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Campbell's British-American Series of School-Books.

THE

FIFTH BOOK

OF

READING LESSONS.

FOR THE USE OF SCHOOLS IN THE BRITISH-AMERICAN PROVINCES.

JAMES CAMPBELL AND SON,
MONTREAL AND TORONTO.

MDCCCLXVI.

PREFACE.

THERE exists among teachers a considerable diversity of opinion as to the place which a Reading Book ought to occupy in the education of youth. On the one hand, it is maintained that such a book ought to be an epitome of universal knowledge, and that the value of each lesson should be estimated by the amount of information it contains, no matter whether interesting to the reader or not; it is upon this principle that the more advanced volumes of the "Irish National Series," have been compiled. On the other hand, it is contended that the sole and simple aim of a book of this character should be, to teach the art of reading; and many of the most modern School Readers have been prepared in accordance with this view. In the present book, and throughout the whole of the Series, the plan adopted is, to combine the advantages of both systems without their disadvantages, or in other words, to convey information in an interesting manner, to endeavour to excite and stimulate the curiosity of the scholar to further researches by extracts which shall not merely convey instruction, but will at once attract his attention and will convert a study into a pleasure.

The lessons in this, as well as in the other advanced books of the Series, have been selected from the works of authors, recpectable not only for their merit but also for their elegance of style; thus preserving the true character of the Series, as intended to teach the Art of Reading. The names of such men as Brougham, Maury, Hugh Miller, Darwin, Dickens, Livingstone, Gosse, Kane, Smiles, Macaulay, Gibbon, Bulwer, Robertson, Warburton, &c., are a sufficient guarantee for the literary character of the work.

One important feature in this and its companion book, the 6th, to which the attention of teachers is directed, is the systematic arrangement of the subjects, by which it is hoped that the pupil may be led to that most important step towards sound scholarship—the accurate classification of all knowledge acquired.

No attempt has been made to give an *epitome* of any science whatever. Under the headings of the Physical and Historical Sciences, the scholar is systematically and progressively introduced to the broad field of knowledge in these departments, of which, the objects are clearly stated, and the boundaries carefully defined in the introductory chapters. Instead of that uninteresting detail which serves but to prejudice the minds of the young against some of the most delightful and elevating studies, the sciences are illustrated by incidents or by examples, and the legitimate curiosity of the scholar is thereby excited and stimulated to obtain a deeper insight into these wonders which are here presented to his fancy. The whole is thickly interspersed with readings in verse from the works of our best poets; and a national tone has been given to the book by the introduction of sketches of the Provinces, &c.

While the lessons are unincumbered with those explanations of commonly occurring words, explanations which reflect upon the teacher, and deprive him at once of pleasure and authority; the etymologies of all scientific terms employed are fully given in the text.

TORONTO, September, 1866.

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OF THE

Fifth Book of Reading Lessons.

MATHEMATICAL SCIENCES.

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OUR LAND; OR, THE SONG OF THE FINNISH PATRIOTS.

(*Translated from the Swedish of Runeberg.*)

OUR land, our land, our Fatherland!
  Thou glorious word, ring forth!
No mountain rises, proud and grand,
Nor slopes a vale, nor sweeps a strand,
  More dear than thou, land of the North—
  Our fathers' native earth.

Our land is poor, as all can tell;
  No gold our rivers hold;
A stranger scorns its heath and fell,
And yet this land we love full well;
  For us—with mountain, wood, and wold—
  'Tis still a land of gold.

We love our rivers' thundering tide,
  Our streamlets sparkling bright;
The murmuring of our forests wide;
Our starry nights, our summer's pride;
  All, all that e'er, with sound or sight,
  Has fill'd us with delight.

'Twas here our fathers fought the fight,
  With thought, and sword, and plough;
Here—here in moments dark or bright,
'Mid Fortune's smile, or Fortune's spite,
  The Finnish people's heart would glow,
  'Twould bear both weal and woe.

A

And who could count the struggles dire
  Which that brave people stood,
When battle raged with sword and fire,
And frost and famine spent their ire?
  And who could mete their outpour'd blood—
  Their patient, dauntless mood?

It was for us their life-blood flow'd,
  Here, here upon this shore;
'Twas here with joy their bosoms glow'd,
'Twas here in sorrow they abode;
  Long ere we lived, in days of yore
  Our burdens here they bore.

How blest, how precious, is this spot,
  All that we love is here;
Howe'er hard fate may cast our lot,
A land—a fatherland—we 've got;
  Oh, what on earth can e'er
  Be to our hearts more dear?

And here, yes here, we see the land—
  O sight, how full of bliss!
We need but stretch our good right hand,
And joyous point to sea and strand,
  And say, "Behold this country—this—
  Our fatherland it is."

And were we call'd to dwell in light,
  'Midst golden clouds of morn,
Where thousand stars are glittering bright,
Where tears ne'er flow, nor sorrows blight;
  Still, for this land so poor, so stern,
  Our longing hearts would yearn.

O land! thou land of thousand lakes,
  Of song and constancy;
Against whose strand life's ocean breaks,
Where dreams the past, the future wakes;
  Oh, blush not for thy poverty—
  Be hopeful, bold, and free.

Thy blossom, in the bud that lies,
  Shall burst its fetters strong;
So, from our tender love shall rise
Thy light, thy fame, thy hopes, thy joys;
  And prouder far shall sound ere long
  Our Finland's Patriot Song.

—Illustrated London News.

ON THE PLEASURES OF SCIENCE.

To pass our time in the study of the sciences has, in all ages, been reckoned one of the most dignified and happy of human occupations, and the name of philosopher, or lover of wisdom, is given to those who lead such a life. But it is by no means necessary that a man should do nothing else than study known truths, and explore new, in order to earn this high title. Some of the greatest philosophers, in all ages, have been engaged in the pursuits of active life; and he who, in whatever station his lot may be cast, prefers the refined and elevating pleasures of knowledge to the low gratification of the senses, richly deserves the name of a philosopher.

It is easy to show that there is a positive gratification resulting from the study of the sciences. If it be a pleasure to gratify curiosity—to know what we were ignorant of—to have our feelings of wonder called forth, how pure a delight of this very kind does natural science hold out to its students! Recollect some of the extraordinary discoveries of mechanical philosophy. Is there anything in all the idle books of tales and horrors, with which youthful readers are so much delighted, more truly astonishing, than the fact, that a few pounds of water may, without any machinery, produce an irresistible force? What can be more strange, than that an ounce weight should balance hundreds of pounds, by the intervention of a few bars of thin iron?—Observe the extraordinary truths which optical science discloses! Can anything surprise us more, than to find that the colour of white is a mixture of all others; that red, and blue, and green, and all the rest, merely by being blended in certain proportions, form what we had fancied rather to be no colour at all than all colours together?—Chemistry is not behind in its wonders. That the diamond should be made of the same material with coal; that water should be chiefly composed of an inflammable substance;

that acids should be almost all formed of different kinds of air; and that one of those acids, whose strength can dissolve almost any of the metals, should be made of the self-same ingredients with the common air we breathe; these surely are things to excite the wonder of any reflecting mind—nay, of any one but little accustomed to reflect. And yet these are trifling when compared to the prodigies which astronomy opens to our view: the enormous masses of the heavenly bodies; their immense distances; their countless numbers, and their motions, whose swiftness mocks the uttermost efforts of the imagination.

Akin to this pleasure of contemplating new and extraordinary truths, is the gratification of a more learned curiosity, by tracing resemblances and relations between things which, to common apprehension, seem widely different. It is surely a satisfaction, for instance, to know that the same thing which causes the sensation of heat causes also fluidity; that electricity, the light which is seen on the back of a cat when slightly rubbed on a frosty evening, is the very same matter with the lightning of the clouds; that plants breathe like ourselves, but differently, by day and by night; that the air which burns in our lamps enables a balloon to mount. Nothing can at first sight appear less like, or less likely to be caused by the same thing, than the processes of burning and of breathing,—the rust on metals and burning,—the influence of a plant on the air it grows in by night, and of an animal on the same air at any time, nay, and of a body burning in that air; and yet all these operations, so unlike to common eyes, when examined by the light of science, are the same. Nothing can be less like than the working of a vast steam-engine and the crawling of a fly upon the window; yet we find that these two operations are performed by the same means—the weight of the atmosphere; and that a sea-horse climbs the ice-hills by no other power. Can anything be more strange to contemplate? Is there, in all the fairy tales that ever were fancied, anything more calculated to arrest the attention, and to occupy and gratify the mind, than this most unexpected resemblance between things so unlike to the eyes of ordinary beholders? Then, if we raise our views to the structure of the heavens, we are again gratified with tracing accurate but most unexpected resemblances. Is it not in the highest degree interesting to find, that the power which keeps the earth in its shape and in its path, wheeling round the sun, extends over all the other worlds that compose the universe, and gives to each its proper place and motion; that the same power keeps the moon in her path round the earth; that the same power causes the tides upon our earth, and the peculiar form of the earth itself; and that, after all, it is the same power which makes a stone fall to the ground? To learn these things, and to reflect upon them, fills the mind, and produces certain as well as pure gratification.

The highest of all our gratifications in the study of science remains. We are raised by science to an understanding of the infinite wisdom and goodness which the Creator has displayed in all His works. Not a step can we take in any direction without perceiving the most extraordinary traces of design; and the skill everywhere conspicuous is calculated in so vast a proportion of instances to promote the happiness of living creatures, and especially of ourselves, that we can feel no hesitation in concluding, that if we knew the whole scheme of Providence, every part would appear to be in harmony with a plan of absolute benevolence. Independently, however, of this most consoling inference, the delight is inexpressible, of being able to follow, as it were, with our eyes, the marvellous works of the great Architect of Nature, and to trace the unbounded power and exquisite skill which are exhibited in the most minute as well as in the mightiest parts of His system.

—Brougham.

THE SEA.

"The sea is His, and He made it," cries the Psalmist of Israel in one of those bursts of enthusiasm in which he so often expresses the whole of a vast subject by a few simple words. Whose else, indeed, could it be, and by whom else could it have been made? Who else can heave its tides and appoint its bounds? Who else can urge its mighty waves to madness with the breath and wings of the tempest, and then speak to it again in a master's accents, and bid it be still? Who else could have peopled it with countless inhabitants, and filled it from its deepest bed to its expanded surface, filled it from its centre to its remotest shores, filled it to the brim with beauty and mystery and power? Majestic ocean! Glorious sea! No created being rules thee or made thee.

There is mystery in the sea. There is mystery in its depths. It is unfathomed, and perhaps unfathomable. What glittering riches, what heaps of gold, what stores of gems, there must be scattered in lavish profusion in the ocean's lowest bed! What spoils from all climates, what works of art from all lands, have been ingulfed by the insatiable and reckless waves! Who shall go down to examine and reclaim this uncounted and idle wealth? Who bears the keys of the deep? Who but He to whom the wildest waves listen reverently, and to whom all nature bows; He who shall one day speak, and be heard in the ocean's profoundest caves; to whom the deep, even the lowest deep, shall give up its dead, when the sun shall sicken, and the earth and the isles shall languish, and the heavens be rolled together like a scroll, and there shall be NO MORE SEA!

In early times, in the scriptural and classic periods, the great oceans were unknown. Mankind—at least that portion whose history has descended to us—dwelt upon the borders of an inland, mediterranean sea. They had never heard of such an expanse of water as the Atlantic, and certainly had never seen it. The landlocked sheet which lay spread out at their feet was at all times full of mystery, and often even of dread and secret misgiving. Those who ventured forth upon its bosom came home and told marvellous tales of the sights they had seen, and the perils they had endured. Homer's heroes returned to Ithaca with the music of the sirens in their ears, and the cruelties of the giants upon their lips. The Argonauts saw whirling rocks implanted in the sea, to warn and repel the approaching navigator; and, as if the mystery of the waters had tinged with fable even the dry land beyond it, they filled the Caucasus with wild stories of enchantresses, of bulls that breathed fire, and of a race of men that sprang, like a ripened harvest, from the prolific soil. If the ancients were ignorant of the shape of the earth, it was for the very reason that they were ignorant of the ocean. Their geographers and philosophers, whose observations were confined to fragments of Europe, Asia, and Africa, alternately made the world a cylinder, a flat surface begirt by water, a drum, a boat, a disk. The legends that sprang from these confused and contradictory notions made the land a scene of marvels, and the water an abode of terrors.

