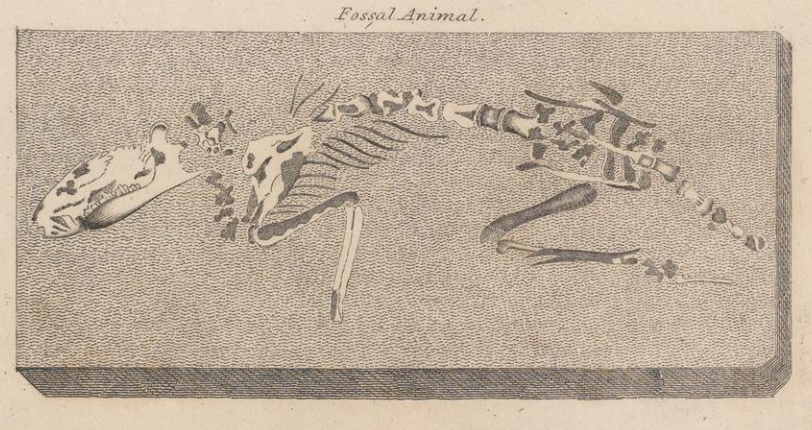
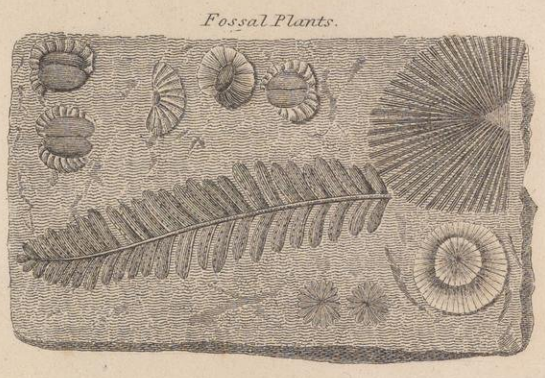
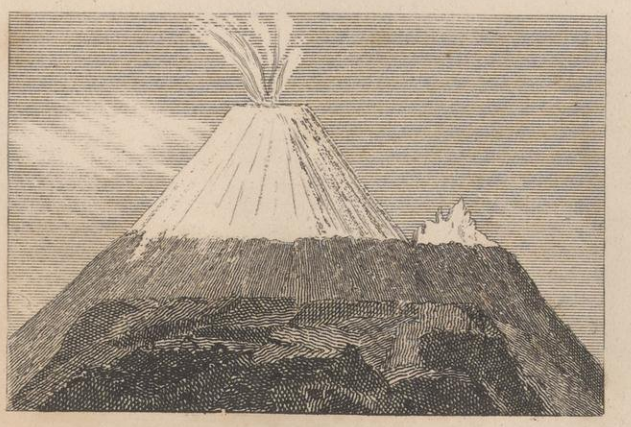
CHIMBORAZO the loftiest Peak of the ANDES.

Fossal Animal.



Fossal Plants.

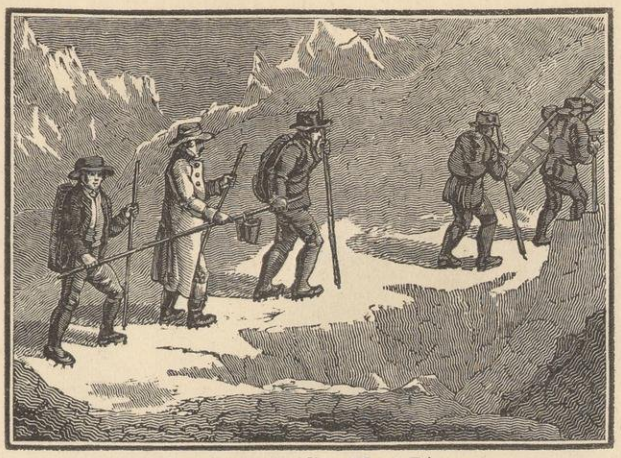




The Volcano of COTOPAXI in the ANDES.

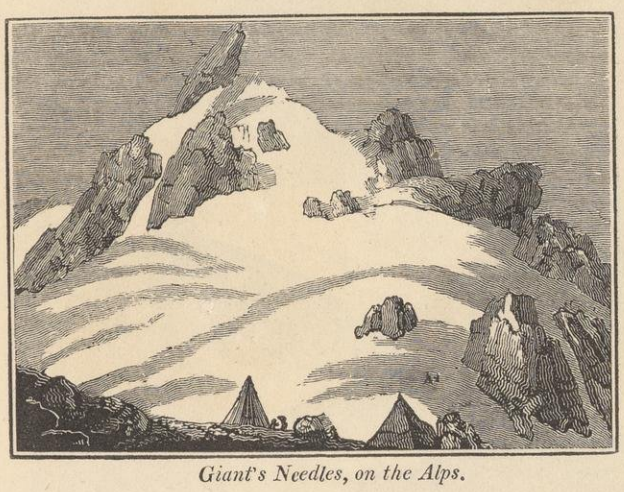
Fossal Marble.

MOUNTAINS.

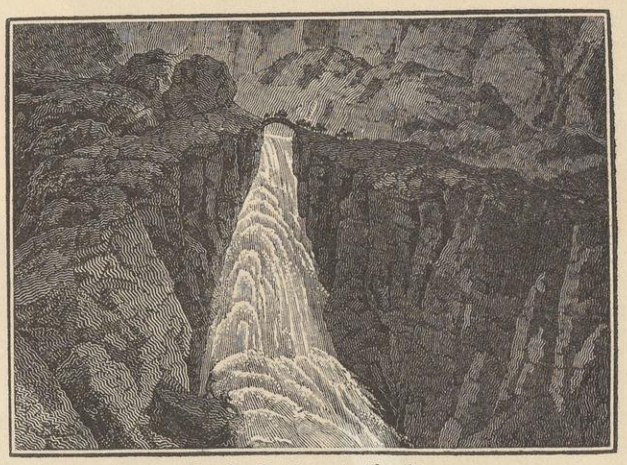


Saussure ascending Mont Blanc.

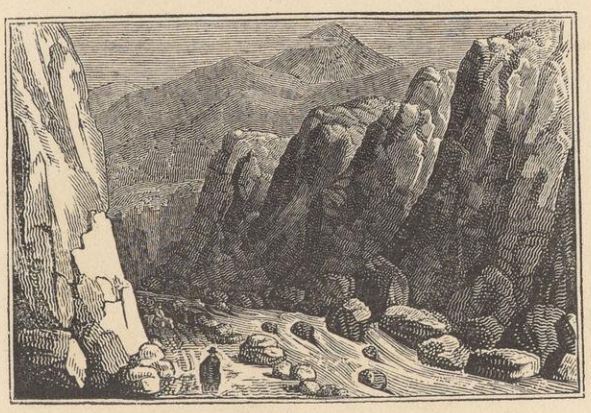
Glaciers of Miage.



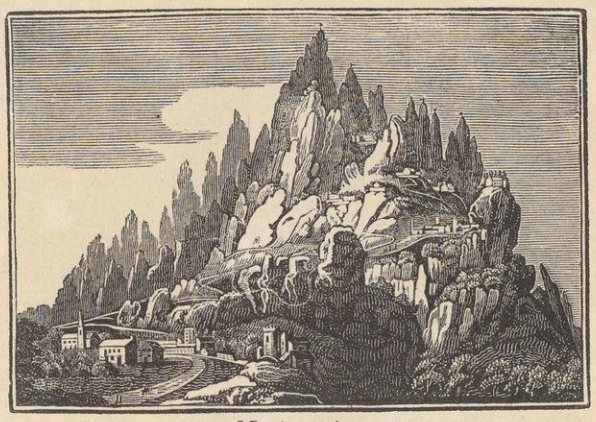
Giant's Needles, on the Alps.



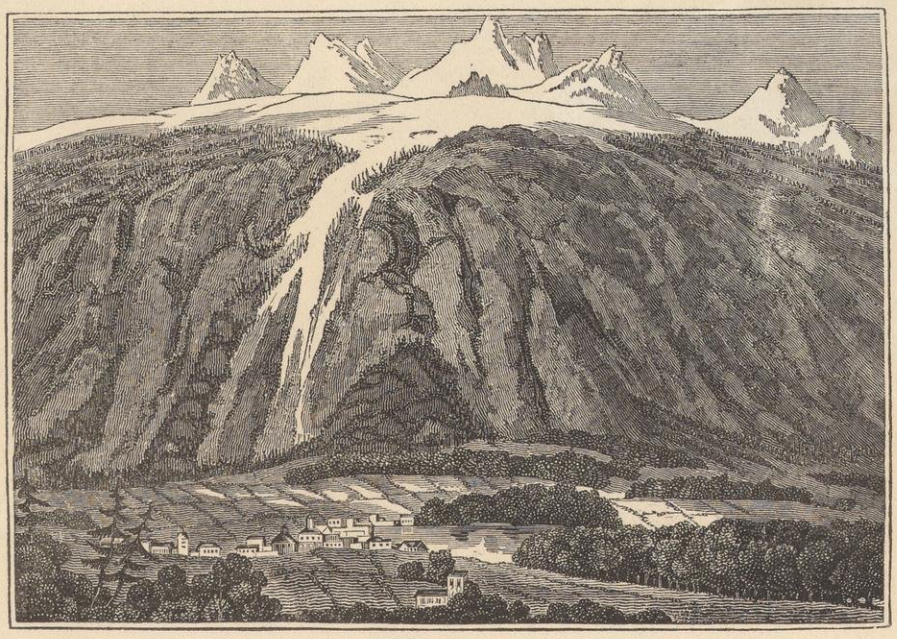
Devil's Bridge, in the Alps.



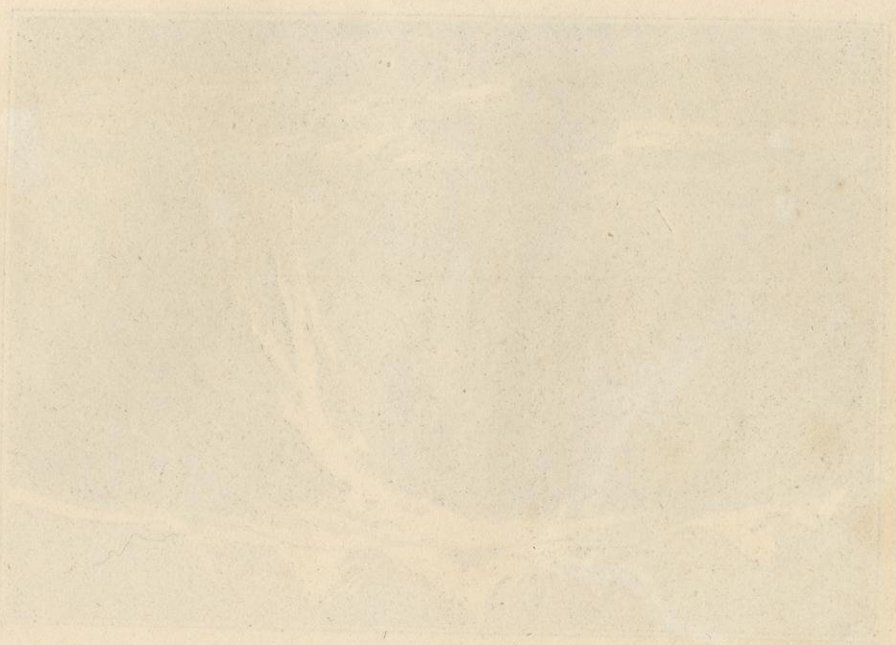
Snowdon.

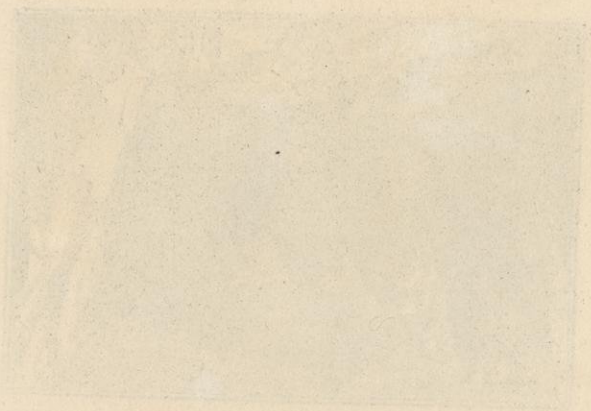


Montserrat.



Chamouni.





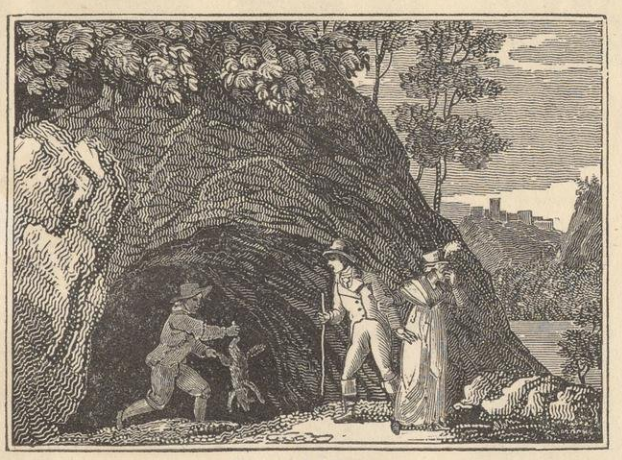
WESTERN HEMISPHERE

EASTERN HEMISPHERE

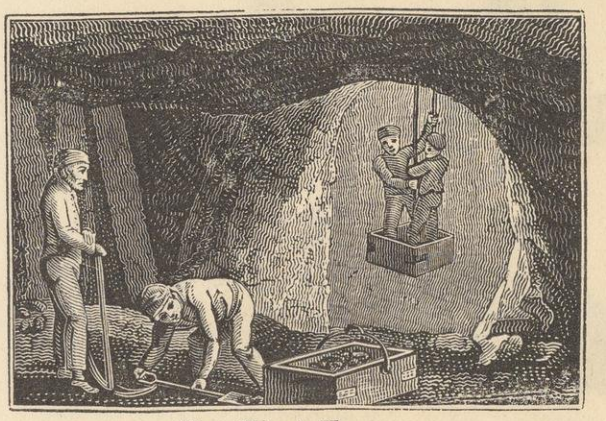
COMPARATIVE HEIGHT OF PRINCIPAL MOUNTAINS.

PHILOSOPHY OF MOUNTAINS.

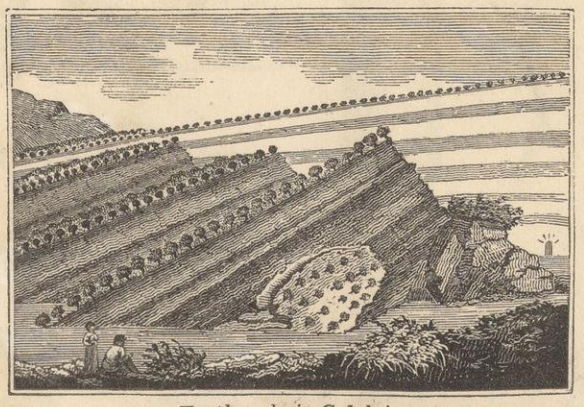
Scale of Yards	Dist. at which the Mountns. are visible in Miles.	HEIGHTS Measured in different Parts of the Globe.	CULTURE OF SOIL on THE ANDES.	Decrease weight indicated by the oscillation of a pendulum in a vacuum.	Colour of the sky by Cyanometer.	Humidity of the air by Saussure's hygrometer.	Height of Barometer.	Temperature in Maximum and Minimum, of the Centigrade Thermometer.	Chemical Composition of the Atmospheric Air.	Inferior limit of the Perpetual Snow, under different Latitudes.	SCALE of ANIMALS.	GEOLOGICAL VIEWS.	Intensity of the Light in the Air.
8500		Himaylayas.					11·884					The nature of rocks appears, in general, independent of differences of latitude and height. But in considering for a small part of the globe, the order of superposition of rocks, one discovers that in each region the inclination and direction of their beds, has been determined by a system of particular forces. It is known that there exist certain local laws, according to which are raised the different formations under the level of the sea.	
		Elevation of small fleecy Clouds.		99889638									
7000													
	195	Top of Chimborazo, 21,921 feet.					12·691	Regions too little frequented to know the mean temperature, which nevertheless appears to be below zero. At 18,200 ft. the thermometer sometimes at 1°.	The quantity of oxygen in the atmosphere about the same in these high regions as in the plains.	The air drawn from snow water contained 0·287 of oxygen.			
		Top of Cayamba,		99905404									0·9164
6500		Top of Antisana,									The condor of the Andes, some flies and sphinx fluttering in the air, perhaps raised into this region by the ascending currents.		
		Top of Cotopaxi,											
		Top of Mount St. Elia, 18,541 ft.			44°		13·571						
6000	186	Top of Popocatepetel, 18,131 ft.											
		Top of OrizazaPeak, 17,856 ft.		99921170			14·488						
	176	Volcano of Tungurahua, 16,718 ft.	No cultivation.							Perpetual snow about the Equator, from the 3° of N. & S. lat. at 16,500ft. without variations of 250 ft. Perpetual snow at 20° N. lat. at 13,500 ft. but it descends in winter to 12,000 ft.	Numerous flocks of Alpacca and Guanacha sheep. Some bears, condor, falcons.		0·9047
5500		Top of Rucu Sinchincha, 16,423 ft,	Pasturage for Lamas, sheep, oxen, and goats.					From 66° mean temperature, to 39°. Snow falls to 14,700 ft.	But the proximity of volcanoes may sometimes on the high tops of the Andes, modify the composition of the air.			The equatorial plains, on the contrary, that are between the eastern point of the Andes and the coasts of Brazil, about 700 leagues in length, are but from 250 to 700 feet above the level of the ocean.	
		Mount Blanc, 16,118 ft.			38°	54°	15·45						
	168	Mount Rosa, 15,432 ft.										All the formations scattered over the rest of the globe, are found re-united under the Equator. Their relative age, manifested by their order of superposition, is in general the same as those under the temperate zones.	
5000		Finsterahorn, 14,395 ft.											
		Petrified shells at Huancavelica, 14,192 ft.					16·436						
	157	Farm inhabited by Antisana, 13,520 ft.		99936936									0·8922
4500		Gross Glokner (in Tyrol) 12,871 ft.	Potatoes, olluco, tropæolum, esculenium; no wheat, beyond 10827 feet.								Lamas run wild on the western declivity of Chimborazo; little bears with white faces, great stags, the little lion, some humming birds, many fleas.		
	147	City of Micuipampa, 11,752 ft					17·518	From 32 to 68°. Mean temperature 488. Much hail—sometimes bynight.		Perpetual snow below 35° N. lat. at 11,500 ft.			
		Peak of Teneriffe, 11,424 ft.			32°	65°							
		Mount Perdu, 11,367 ft.											
4000		Etna, 10,936 ft.											
		Chief Rock of Marbore, 10,448 ft.	Barley.				18·626		The quantity of hydrogen contained in the atmospheric air is less than two thousandthparts. Nor is there found more of hydrogen at 23,660 ft. than at the level of the sea.	Perpetual snow below 40° lat. at 10,500 ft.			
	137	Watsmann, 9,638 ft.		99952702									0·8787
		Canigou, 9,113 ft.					19·831						
3500		St. Gothard, top of Pettine, 8,920 ft.	Wheats of Europe, Triticum, Hordeum Avena,					From 34 to 74°5. Mean temp. 66° Much hail, fogs frequent to a small height.		Perpetual snow below 5° lat. at 8000 ft.; on the Pyrennees, at 7500; ft.; in Switzerland, at 9000 ft.; upon the separate cones, at 8600 ft. But if at the tops of mountains beyond 10,500 ft., few phenomena constant in the variable zone. Below the Equator, it is seen to snow at 13,500 ft. At Mexico, under the 19° lat., it falls at 6500 ft. Perpetual snow under the 75° N. lat.	Pole-cats, tigers, large stags, palamedea, abundance of ducks and sea fowl, plenty of lice (pedic. hum.)		
	125	Inferior limit of snows, in lat. 45°, at the height of 8,190 ft.	oats; no maize, potatoes, cotton; a few heads of sugar cane. Apples.		27°	74°	21·089						
3000		City of Mexico, 7,424 ft.											
		Bed of gem salt at St. Maurice, in Savoy, 7,166 ft.		99968468									
2500	112	Passage of Mount Cenis, 6,766 ft.	Coffee, cotton, sugar cane, less abundant. Above 5,694 feet. With great difficulty fruits mature. Peruvian erythroxylum, wheat.					From 54° to 86°. Mean temp. 70°. Hail rather rare, atmosphere often foggy.			Little stags, tapir, hogs, panthers, large monkeys, tropical birds, snakes, no crocodiles, plenty of gnats.		0·8640
		Mount D'Or, 6,176 ft.											
		City of Popayan, 5,750 ft.			22°	80°	22·354						
	97	Puy de Dome, 4,834 ft.											
2000		Vesuvius, in 1793, 3,919 ft.											
		——— 1805, 3,251 ft.											
	87	Broken, in the Hartz, 3,473 ft.		99984234									0·8478
		Volcano, of Hecla, 3,296 ft.					23·688				Monkeys, ounces, jaggors, blk. tigers, lions, cavey, sloths, swarms of ants, stags, armadillos, crax, boas, crocodiles, eleter, musquitoes, bats.		
1500								From 65° to 101°. Mean temp. 77°5. Hail. The hour-glass often at 52°.	The atmospheric air contains 0·21 oxygen, 0·787 hydrogen, and about 0·003 of carbonic acid. The maximum of these variations very seldom exceed one thousandth part of oxygen.				
			Sugar, indigo, cocoa, coffee, cotton, maize, atropha, Bananea, vines, milky achras.				25·91						
1000	56												
					18°	86°							0·8309
							26·587	The water of the sea at the surface near the Equator, out of the current at 82°5, but at the depth of 1300 ft. the sea is at the temp. of 46°. The tem. of the interior of the earth at the Equator is 72°.			Within the interior of the globe, are new species of dermestes, which live on the subterraneous plants.	The cordilleras of the Andes present above fifty burning volcanoes, which are distant from the sea from 120 to 150 miles and are most elevated and powerful; by the sides, no vomited lava flows, but pumice-stone, obsidium, porphyry, and basalt, scoria; and above all, the water on this burnt earth, within which is often enveloped a fish, (the pimelodas cyclopum).	
500													
Sea.	080000			10000000			28·15						0·8123



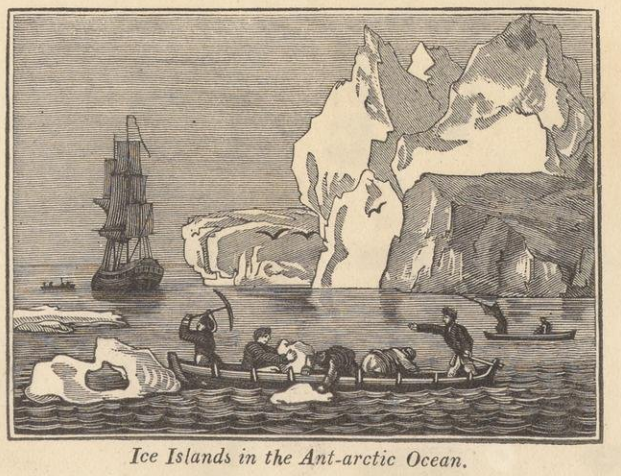
Grotto del Cane.



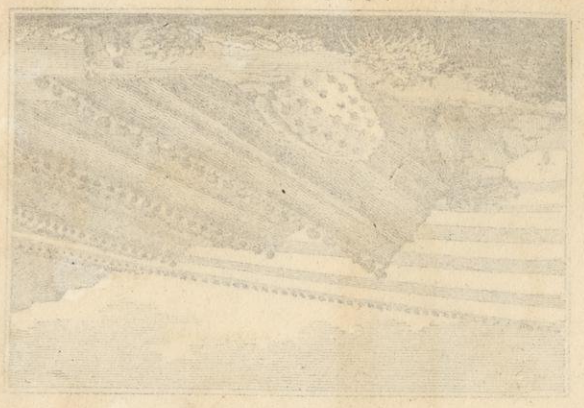
Silver Mine in Hungary.

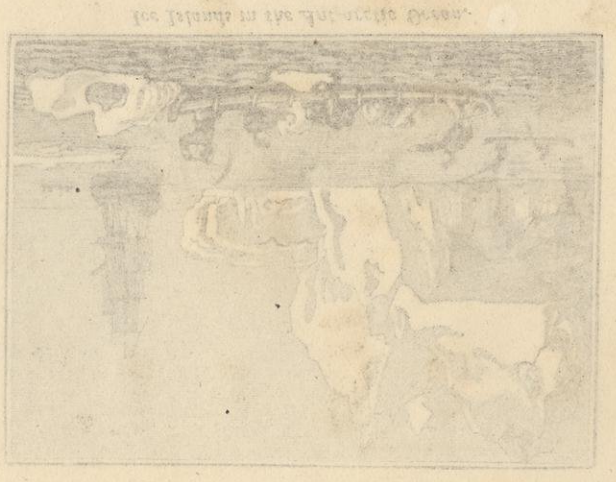


Earthquake in Calabria.



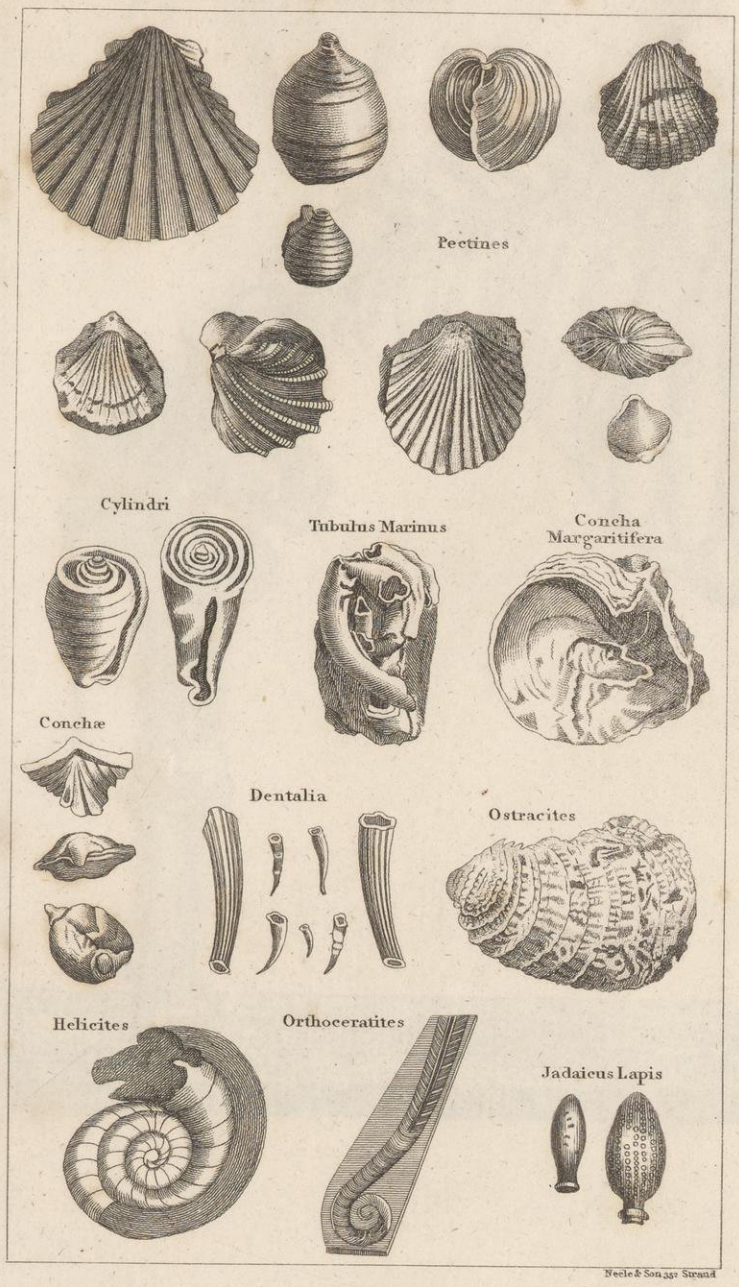
Ice Islands in the Ant-arctic Ocean.





PHILOSOPHY OF MOUNTAINS.

NATURE DISPLAYED.
Fossils, Shells &c.



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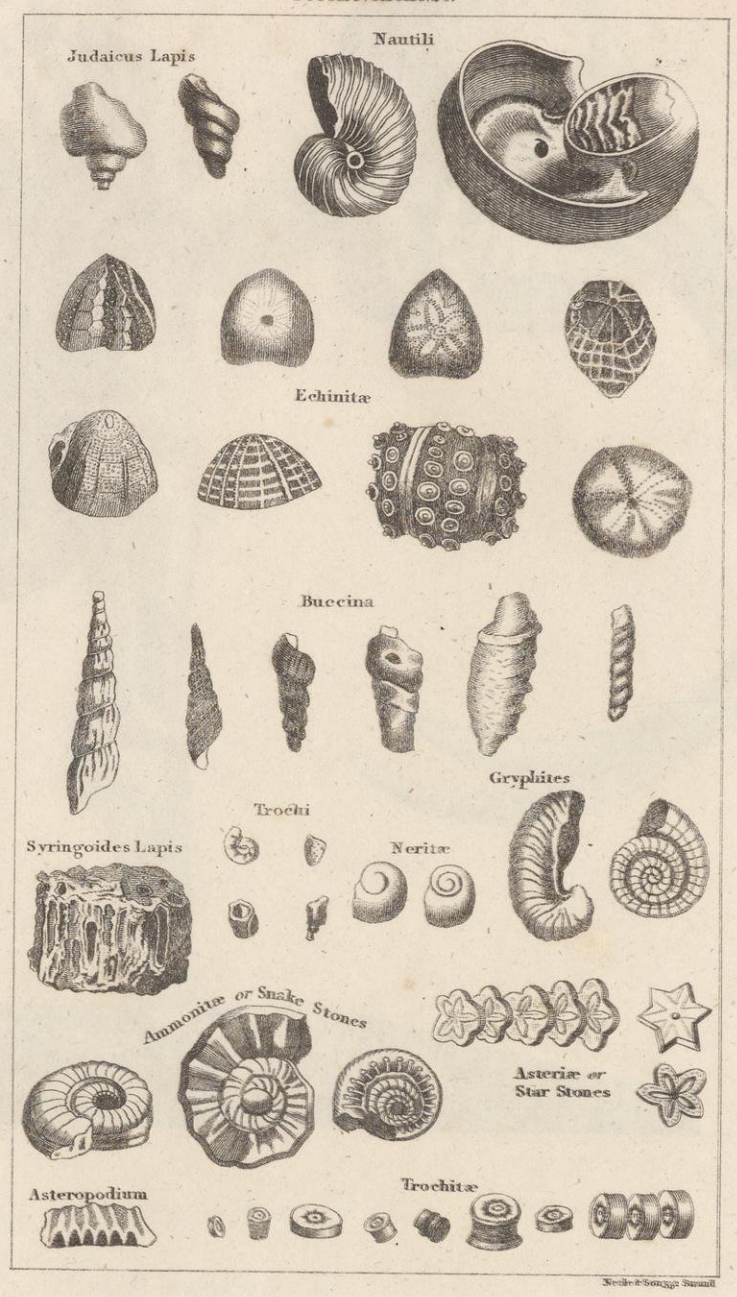
NATURE DISPLAYED.
Fossils, Shells, &c.