At a later period, when, with the progress of time, the love of adventure or the needs of commerce had drawn the navigator from the Mediterranean through the Pillars of Hercules into the Atlantic, and when some conception of the immensity of the waters had forced itself upon minds dwarfed by the contracted limits of the inland sea, then the ocean became in good earnest a receptacle of gloomy and appalling horrors, and the marvels narrated by those fortunate enough to return, told how deeply the imagination had been stirred by the new scenes opened to their vision. Pytheas, who coasted from Marseilles to the Shetland Isles, and who there obtained a glance at the bleak and wintry desolation of the North Sea, declared, on reaching home, that his further progress was barred by an immense black mollusc, which hung suspended in the air, and in which a ship would be inextricably involved, and where no man could breathe. The menaces of the South were even more appalling than the perils of the north; for he who should venture, it was said, across the equator into the regions of the sun, would be changed into a negro for his rashness; besides, in the popular belief, the waters there were not navigable. Upon the quaint charts of the Middle Ages, a giant located upon the Canary Islands forbade all farther venture westward, by brandishing his formidable club in the path of all vessels coming from the east. Upon these singular maps, the concealed and treacherous horrors of the deep were displayed in the grotesque shapes of sea-monsters and distorted water-unicorns, which were represented as careering through space and waylaying the navigators. Even in the time of Columbus, and when the introduction of the compass into European ships should have somewhat diminished the fantastic terrors of the sea, we find that the Arabians, the best geographers of the time, represented the bony and gnarled hand of Satan as rising from the waves of the sea of darkness—as the Atlantic was then called—ready to seize and ingulf the presumptuous mariner. The sailors of Columbus, on reaching the Sargasso Sea, where the collected weeds offered an impediment to their progress, thought they had arrived at the limit of navigation, and the end of the world. Five years later the crew of Da Gama, on doubling the Cape of Good Hope, imagined they saw, in the threatening clouds that gathered about Table Rock, the form of a spectre waving off their vessel, and crying woe to all who should thus invade his dread dominion. The Neptune of the classics, in short, who disported himself in the narrow waters of the Mediterranean, and of whose wrath we have read the famous mythologic accounts, was a deity altogether bland and *debonnaire* compared to the gloomy and revengeful monopolist of the seas, such as the historians and geographers of the Middle Ages painted him.

And now Columbus had discovered the Western Continent, Da Gama had found an ocean route to the Indies, and Magellan, sailing round the world, had proved its sphericity and approached the Spice Islands from the east. For centuries now, the two great oceans were the scenes of grand and useful maritime expeditions. The tropical islands of the Pacific arose, one by one, from the bosom of the sea, to reward the navigator, or relieve the outcast. For years property was not safe upon the sea, and trading ships went armed, while the armed vessels of nations turned buccaneers. Commerce was by and by spread over the world, and civilisation and Christianity were introduced into the desert and the wilderness. Two centuries more, and steam made the Atlantic Ocean a ferry-transit.

The ocean, then, has a history; it has a past worth narrating, adventures worth telling, and it has played a part in the advancement of science, in the extension of geographical knowledge, in the spread of civilisation and the progress of discovery, which it is eminently worth our while to ponder and digest.

—GOODRICH'S "*The Sea.*"

THE FORGING OF THE ANCHOR.

COME, see the Dolphin's anchor forged; 'tis at a white heat now;
The bellows ceased, the flames decreased; though on the forge's brow
The little flames still fitfully play through the sable mound;
And fitfully you still may see the grim smiths ranking round,
All clad in leathern panoply, their broad hands only bare:
Some rest upon their sledges here, some work the windlass there.
The windlass strains the tackle chains, the black mound heaves below,
And red and deep, a hundred veins burst out at every throe;
It rises, roars, rends all outright—O Vulcan, what a glow!
'Tis blinding white, 'tis blasting bright; the high sun shines not so!
The high sun sees not, on the earth, such fiery, fearful show,
The roof-ribs swarth, the candent hearth, the ruddy lurid row
Of smiths that stand, an ardent band, like men before the foe.
As quivering through his fleece of flame, the sailing monster, slow
Sinks on the anvil—all about the faces fiery grow—
"Hurrah!" they shout, "leap out—leap out;" bang, bang the sledges go;
Hurrah; the jetted lightnings are hissing high and low;

A hailing fount of fire is struck at every squashing blow;
The leathern mail rebounds the hail; the rattling cinders strow
The ground around; at every bound the sweltering fountains flow;
And thick and loud the swinking crowd, at every stroke, pant "Ho!"

Leap out, leap out, my masters; leap out and lay on load!
Let's forge a goodly anchor, a bower, thick and broad;
For a heart of oak is hanging on every blow, I bode,
And I see the good ship riding, all in a perilous road;
The low reef roaring on her lee, the roll of ocean pour'd
From stem to stern, sea after sea, the mainmast by the board;
The bulwarks down, the rudder gone, the boats stove at the chains,
But courage still, brave mariners, the bower yet remains,
And not an inch to flinch he deigns save when ye pitch sky-high,
Then moves his head, as though he said, "Fear nothing, here am I!"
Swing in your strokes in order, let foot and hand keep time!
Your blows make music sweeter far than any steeple's chime;
But, while ye swing your sledges, sing; and let the burden be,
"The anchor is the anvil king, and royal craftsmen we."
Strike in, strike in, the sparks begin to dull their rustling red!
Our hammers ring with sharper din, our work will soon be sped.
Our anchor soon must change his bed of fiery rich array,
For a hammock at the roaring bows, or an oozy couch of clay;
Our anchor soon must change the lay of merry craftsmen here,
For the "Yeo-heave-o," and the "Heave-away," and the sighing seaman's cheer;
When weighing slow, at eve they go, far, far from love and home,
And sobbing sweethearts, in a row, wail o'er the ocean foam.

In livid and obdurate gloom, he darkens down at last,
A shapely one he is and strong, as e'er from cat was cast.
O trusted and trustworthy guard, if thou hadst life like me,
What pleasures would thy toils reward beneath the deep green sea!
O deep sea-diver, who might then behold such sights as thou?
The hoary monster's palaces! methinks what joy 'twere now
To go plump plunging down amid the assembly of the whales,
And feel the churn'd sea round me boil beneath their scourging tails!
Then deep in tangle-woods to fight the fierce sea-unicorn,
And send him foil'd and bellowing back, for all his ivory horn;

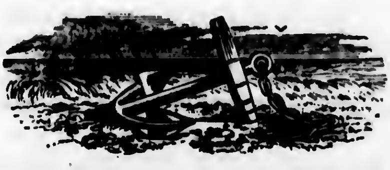
To leave the subtle sworder-fish, of bony blade, forlorn,
And for the ghastly grinning shark, to laugh his jaws to scorn;
To leap down on the kraken's back, where, 'mid Norwegian isles
He lies, a lubber anchorage for sudden shallow'd miles;
Till snorting, like an under-sea volcano, off he rolls,
Meanwhile to swing, a-buffeting the far astonish'd shoals
Of his back-browsing ocean-calves; or haply in a cove,
Shell-strown, and consecrate of old to some Undine's love,
To find the long-hair'd mermaidens; or, hard by icy lands,
To wrestle with the sea-serpent, upon cerulean sands.

O broad-armed fisher of the deep, whose sports can equal thine?
The Dolphin weighs a thousand tons, that tugs thy cable line;
And night by night, 'tis thy delight, thy glory day by day,
Through sable sea and breaker white, the giant game to play.
But, shamer of our little sports! forgive the name I gave,
A fisher's joy is to destroy—thine office is to save.

O lodger in the sea-king's halls, couldst thou but understand
Whose be the white bones by thy side, or who that dripping band,
Slow swaying in the heaving wave, that round about thee bend,
With sounds like breakers in a dream, blessing their ancient friend—
Oh, couldst thou know what heroes glide with larger steps round thee,
Thine iron side would swell with pride, thou 'dst leap within the sea!

Give honour to their memories who left the pleasant strand,
To shed their blood so freely for the love of fatherland—
Who left their chance of quiet age and grassy churchyard grave
So freely, for a restless bed amid the tossing wave—
Oh, though our anchor may not be all I have fondly sung,
Honour him for their memory, whose bones he goes among!

—*Blackwood's Magazine.*



EARLY NAVIGATORS.

We have taken the birth of Christ as a point of departure in the history of navigation, merely because of the prominence of that event in the annals of the world, not on account of any connexion that it has with the chronicles of the sea. So far from that, the first five centuries of the Christian era are an absolute blank in all matters which pertain to our subject. The Roman Empire rose and fell; and its rise and fall concerned the Mediterranean only. Not even Julius Cæsar, the greatest man in Roman history, has a place in maritime records; unless, when crossing the Adriatic in a fishing-boat during a storm, his memorable words of encouragement to the fisherman, "Fear nothing! you carry Cæsar and his fortunes!" are sufficient to connect him with the sea. Neither Pompey, nor Sylla, nor Augustus, nor Nero, nor Titus, nor Constantine, nor Theodosius, nor Attila, can claim part or lot in the dominion of man over the ocean. And so we glide rapidly over five centuries.

Upon the invasion of Italy by the barbarians, A.D. 476, the Veneti, a tribe dwelling upon the north-eastern shores of the Adriatic, escaped from their ravages by fleeing to the marshes and sandy inlets formed by the deposits of the rivers which there fall into the gulf. Here they were secure; for the water around them was too deep to allow of an attack from the land, and too shallow to admit the approach of ships from the sea. Their only resource was the water and the employments it afforded. At first they caught fish; then they made salt, and finally engaged in maritime traffic. Early in the seventh century their traders were known at Constantinople, in the Levant, and at Alexandria. Their city soon covered ninety islands, connected together by bridges. They established mercantile factories at Rome, and extended their authority into Istria and Dalmatia. In the eighth century they chased the pirates, and in the ninth they fought the Saracens. At this period Genoa, too, rose into notice, and the Genoese and the Venetians at once became commercial rivals, and the monopolists of the Mediterranean.

And now Peter the Hermit, barefooted and penniless, inveighing against the atrocities of the Turks towards Christians at Jerusalem, exhorted the warriors of the Cross to take up arms against the infidels. He inspired all Europe with an enthusiasm like his own, and enlisted a million followers in the cause. The passion of the age was for war, peril, and adventure; and fighting for the Sepulchre was a more agreeable method of doing penance than wearing sackcloth or mortifying the flesh. The first Crusade, a motley array of knights, spendthrifts, barons, beggars, women, and children, set out upon their wild career. Then came the second, the third, and the fourth. Crusading was the amusement and occupation of two centuries. Two millions of Europeans perished in the cause before it was abandoned. A few words concerning its effect upon the civilisation of Europe are necessary here, in direct pursuance of our subject.

During their stay in Palestine the Crusaders learned, and in a measure acquired, the habits of Eastern life. They brought back with them a taste for the peculiar products of that region—jewels, silks, cutlery, perfume, spices. A brisk commerce through the length and breadth of the Mediterranean was the speedy consequence. Genoa, Pisa, Florence, Venice, covered the waters of their inland sea with sails, trafficking from the ports of Italy to those of Syria and Egypt. In every maritime city conquered by the Crusaders, trading stations and bazaars were established. Marseilles obtained from the kings of Jerusalem privileges and monopolies of trade upon their territory. Venice surpassed all her rivals in the splendour and extent of her commerce, and it was for this that the Pope, Alexander III., sent the Doge the famous nuptial ring with which, in assertion of his naval supremacy, "to wed the Adriatic." The ceremony was performed from the deck of the *Bucentaur*, or state galley, with every possible accompaniment of pomp and parade. The vessel was crowned with flowers like a bride, and amid the harmonies of music, and the acclamations of the spectators, the ring was dropped into the sea. The Republic and the Adriatic, long betrothed, were now indissolubly wedded. This ceremony was repeated from year to year.

The Normans, the Danes, the Dutch, imitated the example of the Italians, or, as they were then called, the Lombards. but were rather occupied in conveying provisions to the armies than in trading for their own account.

It was during the Crusades that the French navy was created. Philip Augustus, who, on his way to Syria, and thence home again, could not have remained insensible to the advantages of possessing a strong force upon the ocean, formed, upon his return, the nucleus of a national fleet, for the purpose of defending his coasts either against pirates or foreign invasion.

While the necessity of transporting articles from the East to supply the demand thus created in the West, gave a stimulus to commerce and navigation, manufactures were encouraged and developed by the operation of the same cause. The Italians learned from the Greeks the art of weaving silk, which soon resulted in the weaving of cloth of gold and silver. From the manufactories of Syria, where stuffs were made of camels' hair, improvements were introduced into the manufactories of Europe, where they were woven of no other material than lambs' wool. Palestine also suggested to crusaders returning home the advantages of windmills for grinding flour. Arabia furnished the art of tempering arms and polishing steel, of chasing gold and silver, of mounting stones in rich and massive settings. Constantinople furnished the Christians with many splendid specimens of ancient art.

Nearly all the Gothic monuments of Europe which still excite the admiration of the tourist, owe their existence to this communication with the Greeks by means of the Crusades, and to the wonder which seized the Franks and Lombards at the sight of the churches and palaces of Byzantium. Painting upon glass was also brought from Constantinople; and the early painters of Christendom were speedily employed in tracing in colours, upon the windows of abbeys and cathedrals, the exploits of the Crusaders, and the triumphs of the Cross.