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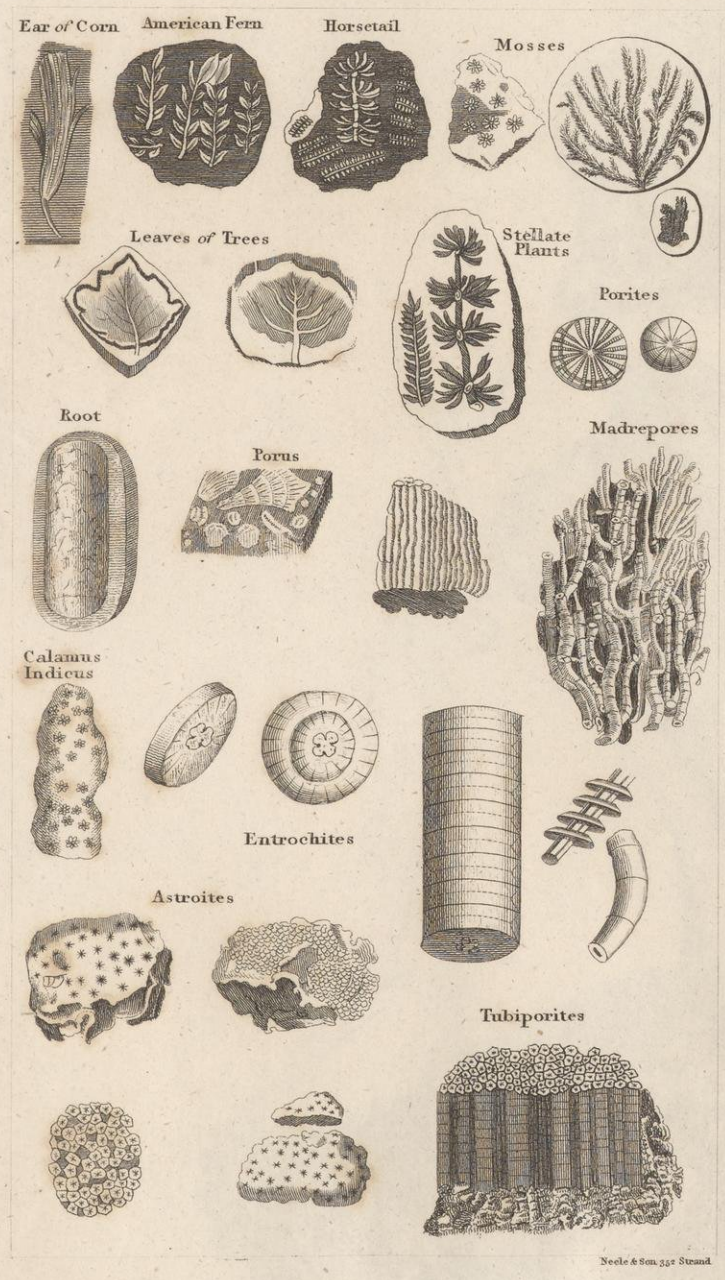
NATURE DISPLAYED
Fossils, Plants in Stone and Coral.



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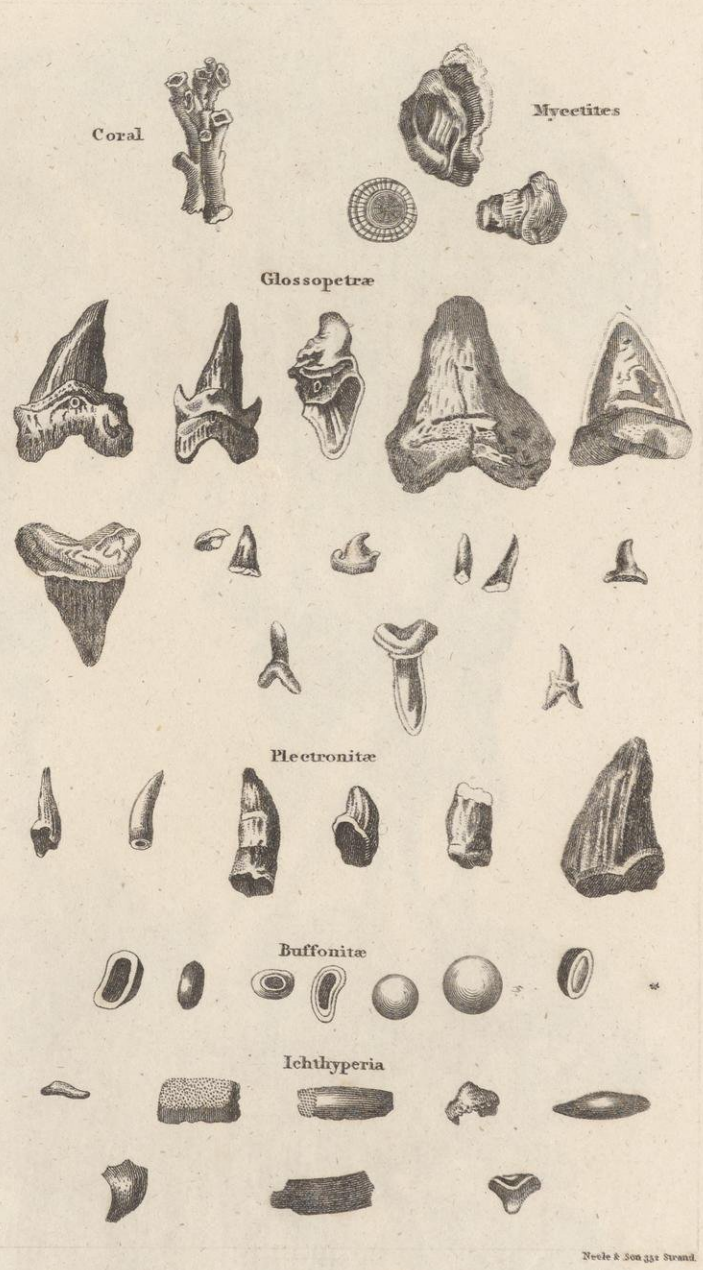
NATURE DISPLAYED.
Corals and Fishes Teeth.



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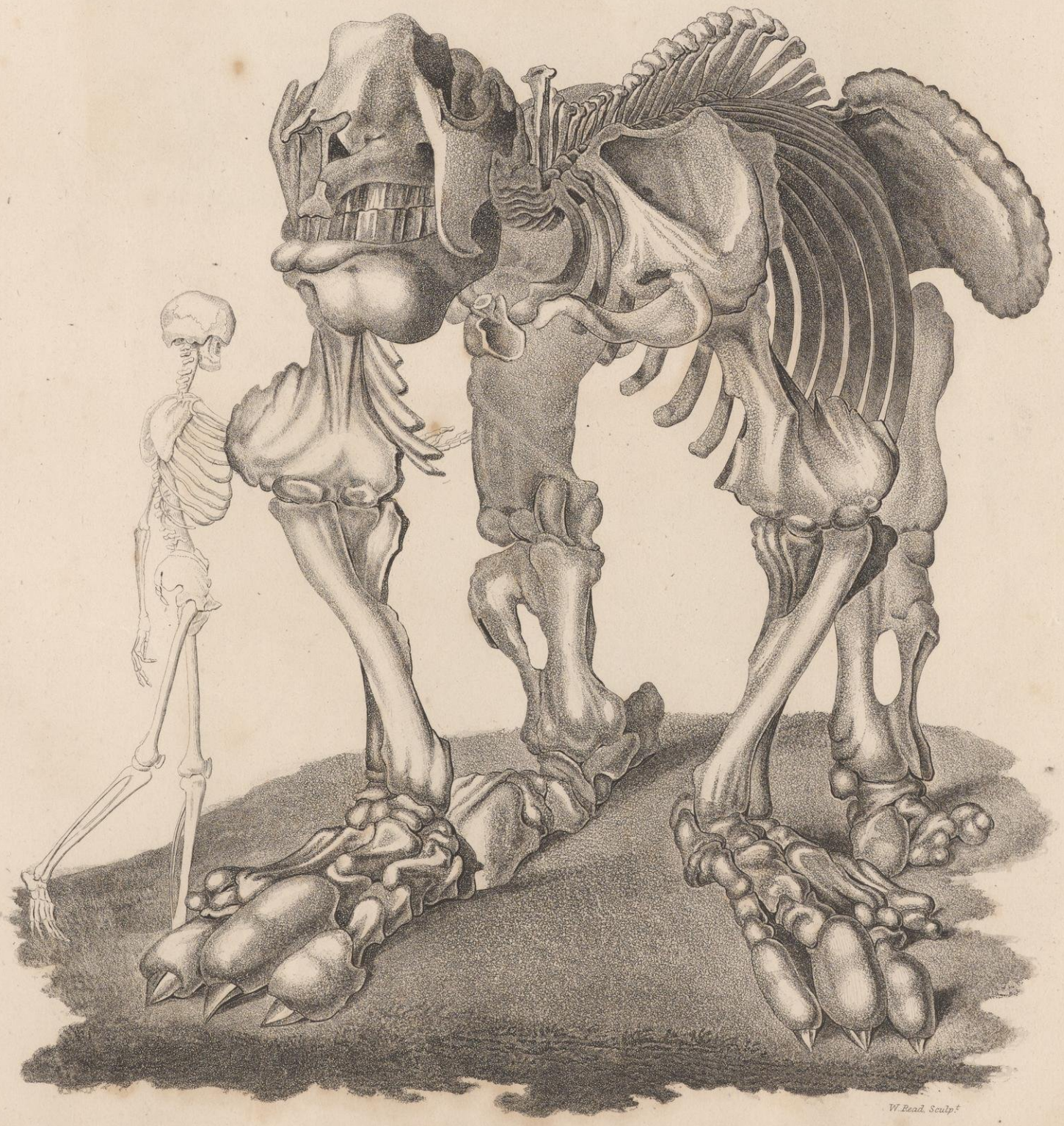
W. Read. Sculp.

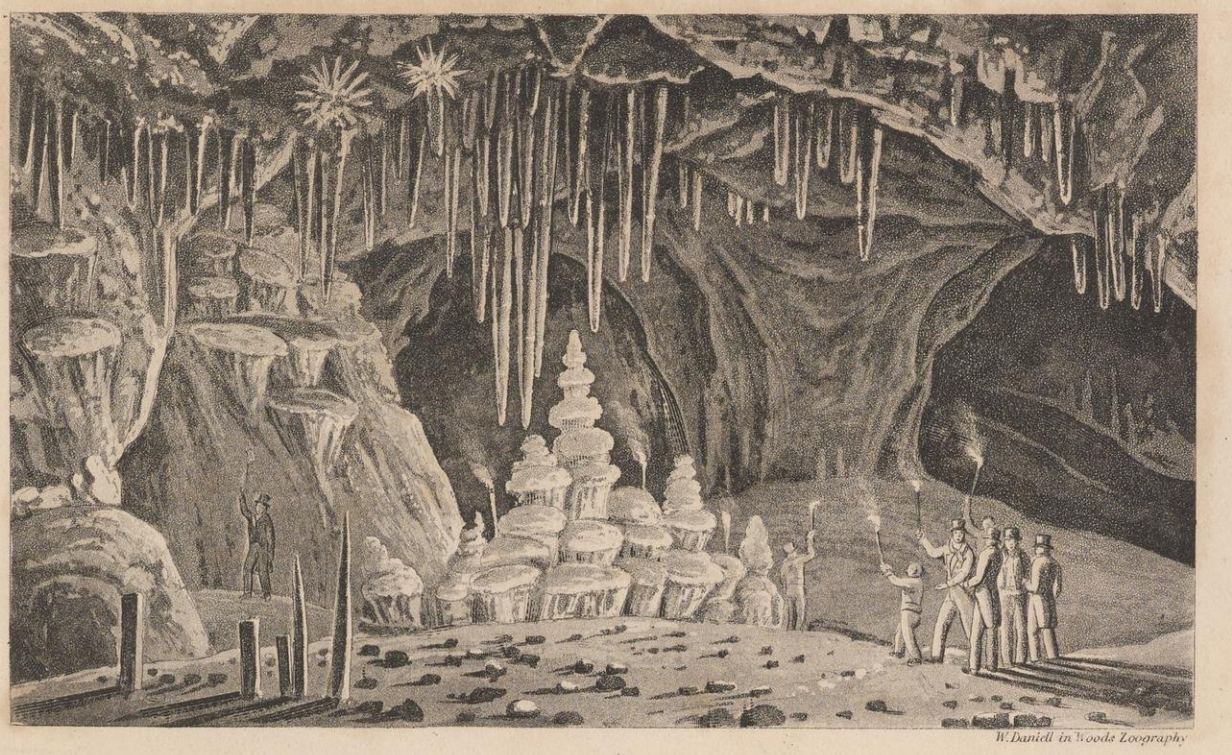
Skeleton of the Young Mammouth
in the Museum at Philadelphia.



Sup. Ency. Brit.

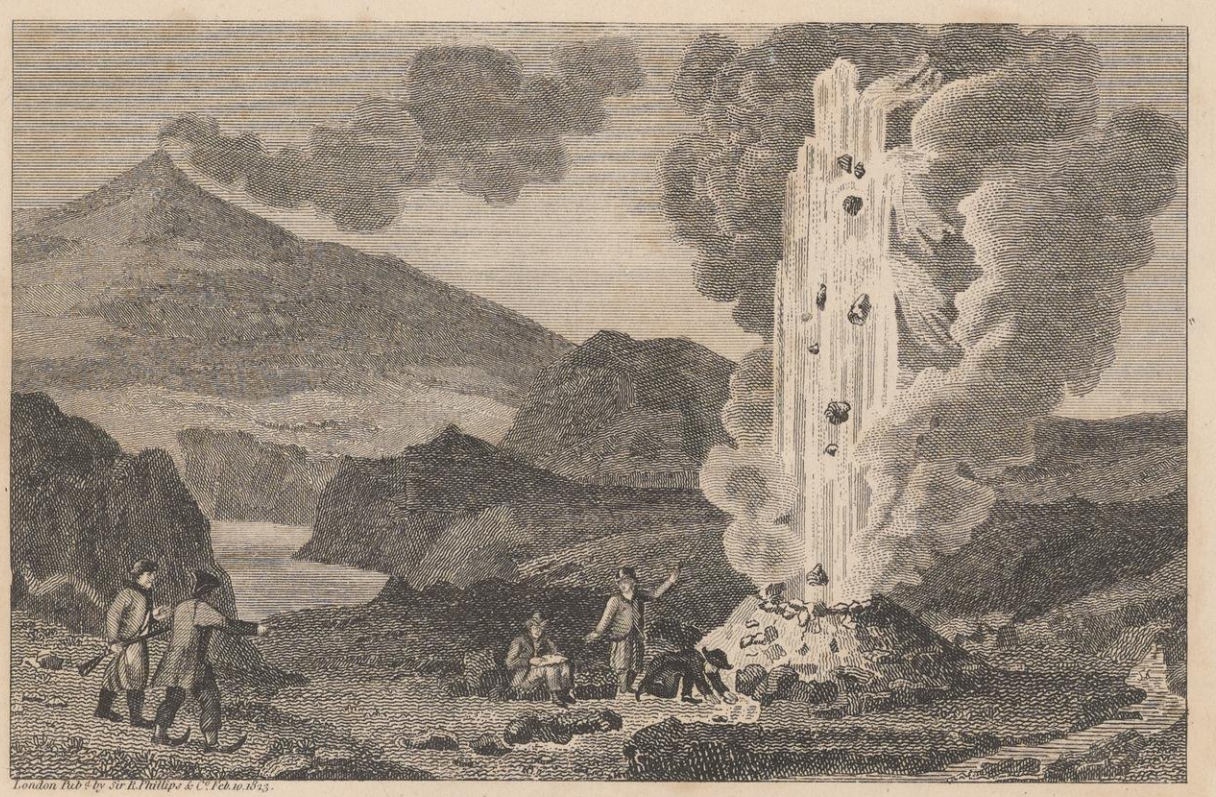
MEGATHERIUM OR SLOTH.

W. Read. Sculp.t



W. Daniell in Woods Looography

GROTTO OF ANTIPAROS.

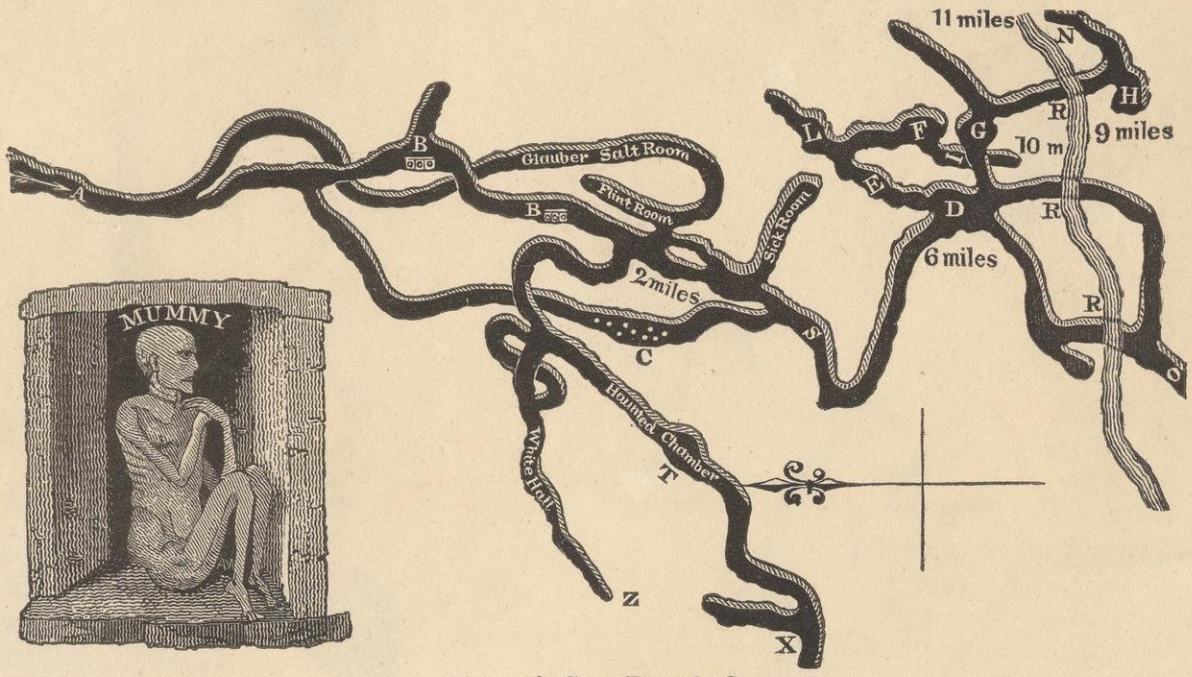


London Pub.d by Sir R. Phillips & C.o Feb.10 1823.

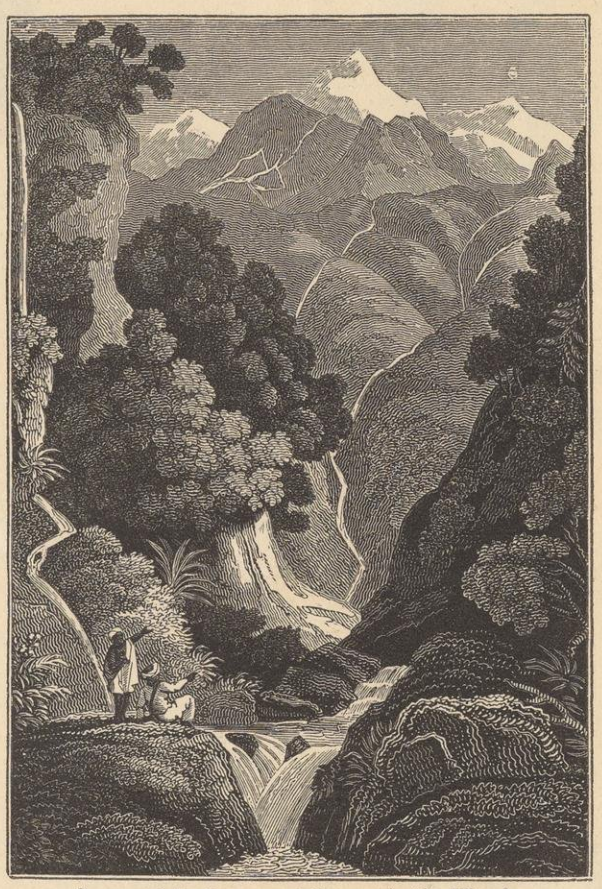
Mount Hecla and the Boiling Spring of Geyser.

Grand Cavern Derbyshire.

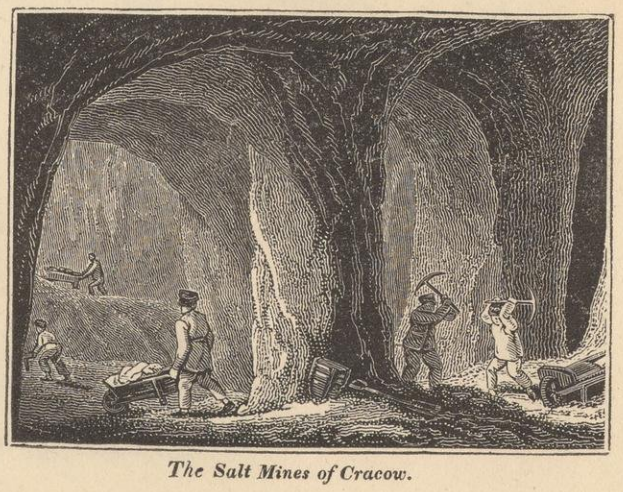
London Published by Sir R. Phillips & C.o Feb.10.1823.



Plan of the Great Kentucky Cavern.



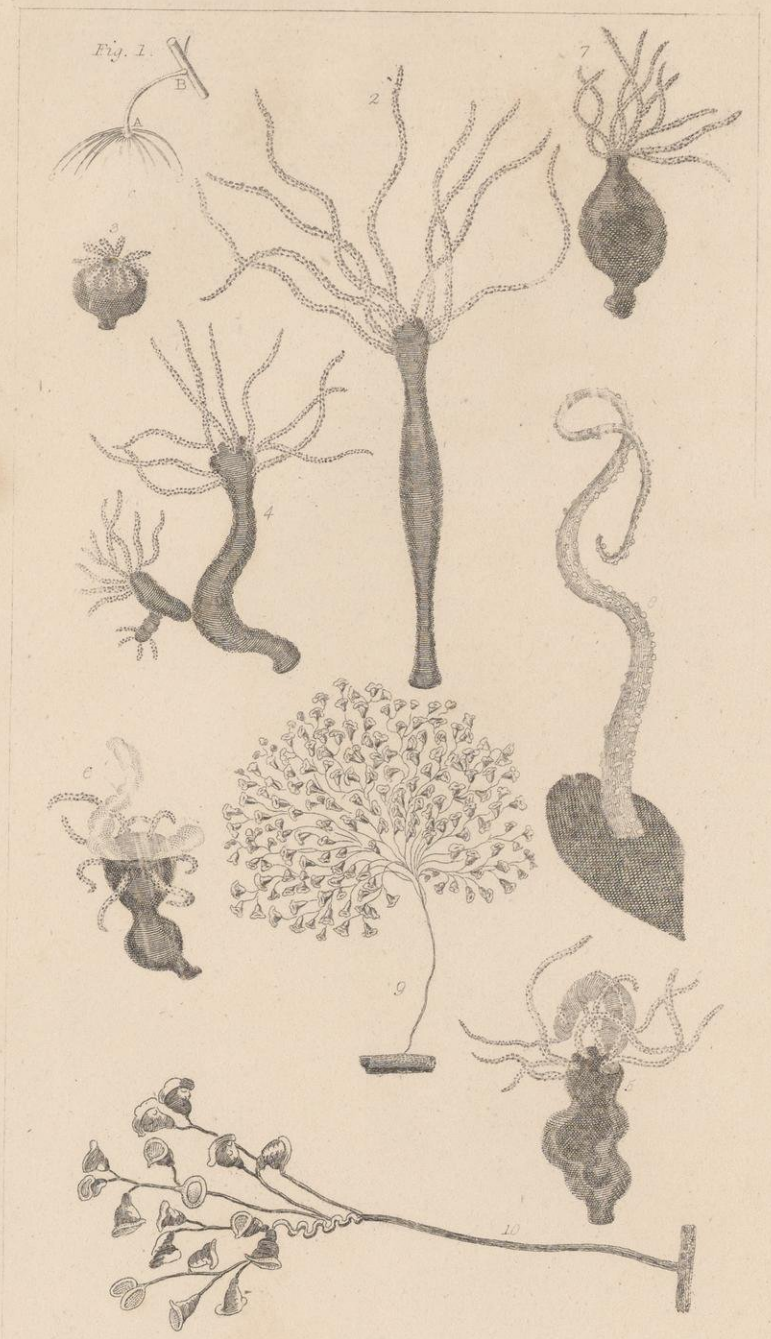
Source of the Jumna and Ganges, in the Himalayas.



The Salt Mines of Cracow.

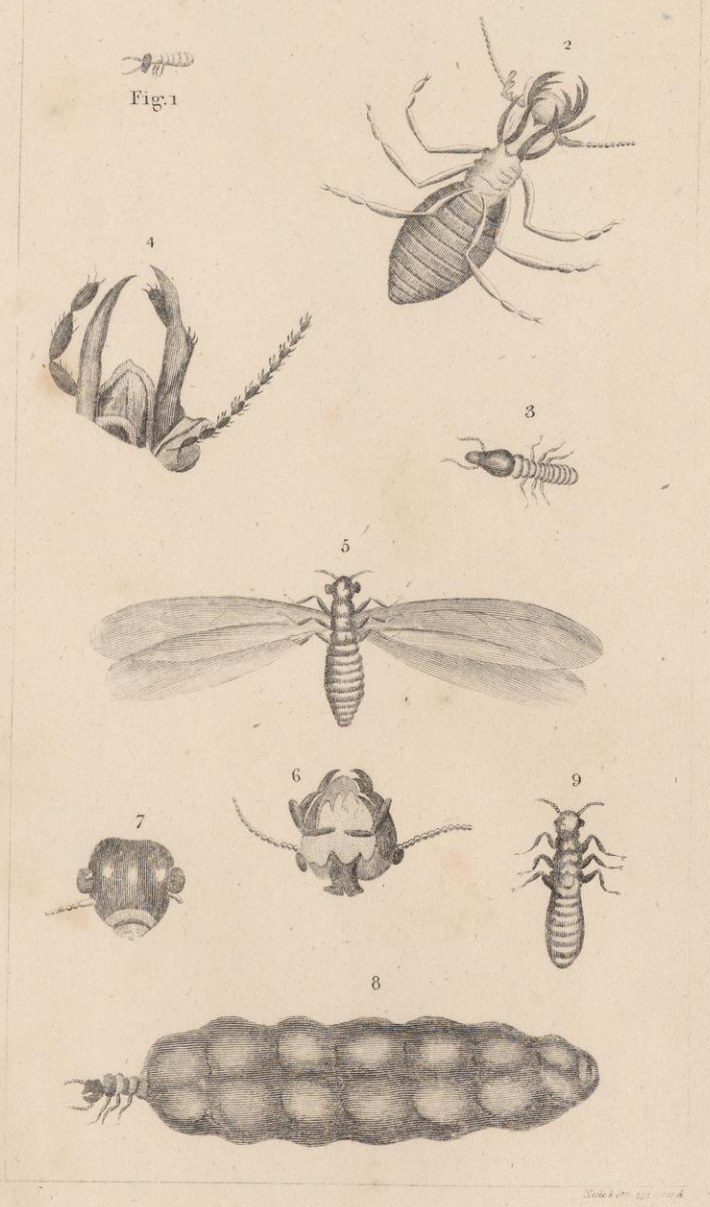
Devil's Peak, Derbyshire.

Forms of Polypi.

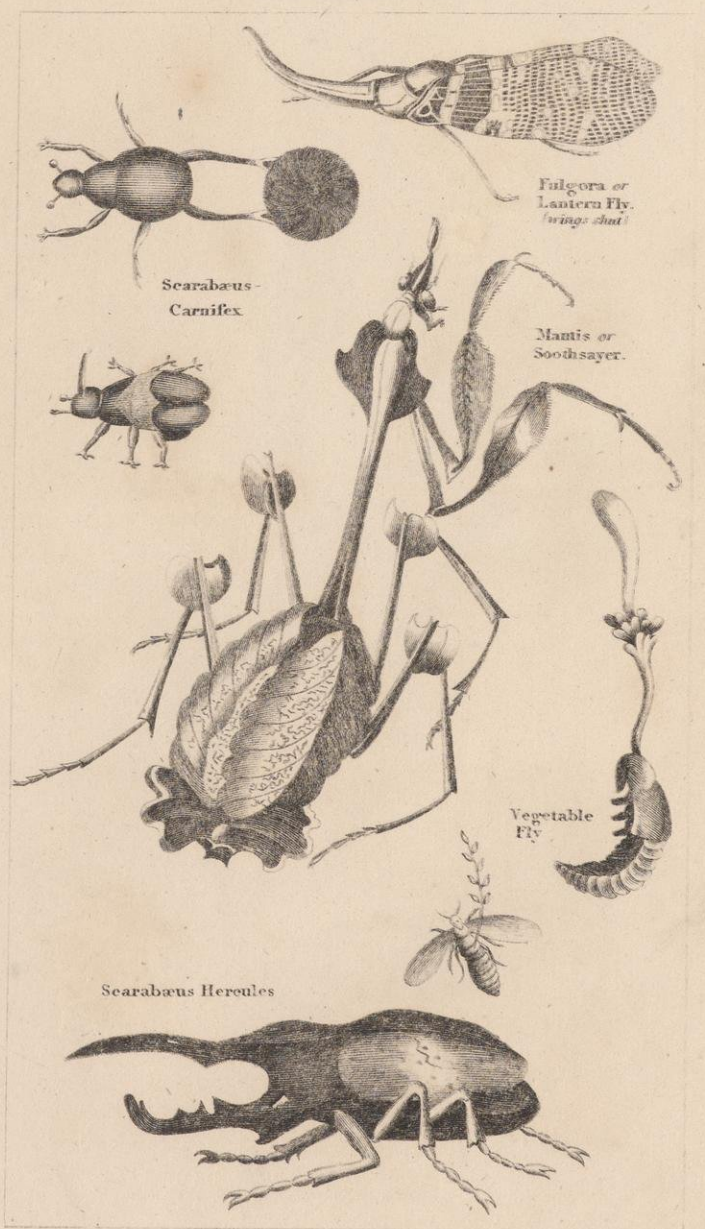


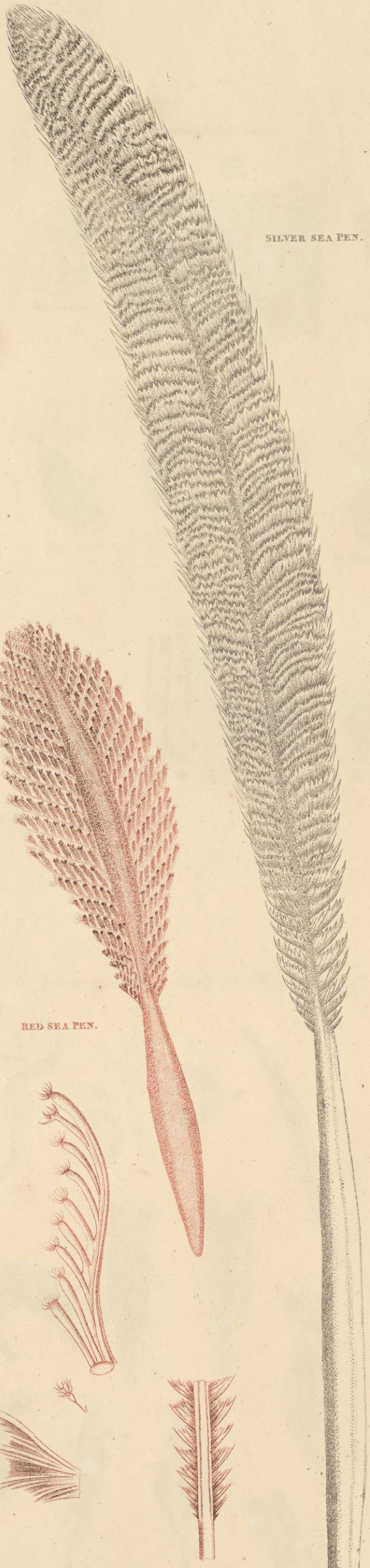
Polypi & their works.

TERMITES OR WHITE ANTS.



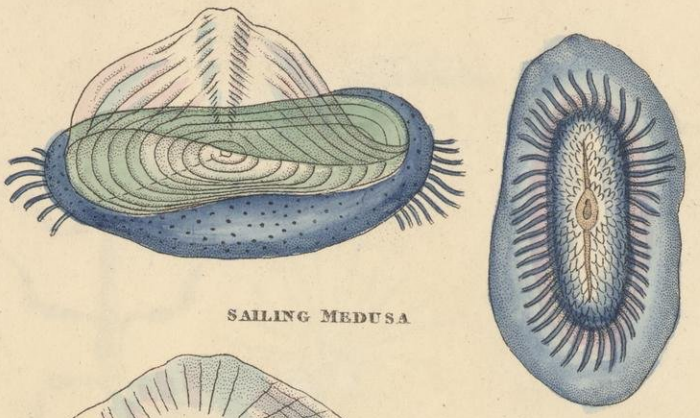
REMARKABLE INSECTS.



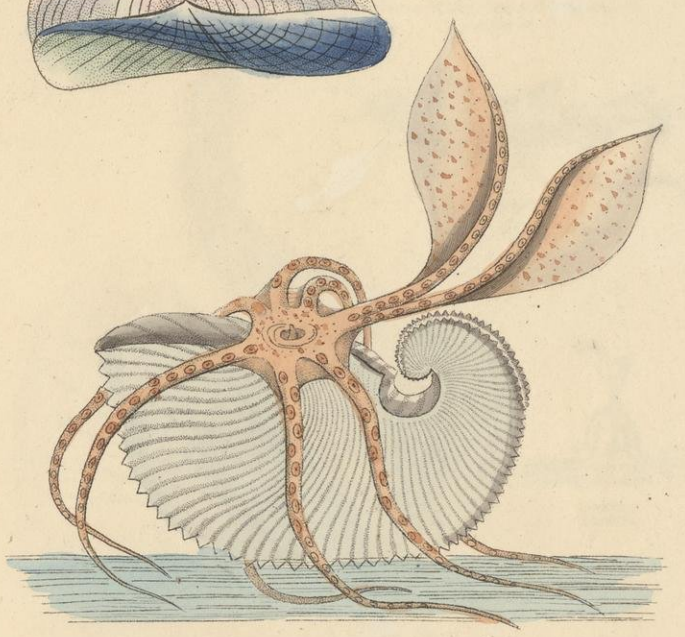


SILVER SEA PEN.

RED SEA PEN.



SAILING MEDUSA



ARGONAUT OR PAPER NAUTILUS.

CAMPANULATED TABULARIA.

London. Published by Sir R. Phillips & Co. Feb. 10. 1823.

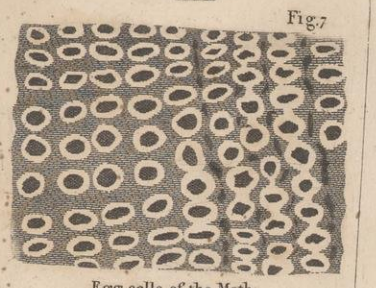
Neale. sc. 352 Strand.

Neale & Son 352 Strand.

Fig.1

Eels in Paste

Fig.7



Egg cells of the Moth.

Fig.4

Bell Flower Polype

Fig.2

Water Flea

Fig.8

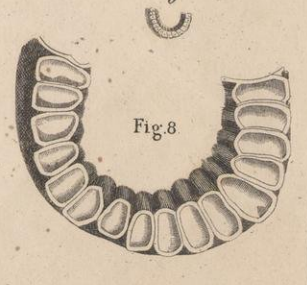


Fig.5

Bell Flower Colony

Fig.9

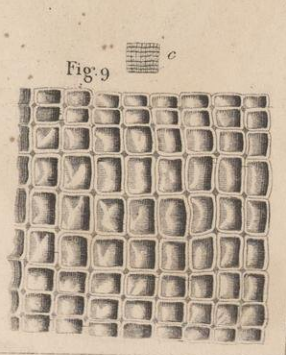
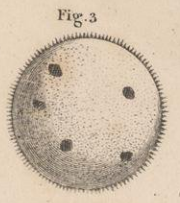


Fig.3



Globe Animal

Fig.6

Colonies dividing

Fig.1

Larva of the Musca Chamæleon

Fig.2

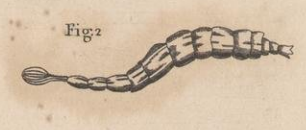
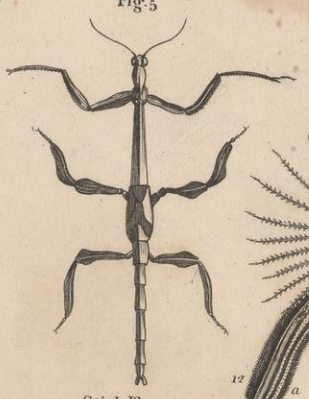
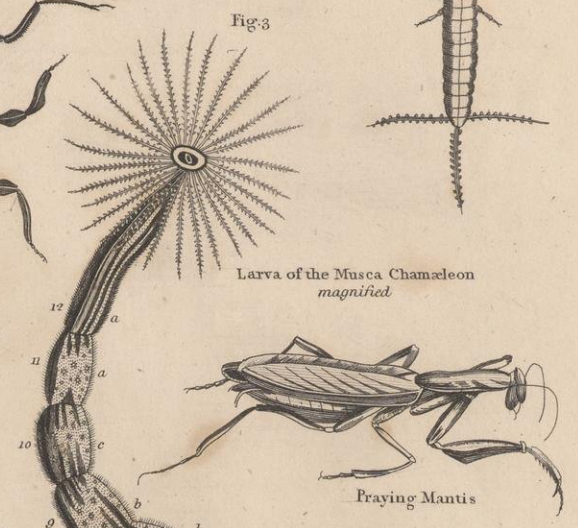


Fig.5



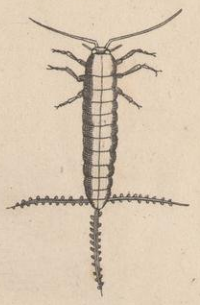
Stick Phasm

Fig.3



Larva of the Musca Chamæleon
magnified

Fig.6



Praying Mantis

Wing of an Earwig
magnified

Fig.4

Praying Mantis

Various forms of Animalculæ or Wheel Insects.

The Cossus or Willow Caterpillar.

Fig.1

Fig.3

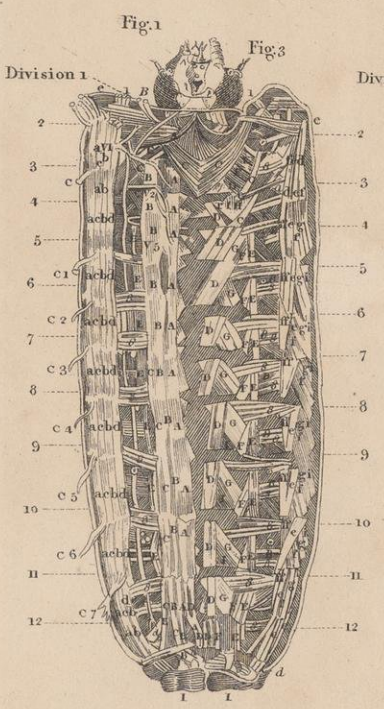
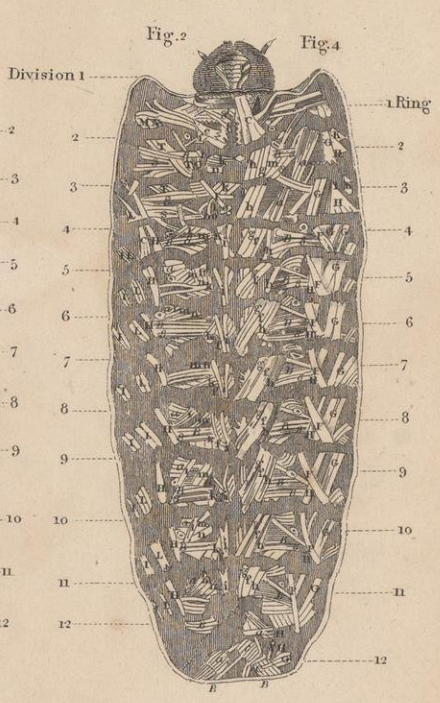


Fig.2

Fig.4



The Head and Body of the Cossus Caterpillar.

Fig.5

Fig.6

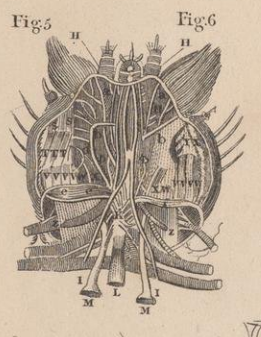
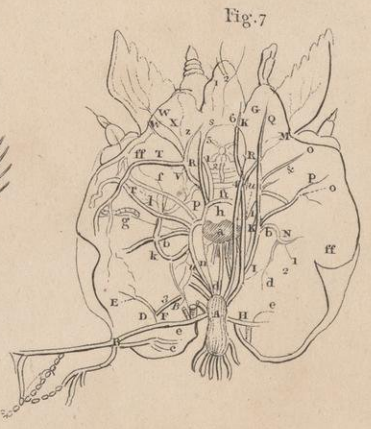


Fig.7



Cimex Striatus

Fig.1

Chrysomela Asparagi

Fig.2

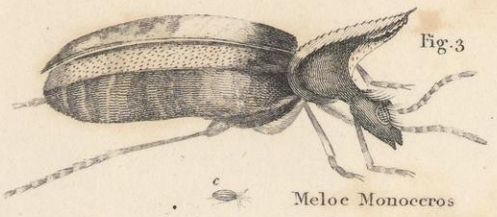


Fig.3

Meloe Monoceros

The magnified Wing of the Hemerobius perla

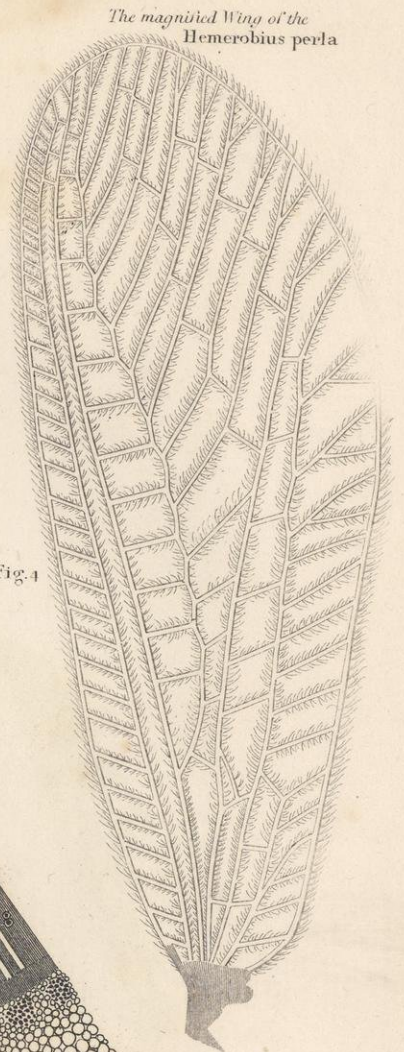
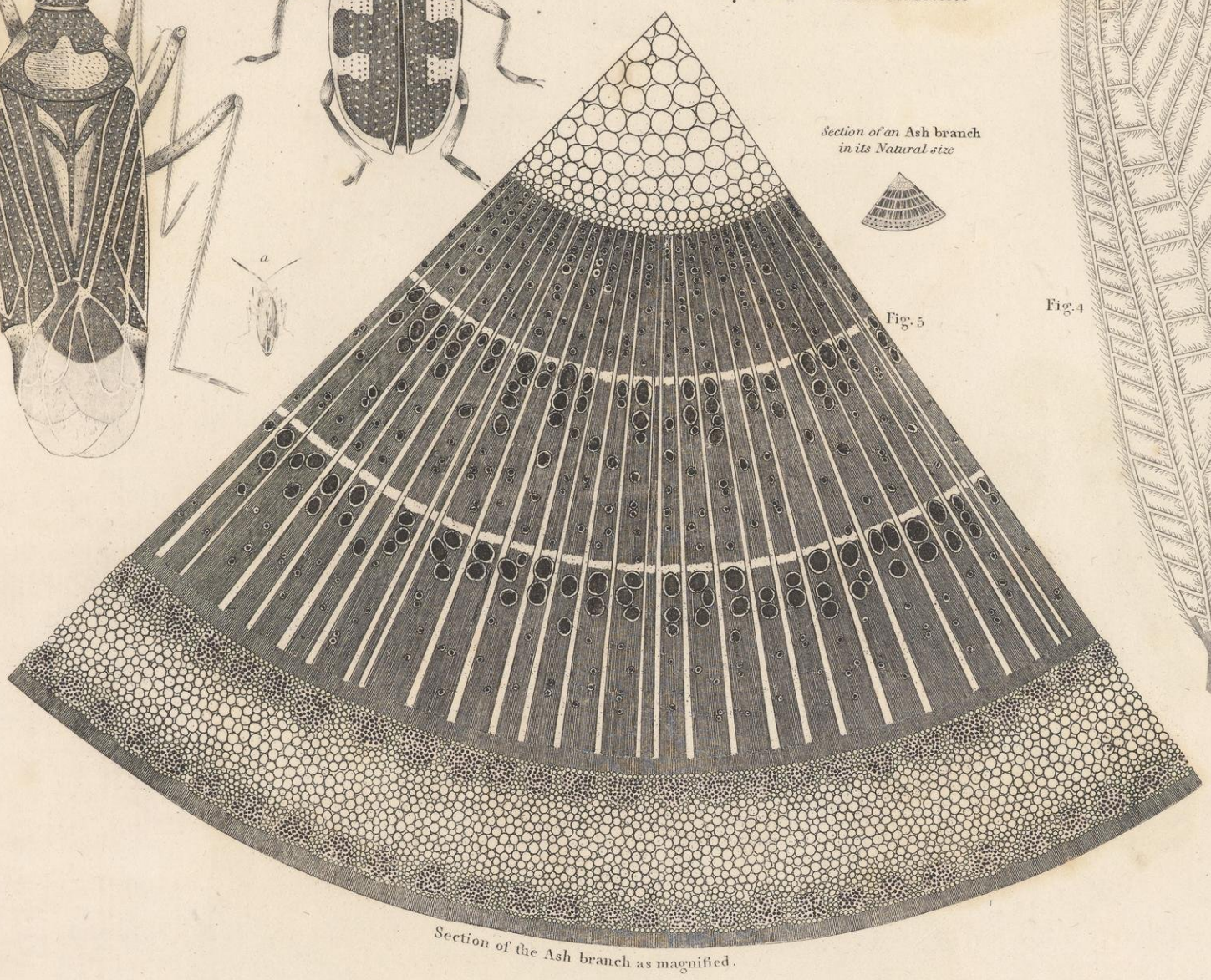


Fig.4

Section of an Ash branch *in its Natural size*

Fig.5



Section of the Ash branch as magnified.

Microscopic Views of Insects, &c.

VOL.II

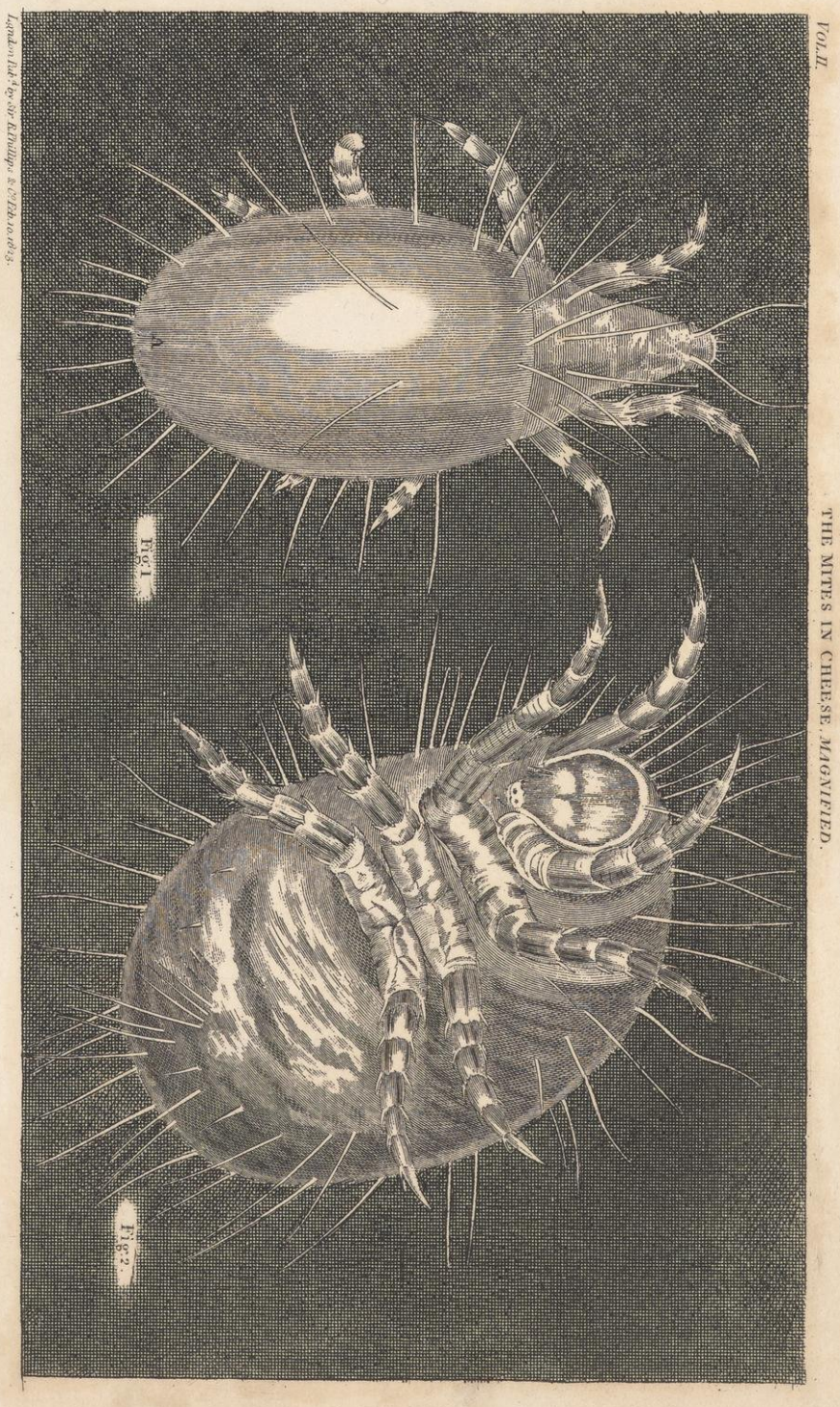
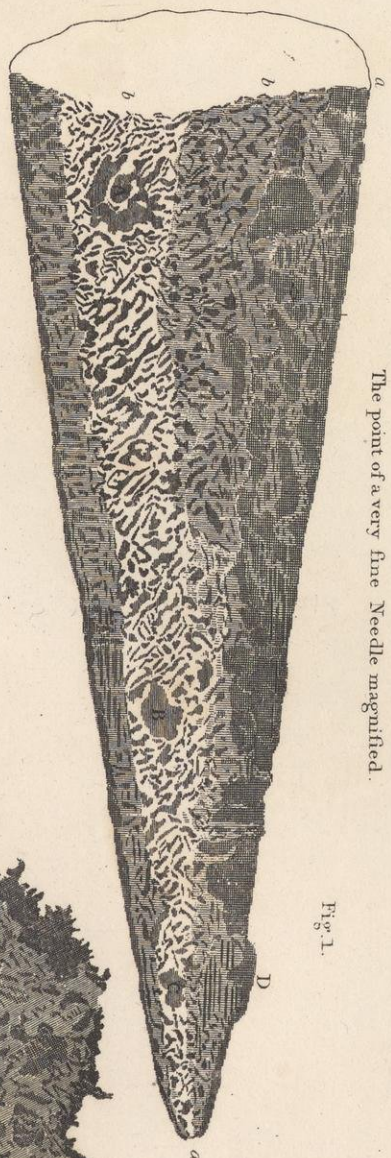


Fig.1.

Fig.2.

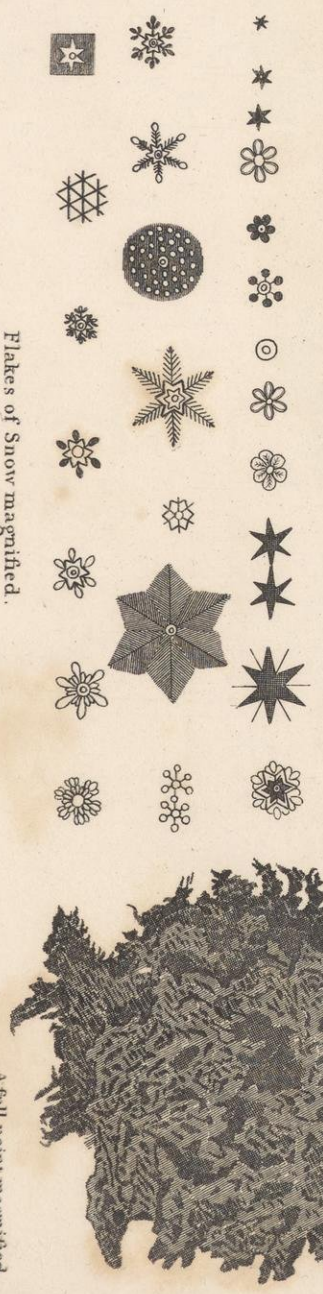
THE MITES IN CHEESE, *MAGNIFIED.*

VOL.II



The point of a very fine Needle magnified.

Fig.1.



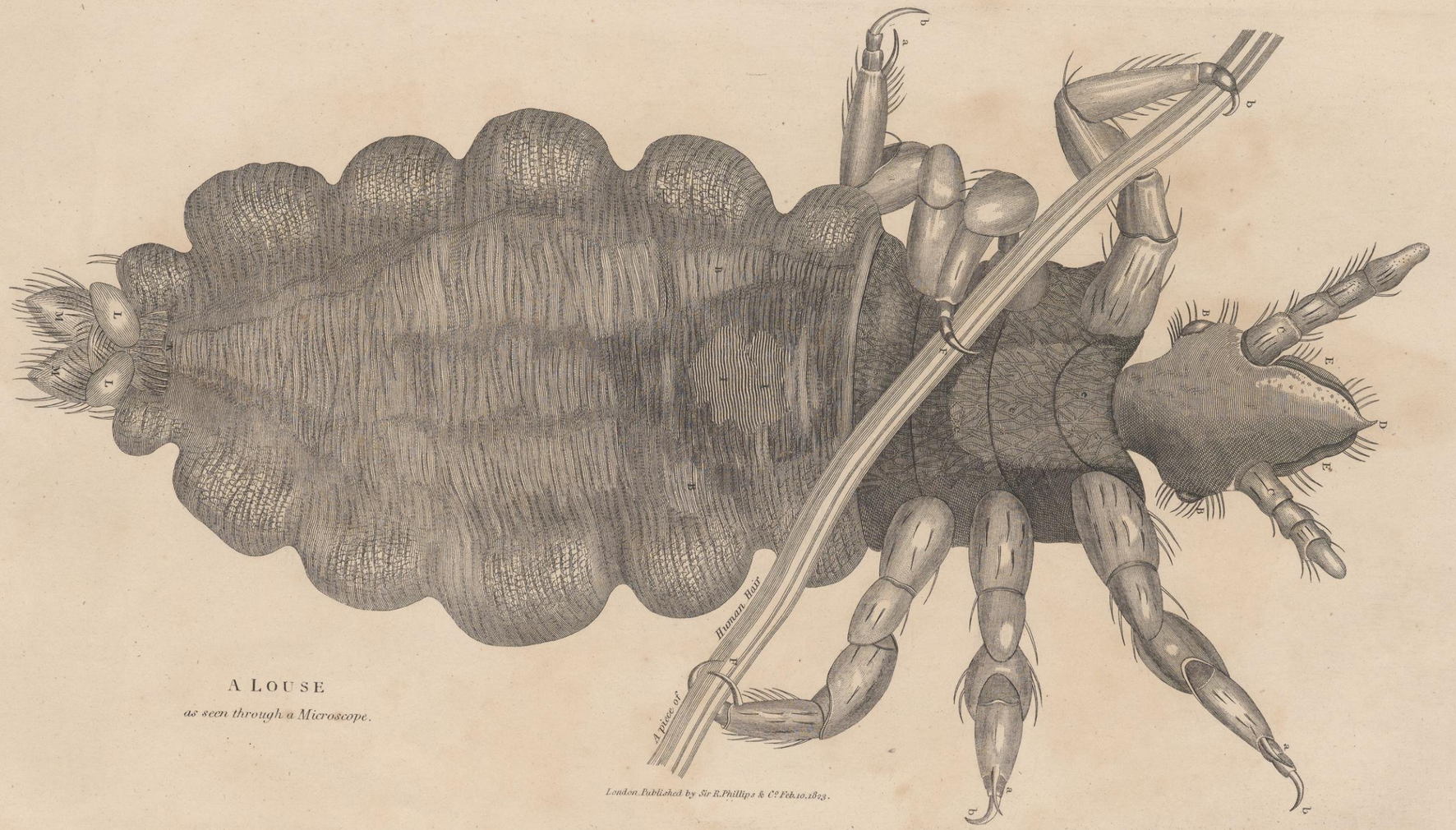
Flakes of Snow magnified.

A full point magnified

A FLEA

as seen through a Microscope.

London. Published by Sir R. Phillips & Co. Feb. 10. 1823.



A LOUSE

as seen through a Microscope.

London. Published by Sir R. Phillips & Co. Feb. 10. 1823.

THE BLUE BOTTLE FLY IN A MICROSCOPE.