From the Arabs and the Greeks, too, the Europeans received their first lessons in the natural and exact sciences. Imperfect and incomplete as were the astronomy, the botany, the mathematics, and the geography of the Arabians, they were far in advance of the same professions as understood and practised in Europe. The languages were improved and enriched by the association and exchange of ideas into which English, Germans, Italians, and French were forced.

It is obvious, therefore, that the effect of the Crusades was to give the people of Europe a new motive for maintaining an intercourse with the people of Asia. They had seen their superior civilisation, and sought to introduce it among themselves. They had learned to appreciate their skill in the arts, and resolved to acclimate those arts at home. They had accustomed themselves to many articles of luxury, which had become articles of necessity, and which it was now essential, therefore, to transport from the Levant, from the Red Sea, and the Persian Gulf, to the Bay of Venice and the Gulf of Genoa. There was a demand, in short, in the West, for the products, the manufactures, the arts, of the East. Here was the origin of the immense Eastern commerce which now fell into the hands of the Genoese and Venetians, and which resulting from the Crusades, compelled us to the digression we have made

A map, published just anterior to the first Crusade, fully displays the ignorance which then prevailed in geographical science. The sea, as in the age of Homer, is made to surround the world as a river, the land being divided into three parts, Europe, Asia, and Africa. Africa and Asia are joined together in the south, and the Indian Ocean is an inland sea. Asia is as large as the other two continents combined. On the east there is a small spot indicated as the position of the Garden of Eden by the words, *Hic est Paradisus*. Europe and Africa are separated from Asia by a long canal, which may be either the Nile or the Hellespont. Africa is still considered the land of mystery and fable; its northern part only is considered inhabitable, the south being even unapproachable, on account of the torrents of flame poured on it by the sun. The Frozen Ocean, the Baltic, the White Sea, and the Caspian, are all united. The northern regions are represented as forming one single island; and Scandinavia is made the birthplace and residence of the Amazons, the famous women-warriors to whom antiquity had given a home in the Caucasus.

—GOODRICH'S "*The Sea.*"

THE WORLD AS KNOWN TO THE ANCIENTS 200 B.C.

THE CHESAPEAKE AND THE SHANNON.

" And as the war they did provoke,
We'll pay them with our cannon;
The first to do it will be Broke,
In the gallant ship the *Shannon*."—*Old Song.*

THE 1st of June has long been a glorious day in the annals of the British navy. It was then, in the year 1665, that the Duke of York and Sir William Penn defeated the Dutch Fleet at Solebay; and on the same day, in 1794, Lord Howe gained his famous victory over the French. But the 1st of June upon which our story opens was that of 1813, the second year of the American war. Great Britain had, for many years, been engaged in an unequal contest with the giant power of the first Napoleon; victorious upon her native element, she was also driving his armies from the soil of Spain, and was tasking all her powers in men and money to the utmost, in order to bring a long and exhaustive struggle to a happy conclusion. Taking advantage of her embarrassed situation, the new republic of the United States availed itself of a supposed insult which Great Britain had offered in searching its ships for naval deserters, and declared war on the 18th of June 1812, exactly three years before the battle of Waterloo. Then commenced a sad and unjust war; sad, because it was between people of the same blood and language; and unjust, because the Americans had no real ground of provocation. The United States carried on the war both by land and by sea, invading Canada with their armies, and attacking British frigates and merchant vessels upon the ocean. No large men-of war could be spared from their duty upon the European coast to oppose the ships of the enemy, which, on account of their superior size and armament, had already succeeded in capturing several of the smaller British craft. "England had so long regarded her naval supremacy as indisputable, and had been rendered so confident by a long series of ocean victories, that, at first, she treated the American war with undisguised contempt. On the other hand, the Americans introduced into their military operations the same 'smartness' which characterised their commercial dealings, and, aware of the importance of damaging the world's belief in England's invincibility, they quickly put to sea several powerful men-of-war, heavily armed and fully manned, which they, nevertheless, designated 'frigates' and 'sloops.' It was then with a burst of indignation, wrath, and wonder, that England heard of disgrace after disgrace, disaster upon disaster,—of English frigates captured by American frigates, and English sloops by American sloops—until it seemed as if the boasted prowess of our sailors had suddenly disappeared, and the knell of England's power was to be rung by her youthful and aggressive offspring. The war spirit, which had hitherto slumbered in the Saxon heart, shot up into a sudden flame, and from north to south, and east to west, went forth the cry that the honour of England must be avenged. It was while public feeling was thus unnaturally excited, that a single ship restored the old and just belief in our maritime renown. That ship was the frigate *Shannon*, whose gallant encounter with the *Chesapeake* is one of the most stirring episodes in all our naval history."

"On the 21st of March 1813, Captain Broke sailed from Halifax, in company with a frigate of the same size as the *Shannon*, the *Tenedos*, commanded by an equally zealous officer, Captain Hyde Parker. Looking into Boston harbour, the two British captains saw, to their great delight, two heavily-armed United States frigates, the *President* and the *Congress*, ready for sea. Notwithstanding the disparity of force, they resolved, if possible, to engage the Americans, and took up a station off the harbour to intercept their escape. Meanwhile, by another channel, the American 36-gun-frigate *Chesapeake* had run into port. During a thick fog on the 1st of May, the two

Americans contrived to elude the vigilance of their sentinels, and put out to sea; and the English captains had the mortification of finding only the *Chesapeake* left in the harbour. They were too brave to think of opposing their united strength to a single frigate, and, moreover, it was evident that the *Chesapeake* would hardly venture from her place of shelter to encounter two British ships of war. Captain Broke, therefore, as senior officer, ordered the *Tenedos* to proceed on a cruise, with instructions not to rejoin him until the 14th of June."

During the long month of May the *Shannon* blockaded Boston harbour, waiting for the *Chesapeake* to come out and fight a fair battle upon the open sea. The two ships were well matched, but the advantage was on the side of the American; for, although it had no more guns than the British ship, they were of heavier calibre, and threw not only the legitimate shot and ball, but star and chain shot, with other equally dangerous and barbarous missiles. Its crew, also, was stronger than that of the *Shannon* by seventy men, and the vessel was about seventy tons larger, so that one would have thought Captain Lawrence had little to fear in the event of an encounter. In spite, however, of the many challenges which Captain Broke sent to him during the month of May, he obstinately refused to emerge from his secure position in Boston harbour. About noon, however, on the 1st day of June, just as Captain Broke had sent off a discharged prisoner with a formal challenge to the commander of the *Chesapeake*, that vessel set sail from the harbour, accompanied by a large fleet of pleasure-boats, in which the good people of Boston expected to witness a great naval victory; and so they did, but, unfortunately for them, the victory was on the wrong side. Five long anxious hours were spent by both vessels in getting out into the open sea, so that they might there fight a fair battle upon neutral waters. When about six leagues' distance from the harbour, the *Shannon* lay to and waited for the *Chesapeake* to come within range. On she came with a fair wind, the stars and stripes flying gaily from the mizzen royal topmasthead, the peak, and the main rigging; contrasting strangely with the *Shannon's* plain union-jack at the fore, and her "old rusty blue ensign at the mizzen peak." But old and rusty as the British colours were, they were worth all the bran new bunting in the world, for the flag was there "that has braved a thousand years the battle and the breeze." In addition to the ensigns above-mentioned, the *Chesapeake* hung out at the fore a large white flag, inscribed with the motto, "Sailors' Right and Free Trade," which the Americans foolishly thought would make

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the British tars turn traitors to their country. About a quarter to six o'clock the *Chesapeake* came up within fifty yards of the *Shannon*.

> "As they drifted on their path,
> There was silence deep as death,
> And the boldest held his breath
> For a time."

Then a cheer arose from the American ship, followed by a shot from the British frigate. Thirteen such single shots passed from vessel to vessel, followed by crashing timbers, and the groans of wounded and dying men. Then the *Chesapeake* poured in a broadside; the *Shannon* replied, and, for a few minutes, the decks of the opposing frigates were swept by the iron hail, driving the men from their quarters in which no human being could live. Now a well-aimed shot, for the *Shannon's* crew are splendid gunners, brings down the steersman of the *Chesapeake;* she falls sharp to the wind, and exposes herself to the full sweep of the British fire. Already Captain Lawrence has fallen mortally wounded, exclaiming, with his last breath, "Don't give up the ship;" for he was a brave man and a good officer. A terrible volley is poured into the sternports of the *Chesapeake*, and the second officer in command wishes to get the vessel away from her gallant British enemy; but Broke will not let him, and so the two ships fall aboard one another. "Lash them together," cries the captain of the *Shannon*, and brave men strive to bind the frigates fast, while the enemy is raining musketry upon them, and Stevens, the veteran boatswain, has his left arm literally hacked off with repeated swordcuts. The rest of the *Shannon's* crew are boarders; the Americans are expecting them, and a large barrel of unslacked lime is at hand to throw in the faces of the British seamen; but, by a just retribution, a shot strikes the barrel, and its contents are dashed into the eyes of those who contrived the cowardly stratagem. In less time than it requires to tell the story, the boarders are ready, seamen with pike, pistol, and cutlass, and marines with musket and bayonet. Over the enemy's taffrail they go, led into action by Captain Broke and Lieutenant Watt, and form upon the deck of the *Chesapeake*. Then follows a scene of confusion and horror, in which shots and cuts and thrusts are succeeded by ghastly wounds and dying groans. The enemy is beaten forward; some escape down the fore hatchway, others over the bow, and others throw themselves into the sea; several surrender as prisoners of war. But the fight is not over. A large number of men are in the hold; they fire through the hatchways and kill a marine. The men who have surrendered take up arms again and attack Captain Broke, one wounding him in the face with a pike, another laying bare his skull with the butt-end of a musket, and a third aiming a blow at him with a cutlass; but his brave seamen cut down the treacherous Americans. Lieutenant Watt now hauls down the stars and stripes, and on the halliards bends a British ensign above them. The halliards are twisted, the stars and stripes rise uppermost, and the *Shannon's* gunners, supposing the act to be performed by the enemy, aim at the lieutenant, who falls, with five seamen, the victims of a melancholy blunder. The marines fire a volley into the hold, where the Americans still keep up a dropping fire upon the victorious enemy. Then follows a summons to surrender from Captain Broke, who, with bandaged head, is sitting upon a gun-carriage. Sullenly they comply, the British flag floats above the American colours, and the *Chesapeake* becomes the prize of her gallant enemy. In this fight the loss of the United States was one hundred and seventy men, that of the British vessel eighty-three.

It was some little time before the shattered frigates were in a fit state to set sail; soon, however, they were repaired and made their way to Halifax. Into that splendid harbour the *Shannon* entered with flying colours and her well-won prize on the 6th of June, amid the booming of artillery and the cheers of loyal British subjects.

"The moral effect of this memorable action, both in England and America, was immense; it restored confidence to the public mind of Great Britain, while it proved to the Americans that they were by no means able to contend with English sailors, when the terms were at all equal. We do not doubt that if a parricidal war should again—which God forbid!—break out between the mother country and the commonwealth, nurtured of her strength and bred from her loins, our seamen would still maintain the honour of the Red Cross, and repeat, if necessary, that gallant encounter between the *Shannon* and the *Chesapeake*, which, in the stirring times of the great war, fired with patriotic ardour the hearts of our forefathers, and reasserted our sovereignty of the seas!"

—*Adapted from* ADAMS'S "*Famous Ships of the British Navy.*"

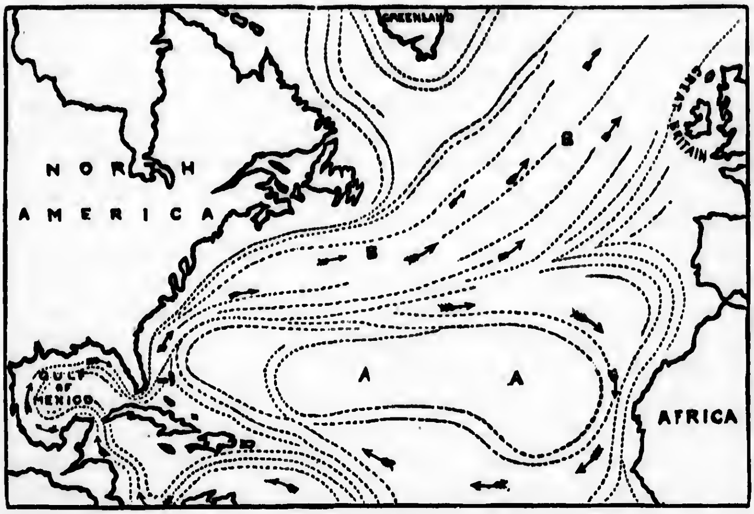
THE CONVICT SHIP.