Fig.1

The Leg and Foot of a Fly

Fig.3

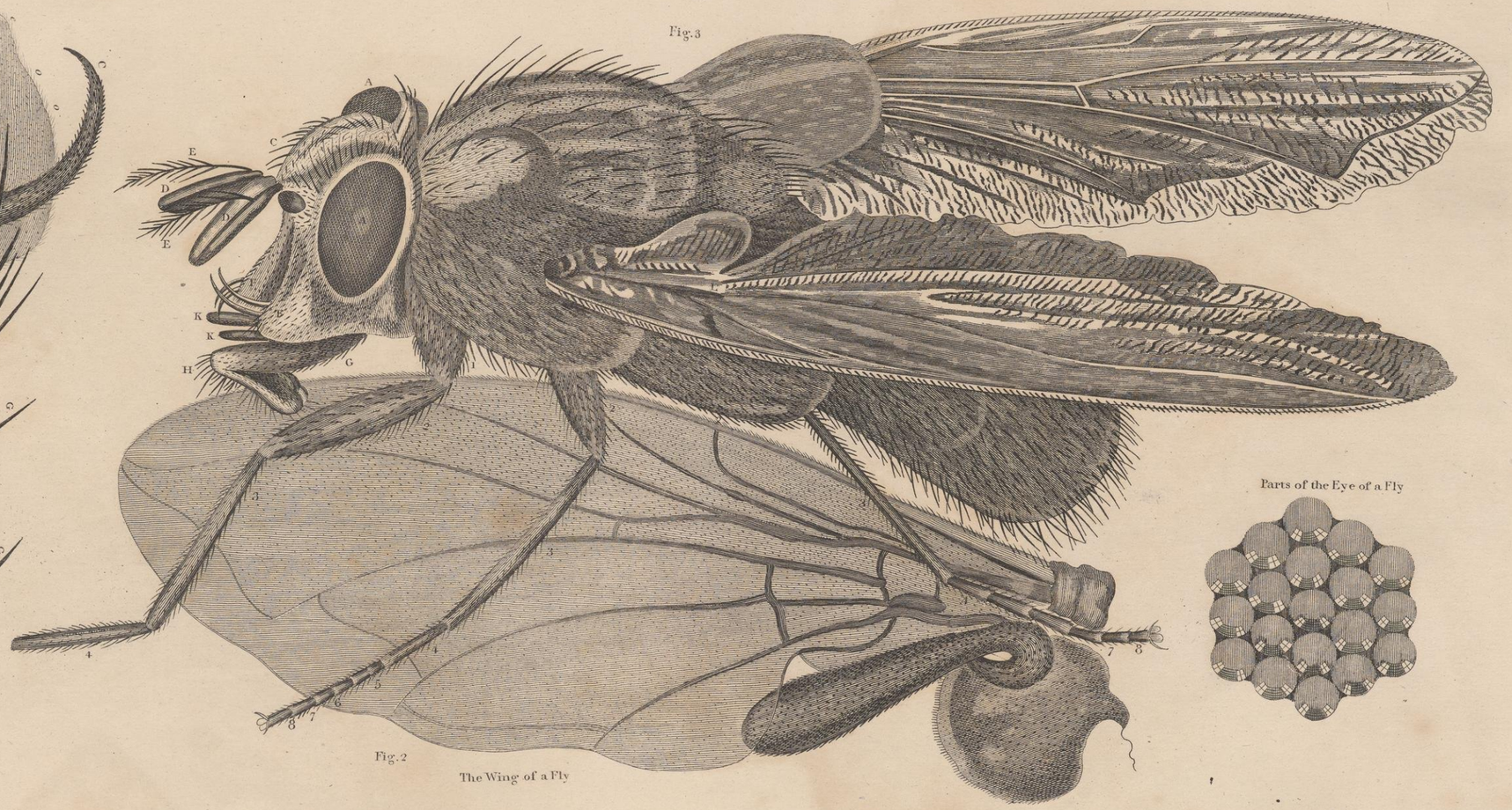


Fig.2

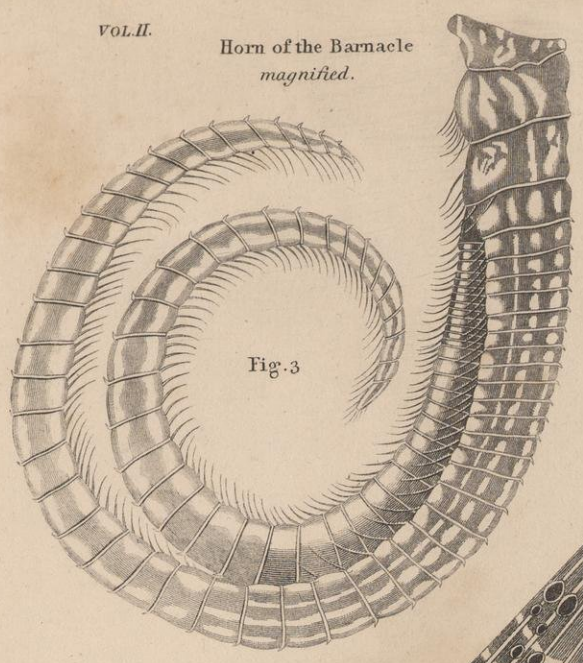
The Wing of a Fly

Parts of the Eye of a Fly

London. Published by Sir R. Phillips & Co. Feb. 10. 1823.

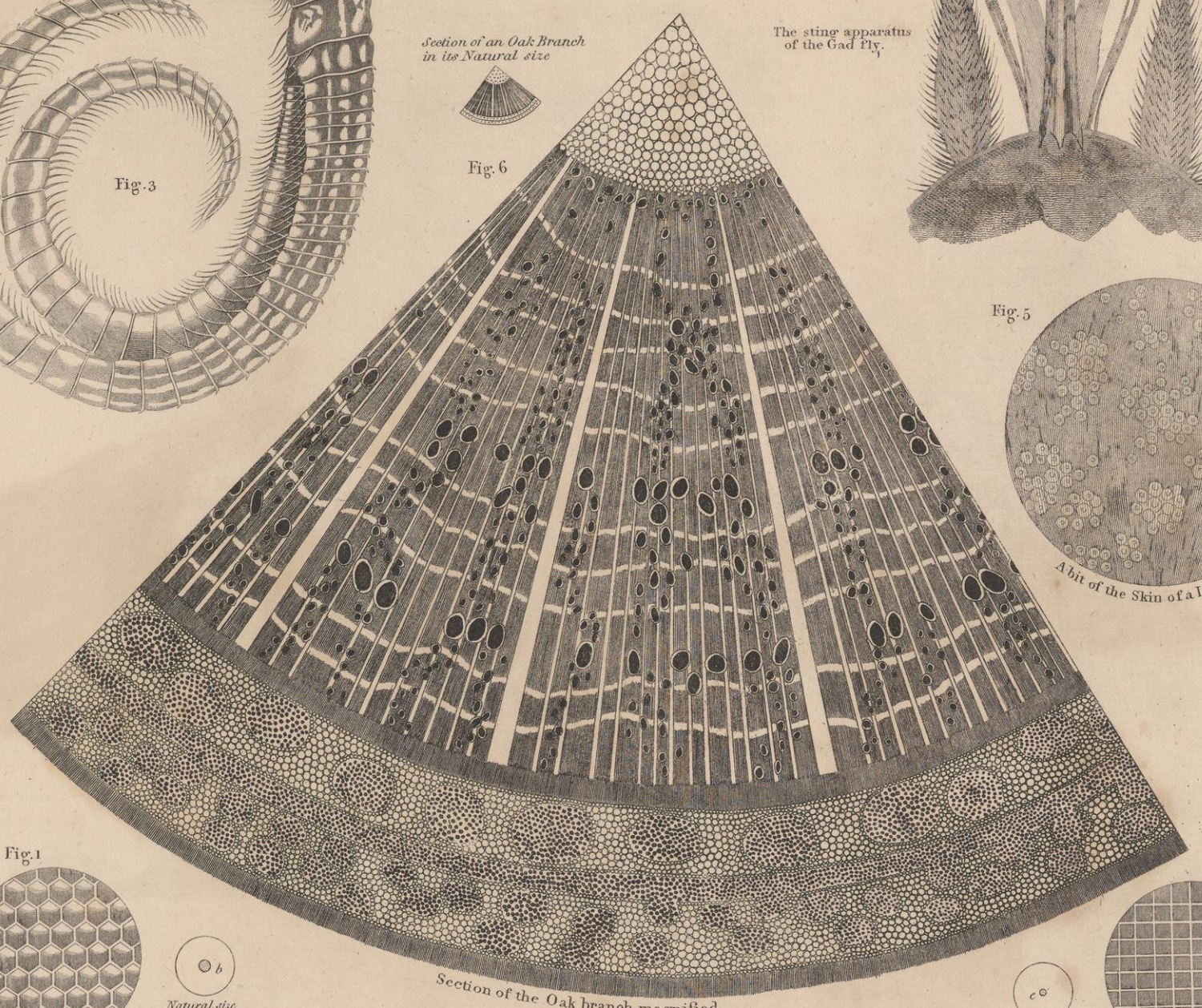
Horn of the Barnacle
magnified.

Fig. 3



Section of an Oak Branch in its Natural size

Fig. 6



Section of the Oak branch magnified.

The sting apparatus of the Gad fly.

Fig. 4

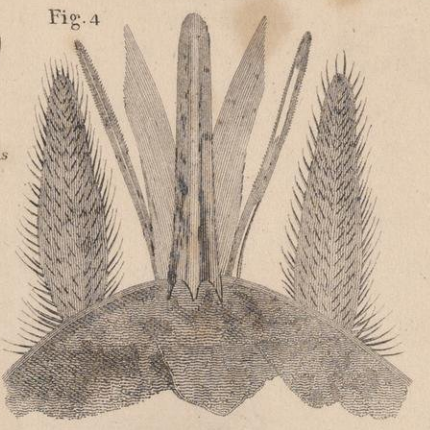
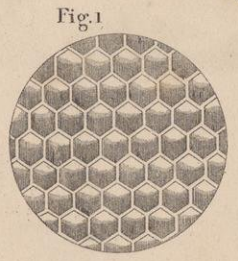


Fig. 5

A bit of the Skin of a Lump Fish.

Fig. 1



The cornea of the Libullula
magnified.

Natural size

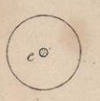
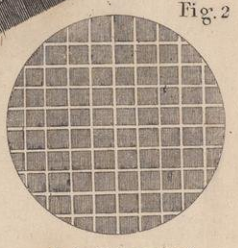


Fig. 2

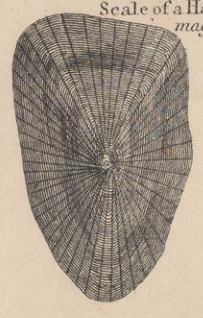


Lobsters cornea
magnified.

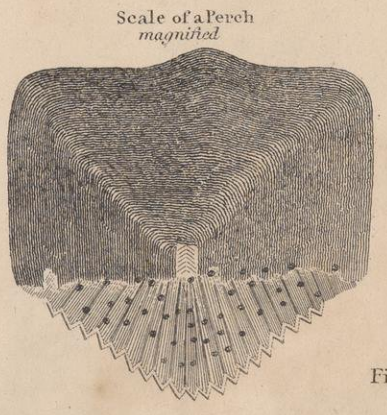
Natural size

Fig. 2

Scale of a Haddock
magnified



Scale of a Perch
magnified



Natural size

Fig. 1

Scale of a West Indian Perch
magnified

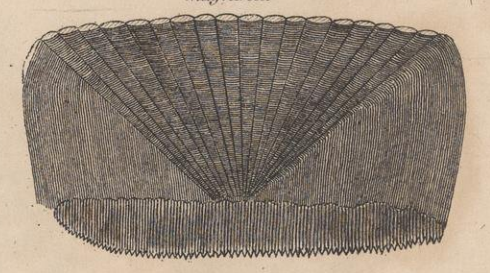
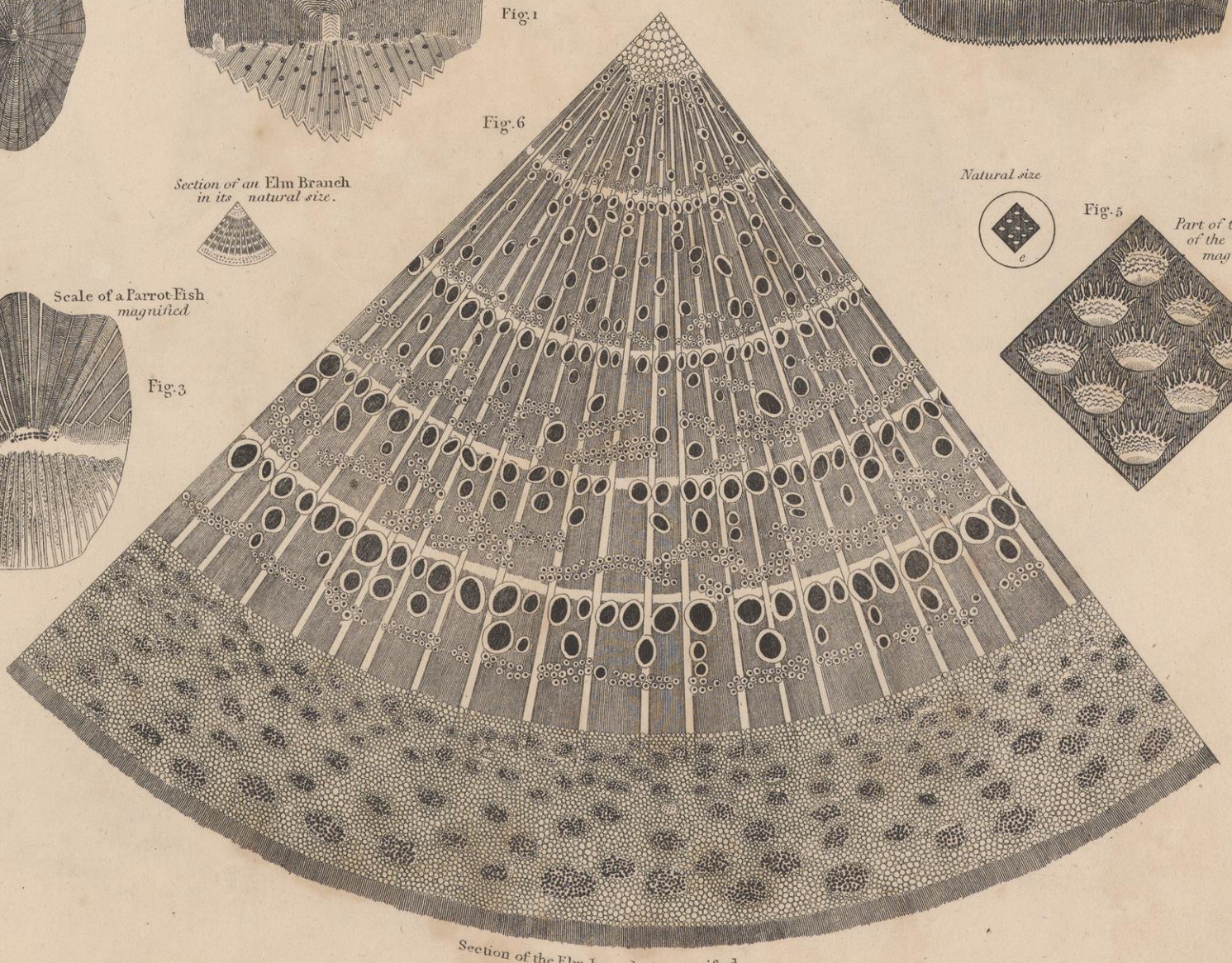


Fig. 6



Section of the Elm branch as magnified.

Section of an Elm Branch
in its natural size.

Natural size

Scale of a Parrot-Fish
magnified

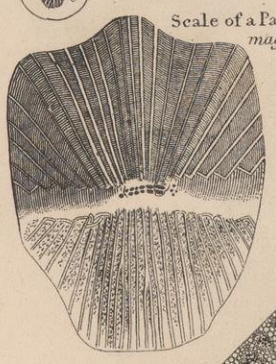
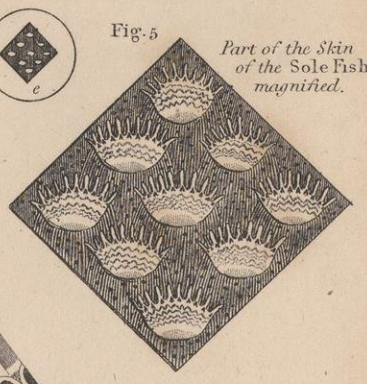


Fig. 3

Natural size

Fig. 5

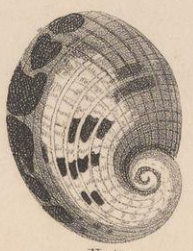
Part of the Skin of the Sole Fish
magnified.

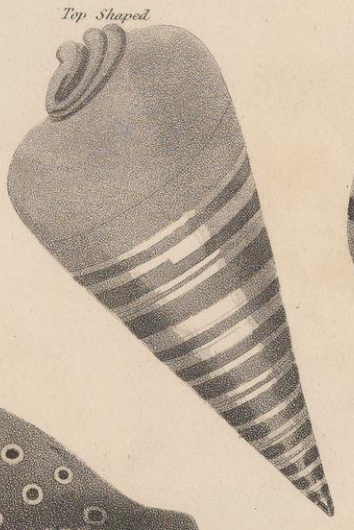


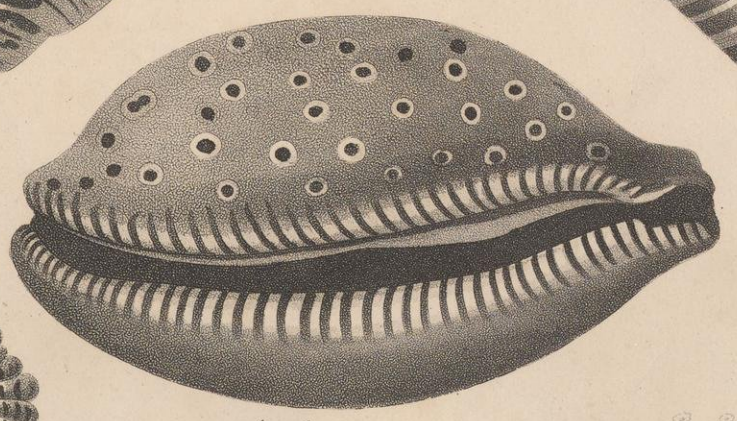
London, Published by Sir R. Phillips & C. Feb. 10. 1823.

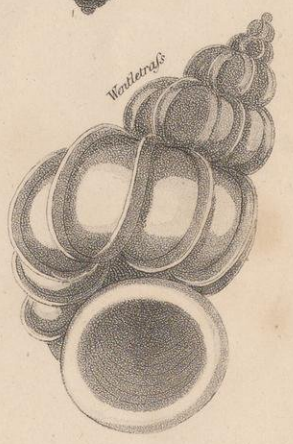
The Capture of a Whale.

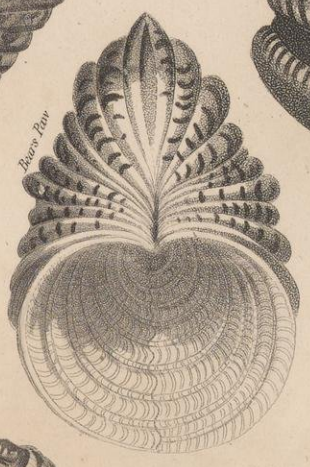
Shells

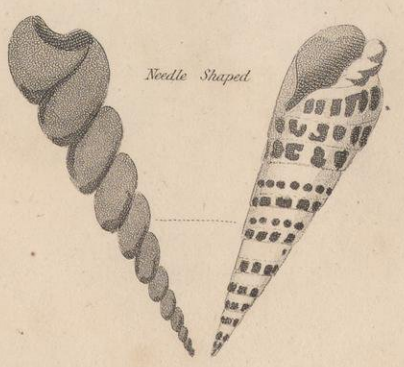


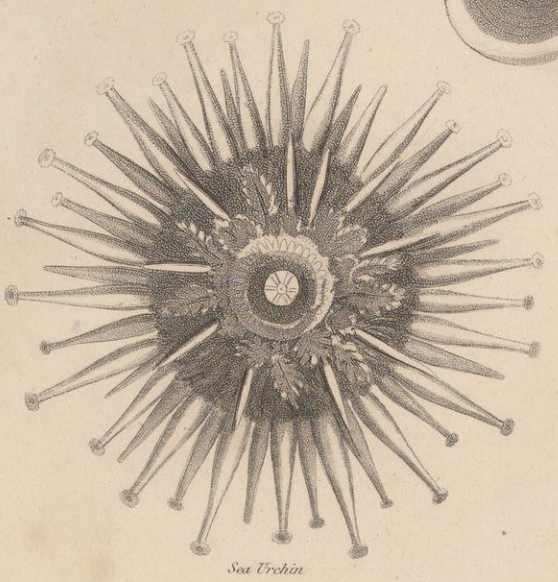












Pub.d March 1, 1823, by Sir R. Phillips, & Co. Bride Ct. Bridge Street.

GREAT LANTHORN OR FIRE FLY.

ATLAS MOTH.

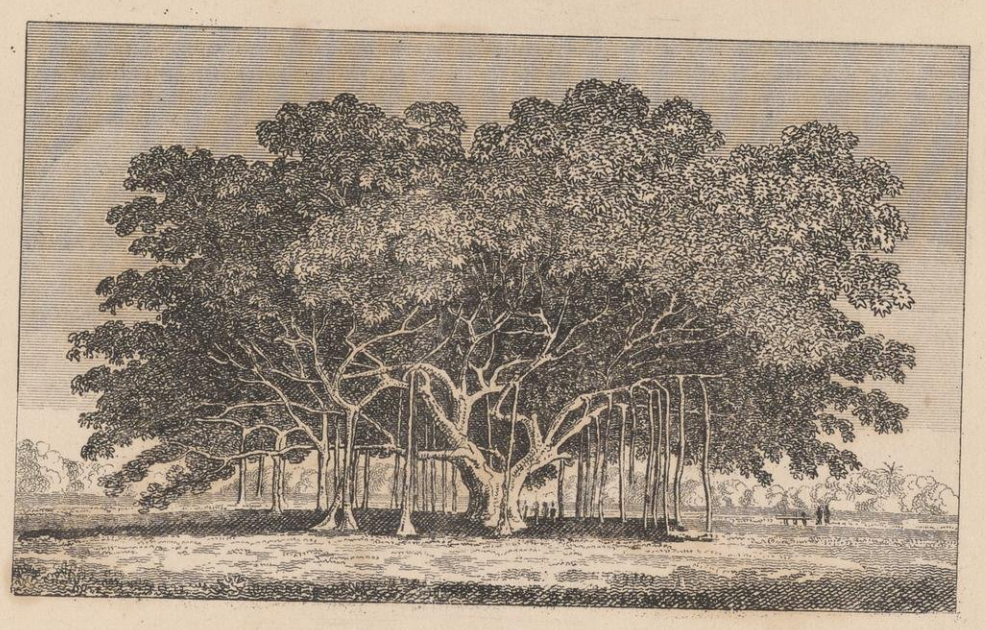
EGYPTIAN LOCUST.

London. Published by Sir R. Phillips & Co. Feb. 10. 1823.

Nodes & Sen. sc. Strand.

W.Daniell in Woods Zoography.

WHITE ANTS HILLS.



The Banian Tree in INDIA.

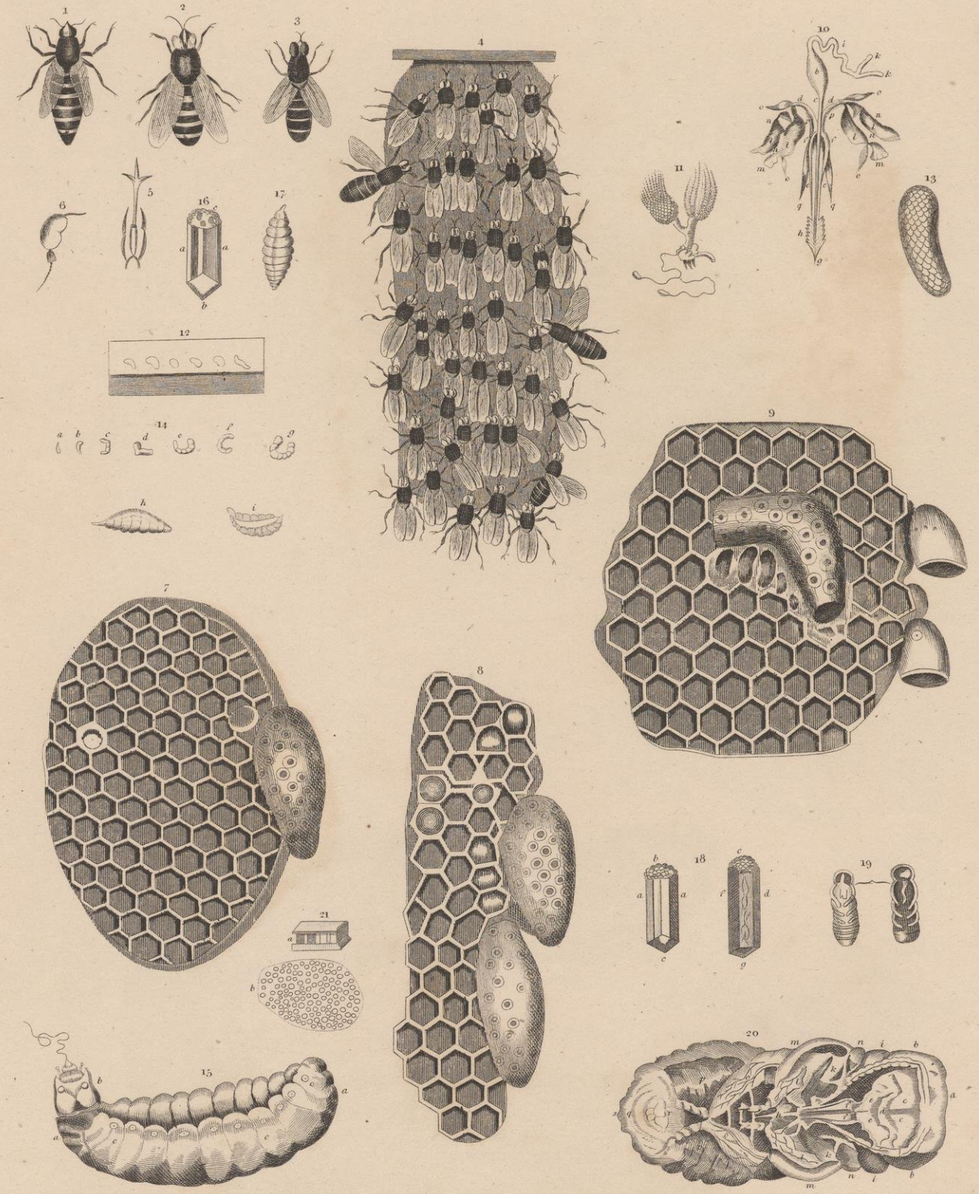
London Pub.d by Sir R.Phillips & C.o Feb.10 1823.

Neele & Son 352 Strand.

AFRICAN BIRDS-NESTS.

FASCIATA OR BARBARY SPIDER.

London Published by Sir R. Phillips & Co. Feb. 10. 1823.



ECONOMY OF THE BEE.

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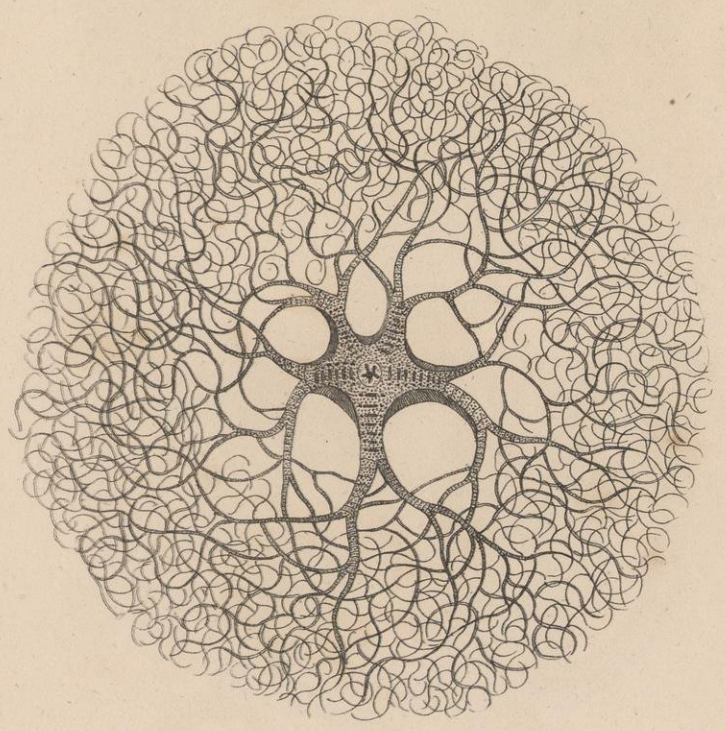
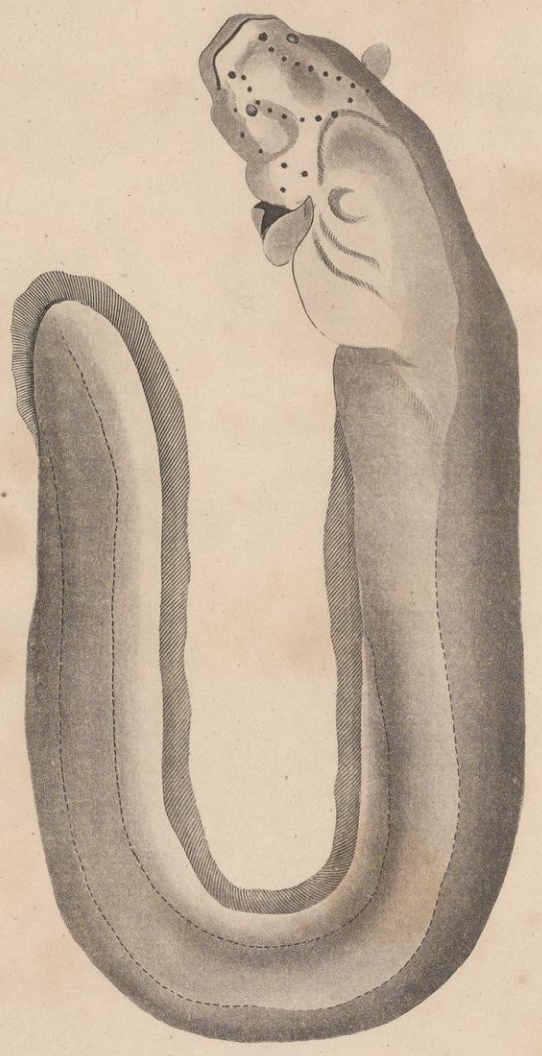


BRANCHED ASTERIAS
OR
MEDUSEAN STAR FISH.



ELECTRICAL GYMNOTUS.

HAMMER HEADED SHARK.

Common Angel Fish.

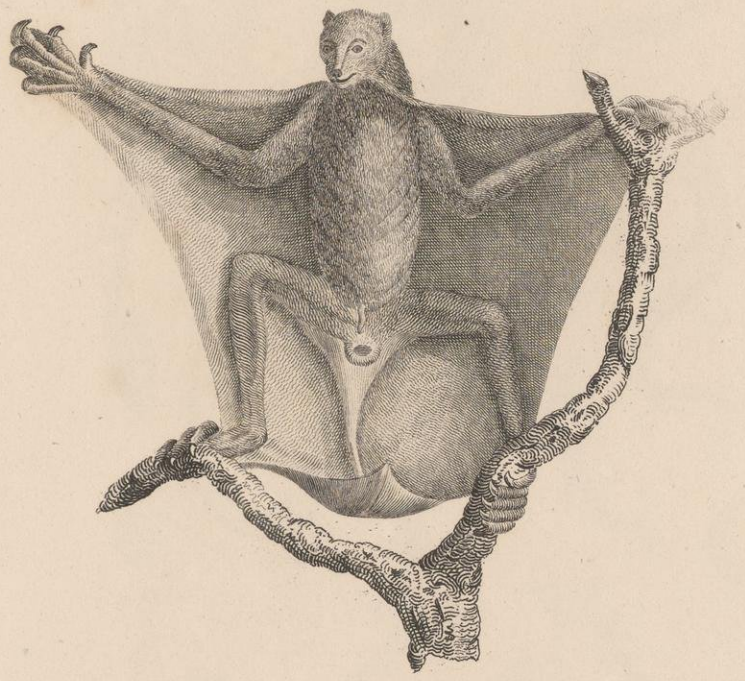
Chaetodon.

Scorpena.

London Published by Sir R Phillips & Co Feb 10 1823.