Morn on the waters! and purple and bright,
Bursts on the billows the flashing of light;
O'er the glad waves, like a child of the sun,
See the tall vessel goes gallantly on;
Full to the breeze she unbosoms her sail,
And her pennon streams onward, like hope, in the gale;
The winds come around her, in murmur and song,
And the surges rejoice as they bear her along.
See! she looks up to the golden-edged clouds,
And the sailor sings gaily aloft in her shrouds:
Onwards she glides amid ripple and spray,
Over the waters, away and away!
Bright as the visions of youth ere they part,
Passing away, like a dream of the heart;
Who, as the beautiful pageant sweeps by,
Music around her, and sunshine on high,
Pauses to think, amid glitter and show,
Oh! there be hearts that are breaking below?

Night on the waves! and the moon is on high,
Hung like a gem on the brow of the sky,
Treading its depths in the power of her might,
And turning the clouds, as they pass her, to light.
Look to the waters! asleep on their breast,
Seems not the ship like an island of rest,
Bright and alone on the shadowy main,
Like a heart-cherish'd home on some desolate plain?
Who, as she smiles in the silvery light,
Spreading her wings on the bosom of night,
Alone on the deep, as the moon in the sky,
A phantom of beauty, could deem with a sigh,
That so lovely a thing is the mansion of sin,
And souls that are smitten, lie bursting within?
Who, as he watches her silently gliding,
Remembers that wave after wave is dividing
Bosoms that sorrow and guilt could not sever,
Hearts that are parted and broken for ever?
Or dreams that he watches, afloat on the wave,
The death-bed of hope, or the young spirit's grave?

'Tis thus with our life: while it passes along,
Like a vessel at sea, amid sunshine and song,
Gaily we glide in the gaze of the world,
With streamers afloat, and with canvas unfurl'd;
All gladness and glory to wandering eyes,
Yet charter'd by sorrow and freighted with sighs:
Fading and false is the aspect it wears,
As the smiles we put on, just to cover our tears;
And the withering thoughts that the world cannot know,
Like heart-broken exiles, lie burning below;
Whilst the vessel drives on to that desolate shore,
Where the dreams of our childhood are vanish'd and o'er.

—T. K. Hervey.



THE GULF STREAM.

There is a river in the ocean. In the severest droughts it never fails, and in the mightiest floods it never overflows. Its banks and its bottom are of cold water, while its current is of warm. The Gulf of Mexico is its fountain, and its mouth is in the Arctic Seas. It is the Gulf Stream. There is in the world no other such majestic flow of waters. Its current is more rapid than the Mississippi or the Amazon, and its volume more than a thousand times greater.

The currents of the ocean are among the most important of its movements. They carry on a constant interchange between the waters of the poles and those of the equator, and thus diminish the extremes of heat and cold in every zone.

The sea has its climates as well as the land. They both change with the latitude; but one varies with the elevation above, the other with the depression below the sea level. The climates in each are regulated by circulation; but the regulators are, on the one hand, winds; on the other, currents.

The inhabitants of the ocean are as much the creatures of climate as are those of the dry land; for the same Almighty hand which decked the lily and cares for the sparrow, fashioned also the pearl, and feeds the great whale, and adapted each to the physical conditions by which His providence has surrounded it. Whether of the land or the sea, the inhabitants are all His creatures, subjects of His laws, and agents in His economy. The sea, therefore, we may safely infer, has its offices and duties to perform; so, may we infer, have its currents; and so, too, its inhabitants: consequently, he who undertakes to study its phenomena must cease to regard it as a waste of waters. He must look upon it as a part of that exquisite machinery by which the harmonies of nature are preserved, and then he will begin to perceive the developments of order and the evidences of design.

From the Arctic Seas a cold current flows along the coasts of America, to replace the warm water sent through the Gulf Stream, to moderate the cold of western and northern Europe. Perhaps the best indication as to these cold currents may be derived from the fishes of the sea. The whales first pointed out the existence of the Gulf Stream by avoiding its warm waters. Along the coasts of the United States all those delicate animals and marine productions which delight in warmer waters are wanting; thus indicating, by their absence, the cold current from the north now known to exist there. In the genial warmth of the sea about the Bermudas on the one hand, and Africa on the other, we find in great abundance those delicate shell-fish and coral formations which are altogether wanting in the same latitudes along the shores of South Carolina.

No part of the world affords a more difficult or dangerous navigation than the approaches of the northern coasts of the United States in winter. Before the warmth of the Gulf Stream was known, a voyage at this season from Europe to New England, New York, and even to the Capes of the Delaware or Chesapeake, was many times more trying, difficult, and dangerous than it now is. In making this part of the coast, vessels were frequently met by snowstorms and gales which mock the seaman's strength, and set at naught his skill. In a little while his bark becomes a mass of ice; with her crew frosted and helpless, she remains obedient only to her helm, and is kept away for the Gulf Stream. After a few hours' run she reaches its edge, and almost at the next bound passes from the midst of winter into a sea at summer heat. Now the ice disappears from her apparel, and the sailor bathes his stiffened limbs in tepid waters. Feeling himself invigorated and refreshed with the genial warmth about him, he realises out there at sea the fable of Antæus and his mother Earth. He rises up and attempts to make his port again, and is again, perhaps, as rudely met and beat back from the north-west; but each time that he is driven off from the contest he comes forth from this stream, like the ancient son of Neptune, stronger and stronger, until, after many days, his freshened strength prevails, and he at last triumphs, and enters his haven in safety, though in this contest he sometimes falls to rise no more.

The ocean currents are partly the result of the immense evaporation which takes place in the tropical regions, where the sea greatly exceeds the land in extent. The enormous quantity of water there carried off by evaporation disturbs the equilibrium of the seas; but this is restored by a perpetual flow of water from the poles. When these streams of cold water leave the poles, they flow directly towards the equator; but, before proceeding far, their motion is deflected by the diurnal motion of the earth. "At the poles they have no rotatory motion; and although they gain it more and more in their progress to the equator, which revolves at the rate of a thousand miles an hour, they arrive at the tropics before they have gained the same velocity of rotation with the intertropical ocean. On that account they are left behind, and, consequently, flow in a direction contrary to the diurnal rotation of the earth. Hence the whole surface of the ocean for thirty degrees on each side of the equator flows in a stream or current three thousand miles broad from east to west. The trade winds, which constantly blow in one direction, combine to give this great Equatorial Current a mean velocity of ten or eleven miles in twenty-four hours."

Were it not for the land, such would be the uniform and constant flow of the waters of the ocean. The presence of the land interrupts the regularity of this great western movement of the waters, sending them to the north or south, according to its conformation.

The principal branch of the Equatorial Current of the Atlantic takes a north-westerly direction from off Cape St Roque, in South America. It rushes along the coast of Brazil; and, after passing through the Caribbean Sea, and sweeping round the Gulf of Mexico, it flows between Florida and Cuba, and enters the North Atlantic under the name of the Gulf Stream, the most beautiful of all the oceanic currents.

In the Straits of Florida the Gulf Stream is thirty-two miles wide, two thousand two hundred feet deep, and flows at the rate of four miles an hour. Its waters are of the purest ultra-marine blue as far as the coasts of Carolina; and so completely are they separated from the sea through which they flow, that a ship may be seen at times half in the one and half in the other.

As a rule, the hottest water of the Gulf Stream is at or near the surface; and as the deep-sea thermometer is sent down, it shows that these waters, though still much warmer than the water on either side at corresponding depths, gradually become less and less warm until the bottom of the current is reached. There is reason to believe that the warm waters of the Gulf Stream are nowhere permitted, in the oceanic economy, to touch the bottom of the sea. There is everywhere a cushion of cold water between them and the solid parts of the earth's crust. This arrangement is suggestive, and strikingly beautiful. One of the benign offices of the Gulf Stream is to convey heat from the Gulf of Mexico,—where otherwise it would become excessive,—and to dispense it in regions beyond the Atlantic, for the amelioration of the climates of the British Islands, and of all Western Europe. Now, cold water is one of the best non-conductors of heat; but if the warm water of the Gulf Stream were sent across the Atlantic in contact with the solid crust of the earth, comparatively a good conductor of heat, instead of being sent across, as it is, in contact with a non-conducting cushion of cold water to fend it from the bottom, all its heat would be lost in the first part of the way, and the soft climates of both France and England would be as that of Labrador, severe in the extreme, and ice-bound.

It has been estimated that the quantity of heat discharged over the Atlantic from the waters of the Gulf Stream in a winter's day would be sufficient to raise the whole column of atmosphere that rests upon France and the British Islands from the freezing point to summer heat.

Every west wind that blows crosses the stream on its way to Europe, and carries with it a portion of this heat to temper there the northern winds of winter. It is the influence of this stream that makes Erin the "Emerald Isle of the Sea," and that clothes the shores of Albion in evergreen robes; while, in the same latitude, the coasts of Labrador are fast bound in fetters of ice.

As the Gulf Stream proceeds on its course, it gradually increases in width. It flows along the coast of North America to Newfoundland, where it turns to the east, one branch setting towards the British Islands, and away to the coasts of Norway and the Arctic Ocean. Another branch reaches the Azores, from which it bends round to the south, and, after running along the African coast, it rejoins the great equatorial flow, leaving a vast space of nearly motionless water between the Azores, the Canaries, and Cape de Verd Islands. This great area is the Grassy or Sargasso Sea, covering a space many times larger than the British Islands. It is so thickly matted over with gulf weeds that the speed of vessels passing through it is often much retarded. When the companions of Columbus saw it, they thought it marked the limits of navigation, and became alarmed. To the eye, at a little distance, it seems substantial enough to walk upon. Patches of the weed are always to be seen floating along the outer edge of the Gulf Stream. Now, if bits of cork or chaff, or any floating substance, be put into a basin, and a circular motion be given to the water, all the light substances will be found crowding together near the centre of the pool, where there is the least motion. Just such a basin is the Atlantic Ocean to the Gulf Stream; and the Sargasso Sea is the centre of the whirl. Columbus first found this weedy sea in his voyage of discovery: there it has remained to this day, moving up and down, and changing its position like the calms of Cancer, according to the seasons, the storms, and the winds. Exact observations as to its limits and their range, extending back for fifty years, assure us that its mean position has not been altered since that time. —MAURY.

CHARACTERISTICS OF THE NEW WORLD.

THREE centuries and a half ago, in October of the year 1492, Christopher Columbus, while sailing from the extreme west of the ancient continents in hopes of finding a direct route to their extreme east, made the wonderful discovery of a new quarter of the globe.

These three centuries and a half have not divested America of its newness; for the novelty which it possesses consists in something more than the lateness of its discovery. Necessarily the physical features of the Old World are reproduced in the New; but their relative proportions and their arrangement are extremely different.

One characteristic of the New World is the uniformity of its two continental masses. Each of the three continents composing the Old World has an individuality of its own—Europe being remarkable for peninsulas, Asia for table-lands, and Africa for deserts; but North and South America are remarkable chiefly as being the counterparts of each other. They occupy, indeed, different zones, and the Rocky Mountains of North America lie much farther from the coast than the Andes of South America, but all else is correspondence. Both are pear-shaped, and the narrow end of the pear points southwards in each; in both, the principal mountains run north and south, and not far from the western shore; the St Lawrence and Mississippi in North America, correspond in direction to the Amazon and La Plata in South America; the Brazilian group of mountains, which separate these in the lower part of their course, is represented by the Alleghanies, which separate those; and towards the sources of the rivers their basins are separated in North America and in South America alike, only by a gentle undulation, so that, as the inland region of North America, from the Arctic Ocean to the Gulf of Mexico, is but one continuous plain, so also is the inland region of South America, from the Caribbean Sea to Patagonia.

The scenery of these plains, called prairies and savannahs in North America, llanos and pampas in South America, is characterised by the same uniformity which pervades the physical conformation of the whole continent. Whether they are clothed with grass, as on the right bank of the Mississippi, or covered with primeval forests, as on the left bank of that river, and throughout the Amazonian plain, day after day the travellers who explores them has but one unvarying landscape all around him. The deep solitude of these plains, wherever it remains unbroken by advancing civilisation, adds power to the depressing uniformity of the scene. In the following passage, Humboldt, the most learned of travellers, while acknowledging the tendency of American scenery to depress, declares the mind capable of recovering itself, so that, though yielding at first, it conquers at last:—"An uninhabited region appears to the European as a land forsaken by its inhabitants. But he who has lived for years in America, in the forests of the flat country, or on the ridge of the

Cordilleras, and has seen districts equal in extent to France, occupied by only a few scattered huts, finds that even solitudes so wide as these lose their power to depress and to alarm. His fancy becomes familiar with the aspect of a world which nourishes only the plant and the beast of the field, and in which the sounds of human joy or woe are never heard."

Everywhere in the New World, size and simplicity characterise its natural features. Their simplicity results from their size; thus, the river-basins depend on the mountain systems; and both are exceedingly simple, because both are enormously large. The only mountains in the Old World which rival the mountain backbone of America in height are the Himalaya, and none of them can at all compare with it in length; for the American range stretches, with the single interruption of Panama, for 10,000 miles, from Tierra del Fuego to the Arctic Ocean, which is about as far as from Gibraltar to Kamtschatka. The Mississippi and the Amazon, including their longest respective affluents, viz., the Missouri and the Ucayali, are the longest rivers in the world, each of them measuring about 4000 miles, which is nearly a thousand more than the Yang-tse-kiang, the largest river in the Old World. The plains, as has been mentioned, extend, like the principal mountains, throughout the whole length of both Americas. The lakes of Canada are inland seas. Lake Superior, the largest of them, though not the largest inland sea, for it yields in extent to the Caspian and the Sea of Aral, is yet the largest collection of fresh water; and the five great Canadian lakes together are believed to contain more than half of all the fresh water on the globe. The American waterfalls also take precedence of all others. The roar of Niagara can be heard at a great distance, and the cloud formed by its spray can be seen at a distance of ninety miles. Scarcely less remarkable are the cataracts of the Madeira, in South America, near the Peruvian frontier. There are nineteen of them, and at the eighteenth the whole river, about half a mile wide, is poured over a rock one hundred feet high. For volume of water this fall is believed to be the largest in the world, not excepting Niagara. The American forests, too, are on a magnificent scale. The largest covers the whole basin of the Amazon and its tributaries. Humboldt calculates its area as being twelve times that of all Germany.

The aboriginal inhabitants of the New World present, like the regions they inhabit, a remarkable uniformity of type. The Esquimaux, who occupy the extreme north, being excepted, a single native race is spread over North and South America; and the nations composing this race have scarcely any distinctive national character. The aboriginal population of America offers no such contrasts as those between Caucasian and Negro; between Anglo-Saxon and Chinese; perhaps not even a difference so great as that between the Northern and Southern European. The mode of life in Mexico and Peru, the only two countries which had risen above barbarism prior to the discovery of America by Columbus, was of course very different from that of the other Indians, who lived chiefly by hunting; for the Mexicans and Peruvians practised most of the useful arts, had constructed good roads, and had built for themselves cities and temples. But they both stopped short at the same level of attainment, and, which is unexampled in the history of the Old World, they had both arrived at the agricultural stage without passing through the pastoral. The Mexicans had no domestic quadrupeds at all; the Peruvians had only the llama, a poor creature, though called the camel of the Andes, which has since been superseded by the mule as a beast of burden, and is now reared only for its wool, called *alpaca.* Such being the case, the value of milk was unknown, and the pastoral stage of civilisation impossible in America.

The native civilisation of America was not strong enough to effect even a compromise with that of Europe. The Spaniards, overbearing right by might, made their discovery of Mexico and Peru the occasion of an attack, which resulted in the complete destruction of every institution native to the soil. Throughout the rest of America barbarism prevailed. Accordingly, the present civilisation of the New World simply repeats that of Europe, or rather of those European countries which have at any time obtained an extensive footing in America, viz., of Spain, Portugal, Great Britain, and France. Though less uniform than that which preceded it, this civilisation is yet less varied, not only than that of the old World, but than that of Europe. Domestic slavery, that great blot in the aspect of the United States, and the Brazilian empire, is the only American feature which does not find its counterpart in Europe. Europeans were certainly not guiltless of this wrong at its commencement, but for a long time now all Europe, excepting only Spain, which cannot protest against a system maintained in her own islands of Cuba and Porto Rico, has protested by word and deed against its continuance. The American slave-holders, however, not only retain negro slavery as a lucrative inheritance, but defend it as an institution sanctioned by reason and revelation.*

* Slavery is now abolished in the United States.

Neither Spain nor Portugal now retains a single foot of ground on the American mainland. It is worth noting that the former Portuguese possessions have been kept together, whereas the former Spanish possessions have fallen asunder into numerous republics, which are in a state of chronic revolution. A portion of Guiana is all that France now possesses on the American mainland, but a French element still prevails in Lower Canada, and in several of the southern states of the Union. British America is nearly as extensive as the territory of the United States; and a British element, in respect of race, language, literature, religion, education, and manners, prevails, not only throughout what still are, but also throughout what formerly were, British possessions, viz., the greater part of the United States.

As the British element is the most widely distributed in America, so it is also inherently the most powerful. The Spaniards and Portuguese have freely mingled their blood, the former with that of the Indians, the latter with that of the negroes. The majority of the inhabitants in some of the Spanish republics are of Indian descent; and in Brazil six-sevenths of the population consists of negroes and mulattoes, the whites amounting to little more than a million. The French have mingled their blood more sparingly than the Spaniards and Portuguese with the non-European races in America, and the British more sparingly still. The British race alone has been able, not only to maintain but rapidly to multiply, its numbers in the New World. It is also the only race there which, instead of merely following in the wake of European civilisation, keeps pace with it, and even contributes to its development.

—Dr Clyde.

WHERE IS THE BRITON'S HOME?

Where is the Briton's home?
Where the free step can roam,
Where the free sun can glow,
Where a free air can blow,
Where a free ship can bear
Hope and strength: everywhere
Wave upon wave can roll—
East and west—pole to pole—

Where a free step can roam—
There is the Briton's home!

Where is the Briton's home?
Where the brave heart can come,
Where labour wins a soil,
Where a stout heart can toil—
Any fair seed is sown—
Where gold or fame is won,
Where never sets the sun,
Where a brave heart can come—
There is the Briton's home!

Where is the Briton's home?
Where the mind's light can come,
Where our God's holy word
Breaks on the savage herd—
Where a new flock is won
To the bright Shepherd-one,
Where the church-bell can toll,
Where soul can comfort soul,
Where holy faith can come—
There is the Briton's home!

Where is the Briton's home?
Where man's great law can come,
Where the great truth can speak,
Where the slave's chain can break,
Where the white's scourge can cease,
Where the black dwells in peace,
Where, from His angel-hall,
God sees us brothers all—
Where light and freedom come,
There is the Briton's home!

—Bulwer.

THE youngest reader of this book will easily understand the difference that there is between natural and artificial objects. The great Creator of all things has placed mankind in a world of earth and air and sea, of rocks and plants and living creatures; this is the natural world. But man could never supply all his wants or provide for his comfort without making some alteration in the form and character of these objects in the natural world; this he accordingly does, and the materials, thus changed and fitted for the conveniences of human life by the labour of his hands, are called artificial. The pine-tree in the forest, the clay which lies under the soil, and the limestone in the quarry, are the works of Nature; but the house, whether built of timber, bricks, or stone, is a work of Art. Everything, then, in the wide world, belongs to one or other of these two great classes of natural and artificial objects.

Let us, for the time, strive to forget the existence of all that is artificial; this will not be a very difficult task for those who live in the country. Away with shops and houses, bridges and boats, roads, fences, and everything that bears the impress of man's hand upon it. Look around now, and see what still remains with us. Above is the blue sky, partly hidden by fleecy clouds, lit up during the day by the brilliant beams of the sun, at night by the pale-faced moon and all the stars of heaven. Around us is the air we breathe, and without which we and all other living beings would soon cease to exist. Sometimes it is silent and almost motionless, while at others it moves gently along as a summer breeze, or rushes fiercely on its path, a tempestuous whirlwind; through its invisible body the clouds roll their thunders, flash their lightnings, and send down hail, snow, and rain, to protect and water the earth. Tall forests of pine and oak, of birch and maple trees, raise their green summits over the shrubs and wild flowers, ferns and mosses, that cover the ground; through their tangled mazes, four-footed animals, birds, reptiles, and insects, run and fly and crawl; and in the mighty ocean which beats upon the shore, in the lakes and rivers which divide the empire with the land, other plants and animals, with all the finny tribes, find a suitable habitation. But this is not all. Beneath our feet is the great earth's crust, consisting of broad layers of sand and clay, rock, slate, and gravel, traversed by rich metallic veins; and, firmly imbedded in their surface, lie the record of many thousand years, in the shape of fossil plants and animals, that once peopled with life the face of our old mother Earth.

Such are the works of Nature, some of which, at least, we meet with in their natural state every day that we live, and which afford the materials for those artificial objects upon which the ingenuity and activity of mankind are exercised.

From a very early period in the history of the world, men have examined these objects, have studied their nature and properties, have classed them according to their resemblance to one another, and, collecting all the information they could concerning them, have formed sciences or systems of knowledge.

The total number of the sciences and their subdivisions is very large, as you will hereafter learn; but we shall at present turn our attention only to five of them, commonly called the Natural Sciences. Remember, now, all those objects which we found to remain with us after carefully excluding the works of man. They were the heavens above us, the earth with its minerals and rock masses beneath our feet, and around us plants and animals and the invisible atmosphere. The first of these—namely, the heavens—we shall not consider at present, because Astronomy, the science that treats of them, belongs to what you will afterwards become acquainted with as the Mathematical sciences. Let us, therefore, keep our eyes from wandering out of the world we live in, and endeavour to understand how it is, that the many natural objects which meet our view are all comprised within the small compass of five sciences.

One of the earliest objects that would naturally strike a man of observant mind is the ground he walks upon, in its diversified forms of mountain, plain, and valley, with the seas, lakes, and rivers that flow over many parts of its surface. Digging far down below the soil, he would find regular beds of black earth and clay, of sand and rock, lying evenly upon one another, as if a master mason had laid their great foundations with scrupulous care. He picks up a piece of stone, finds in it curious petrified figures of shells and corals, and strange creatures that do not now exist in the world, and wonders how they came there, so far below the surface of the earth. At other times he stumbles upon a great vein or fissure in the solid rock, containing lead or tin, iron or copper ore; or, perhaps, falls in with vast beds of coal, and sees, rising erect through the grimy mass, ferns and cones and trunks of trees, all of the same black material. Then he asks himself the questions—What are all these things? Where did they come from? At what time, and for what purpose, were they created? As soon as he sets his mind and his eyes to work to answer these interesting questions, he has become a student of the science of Geology.

The term Geology, like most names of sciences, consists of two Greek words, and means *a discourse about the earth.* Just as one cordial friend cheerfully communicates information to another, so will our good friend Geology, if we are really desirous to learn, discourse pleasantly to us about the earth, and tell us all that man has hitherto discovered as to its character and history. It is a mistake to suppose that this science has to do only with the rock masses that occur within the earth; everything upon our globe that is *unorganised* or without life, whether land or water, earth or rock, metals or fossils, coal or amber, volcanoes or mineral springs, all belong to the science of Geology. You will afterwards learn more fully what are the special objects of this youngest of the natural sciences in its subdivisions of Physical Geography, Mineralogy, and Geology proper.

Although we naturally imagine that man would early turn his attention to the study of Geology, this is not the case. Long before men thought of examining the crust of the earth, they had made themselves familiar with the several objects composing the beautiful mantle of verdure that nature has thrown over its otherwise bare and uninviting surface. Far away, in the Eastern birthplace of our race, they saw

"The feathery palm-tree rise,
And the date grow ripe under sunny skies;"

or the great banian, the fig-tree of India, sending down roots from his giant branches, and, like a broad, living tent, spreading his cool shade over a circumference of 1500 feet. In more western lands a different sight awaited them; there they beheld the orange groves of

Italy, the chestnut forests of Spain, the vine-clad hills of Portugal, the apple orchards of France, and the linden avenues of Germany, with the English oaks, the Scotch firs, and the Norway pines, that adorn the landscapes of these northern countries. Crossing the ocean to the shores of this great Western continent, covered with thick forests of maple and birch, tamarack and balsam trees, what new objects of interest in the plant world must have greeted them. Then, when other distant lands had been explored, and the productions of other climes had been pressed into the service of men for the supply of their luxuries, how interested must they have been in the tea and coffee plants of China and Arabia, the cotton shrub of the East, the scarlet geraniums of the Cape of Good Hope, the variegated fuchsia of Mexico, and the vast variety of shrubs and flowers that please the eye and minister to the wants and enjoyments of man. What a mine of wealth appeared to them in the great family of the grasses, from the gigantic bamboo, sixty feet high, to the delicate meadow grass, six inches in length; and what objects of wonder and admiration in the graceful fern, the velvety moss, the dry lichen, the fleshy mushroom, and the floating seaweed! But the number of these objects of the vegetable world was too vast, too overpowering, for the memory of man. No sooner had he acquired the knowledge of some new plant than the old ones vanished away; and he put to himself the question, "How can I remember all these objects, and distinguish them from one another?" You have, no doubt, already guessed his answer to this self-put question. It was—"by carefully examining the form and structure of every plant; by comparing them with each other; and, finally, by arranging them in groups or classes according to their points of resemblance." And thus the science of Botany was commenced.