The Bat

The Vampire



BRITISH AND FOREIGN FROGS AND TOADS.

REPTILES

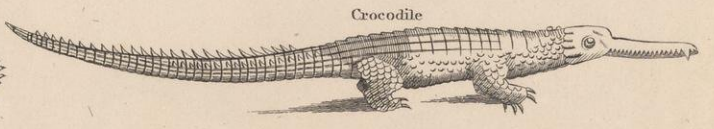
Nature Displayed. Vol. 2.

Dwarf Chameleon

Common Chameleon

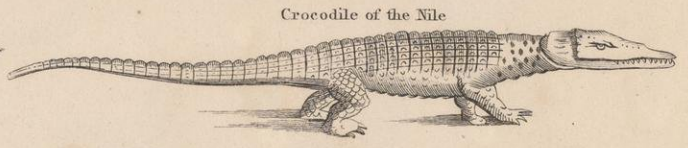
Green Lizard

Crocodile



Cloven-footed Chameleon

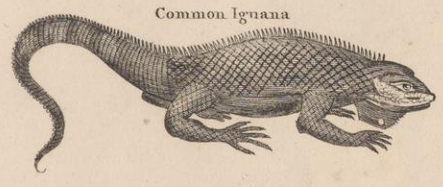
Crocodile of the Nile



Flat-headed Gecko

Striped Gecko

Common Iguana



Red-throated Iguana

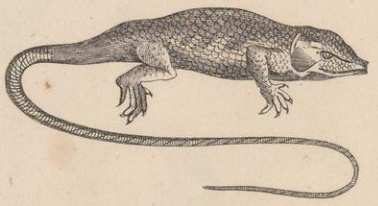
Common Gecko

Striped Iguana

Iguana

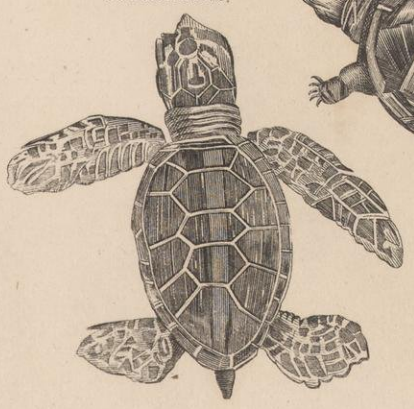
Banded Gecko

Marble Iguana



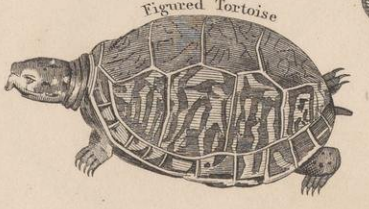
Mud Tortoise

Common Turtle



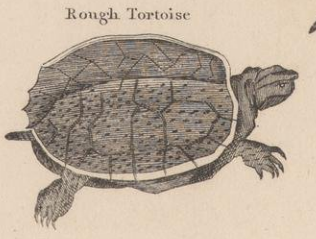
Dark Lizard

Figured Tortoise

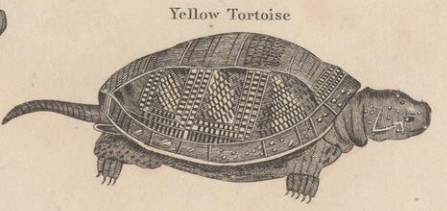


Spotted Lizard

Rough Tortoise



Yellow Tortoise



TWENTY SEVEN VARIETIES OF SERPENTS.

GREAT SCOLOPENDRA OR CENTIPEDE.

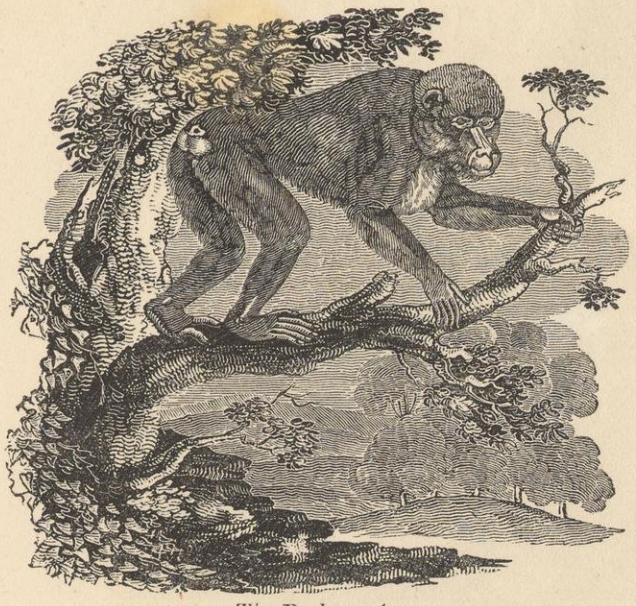
Neale & Son 332 Strand.

FLYING DRAGON.

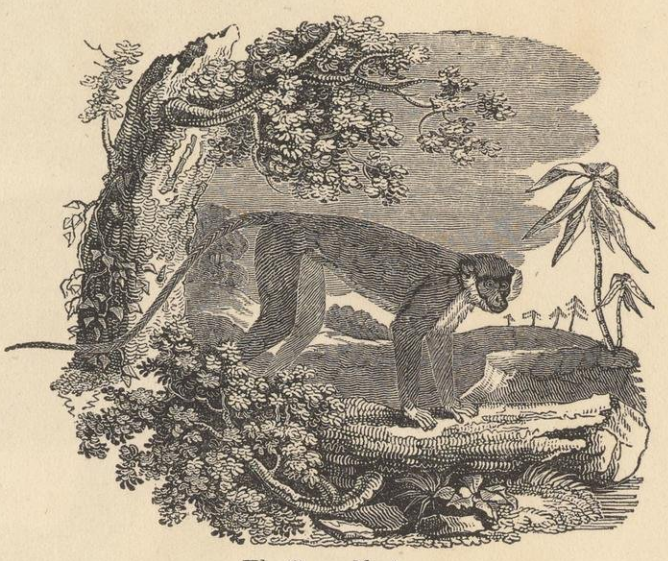
Neale & Son 332 Strand.

HOODED SNAKE OF HINDOSTAN.

Neale Sculp. Strand.



The Barbary Ape.



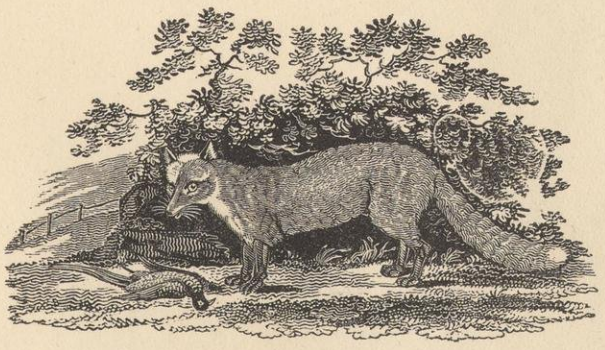
The Green Monkey.

The Ribbed-Nose Baboon.

The Great Baboon.

The Ourang Outang.

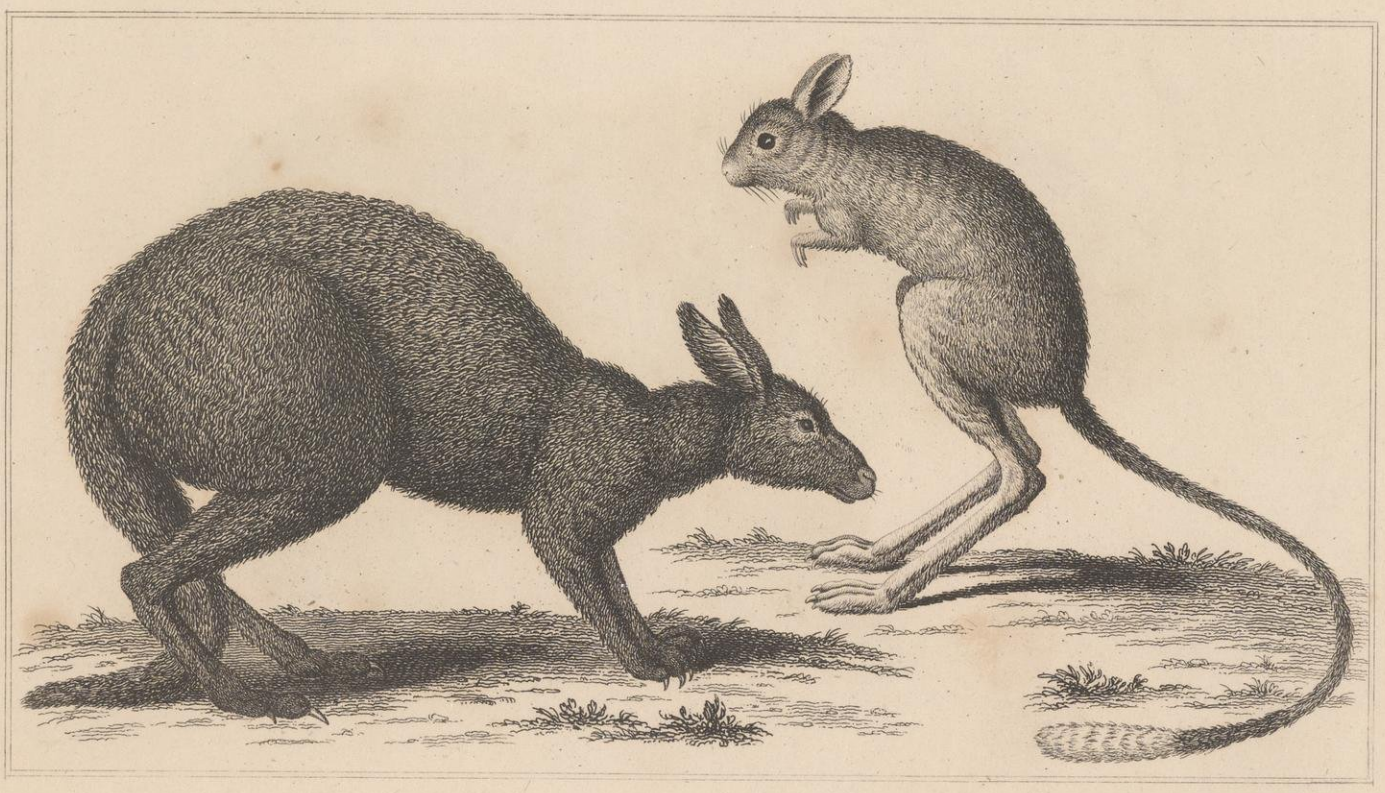
The Gibbon Monkey.



The Fox.

The Cur Fox.

The Ant Eater.

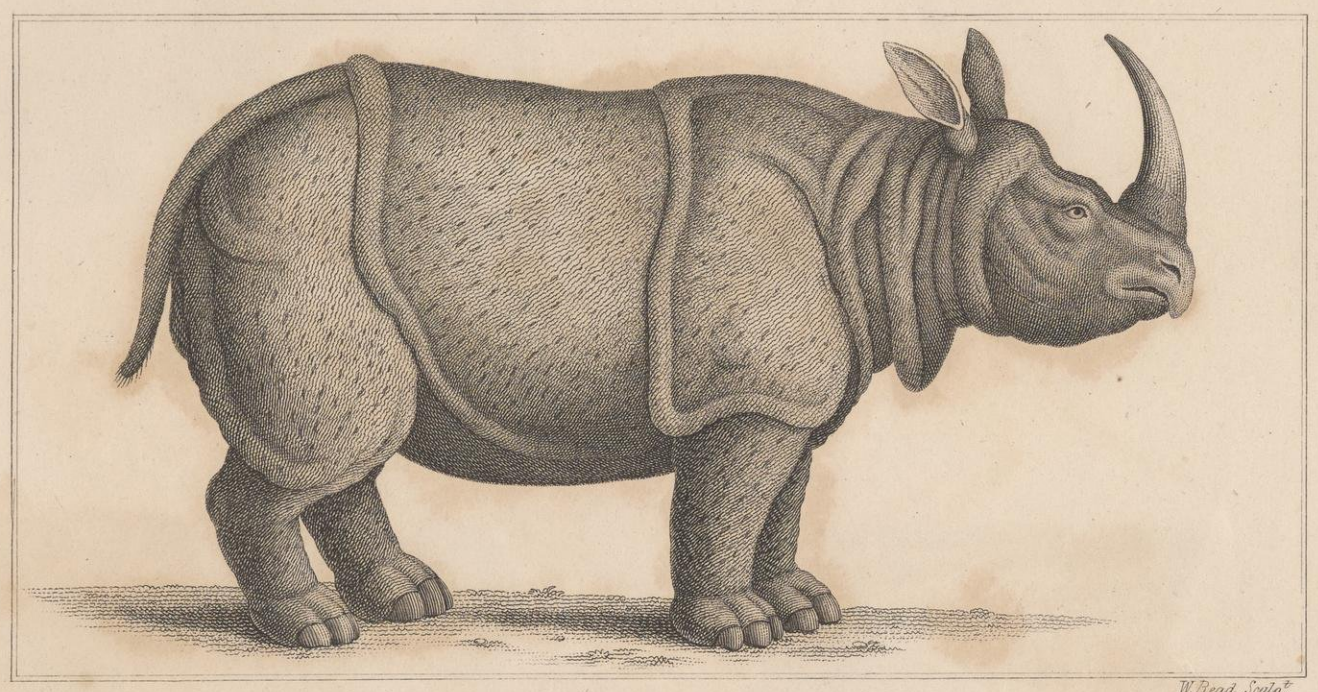


The Kangaroo. *The Jerbo.*

The Sloth.

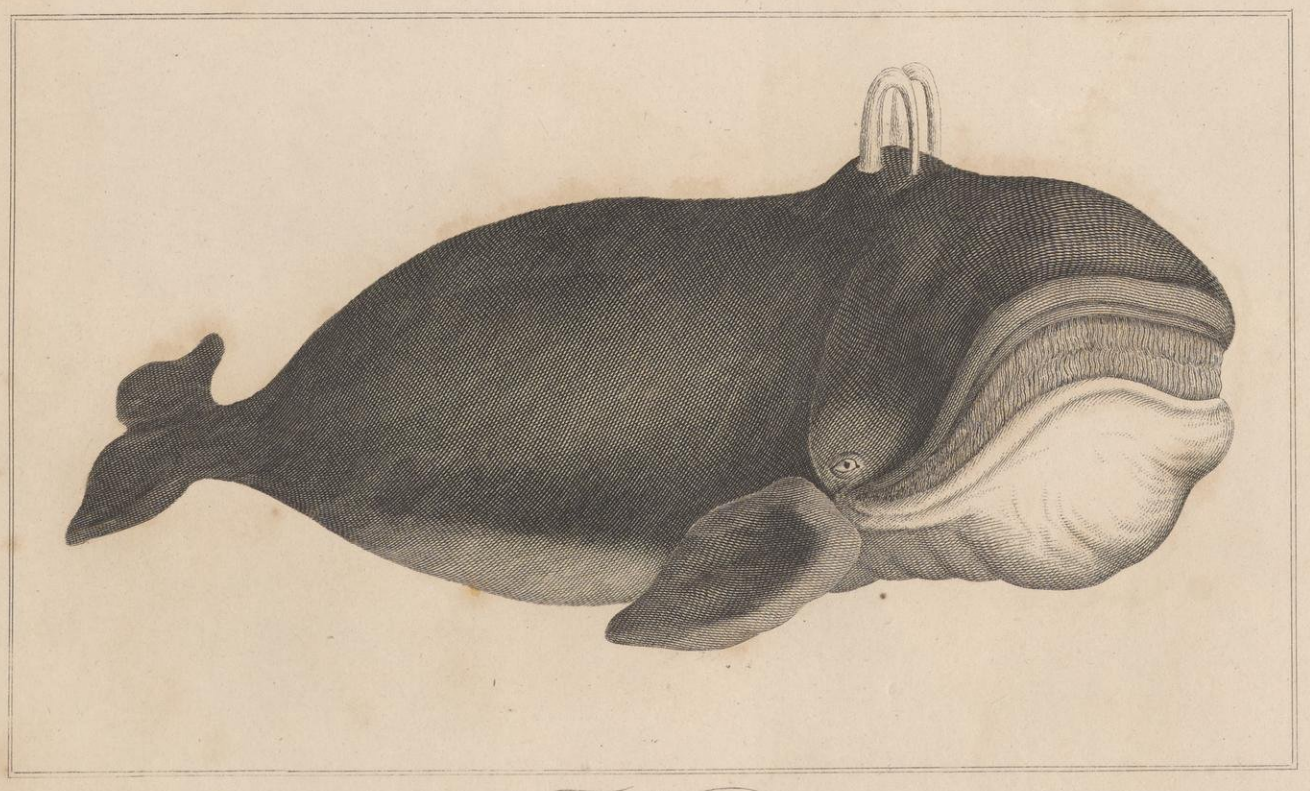
W. Read. Sculp.r

The Hippopotamus.



W. Read. Sculp.r

The Rhinoceros.

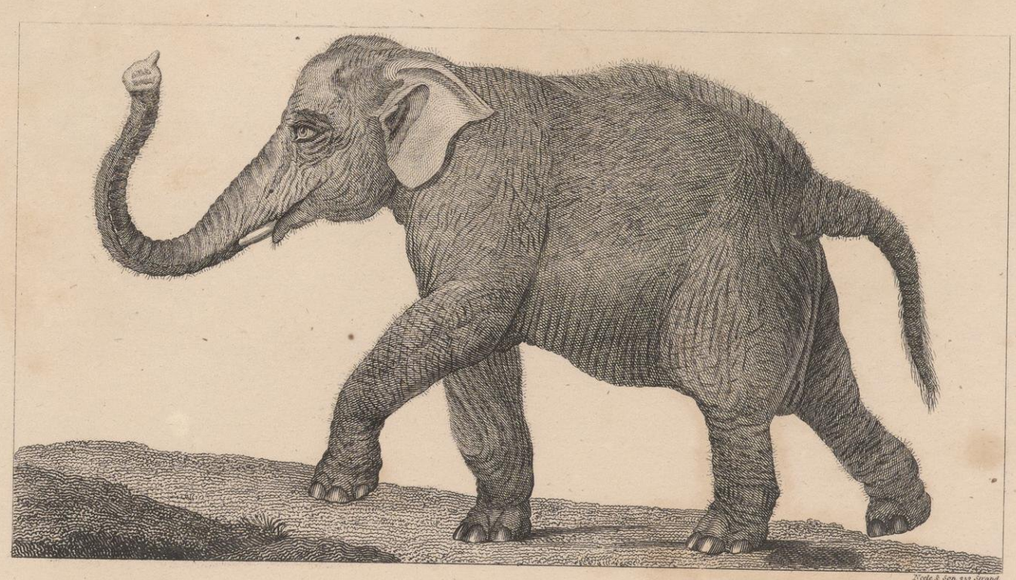


The Whale.

A LIONESS & HER WHELPS.

LION.

WHITE BEAR.



THE ELEPHANT.

W. Read. Sc.

The Brown Bear, seizing his prey.

W. Read. Sc.

The Wolf.

The Porcupine.

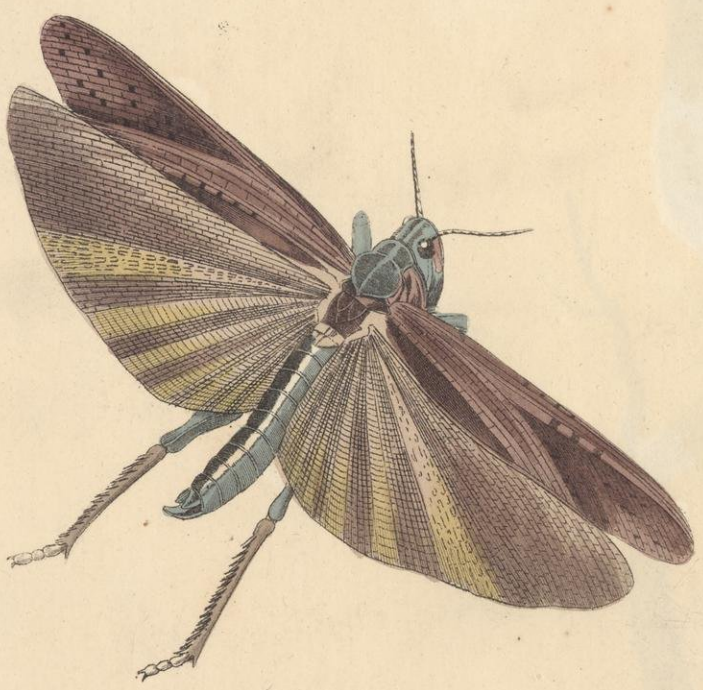
The Camel

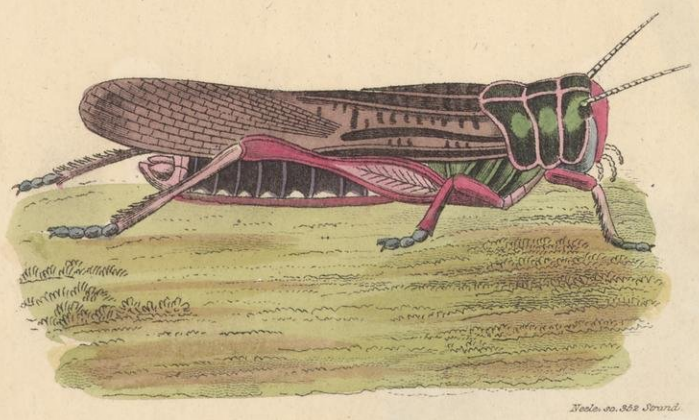
The Camel in his recumbent posture.

The Tiger

TAILOR BIRD.

RED THROATED HUMMING BIRD.





Neele. sc. 352 Strand.

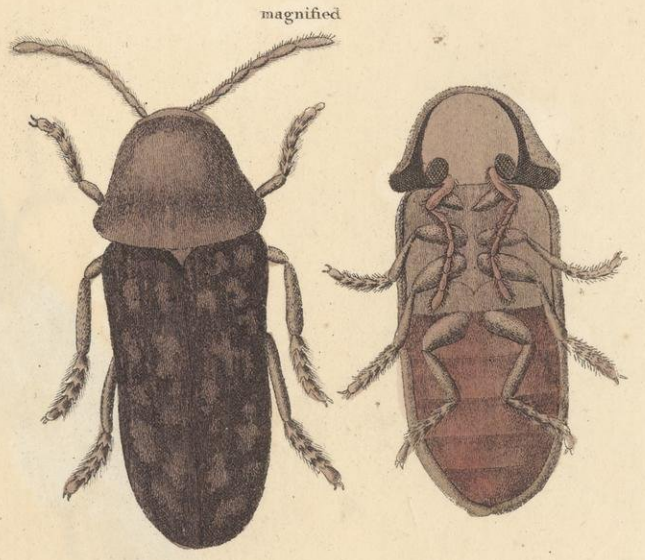
THE MIGRATORY OR WANDERING LOCUST.

BEATING PTINUS

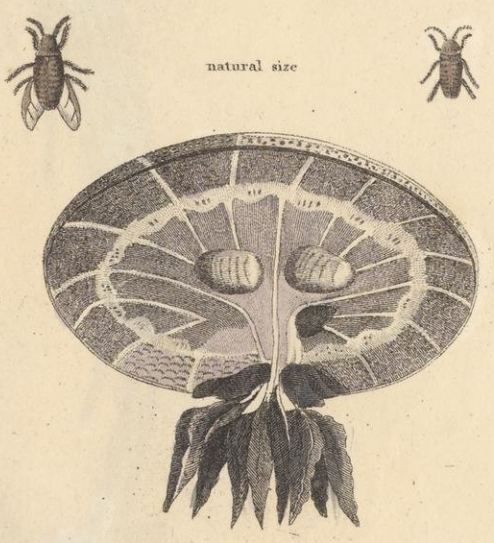
OR

DEATH WATCH.

magnified



natural size



MEDUSA

Neele & Son, 352 Strand.

THE FLAMINGO.

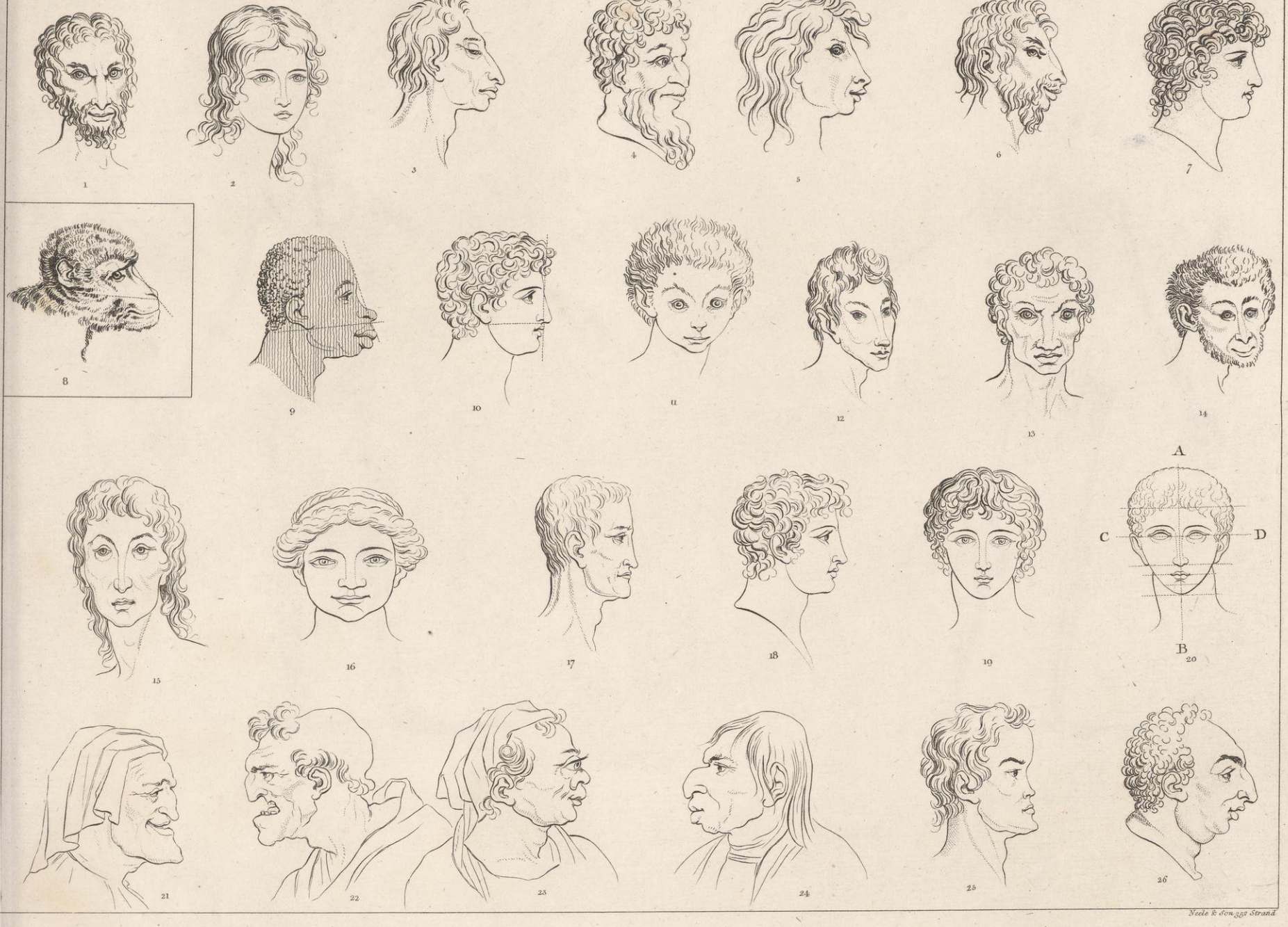
THE NUMIDIAN, OR BALEARIC CRANE.

CHINESE PAINTED PHEASANT.

THE HOOPOE.

THE PELICAN.

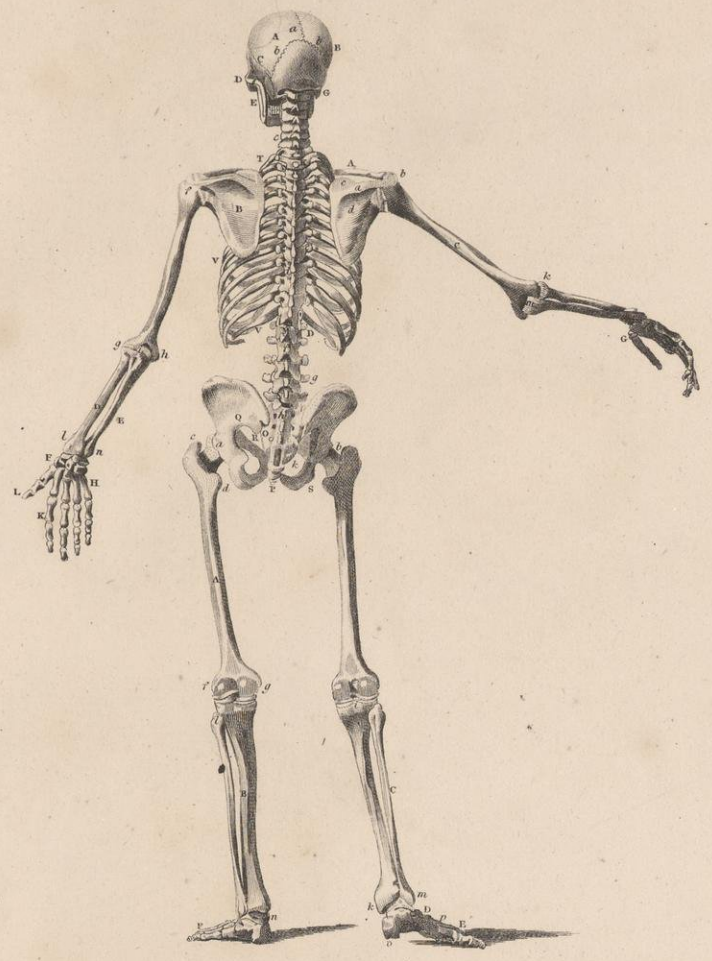
THE SCARLET IBIS.



Neele & Son 352 Strand

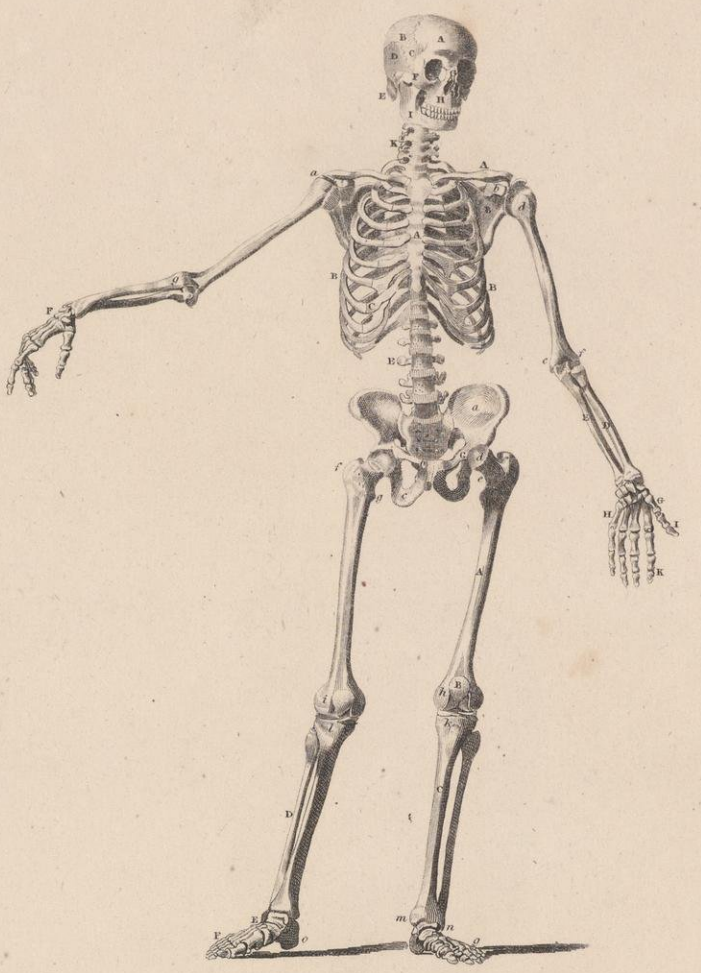
PHYSIOGNOMIES OF THE HUMAN SPECIES.

London, Published by Sir R. Phillips & Co. Feb. 10. 1823.



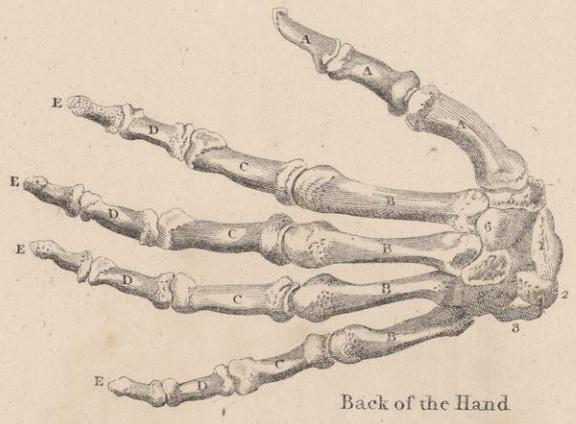
BONES OF THE BACK.

Neale & Son, 352 Strand.

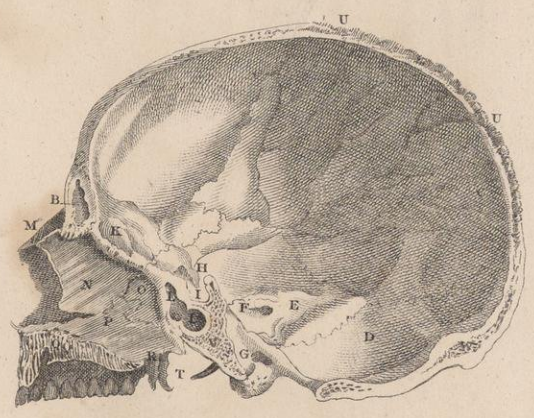


BONES IN FRONT.

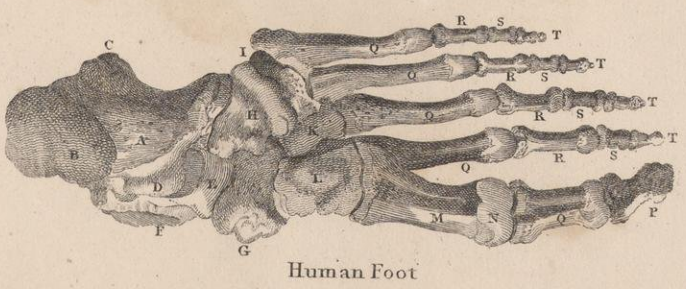
Neale & Son, 352 Strand.



Back of the Hand



Human Skull cut perpendicularly



Human Foot

Neale & Son, 352 Strand.

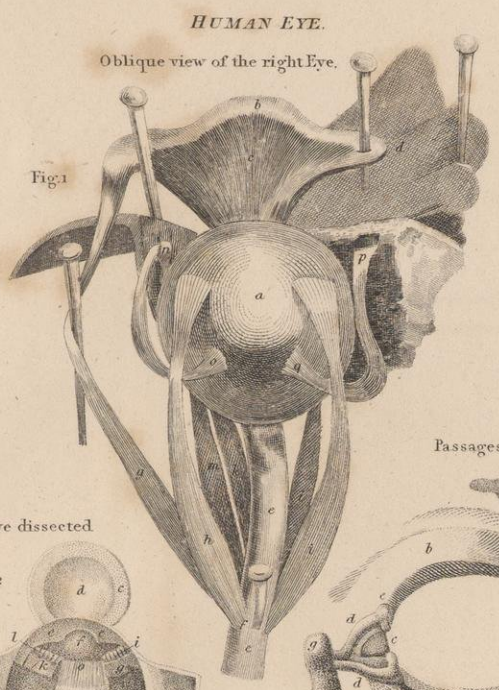
TATOOED SOUTH SEA ISLANDER.

Neale & Son, 352 Strand.

HUMAN EYE.

Oblique view of the right Eye.

Fig.1

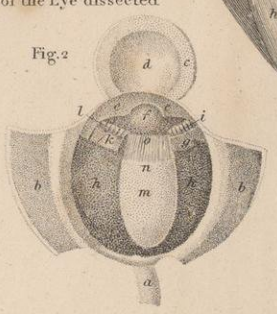


Passages of the Tears

Fig.3

Coats of the Eye dissected

Fig.2



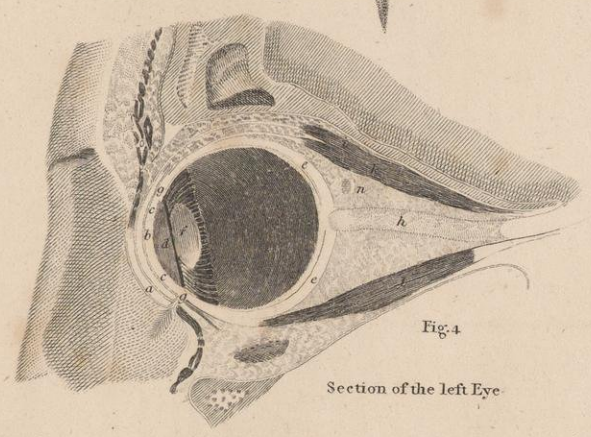
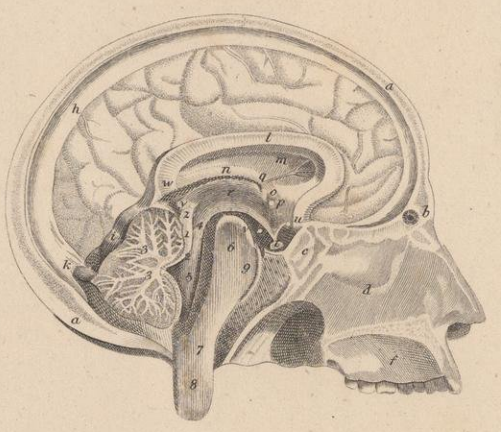


Fig.4

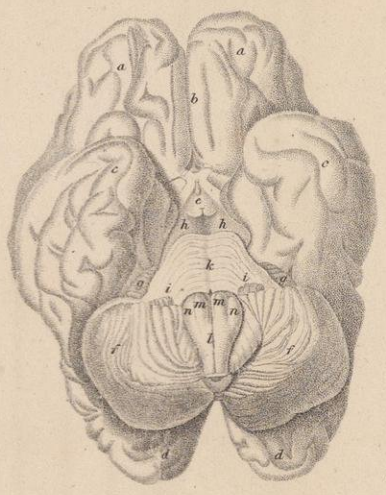
Section of the left Eye

Neale & Son, 332 Strand.

Vertical Section of the Brain.

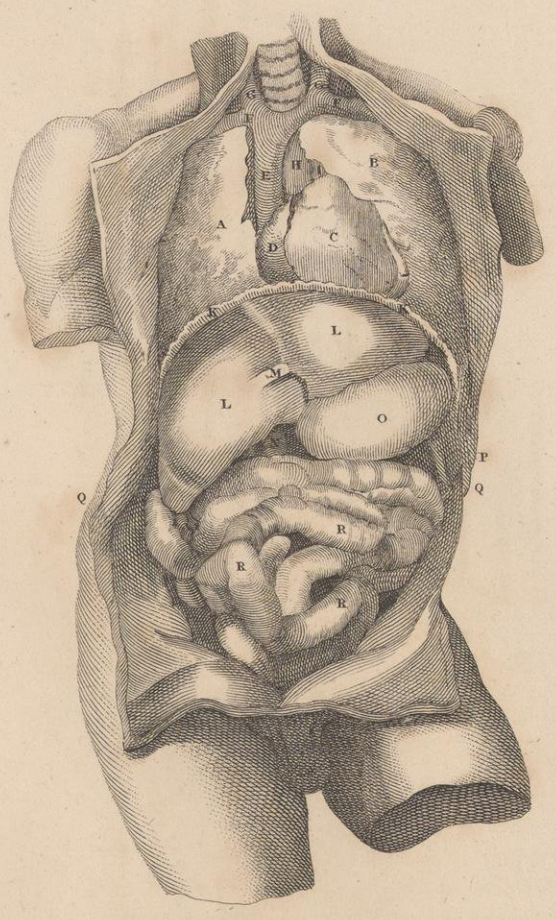


Horizontal view of the Brain.



Neale & Son, 332 Strand.

Viscera of the Human Body.



Neale & Son, 332 Strand.

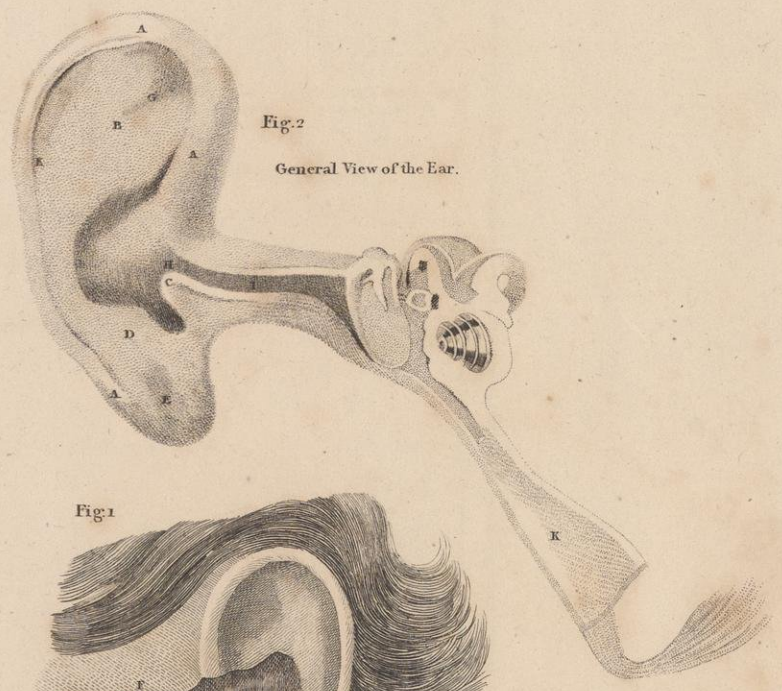


Fig.2

General View of the Ear.

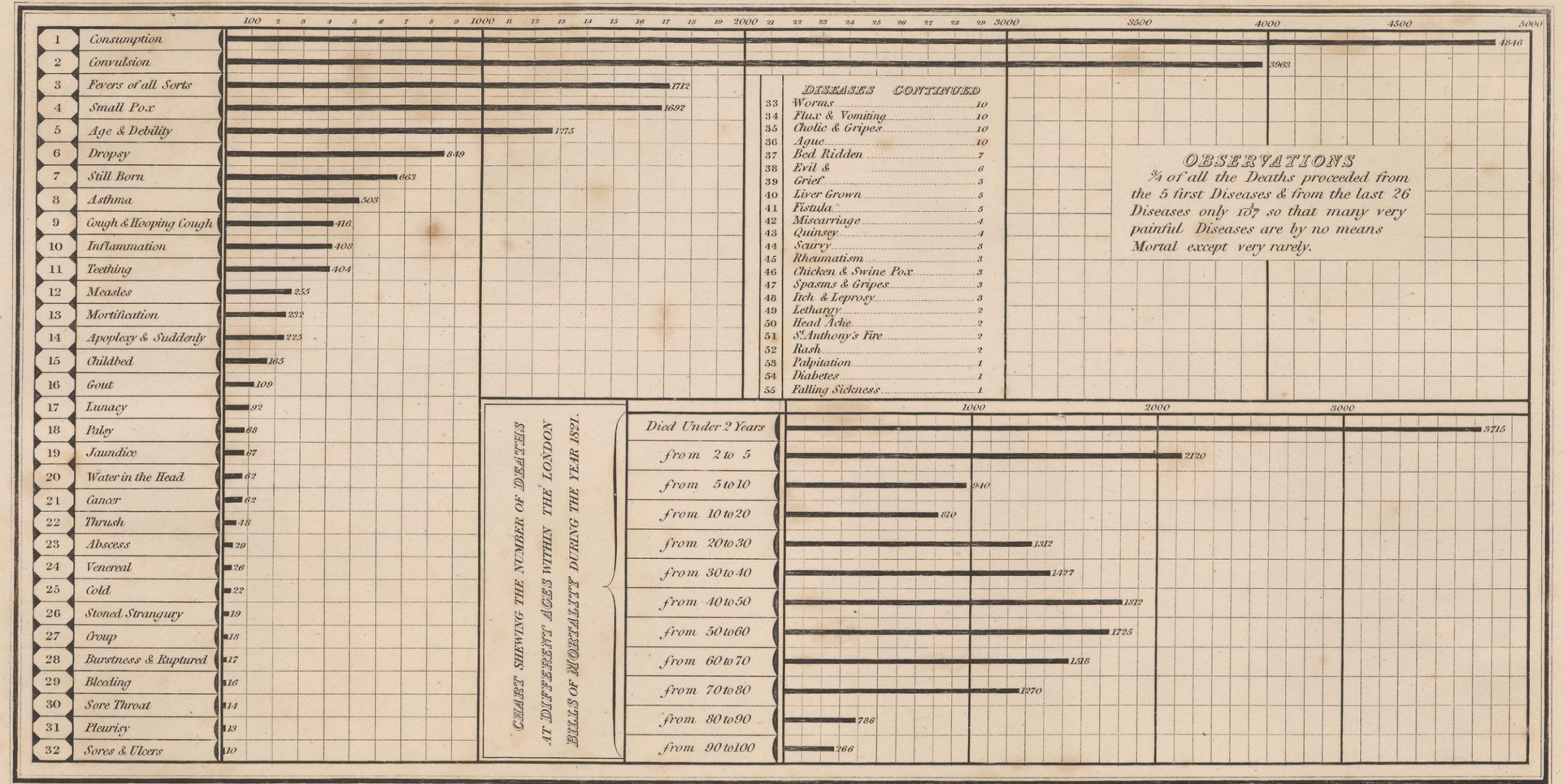
Fig.1

Fig.3

Region of the Ear.

Neale & Son, 332 Strand.

CHART SHEWING THE NUMBER OF DEATHS ARISING IN ONE YEAR FROM DIFFERENT DISEASES WITHIN THE LONDON BILLS OF MORTALITY DURING THE YEARS 1796 97 98 99 & 1800 ON AN AVERAGE.

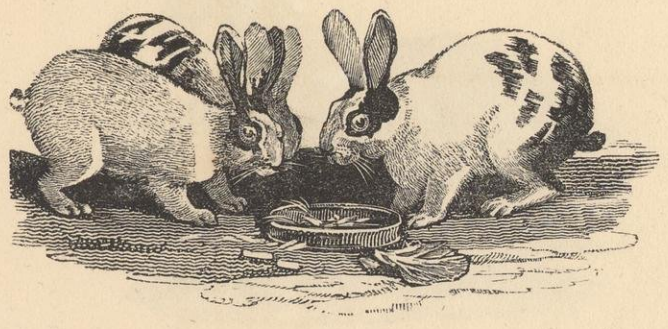


Neele & Son Sculp.t 352 Strand.

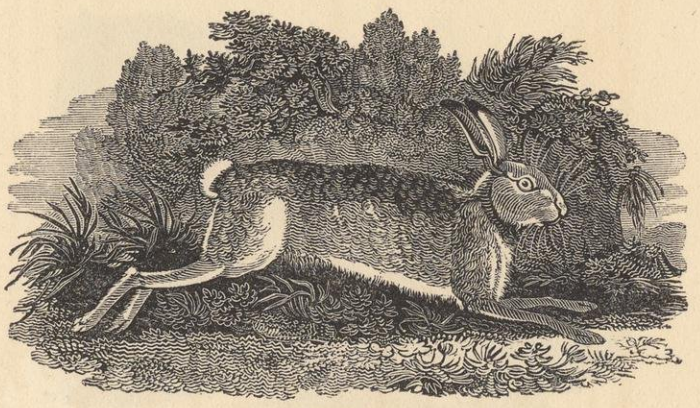
London Published by Sir R. Phillips & Co.t Feb. 10. 1823.

The Pole Cat.

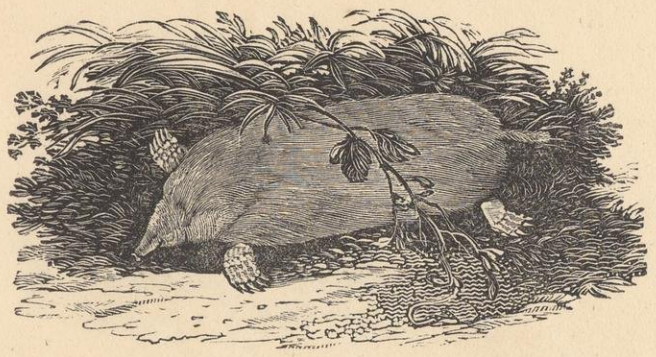
The Fallow Deer.



Rabbits.



The Hare.



The Mole.

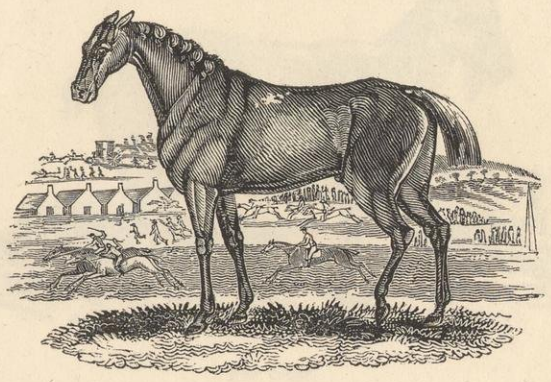
The Hedge Hog.

The Badger.

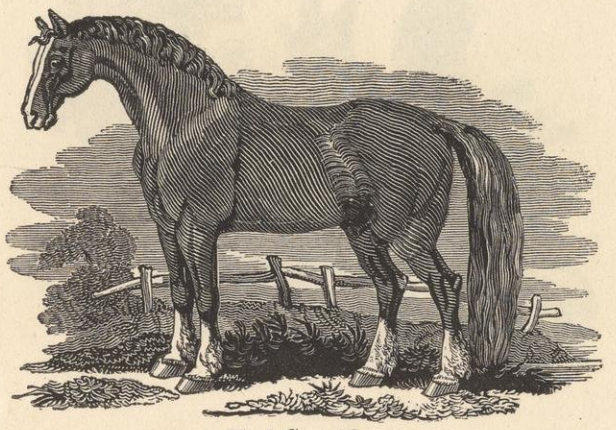
The Otter.

The Spaniel.

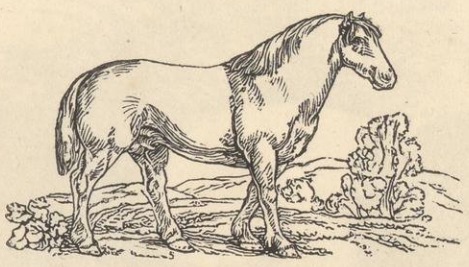
The Greyhound.



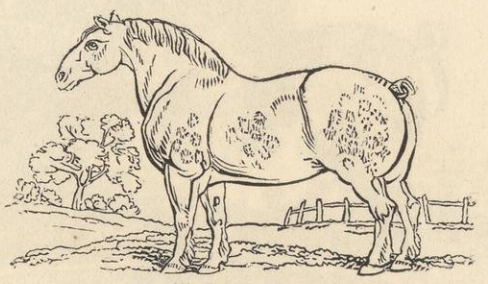
Race Horse.



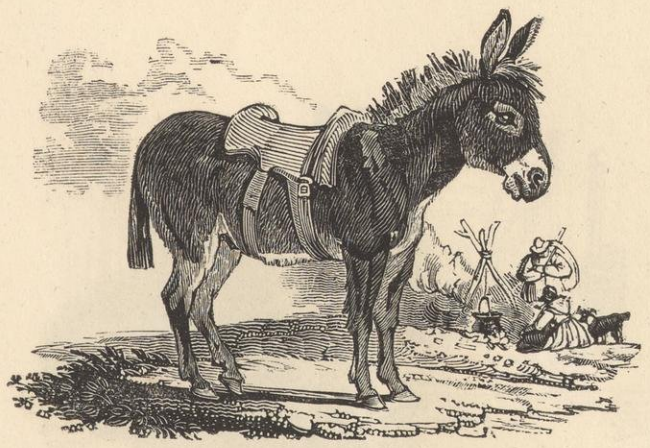
Black Cart Horse.



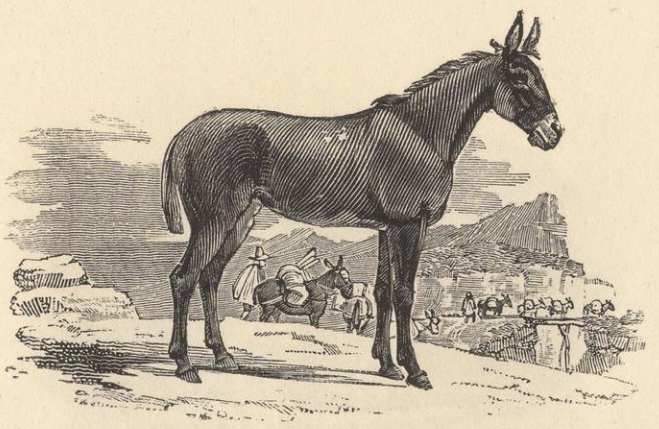
Suffolk Punch.



Clydesale Horse.

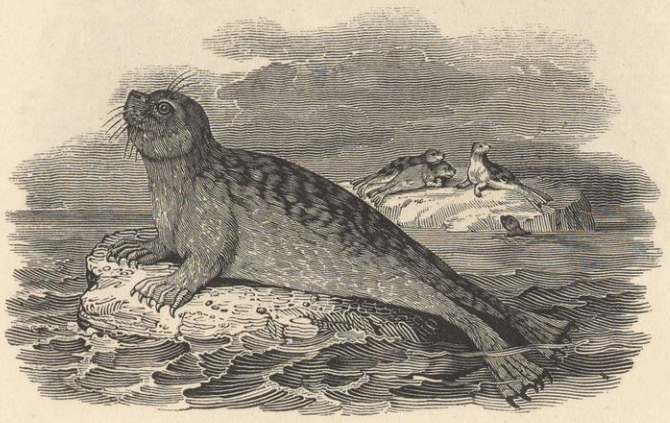


The Ass.



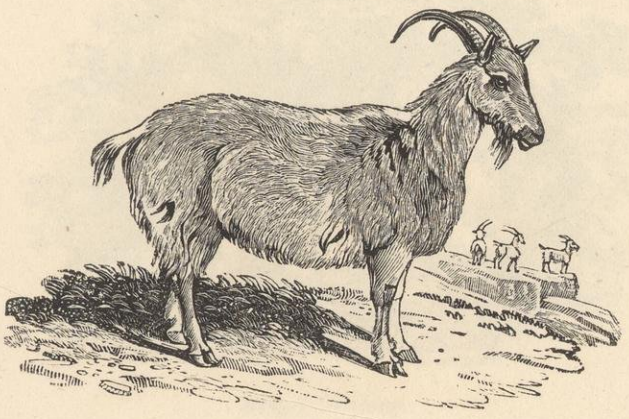
The Mule.

NATURE DISPLAYED.



The Seal.

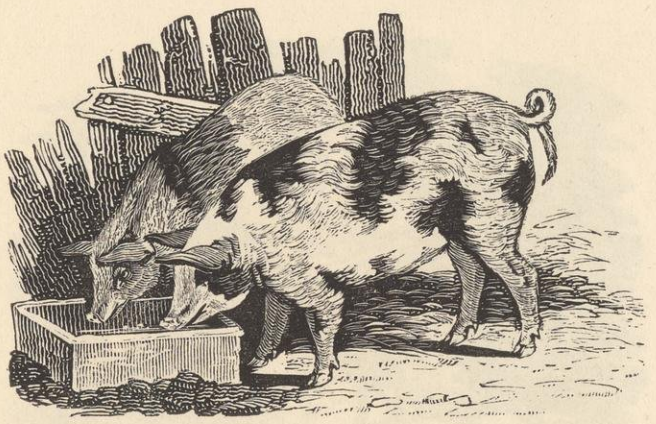
The Beaver.



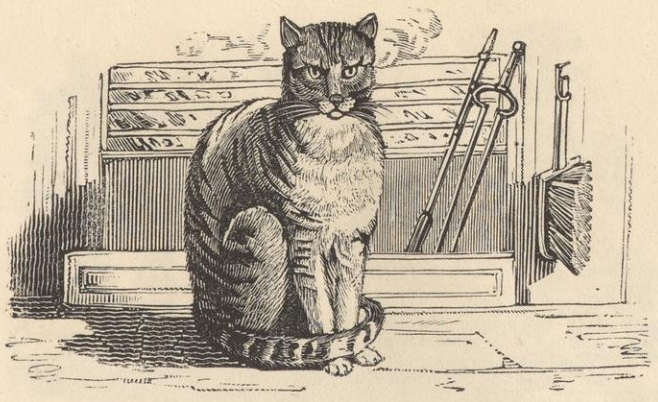
The Goat.

The Squirrel.

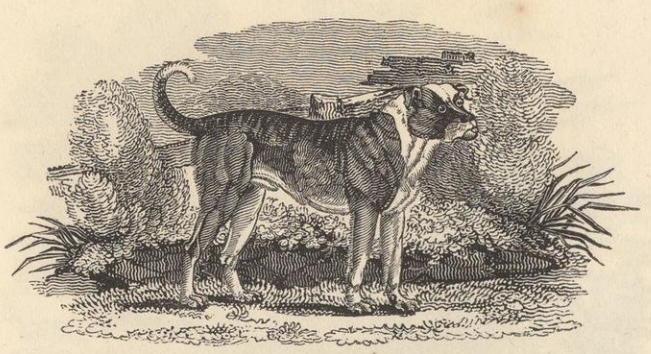
The Guinea Pig.



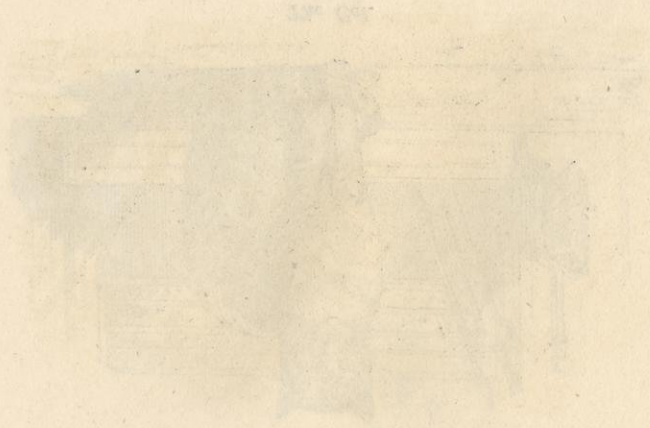
Hogs.



The Cat.

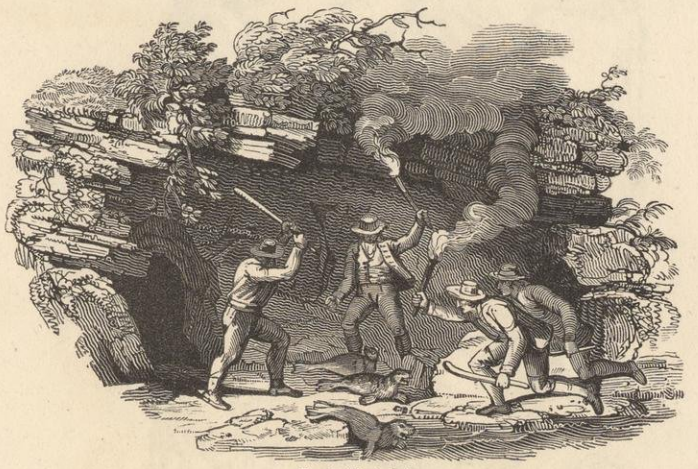


Bull Dog.



HABITS OF ANIMALS.

Beavers in Council.



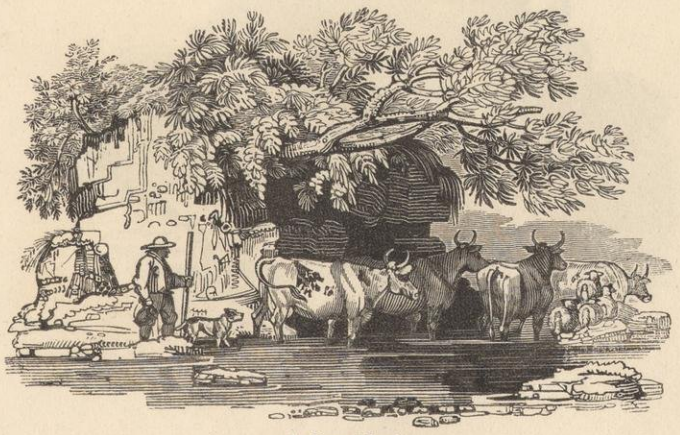
Seal Catching.

Badger Catching.

Feeding Guinea Pigs.