Botany is a Greek word, and, in that language, simply means *a plant;* so that the science of Botany is the *system of knowledge about plants.* What more simple, beautiful, and interesting study could there be than that of Botany? The materials for it are all around us, in fields, and on the road-sides, in woods and gardens; even a vacant town-lot, overgrown with rank weeds, contains sufficient variety to occupy and interest a botanist for whole weeks and months. No country affords greater opportunities for the study of this science than the one we live in; and, among civilised regions, there are very few in which the labours of the botanist will be better rewarded by the discovery of unknown plants, or of interesting particulars regarding those already known.

Plants, however, were not the only, nor, perhaps, the first natural objects that attracted the attention of man. If he were an Egyptian, a worshipper of animals, his were the wary crocodile and the sacred ibis of the muddy Nile. If a Greek, he had no doubt heard the fierce laugh of the hyena in Asia Minor; or fished at Crete for the bee-eater, as the boys do at the present day, with a locust flying from the end of his line; or quarrelled with a friend over the changing hues of the chameleon in Greece or Sicily. If a Roman, he had seen, in the cruel games of the amphitheatre, elephants, lions, and panthers slaughtered for the amusement of the people. Whatever his country may have been, at whatever time he lived, whether an ancient patriarch or a modern farmer, he was perfectly at home among the domestic animals, and had, no doubt, also marked the deer in the forest, the fish in the river, the croaking frog in the swamp, and the busy insect flitting through the air or creeping on the ground. If he were a man of inquiring mind, he would be anxious to learn what forms of animal life other lands had to exhibit, to compare them with those of his own country, and thus to find, little by little, all the links in that wondrous chain which leads from the minute animalcule, of which the point of a needle will crush a thousand, to man himself, the noblest work of the Creator.

The man who thus observed the habits and peculiarities of the animal kingdom, who sought to accumulate information regarding its different members, and who classed them together in accordance with their manifest points of resemblance, would be called a student of Natural History; but he would, at the same time, be a builder up of the science of Zoology. As *ge* in Geology means *the earth*, so the word *zoon* is the Greek for *an animal*, and Zoology is thus *a discourse about animals*. This study, above all others, is that in which young people take especial delight, and it is also one to which have been devoted the life labours of some of the greatest minds that the world has produced.

We have now surveyed three of the Natural Sciences, embracing the mineral, vegetable, and animal kingdoms. You will be ready to say, "Surely we have exhausted the world of Nature; what is there that is not included in those three sciences of Geology, Botany, and Zoology?" Not so fast, dear reader. Have we not an atmosphere around us, invisible it may be, yet in which we live and breathe? Are there no clouds in the heavens, no dew on the grass? Are there no long rainy days and months of ice and snow? Do not the cold March winds chill us with their keen blast, and the summer breezes fan our flushed cheeks with their cool and gentle motion? Then, have we not watched the coming of the fierce tempest, heard the rumbling of the thunder, and seen the vivid lightning flash across the sky? We have seen, too, the beautiful arch of the rainbow by day, and the fiery meteor at night; and, in books, we have read about the great ice mountains of the North, the waterspouts that, uniting the clouds above to the sea beneath, break with fatal violence in the Southern Ocean; with many other strange sights and sounds that take place in the unseen body around us. All these are well worthy, not only of observation, but of diligent and accurate investigation; therefore they have a science to themselves, and that science is called Meteorology.

Meteorology is a Greek word, made up of *meteora,* meaning *things in the air*, and *logos*, a discourse—a *discourse about things in the air.* Learned men, masters of this science, are employed by many governments to observe the state of the atmosphere, and to keep a record of all that occurs in it from year to year; for this purpose, they are furnished with a suitable building, generally situated on a rising ground, and having a tower of some height upon it, whence they may be able to detect the appearance of anything in the air, whether it be watery like snow and rain, airy like wind, or fiery as falling stars. Such a building is called an *observatory*, and is also sometimes used for making astronomical observations; the most celebrated one is that of Greenwich, near London in England.

So far then, we have four sciences brought before us; discourses about plants and animals, about the earth and things in the air. Is there any natural object upon this earth which is not included in the four sciences that treat of these several departments of Nature? No, there is nothing more, but yet there is another science. We examine a piece of rock, the leaf of a tree, the leg of a frog, and a handful of snow, and we put the question—What are all these things made of? Now, this seems a very strange question; if you were asked, you would, perhaps, answer, that the rock was made of some kind of stone, and the leaf of delicate fibres and cells, the frog's leg of flesh and bones, and the snow of frozen water; and you would expect the person who put the question to smile approvingly and say—"Your reply is quite correct." But I very much fear that such an answer would not satisfy a chemist; he would desire to go deeper into the matter, and would, probably, ask you, what stone and fibres, flesh and bones and water are composed of. To say that rock is stone is as much an explanation as to say that a house is a domicile, and that a leaf is made up of fibres and cells, as that a house is made up of rooms. But if you were asked what a house were made of, you would reply, "of brick or stone, and mortar," or "of wood," as the case might be. Now, just such an answer as this is what the chemist requires to his question. He would tell you that the stone, suppose it were limestone, was composed of a certain number of parts of lime and carbonic acid, and so on with the rest. Again, he would inform you that lime is made up of so many atoms or small particles of a metal called calcium, and a gas called oxygen; and carbonic acid, of similar atoms of oxygen, and another substance, denominated carbon. But calcium, oxygen, and carbon cannot be reduced to anything lower; they are the bricks and mortar that make the house, and all that went before them were only the rooms. These three bodies, or substances, are named *elements* or *elementary substances*, because they are not composed of anything more simple. The elementary bodies are about sixty-three in number, and of these sixty-three elements everything in the world is made up, whether it belong to the mineral or vegetable, the animal or the aerial kingdom. It is with these simple bodies that the chemist works, building up or taking to pieces, room by room, and brick by brick, the materials of which the earth and everything in it is composed; and the science which teaches the one and explains the other is called Chemistry.

The term Chemistry is very like one of the simple bodies which the science investigates, for its origin is very obscure, and the Greek word *chemeia*, from which it is thought to be derived, has no simpler meaning. However, it is supposed by some that it comes from the Greek *chymicos*, equivalent to what is said *concerning a thing extracted*; so that, with this explanation, chemistry would be *the system of knowledge about things extracted.* Since *to extract* has the meaning of *to draw out,* you will easily perceive that it is applicable to the science which draws forth the simple elements that make up a compound body. Of all the sciences, none is so practically useful as that of chemistry, the laws of which are found to govern most of the simplest as well as the most important operations of man upon natural objects.

We have now found out what are the five natural sciences, under which everything in the world, whether simple or compound, may be ranked. If you would be well-informed men and women, you should gain some knowledge of each of these. To all right-minded persons they will prove an endless source of amusement, as well as of profit, stimulating legitimate curiosity, encouraging habits of observation, and increasing reverence for Him who in wisdom has made all the objects of which they treat.

The Natural Sciences are—

1. Geology.
2. Botany.
3. Zoology.
4. Meteorology.
5. Chemistry.

GEOLOGY.

RAILWAY CUTTING SHOWING STRATA.

Geology, from two Greek words—*ge*, the earth, and *logos*, a discourse or reasoning—embraces, in its widest sense, all that can be known of the constitution and history of our globe. Its object is to examine the various materials of which our planet is composed, to describe their appearance and relative positions, to investigate their nature and mode of formation, and generally to discover the laws which seem to regulate their arrangement.

As a department of natural science, Geology confines itself more especially to a consideration of the mineral or rocky constituents of the earth, and leaves its surface configuration to Geography, its vegetable life to Botany, its animal life to Zoology, and the elementary constitution of bodies to the science of Chemistry. Being unable to penetrate beyond a few thousand feet into the solid substance of the globe, the labours of geologists are necessarily confined to its exterior shell or crust; hence we speak of the "crust of the globe," meaning thereby that portion of the rocky structure accessible to human investigation.

The materials composing this crust are rocks or minerals of various kinds—as granite, basalt, roofing-slate, sandstone, marble, coal, chalk, clay, and sand—some hard and compact, others soft and incohering. These substances do not occur indiscriminately in every part of the world, nor, when found, do they always appear in the same position. Granite, for example, may exist in one district of a country, marble in another, coal in a third, and chalk in a fourth. Some of these rocks occur in regular layers or courses, termed *strata*, from the Latin word *stratum*, strewn or spread out, while others rise up in irregular mountain-masses. It is evident that substances differing so widely in composition and structure must have been formed under different circumstances and by different causes; and it becomes the task of the geologist to discover those causes, and thus infer the general conditions of the regions in which, and of the periods when, such rock substances were produced.

When we sink a well, for example, and dig through certain clays, sands, and gravels, and find them succeeding each other in layers, we are instantly reminded of the operations of water, seeing it is only by such agency that accumulations of clay, sand, and gravel are formed at the present day. We are thus led to inquire as to the origin of the materials through which we dig, and to discover whether they were originally deposited in river-courses, in lakes, in estuaries, or along the sea-shore. In our investigation we may also detect shells, bones, and fragments of plants imbedded in the clays and sands; and thus we have a further clue to the history of the strata through which we pass, according as the shells and bones are the remains of animals that lived in fresh-water lakes and rivers, or inhabited the waters of the ocean. Again, in making a railway-cutting, excavating a tunnel, or sinking a coal-pit, we may pass through many successions of strata—such as clay, sandstone, coal, ironstone, limestone, and the like; and each succession of strata may contain the remains or impressions of different plants and animals. Such differences can only be accounted for by supposing each stratum or set of strata to have been formed by different agencies, and under different conditions of climate, as well as under different arrangements of sea and land, just as at the present day the rivers, estuaries, and seas of different countries are characterised by their own special accumulations, and by the imbedded remains of the plants and animals peculiar to these regions.

In making these investigations, the geologist is guided by his knowledge of what is now taking place on the surface of the globe —ascribing similar results to similar or analogous causes. Thus, in the present day, we see rivers carrying down sand and mud and gravel, and depositing them in layers either in lakes, in estuaries, or along the bottom of the ocean. By this process many lakes and estuaries have, within a comparatively recent period, been filled up and converted into dry land. We see also the tides and waves wasting away the sea-cliffs in one district, and accumulating expanses of sand and salt-marsh in some sheltered locality. By this agency thousands of acres of land have been washed away and covered by the sea, even within the memory of man; while, by the same means, new tracts have been formed in districts formerly covered by the tides and waves. Further, we learn that, during earthquake convulsions, large districts of country have sunk beneath the waters of the ocean; while in other regions the sea bottom has been elevated into dry land. Volcanic action is also sensibly affecting the surface of the globe—converting level tracts into mountain-ridges, throwing up new islands from the sea, and casting forth molten lava and other materials, which in time become hard and consolidated rock-masses.

As these and other agents are at present modifying the surface of the globe, and changing the relative positions of sea and land, so in all time past have they exerted a similar influence, and have necessarily been the main agents employed in the formation of the rocky crust which it is the province of Geology to investigate. Not a foot of the land we now inhabit but has been repeatedly under the ocean, and the bed of the ocean has formed as repeatedly the habitable dry land. No matter how far inland, or at what elevation above the sea, we now find accumulations of sand and gravel,—no matter at what depth we now discover strata of sandstone or limestone,—we know, from their composition and arrangement, that they must have been formed under water, and brought together by the operation of water, just as layers of sand and gravel and mud are accumulated or deposited at the present day. And as earthquakes and volcanoes break up, elevate, and derange the present dry land, so must the fractures, derangements, and upheavals among the strata of the rocky crust be ascribed to the operation of similar agents in remote and distant epochs.

By the study of existing operations, we thus get a clue to the history of the globe; and the task is rendered much more certain by an examination of the plants and animals found imbedded in the various strata. At present, shells, fishes, and other animals are buried in the mud or *silt* of lakes and estuaries; rivers also carry down the remains of land-animals, the trunks of trees, and other vegetable drift; and earthquakes submerge plains and islands, with all their vegetable and animal inhabitants. These remains become enveloped in the layers of mud and sand and gravel formed by the waters, and in process of time are *petrified*, (*petra*, a stone, and *fio*, I become;) that is, are converted into stony matter like the shells and bones found in the deepest strata. Now, as at present, so in all former time must the remains of plants and animals have been similarly preserved; and as one tribe of plants is peculiar to the dry plain, and another to the swampy morass,—as one family belongs to a temperate, and another to a tropical region,—so, from the character of the imbedded plants, are we enabled to arrive at some knowledge of the conditions under which they flourished. In the same manner with animals: each tribe has its locality assigned it by peculiarities of food, climate, and the like; and by comparing *fossil* remains (fossil, from *fossus*, dug up, applied to all remains of plants and animals imbedded in the rocky crust) with existing races, we are enabled to determine many of the past conditions of the world with considerable certainty.