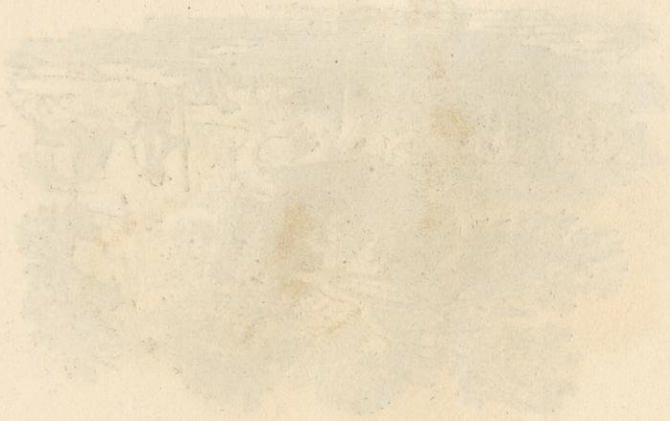
Mule Driving in Spain.

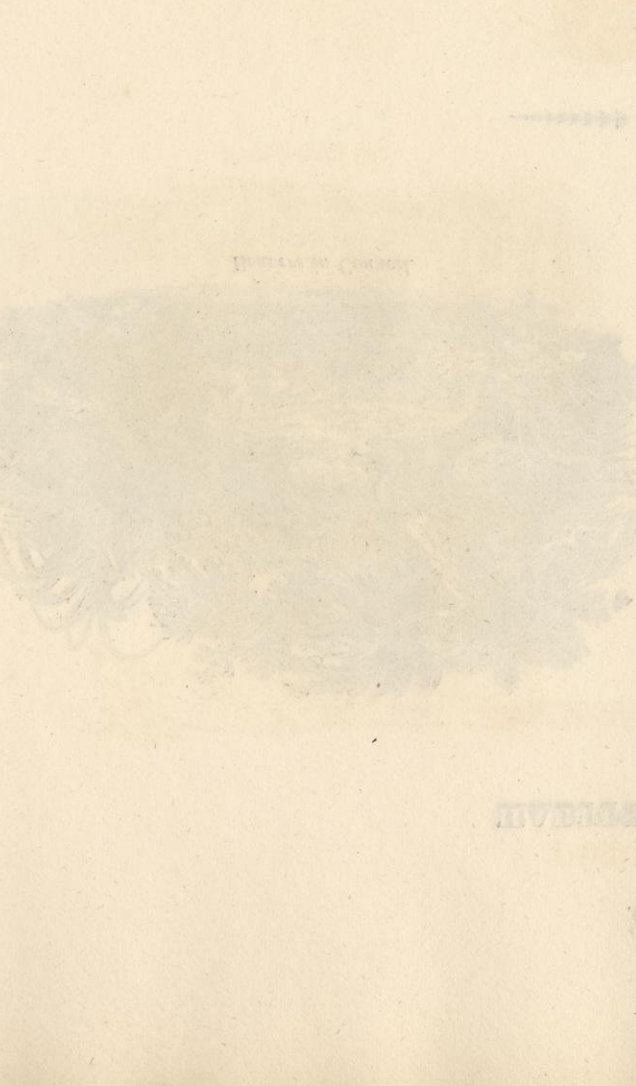
The Goat Herd.

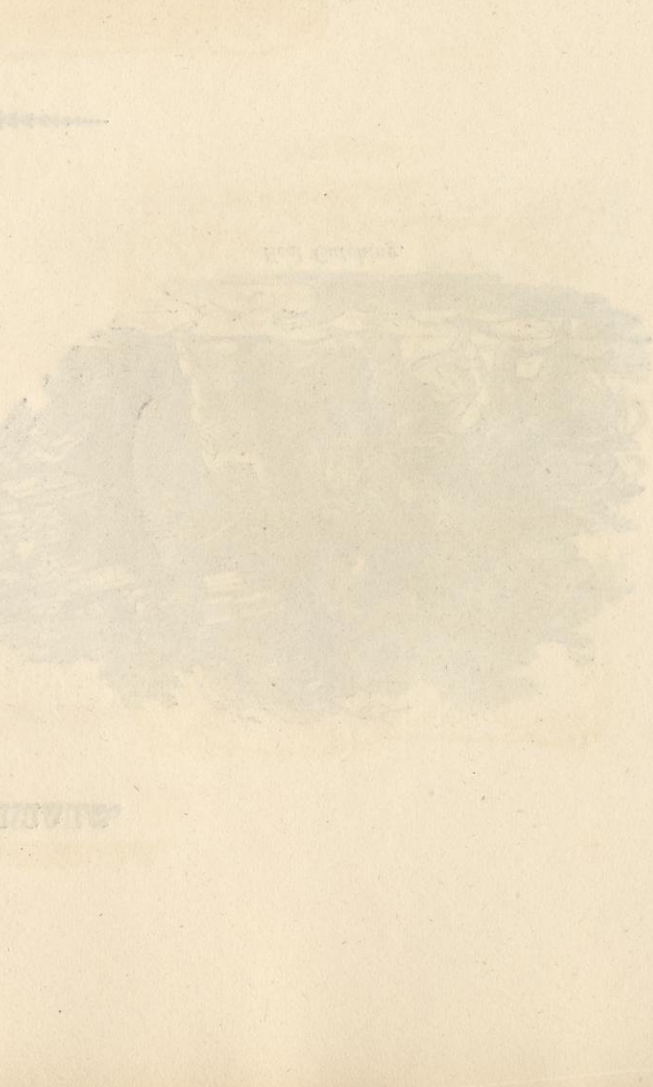


A Cow Herd.

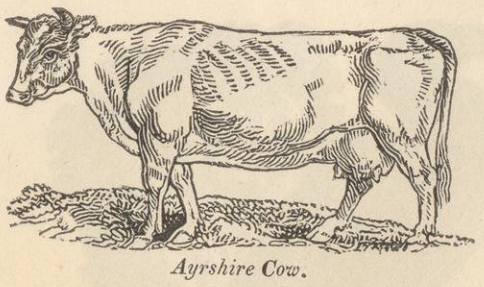
Drove of Hogs.



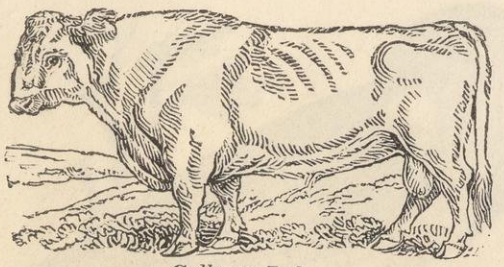




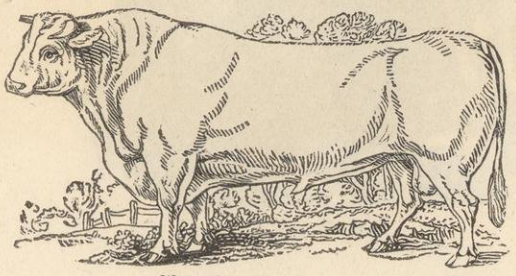
DOMESTIC ANIMALS.



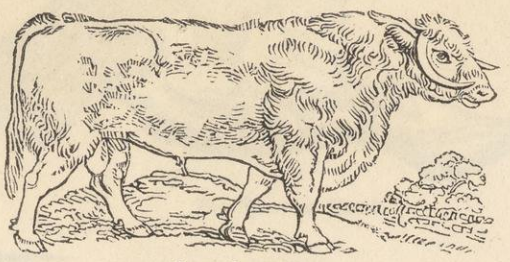
Ayrshire Cow.



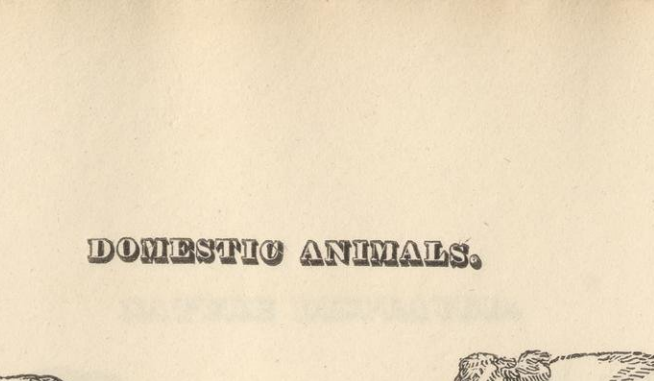
Galloway Bull.



Short-horned Bull.

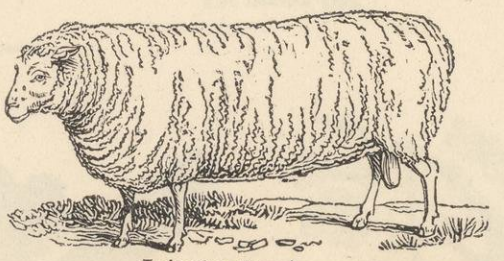


Long-horned Ox.



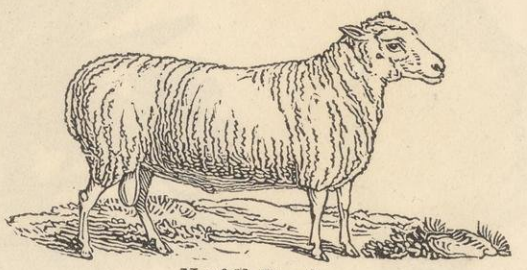
Long-horned Ox.

Cheviot Sheep.

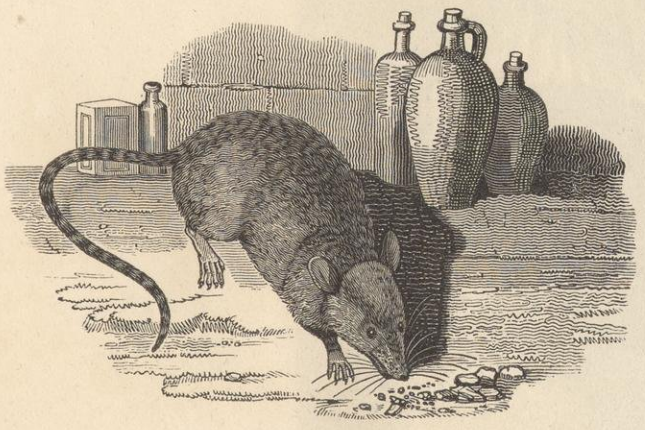


Leicester Breed.

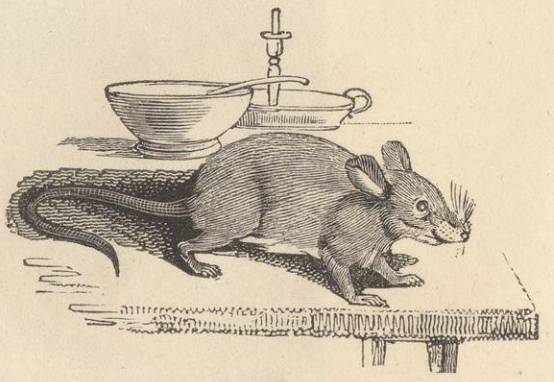
South Down Breed.



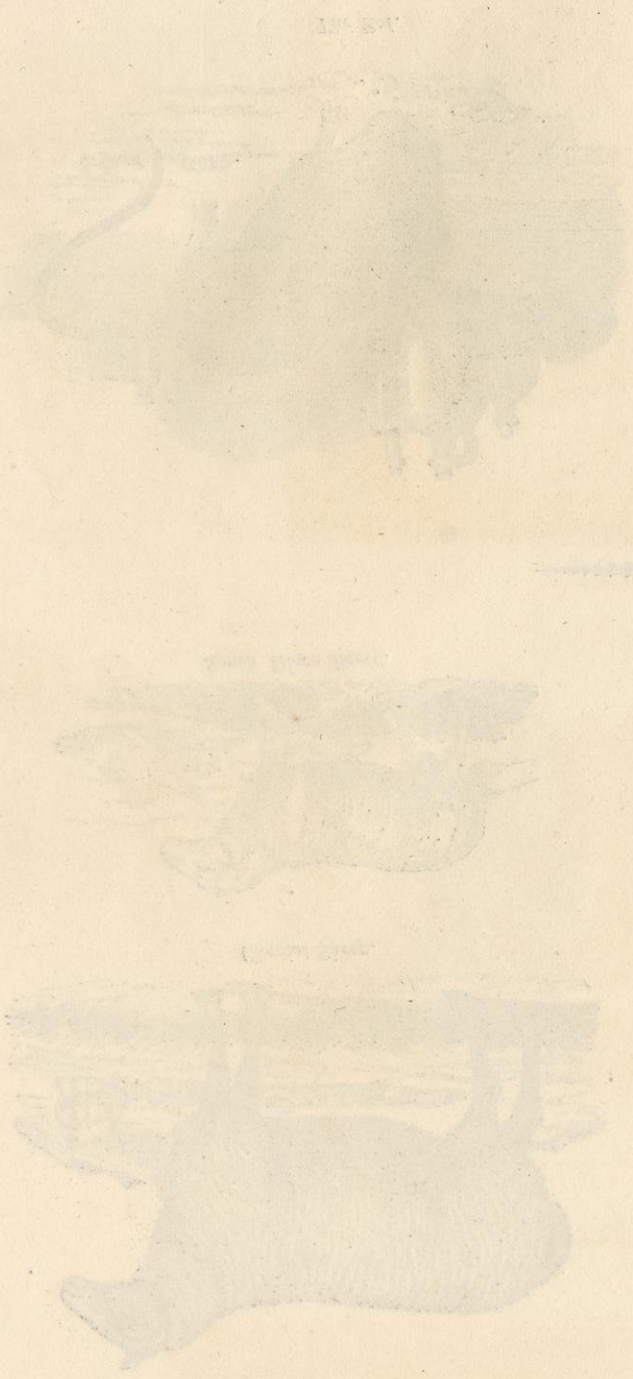
Norfolk Breed.

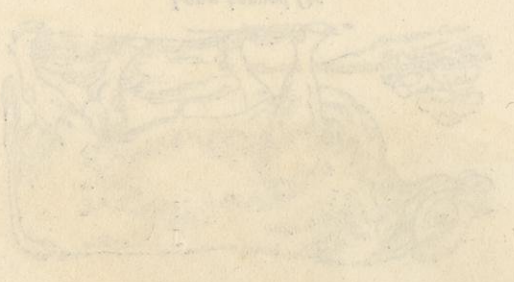


The Rat.

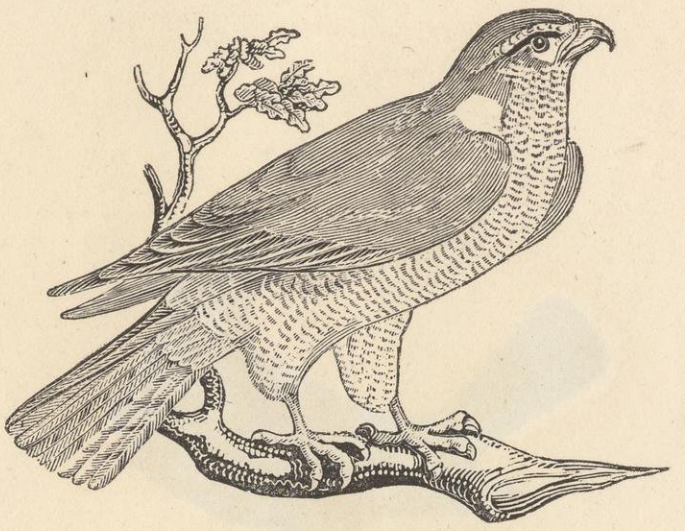


The Mouse.





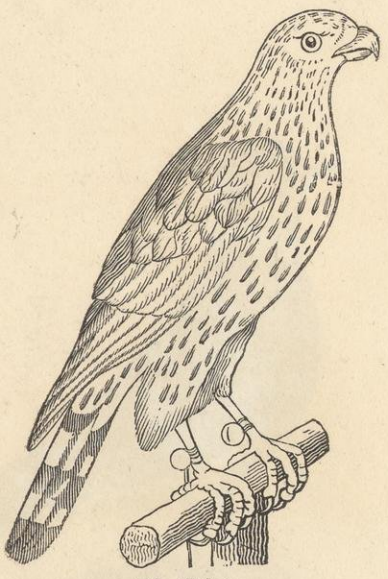
The Eagle.



The Sparrow Hawk.

The Owl.

The Horned Owl.

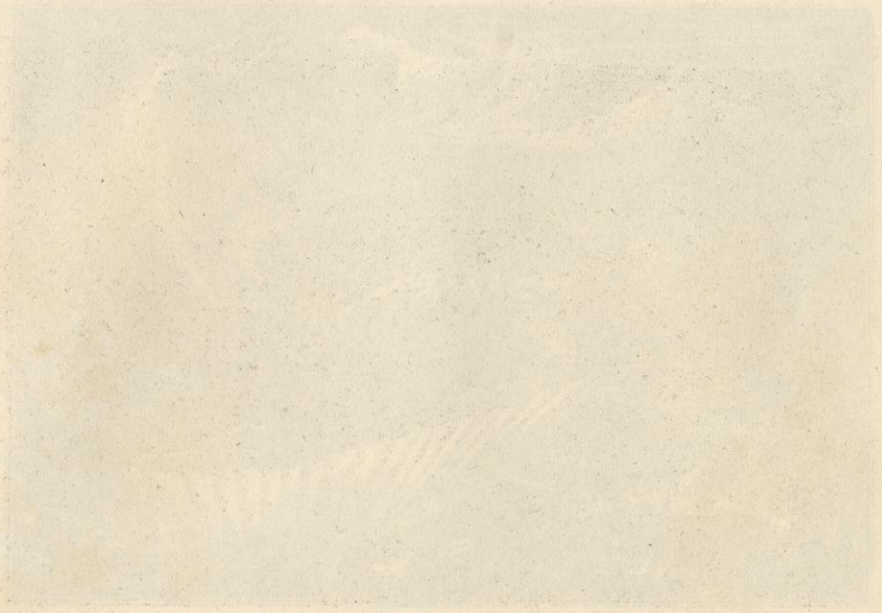


The Falcon.

The Cuckcoo.

The Pendulous Bird's Nest.

The Social African Bird's Nest.



THE SPARROW

THE BLACKBIRD

THE SKY LARK

THE THRUSH

THE BULLFINCH

THE WREN

THE CANARY BIRD

THE NIGHTINGALE

THE LINNET

THE REDSTART

THE ROBIN

THE GOLDFINCH

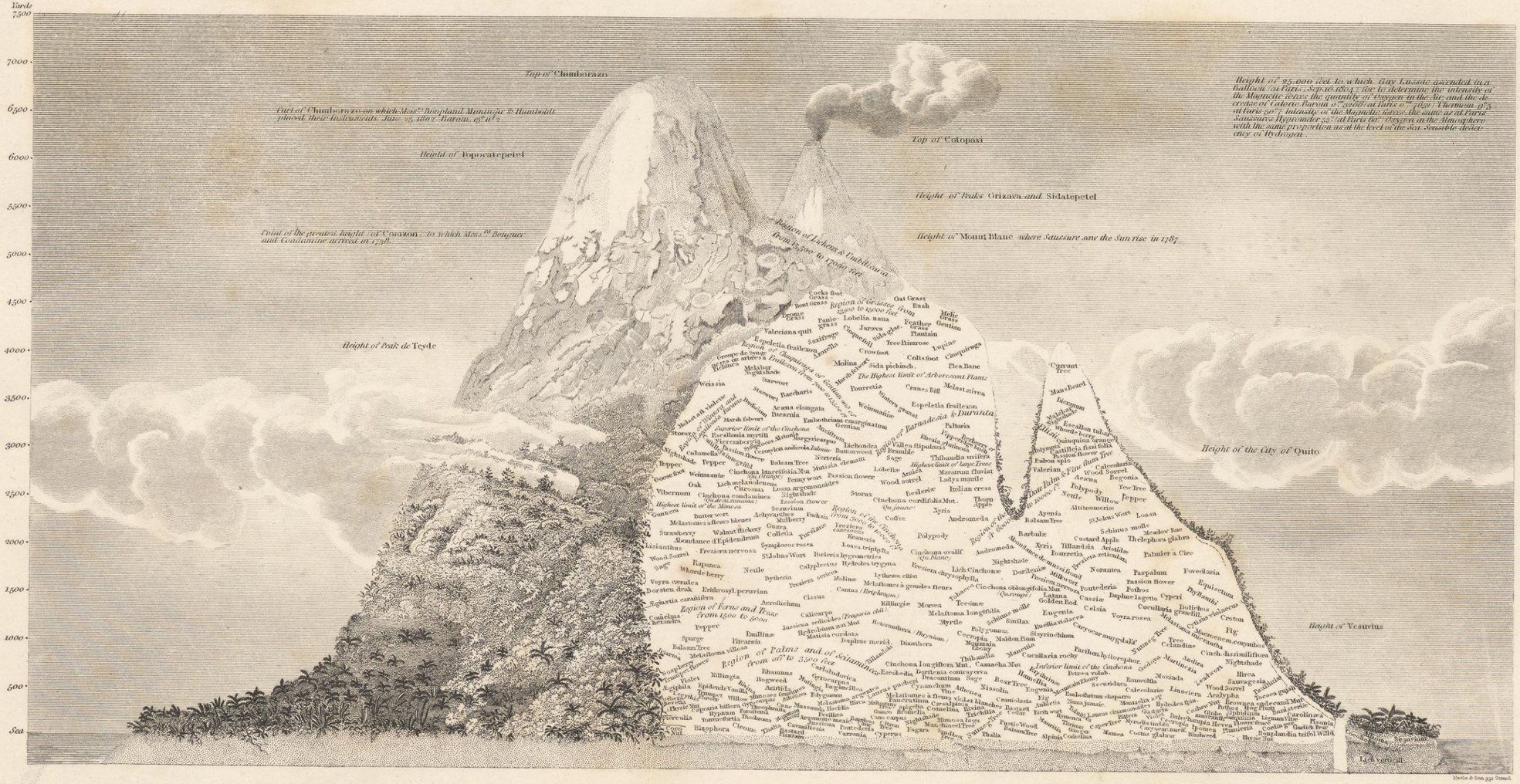
Camberwell Beauty.

Swallow Tail.

Chickweed

Pink Underwing

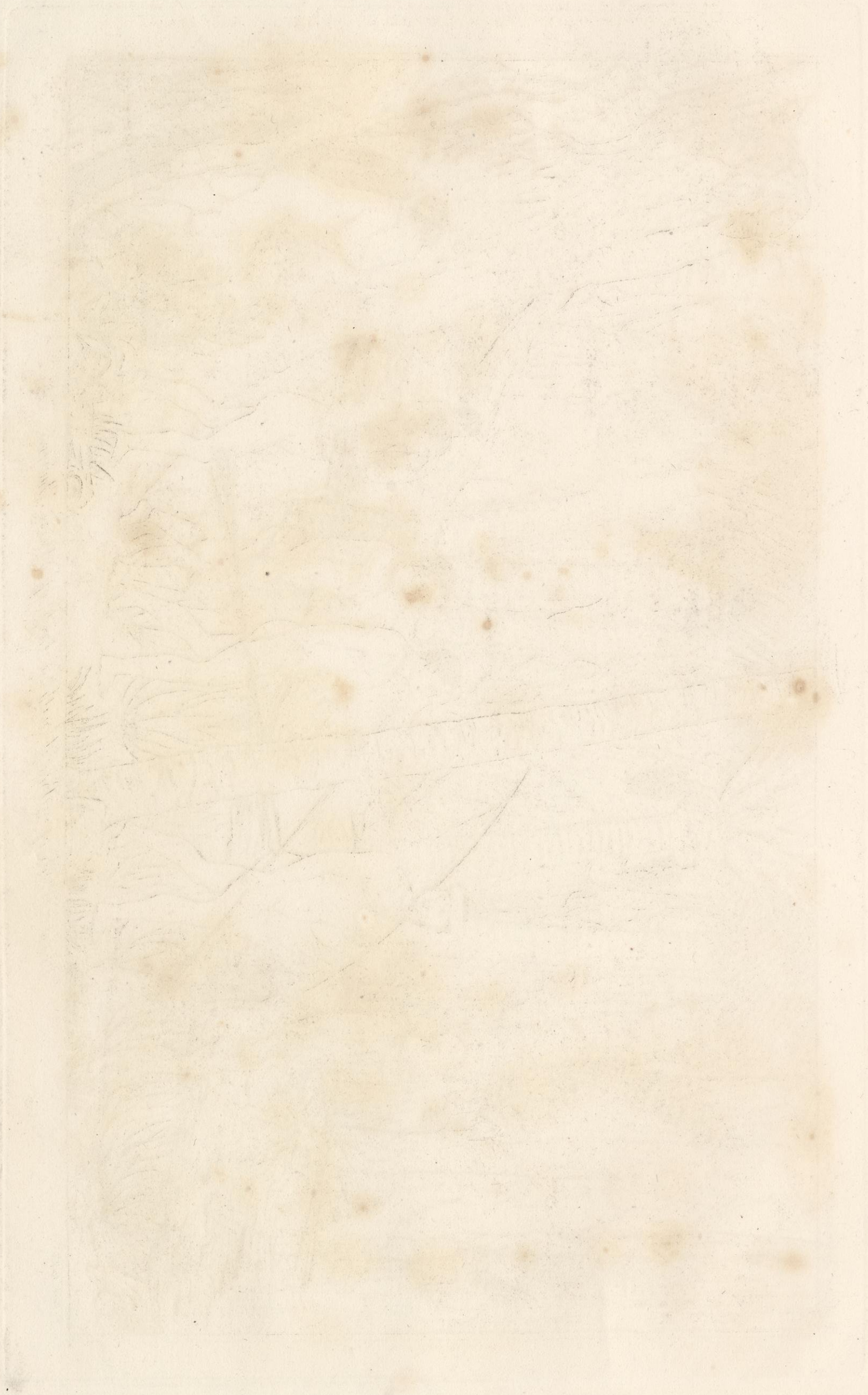
Purple Emperor



PROGRESS OF VEGETATION AT DIFFERENT ELEVATIONS.

W. Read, Sculp.

Dense Woods of Brazil, with a troop of Paris Indians.



THE TWENTY-FOUR CLASSES OF VEGETABLES. ACCORDING TO THE LINNÆAN SYSTEM.

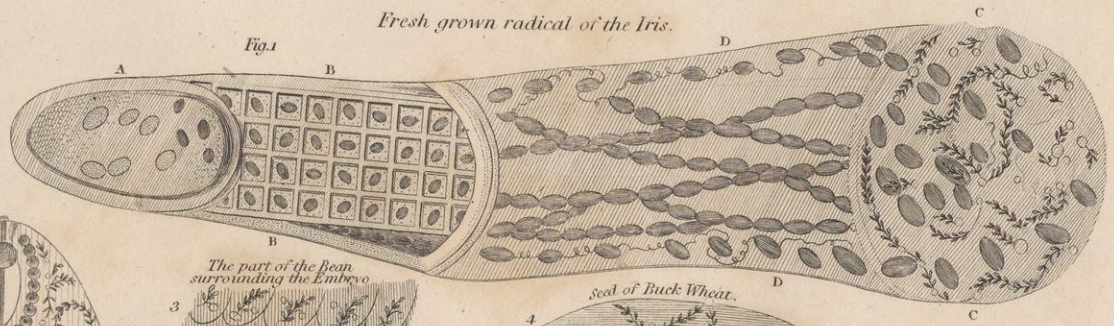
Neele & Son, 352 Strand

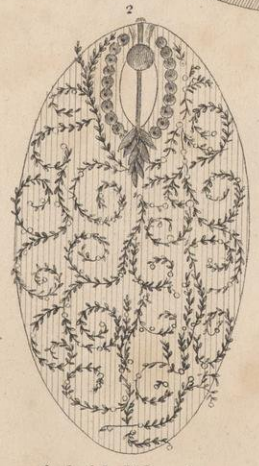
Mrs Ibbetson's Observations.

Ibbetson Pl. III.

Fresh grown radical of the Iris.

Fig. 1





Seed of the Melon after fructification.

The part of the Bean surrounding the Embryo

Heart of the Seed of the Fir germinating.

Seed of Buck Wheat.

Heart of the Fir Seed.

Interior of a Pea before fructification

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Mrs Ibbetson's, Microscopical observations on Plants.

Fig. 1.