By examining, noting, and comparing, as indicated in the preceding paragraphs, the geologist finds that the strata composing the earth's crust can be arranged in series; that one set or series always underlies, and is succeeded by another set; and that each series contains the remains of plants and animals not to be found in any other series. Having ascertained the existence of such a sequence among the rocky strata, his next task is to determine that sequence in point of time—that is, to determine the older from the newer series of strata; to ascertain, if possible, the nature of the plants and animals whose remains are imbedded in each set; and, lastly, to discover the geographical range or extent of the successive series. These series he calls *formations*, as having been formed during different arrangements of sea and land, and under the varying influences of climate and other external conditions; and it is by a knowledge of these that the geologist is enabled to arrive at something like a history of the globe—imperfect, it may be, but still sufficient to show the numerous changes its surface has undergone, and the varied and wonderful races of plants and animals by which it has been successively inhabited. To map out the various mutations of sea and land, from the present moment to the earliest time of which we have any traces in the rocky strata: to restore the forms of extinct plants and animals; to indicate their habits, the climate and conditions under which they grew and lived,—to do all this, and trace their connexion up to existing races, would be the triumph, as it is now the aim, of all true geology.

—PAGE.

Rocks as to their origin are—

1. *Sedimentary or Aqueous*, formed by the agency of water and deposited in regular strata; these rocks are either { *Inorganic*, as Sandstone. *Organic*, as Coal, Shell-marl, &c.
2. *Metamorphic or Changed Rocks;* originally Sedimentary, but become crystallised by the action of heat; such are gneiss, marble, &c.
3. *Eruptive;* never occur in strata but in irregular masses; when appearing on the surface are called *Volcanic;* such are granite, lava, pumice, &c.

FIRST STUDIES OF A YOUNG GEOLOGIST.

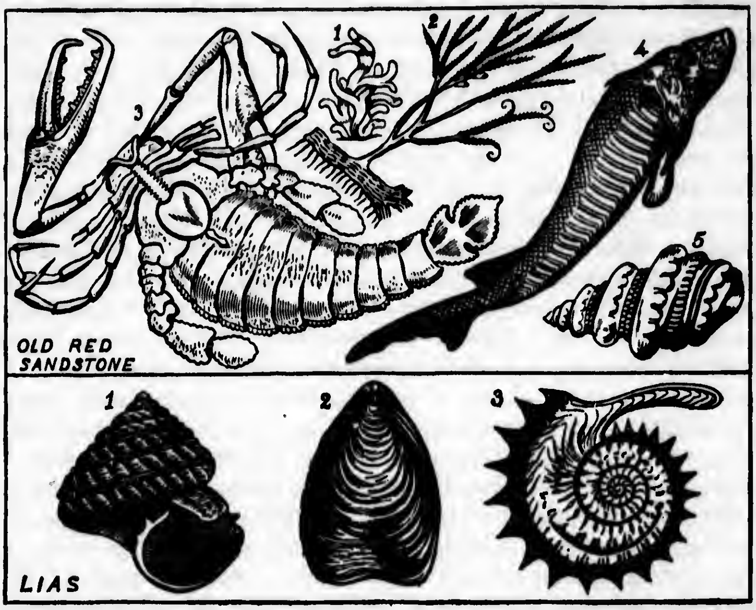
IT was twenty years last February since I set out a little before sunrise to make my first acquaintance with a life of labour and restraint, and I have rarely had a heavier heart than on that morning. I was but a slim loose-jointed boy at the time—fond of the pretty intangibilities of romance, and of dreaming when broad awake; and, woeful change! I was now going to work at what Burns has instanced, in his "Twa Dogs," as one of the most disagreeable of all employments, to work in a quarry. Bating the passing uneasiness occasioned by a few gloomy anticipations, the portion of my life which had already gone by had been happy beyond the common lot. I had been a wanderer among rocks and woods,—a reader of curious books when I could get them,—a gleaner of old traditionary stories; and now I was going to exchange all my day-dreams, and all my amusements, for the kind of life in which men toil every day that they may be enabled to eat, and eat every day that they may be enabled to toil!

The quarry in which I wrought lay on the southern shore of a noble inland bay, or frith rather, with a little clear stream on the one side, and a thick fir wood on the other. It had been opened in the old red sandstone of the district, and was overtopped by a huge bank of diluvial clay, which rose over it in some places to the height of nearly thirty feet, and which at this time was rent and shivered, wherever it presented an open front to the weather, by a recent frost. A heap of loose fragments, which had fallen from above, blocked up the face of the quarry, and my first employment was to clear them away. The friction of the shovel soon blistered my hands, but the pain was by no means very severe, and I wrought hard and willingly that I might see how the huge strata below, which presented so firm and unbroken a frontage, were to be torn up and removed. Picks and wedges and levers were applied by my brother workmen; and simple and rude as I had been accustomed to regard these implements, I found I had much to learn in the way of using them. They all proved inefficient, however, and the workmen had to bore into one of the inferior strata, and employ gunpowder. The process was new to me, and I deemed it a highly amusing one: it had the merit, too, of being attended with some such degree of danger as a boating or rock excursion, and had thus an interest independent of its novelty. We had a few capital shots; the fragments flew in every direction, and an immense mass of the diluvium came toppling down, bearing with it two dead birds, that in a recent storm had crept into one of the deeper fissures, to die in the shelter. I felt a new interest in examining them. The one was a pretty cock goldfinch, with its hood of vermilion, and its wings inlaid with the gold to which it owes its name, as unsoiled and smooth as if it had been preserved for a museum. The other, a somewhat rarer bird, of the woodpecker tribe, was variegated with light blue and a grayish yellow. I was engaged in admiring the poor little things, more disposed to be sentimental, perhaps, than if I had been ten years older, and thinking of the contrast between the warmth and jollity of their green summer haunts, and the cold and darkness of their last retreat, when I heard our employer bidding the workmen lay by their tools. I looked up and saw the sun sinking behind the thick fir wood beside us, and the long, dark shadows of the trees stretching downwards towards the shore.

This was no very formidable beginning of the course of life I had so much dreaded. To be sure, my hands were a little sore, and I felt nearly as much fatigued as if I had been climbing among the rocks; but I had wrought and been useful, and had yet enjoyed the day fully as much as usual. It was no small matter, too, that the evening, converted, by a rare transmutation, into the delicious "blink of rest" which Burns so truthfully describes, was all my own. I was as light of heart next morning as any of my brother-workmen. There had been a smart frost during the night, and the rime lay white on the grass as we passed onwards through the fields; but the sun rose in a clear atmosphere, and the day mellowed as it advanced, into one of those delightful days of early spring, which give so pleasing an earnest of whatever is mild and genial in the better half of the year. All the workmen rested at midday, and I went to enjoy my half-hour alone on a mossy knoll in the neighbouring wood, which commands through the trees a wide prospect of the bay and the opposite shore. There was not a wrinkle on the water, not a cloud in the sky, and the branches were as motionless in the calm as if they had been traced on canvas. From a wooded promontory that stretched half-way across the frith, there ascended a thin column of smoke. It rose straight as the line of a plummet for more than a thousand yards, and then, on reaching a thinner stratum of air, spread out equally on every side, like the foliage of a stately tree. Ben Wyvis rose to the west, white with the yet unwasted snows of winter, and as sharply defined in the clear atmosphere, as if all its sunny slopes and blue retiring hollows had been chiselled in marble. A line of snow ran along the opposite hills; all above was white, and all below was purple. They reminded one of the pretty French story, in which an old artist is described as tasking the ingenuity of his future son-in-law, by giving him, as a subject for his pencil, a flower-piece composed of only white flowers, of which the one half were to bear their proper colour, the other half a deep purple hue, and yet all be perfectly natural; and how the young man resolved the riddle, and gained his mistress, by introducing a transparent purple vase into the picture, and making the light pass through it on the flowers that were drooping over the edge. I returned to the quarry, convinced that a very exquisite pleasure may be a very cheap one, and that the busiest employments may afford leisure enough to enjoy it.

The gunpowder had loosened a large mass in one of the inferior strata, and our first employment, on resuming our labours, was to raise it from its bed. I assisted the other workmen in placing it on edge, and was much struck by the appearance of the platform on which it rested. The entire surface was ridged and furrowed like a bank of sand that had been left by the tide an hour before. I could trace every bend and curvature, every cross hollow and counter ridge of the corresponding phenomena; for the resemblance was no half resemblance—it was the thing itself; and I had observed it a hundred and a hundred times, when sailing my little schooner in the shallows left by the ebb. But what had become of the waves that had thus fretted the solid rock, or of what element had they been composed? I felt as completely at fault as Robinson Crusoe did on discovering the print of the man's foot on the sand. The evening furnished me with still further cause of wonder. We raised another block in a different part of the quarry, and found that the area of a circular depression in the stratum below was broken and flawed in every direction, as if it had been the bottom of a pool recently dried up, which had shrunk and split in the hardening. Several large stones came rolling down from the diluvium in the course of the afternoon. They were of different qualities from the sandstone below, and from one another; and, what was more wonderful still, they were all rounded and water-worn, as if they had been tossed about in the sea, or on the bed of a river for hundreds of years. There could not, surely, be a more conclusive proof that the bank which had enclosed them so long could not have been created on the rock on which it rested. No workman ever manufactures a half-worn article, and the stones were all half-worn! And if not the bank, why then the sandstone underneath? I was lost in conjecture, and found I had food enough for thought that evening, without once thinking of the unhappiness of a life of labour.

The immense masses of diluvium which we had to clear away rendered the working of the quarry laborious and expensive, and all the party quitted it in a few days, to make trial of another that seemed to promise better. The one we left is situated, as I have said, on the southern shore of an inland bay—the Bay of Cromarty; the one to which we removed has been opened in a lofty wall of cliffs that overhangs the northern shore of the Moray Frith. I soon found I was to be no loser by the change. Not the united labours of a thousand men for more than a thousand years could have furnished a better section of the geology of the district than this range of cliffs. It may be regarded as a sort of chance dissection on the earth's crust. We see in one place the primary rock, with its veins of quartz and granite, its dizzy precipices of gneiss, and its huge masses of hornblende; we find the secondary rock in another, with its beds of sandstone and shale, its spars, its clays, and its nodular limestones. We discover the still little known but highly interesting fossils of the Old Red Sandstone in one deposi-



tion; we find the beautifully preserved shells and lignites of the Lias in another. There are the remains of two several creations at once before us. The shore, too, is heaped with rolled fragments of almost every variety of rock,—basalts, ironstones, hypersthenes, porphyries, bituminous shales, and micaceous schists. In short, the young geologist, had he all Europe before him, could hardly choose for himself a better field. I had, however, no one to tell me so at the time, for geology had not yet travelled so far north; and so, without guide or vocabulary, I had to grope my way as I best might, and find out all its wonders for myself. But so slow was the process, and so much was I a seeker in the dark, that the facts contained in these few sentences were the patient gatherings of years.

—HUGH MILLER.

Rocks as to age and order of succession are classified as—

Epoch of Modern Life.	1. Modern deposits,	changes now going on.
	2. Drift formation,	to this belong the scattered boulders.
	3. Tertiary system,	recent fossil remains.

Epoch of Middle Life.	1. Cretaceous system,	from the Latin *creta*, chalk, which accompanies it in Europe.
	2. Oolitic ,,	from two Greek words meaning *egg* and *stone*, because composed of limestone consisting of egg-shaped grains.
	3. Triassic ,,	so called from the number *three*, because in Europe it consists of three strata—marl, limestone and sandstone.
Epoch of Ancient Life.	1. Permian system,	from Perm in Russia; in England it is called New Red Sandstone.
	2. Carboniferous ,,	or *coal-bearing;* to this belong the coal-fields.
	3. Devonian ,,	from Devonshire in England; also called Old Red Sandstone.
	4. Silurian ,,	from the ancient kingdom of the Silures in Britain, where it was first observed.
Epoch of Doubtful Life.	Metamorphic System,	from the Greek words meaning "changed form."
	This system is sometimes divided into two formations, called the	Huronian, from Lake Huron, and Laurentian, from the river St Lawrence, near which they are found.

Eruptive rocks being of all ages have no order of succession.

MINERALOGY.

Natural History is a science which consists of many branches; one, which treats of animals, is called Zoology; another, Botany, teaches the structure and properties of plants; the third, which makes us acquainted with the inorganic portions of our planet, namely, stones or minerals, is called Mineralogy; and if, at first sight, it should appear less attractive or less useful than the other two branches, a very little consideration will prove that it is of equal importance to mankind, and contributes materially to their comfort, wealth, and luxury. From materials found in the interior of the earth we erect our dwellings, we supply ourselves with fuel, we construct numberless tools and machines; and, finally, we obtain our most brilliant ornaments.