I Dissection of an Elm leaf

II Dissection of a leaf of an Herbaceous Plant

III Dissection of a young Grat's leaf

IV Dissection of a leaf of an Evergreen

1st Cuticle
2
3rd Cuticle
Veins and Spiral wire or muscles
3
4
Pabulum
5
Under Cuticle
6
Vertical Section of an elm leaf
7
2nd Cuticle
8
Pabulum
9
Veins and muscles
10
11
Section
12
The leaf drawn up
13
1st Cuticle
14
2nd Cuticle
15
Pabulum
Thickness
16
21
Grat's leaf thickness
26
Edge of a young leaf
16
Section
17
1st Cuticle
18
3rd Cuticle
19
Pabulum
20
22
Swellings
Upper Cuticle of Rock Plants
27
23
Swelling in a Cuticle of rock Plants
Swellings of Rock Plants enlarged
24
28
Edge of a young Leaf
Male Flower of Willow
30
A
a
B
Fig. 29.
A
Male Flowers of the Willow
Aa
25
The hairs of a leaf
32
Top root of the miller
1st Cuticle
2. dº
3. dº
31
Stem with pollen ascending
33
Oblong Pollen
The single Anemone
35
34
Single Anemone
a
b
36
Single Anemone
b
b
37
Hairs & valves of a leaf
38
Section of a Floating water leaf
b
a
39
Section of an upright water leaf

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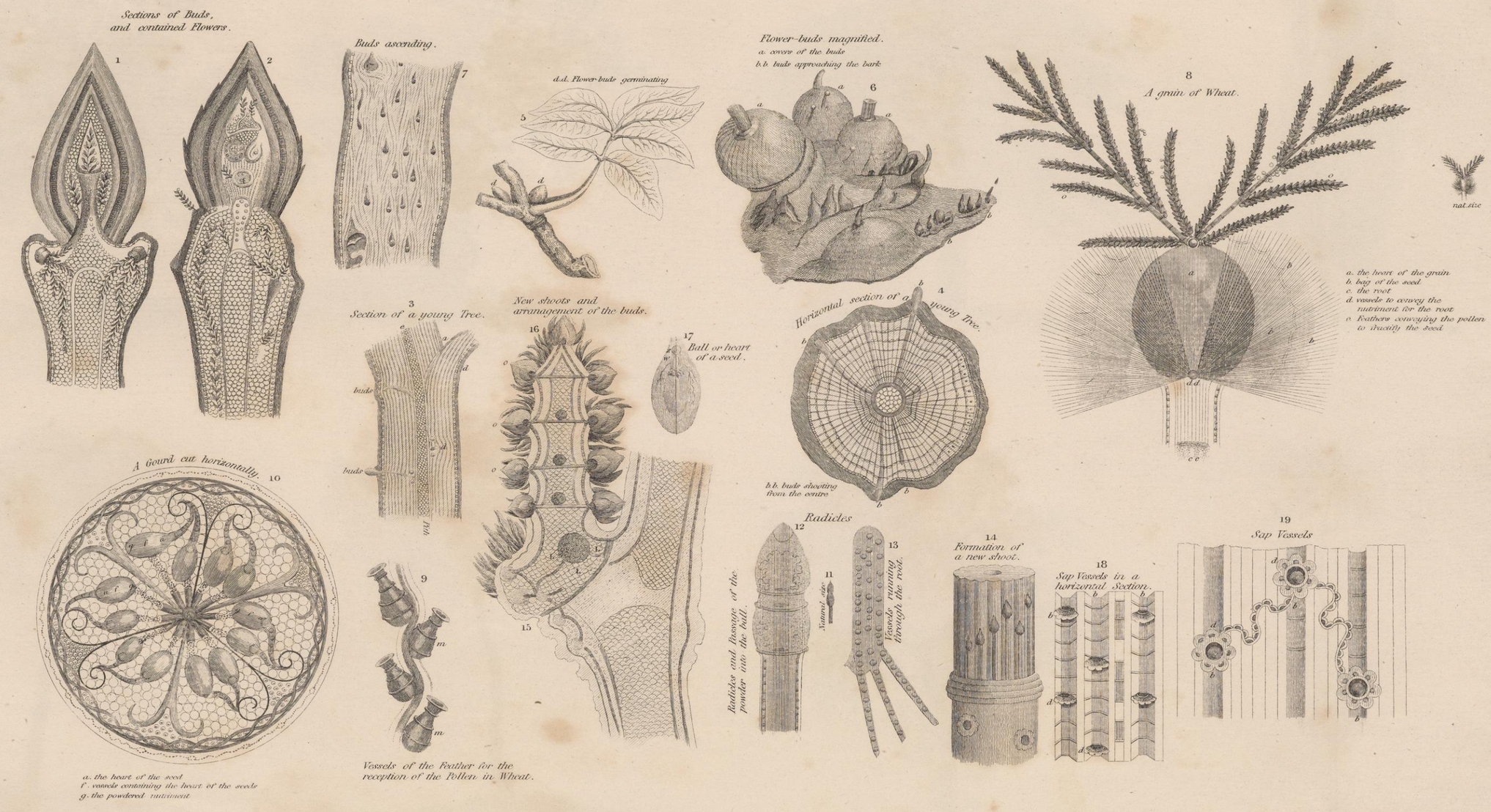
Sections of Buds, and contained Flowers.
1
2
Buds ascending.
7
d.d. Flower-buds germinating
5
Flower-buds magnified.
a. covers of the buds
b.b. buds approaching the bark
6
8
A grain of Wheat.
nat. size
a. the heart of the grain
b. bag of the seed
c. the root
d. vessels to convey the nutriment for the root
e. Feathers conveying the pollen to fructify the seed
3
Section of a young Tree.
buds
New shoots and arrangement of the buds.
16
17
Ball or heart of a seed.
Horizontal section of a young Tree.
4
b.b. buds shooting from the centre
A Gourd cut horizontally.
10
a. the heart of the seed
f. vessels containing the heart of the seeds
g. the powdered nutriment
9
Vessels of the Feather for the reception of the Pollen in Wheat.
15
Radicles
12
Radicles and Passage of the powder into the ball.
11
Natural size
13
Vessels running through the root.
14
Formation of a new shoot.
18
Sap Vessels in a horizontal Section.
19
Sap Vessels

OAK

POLLARD OAK

CEDAR

CYPRESS

PALM

ITALIAN PINE

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ELM

LOPPED ELM

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ASPIN.

POLLARD-ASPIN.

LIME.

HOLLY.

ASH.

ABELE OR POPLAR.

LABURNUM.

LAUREL.

ELDER.

LARCH FIR.

SCOTCH FIR.

SPRUCE OR NORWAY FIR.

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POLLARD WILLOW.

WEEPING WILLOW.

POLLARD WEEPING WILLOW.

YEW.

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BEECH

BIRCH

SYCAMORE

THORN

WALNUT

WILLOW

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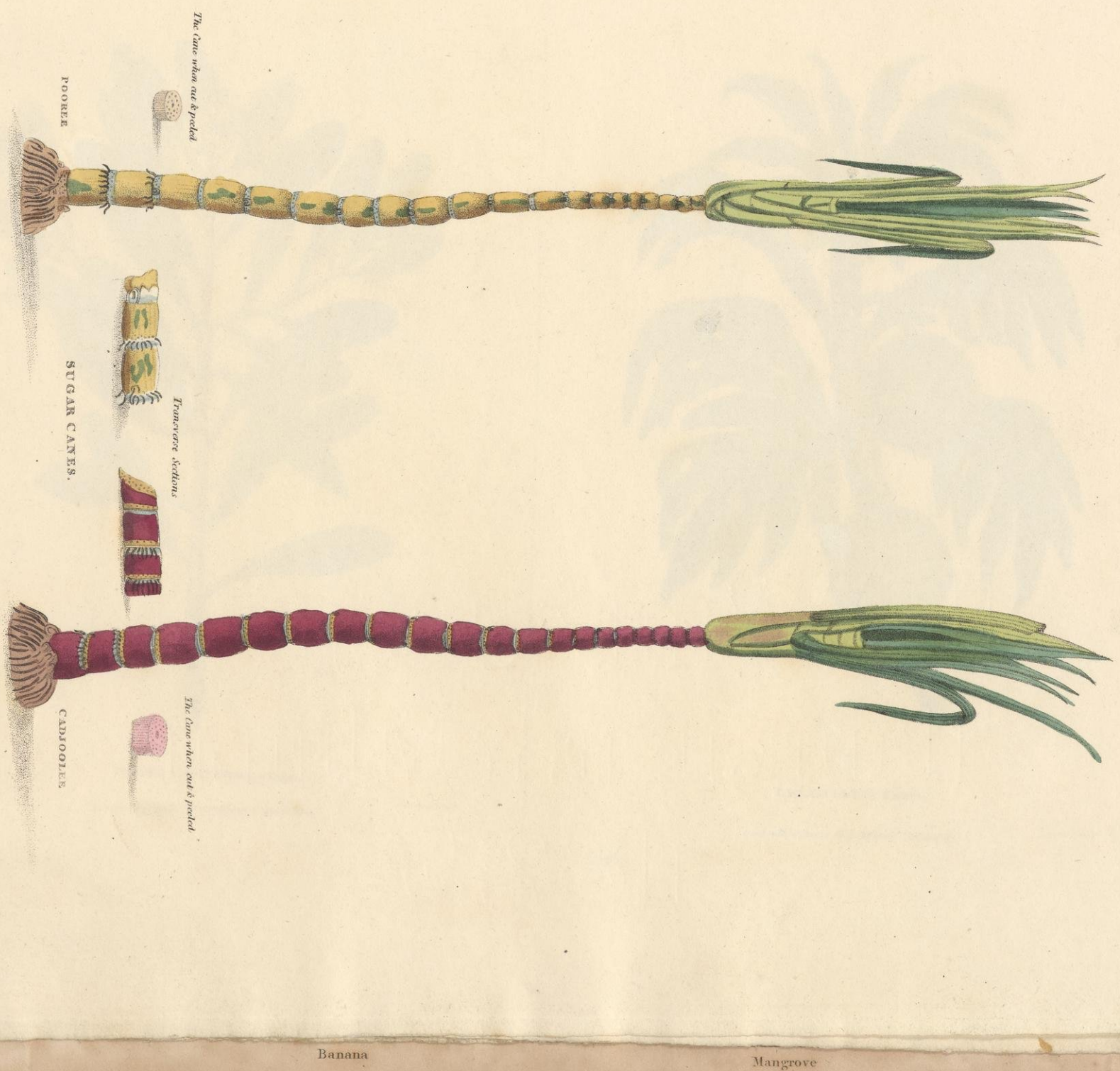
Citrus Aurantium _ Orange Tree.

Neale & Son, 332 Strand.

Citrus Medica _ Lemon Tree.

Neale & Son, 332 Strand.



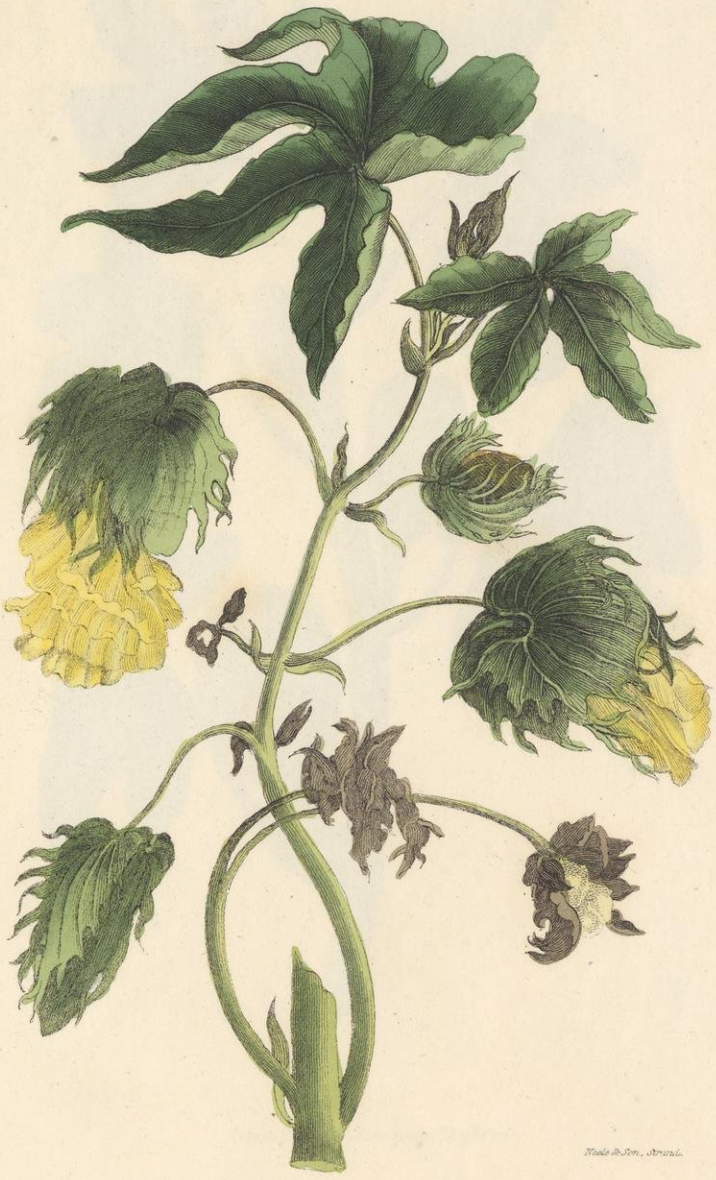
Banana

Mangrove

Neele & Son, Strand.

COFFEE TREE.

London, Published by Sir R. Phillips & Co. Feb. 10. 1823.



Neele & Son, Strand.

COTTON TREE.

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WHITE CINNAMON TREE.

London Published by Sir R. Phillips & Co. Feb. 10. 1823.

Neele & Son, 352 Strand.

BREAD FRUIT TREE.

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Neele & Son, 352 Strand.

Myrtus Pimenta _ Pimento, Jamaica Pepper *or* Allspice.

London Published by Sir R Phillips & C° Feb 10 1823.

Ficus Carica _ Common Fig Tree.

London Published by Sir R Phillips & C° Feb 10 1823.

TEA TREE

London Published by Sir R Phillips & C° Feb 10 1823.

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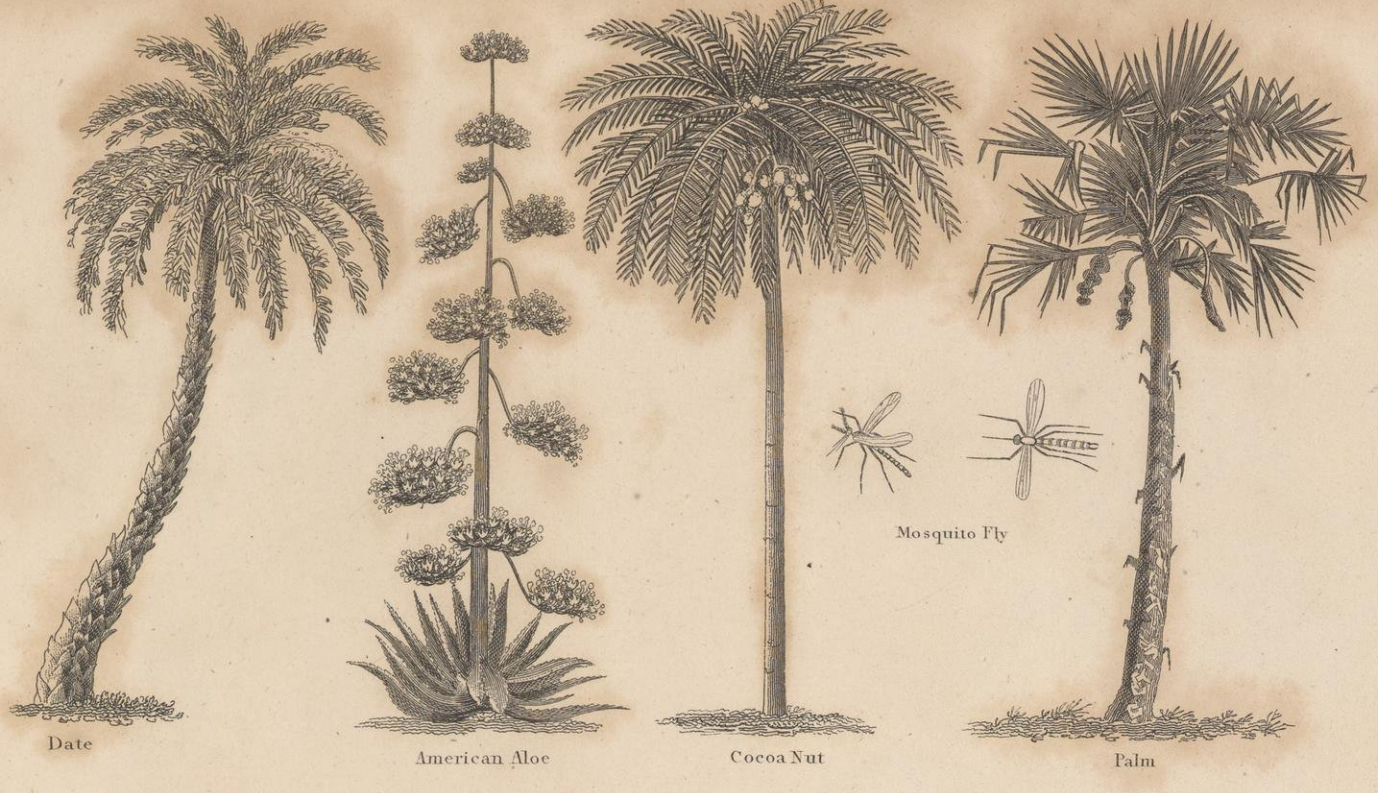
Eugenia Caryophyllata _ Clove Tree.

London Published by Sir R Phillips & C° Feb 10 1823.

Neele & Son 352 Strand

Banana

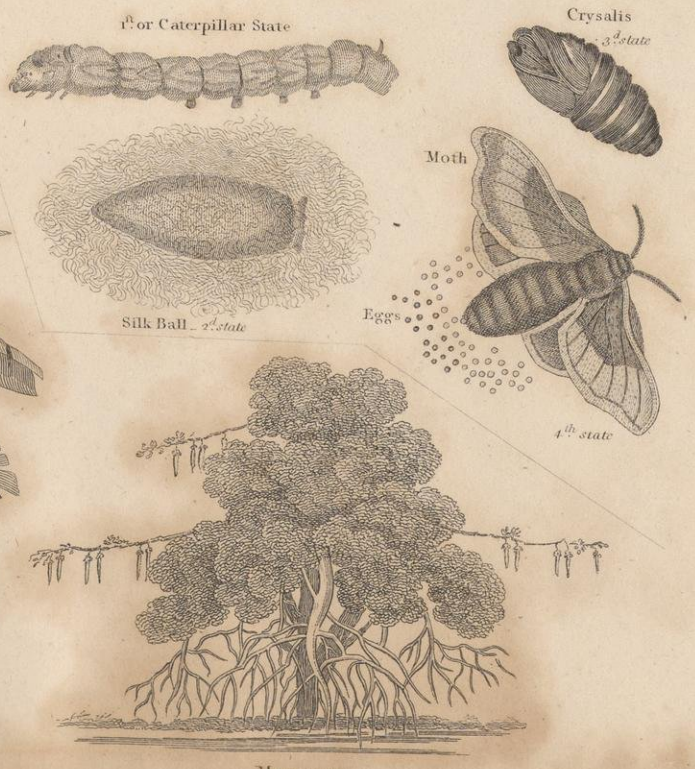
Mangrove



PLANTAIN TREE.

Myristica Moschata _ Nutmeg Tree.

SILK WORM



Linum Usitatissimum _ Common Flax.

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Nicotiana Tabacum _ Virginian Tobacco.

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Crocus Sativus _ Saffron Crocus.

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Rheum Palmatum _ Palmated *or* officinal Rhubarb.

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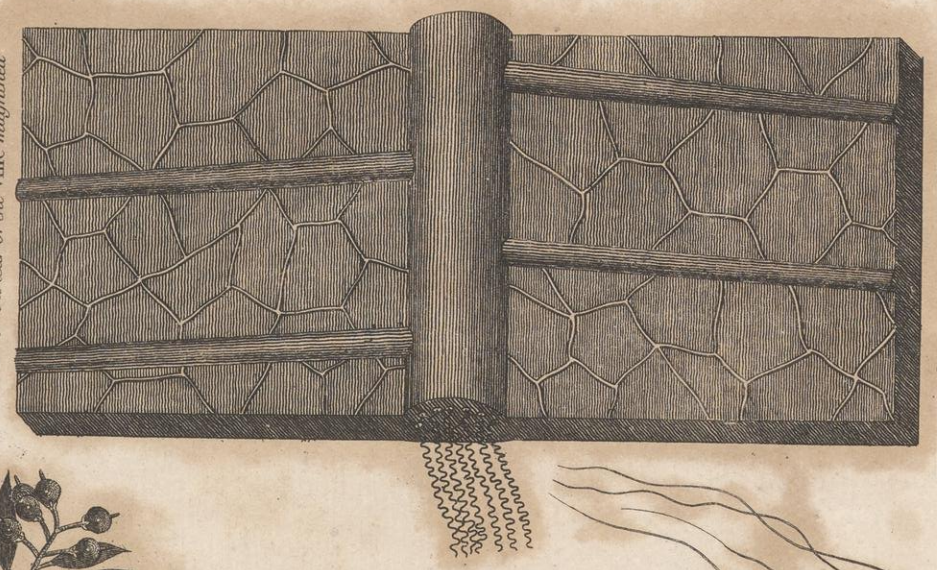
Animal Flowers

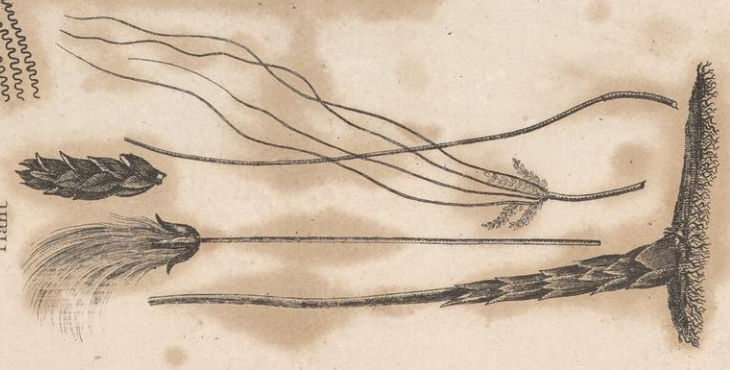
CASTOR TREE.
(Ricinus)



Part of the leaf of the Vine magnified

and so cut as to shew the Trachæ.

Soap Tree



Papyrus Plant

Myrtle

Sensitive Plant

Benzoin

Euphorbia

Coccus Plant and Insect.

THE PAPYRUS.

SPONGES.

Madrepore.

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BRITISH GRASSES.

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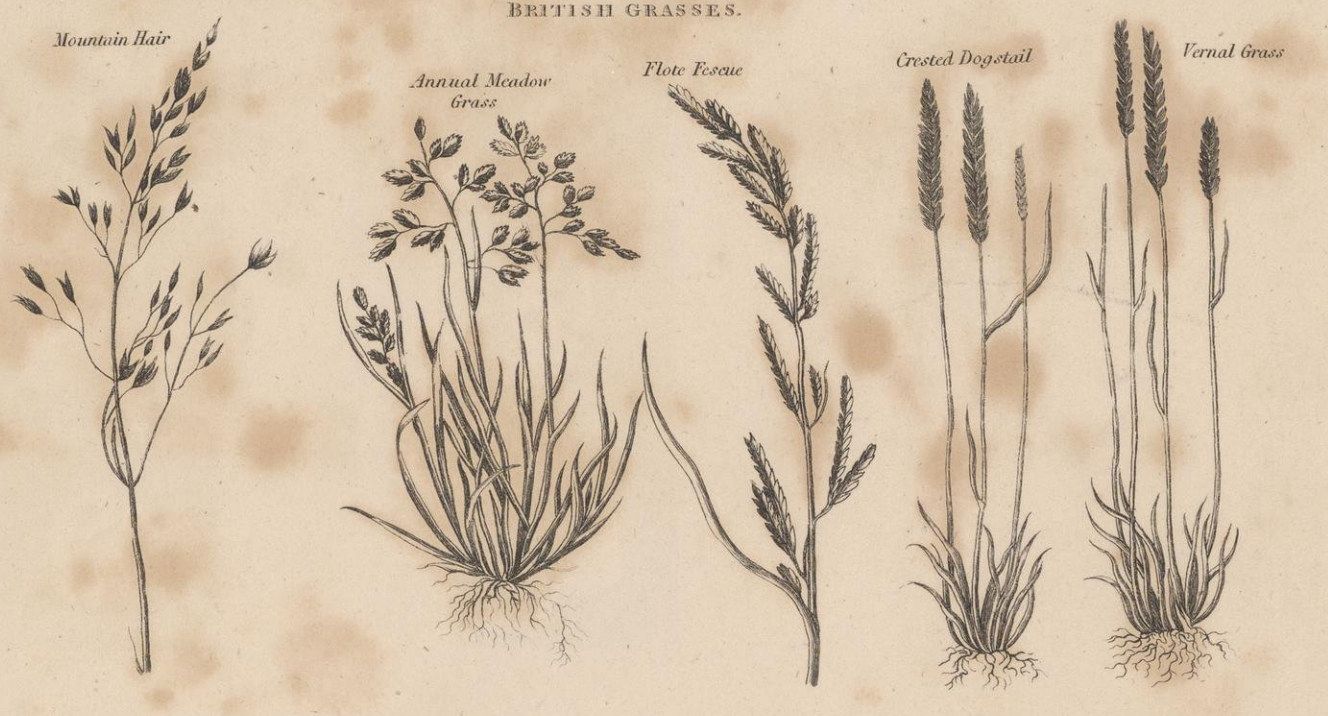
BRITISH GRASSES.



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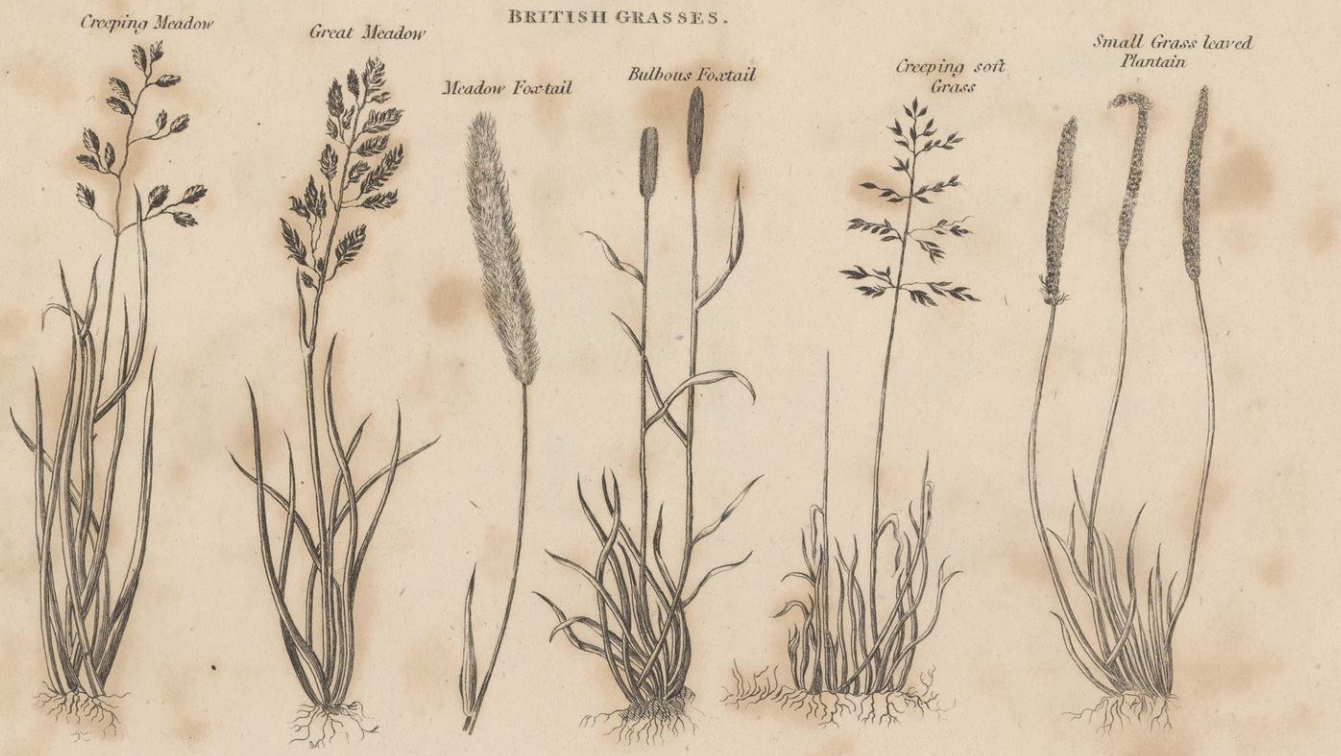
BRITISH GRASSES.



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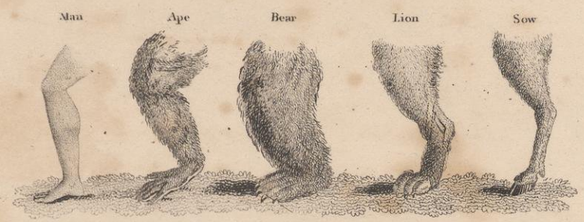
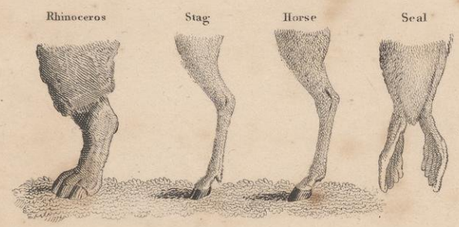
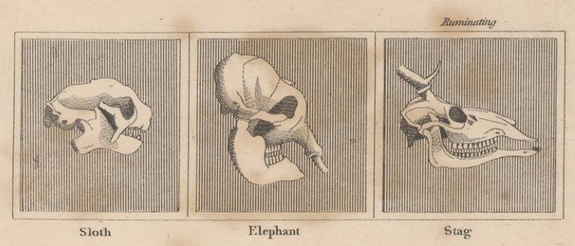
Comparative Physiognomies of Birds & Quadrupeds.

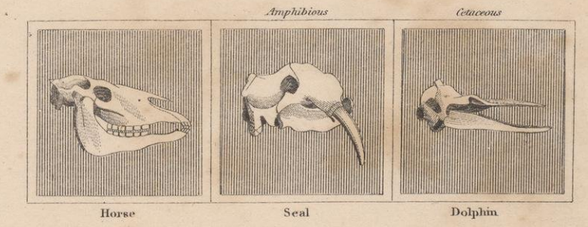


Comparative Legs of various Animals.

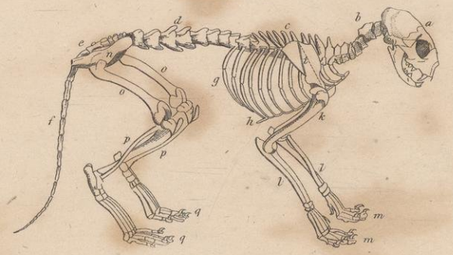




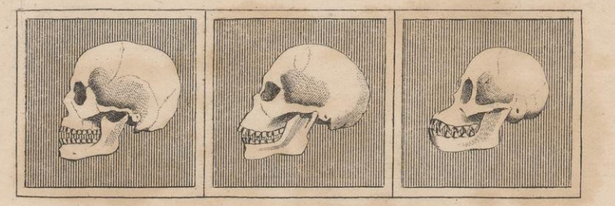
Skulls of Animals.

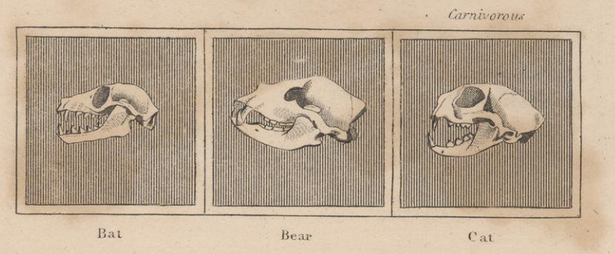


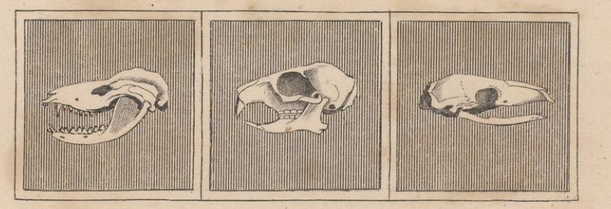
Skeleton of a Cat



a Head
b Vertebræ of the neck
c Vertebræ of the shoulders
d Vertebræ of the back
e
f Vertebræ of the tail
g Ribs
h Sternum
i Shoulder blade
k Thigh bones
l Leg bones
m Paws
n Hip bone
o Thighs of the hind legs
p Legs
q Feet







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