Some knowledge of many of these substances must have been possessed at a very remote period. The most ancient nations of whom we have any record manufactured arms, and ornaments of gold and silver. The Romans, who made great improvements in the arts of civilisation, greatly enlarged this knowledge; bringing to light many substances previously unknown, and employing them for useful or ornamental purposes; they were acquainted with several of the precious stones, and, with the exception of the diamond, succeeded in cutting and engraving on them.

The elder Pliny, a man of inquiring mind and unwearied diligence in the pursuit of knowledge, collected, from every source within his reach, accounts of all the natural productions that were then known, or of which any description existed in his time; and he added to these his own observation on such as he had actually examined. It is much to be regretted that the latter were not more numerous; for he too often copied, without inquiry, the descriptions he met with; and has transmitted to us a vast number of inaccuracies and absurdities, such as accounts of the magical properties of certain stones, plants, and animals, and charms, by which particular diseases might be cured.

As civilisation extended, and the arts of life advanced, a greater number of useful minerals became known; improvements in machinery and practical science led to greater facility in the working of mines, metals were more sought after, new ones were discovered, and new and rich ores of those already known were found to exist, which had formerly been thrown aside as valueless, from ignorance of their nature. Mineralogy now became a subject of importance, and much attention was paid to it; but it still retained somewhat of a vague and unsatisfactory character, from want of knowledge of the principles on which it ought to be based. Chemistry, indeed, lent its aid in the analysis of minerals; but it was before chemistry itself had been raised to the state of an exact science by the wonderful and beautiful law of *definite proportions*, a law which pervades all chemical combinations, whether natural compounds or the result of operations in our laboratories. This law assists us in ascertaining with precision the composition of mineral substances, and consequently in identifying mineral species, and giving them their true place in a scientific classification.

The want of some knowledge of the real nature of stones, which even a slight acquaintance with mineralogy would furnish, has occasioned to many persons, within a comparatively recent period, very ruinous loss; whilst others have rapidly acquired a fortune from profiting, under similar circumstances, by opportunities that had been unseen or totally neglected. It is not above fifty years since a man found in Shropshire a considerable vein of sulphate of baryta, which, in consequence of its weight, he mistook for white lead ore, and he erected a smelting-house and furnaces for the purpose of reducing it to a metallic state. Another person in the same county, having met with some mica in the form of small silvery scales or spangles, was persuaded that he had found a silver mine, and ruined himself in attempts to obtain the silver.

Among many other unfortunate adventures which have arisen from ignorance of mineralogy, may be mentioned that of a poor man, who was persuaded to lay out a hundred pounds, nearly the whole of some years' economy, in the purchase of a few pieces of white topaz, under the idea that they were diamonds. But independently of the utility of this science, any one who studies natural history for his amusement, will be richly rewarded by the wonders and the beauties displayed in the mineral kingdom. The bodies which are the objects of study to the mineralogist, comprise the earthy, metallic, saline, and other substances which compose our earth—that is to say, the unorganised part of the creation.

To understand clearly what is meant by the term *unorganised*, let us remember that an animal and a plant are said to be *organised*, because they consist of several different parts, all varying in their form, their position, and their functions, yet all equally necessary to form a perfect animal, or a perfect plant; so that to remove any one of them would be to destroy, or at least to render imperfect, the body to which it belongs. These parts are called *organs;* in animals we find a *stomach* to digest the food they convey to it, and by means of which they are nourished and have life; *nerves* and *muscles* for sensation and motion; in plants we observe a root to fix them to the ground, and absorb nourishment from it, and *vessels* for the circulation of the *sap*.

But in a mineral, in its most perfect state, all the parts exactly resemble each other, so that, by breaking it, we diminish it in size without destroying its existence or its completeness. Take, for example, a flat pebble, or a fragment of limestone from a quarry, and break it; we shall find that each substance is of the same texture and composition throughout. It is true that we may also take up a stone, or break off a piece of rock, which has not this homogeneous structure, as, for instance, a granite paving stone; but granite is an aggregate rock, which consists essentially of three simple minerals, each of which may plainly be distinguished on inspection; and mineralogy teaches us to recognise in it,—1st, quartz, which usually appears in grayish semi-transparent grains, of a somewhat glassy appearance; 2d, felspar, of a reddish or yellowish white, and opaque; 3d, mica, in small scales, which have a shining and somewhat metallic lustre.

It is true that the essential difference of minerals consists in their composition; but it is not therefore necessary to subject every mineral to chemical analysis in order to know something of its nature. The difference of composition is manifested in difference of form, structure, colour, weight, hardness, transparency, &c.; and an acquaintance with these and some other properties or characters will, in most cases, enable us to recognise a mineral species, and to know of what elementary substances it principally consists. These are called *physical characters.* But it sometimes happens that we meet with a specimen in which these characters are not clearly marked, or some of them may have a great resemblance to those of another species; in such cases we may derive great assistance from an examination of some of the *chemical characters*, by means of acids and the action of the blowpipe, which have a very different effect on different species.

—Weale.

Dana's Classification of Minerals—

Class I.	Gases; consisting of, or containing nitrogen or hydrogen, air, &c.
Class II.	Water; crystallises as ice.
Class III.	Carbon and compounds of carbon; the diamond, coal, plumbago, amber, &c.
Class IV.	Sulphur and its acids.
Class V.	Haloid or salt-like minerals; salt, nitre, borax, alum, gypsum, &c.
Class VI.	Earthy minerals; quartz, opal, felspar, mica, ruby, emerald, &c.
Class VII.	Metals and metallic ores; gold, silver, mercury, iron, lead, copper, &c.

TUBAL CAIN.

Old Tubal Cain was a man of might,
In the days when earth was young;
By the fierce red light of his furnace bright,
The strokes of his hammer rung:
And he lifted high his brawny hand
On the iron glowing clear,
Till the sparks rush'd out in scarlet showers,
As he fashion'd the sword and spear.

And he sang,—"Hurrah for my handiwork!
  Hurrah for the spear and sword!
Hurrah for the hand that shall wield them well,
  For he shall be king and lord!"

To Tubal Cain came many a one,
  As he wrought by his roaring fire,
And each one pray'd for a strong steel blade,
  As the crown of his desire:
And he made them weapons sharp and strong,
  Till they shouted loud for glee;
And they gave him gifts of pearls and gold,
  And spoils of the forest free.
And they sang,—"Hurrah for Tubal Cain,
  Who hath given us strength anew!
Hurrah for the smith, hurrah for the fire,
  And hurrah for the metal true!"

But a sudden change came o'er his heart,
  Ere the setting of the sun;
And Tubal Cain was fill'd with pain
  For the evil he had done:
He saw that men, with rage and hate,
  Made war upon their kind,
That the land was red with the blood they shed,
  In their lust for carnage blind.
And he said, "Alas! that I ever made,
  Or that skill of mine should plan,
The spear and the sword, for men whose joy
  Is to slay their fellow-man!"

And for many a day old Tubal Cain
  Sat brooding o'er his woe;
And his hand forbore to smite the ore,
  And his furnace smoulder'd low.
But he rose at last with a cheerful face,
  And a bright courageous eye,
And bared his strong right arm for work,
  While the quick flames mounted high.
And he sang,—"Hurrah for my handiwork!"
  And the red sparks lit the air;
"Not alone for the blade was the bright steel made,"
  And he fashion'd the first ploughshare.

And men, taught wisdom from the past,
  In friendship join'd their hands;
Hung the sword in the hall, the spear on the wall,
  And plough'd the willing lands:
And sang,—"Hurrah for Tubal Cain!
  Our staunch good friend is he;
And for the ploughshare and the plough,
  To him our praise shall be.
But while oppression lifts its head,
  Or a tyrant would be lord;
Though we may thank him for the plough,
  We'll not forget the sword!"

—CHARLES MACKAY.

COPPER MINES OF LAKE SUPERIOR.

To untutored man, provided only with implements of stone, the facilities presented by the great copper regions of Lake Superior, for the first step in the knowledge of metallurgy, were peculiarly available. The forests that flung their shadows along the shores of that great lake were the haunts of the deer, the beaver, the bear, and other favourite objects of the chase; the rivers and the lake abounded with fish; and the rude hunter had to manufacture weapons and implements out of such materials as nature placed within his reach. The water-worn stone from the beach, patiently ground to an edge, made his axe and tomahawk; by means of which, with the help of fire, he could level the giants of the forest, or detach from them the materials for his canoe and paddle, his lance, club, or bow and arrows. The bones of the deer pointed his spear, or were wrought into fish-hooks; and the shale or flint was chipped and ground into his arrow-head, after a pattern repeated with little variation, in all countries, and in every primitive age. But besides such materials of universal occurrence, the primeval occupant of the shores of Lake Superior found there a *stone* possessed of some very peculiar virtues. It could not only be wrought to an edge without liability to fracture, but it was malleable, and could be hammered out into many new and convenient shapes. This was the copper, found in connexion with the trappean rocks of that region, in inexhaustible quantities, in a pure metallic state. In other rich mineral regions, as in those of Cornwall and Devon, the principal source of this metal is from ores, which require both labour and skill to fit them for economic purposes. But in the veins of the copper-region of Lake Superior the native metal occurs in enormous masses, weighing hundreds of tons; and loose blocks of various sizes have been found on the lake shore, or lying detached on the surface, in sufficient quantities to supply all the wants of the nomad hunter. These, accordingly, he wrought into chisels and axes, armlets, and personal ornaments of various kinds, without the use of the crucible; and, indeed, without recognising any precise distinction between the copper which he mechanically separated from the mass, and the unmalleable stone or flint out of which he had been accustomed to fashion his spear and arrow-heads.

It was in the year 1847 that attention was first directed to such traces of ancient mining operations by the agent of the Minnesota Mining Company. Following up the indications of a continuous depression in the soil, he came at length to a cavern where he found several porcupines had fixed their quarters for hybernation; but detecting evidences of artificial excavation, he proceeded to clear out the accumulated soil, and not only exposed to view a vein of copper, but found in the rubbish numerous stone mauls and hammers of the ancient workmen. Subsequent observation brought to light ancient excavations of great extent, frequently from twenty-five to thirty feet deep, and scattered over an area of several miles. The rubbish taken from these is piled up in mounds alongside, while the trenches have been gradually refilled with the soil and decaying vegetable matter gathered through the long centuries since their desertion; and over all the giants of the forest have grown, withered, and fallen to decay.

Whatever be the dates of their commencement or desertion, the condition in which some of the ancient works on Lake Superior have been found, when reopened in later times, is suggestive of peculiar circumstances attending their abandonment. It is inconceivable that the huge mass of copper discovered in the Minnesota mine, resting on its oaken cradle, beneath the accumulations of centuries, was abandoned merely because the workmen, who had overcome the greatest difficulties in its removal, were baffled in the subsequent stages of their operations, and contented themselves by chipping off any accessible projecting point. Well-hammered copper chisels, such as lay alongside of it, and have been repeatedly found in the works, were abundantly sufficient, with the help of stone hammers, to enable them to cut it into portable pieces. If, indeed, the ancient miners were incapable of doing more with their mass of copper in the mine than breaking off a few projections, to what further use could they have turned it when transported to the surface? It weighed upwards of six tons, and measured ten feet long and three feet wide. The trench, at its greatest depth, was twenty-six feet; while the mass was only eighteen feet from the surface; and in the estimation of the skilled engineer by whom it was first seen, it had been elevated upwards of five feet since it was placed on its oaken frame. The excavations to a depth of twenty-six feet, the dislodged copper block, and the framework prepared for elevating the solid mass to the surface, all consistently point to the same workmen. But the mere detachment of a few accessible projecting fragments is too lame and impotent a conclusion of proceedings carried thus far on so different a scale. It indicates rather such results as would follow at the present day, were the barbarian tribes of the North-west to displace the present Minnesota miners, and possess themselves of mineral treasures they are as little capable as ever of turning to any but the most simple uses.

Such evidences, accordingly, while they serve to prove the existence, at some remote period, of a mining population in the copper regions of Lake Superior, seem also to indicate that their labours had come to an abrupt termination. Whether by some terrible devastating pestilence, like that which nearly exterminated the native population of New England immediately before the landing of the Pilgrim Fathers, or by the breaking out of war, or, as seems not less probable, by the invasion of the mineral region by a barbarian race, ignorant of all the arts of the ancient mound-builders of the Mississippi, and of the miners of Lake Superior: certain it is that the works have been abandoned, leaving the quarried metal, the laboriously wrought hammers, and the ingenious copper tools, just as they may have been left when the shadows of the evening told their long-forgotten owners that the labours of the day were at an end, but for which they never returned. Nor during the centuries which have elapsed since the forest reclaimed the deserted trenches for its own, does any trace seem to indicate that a native population again sought to avail itself of their mineral treasures, beyond the manufacture of such scattered fragments as lay upon the surface.

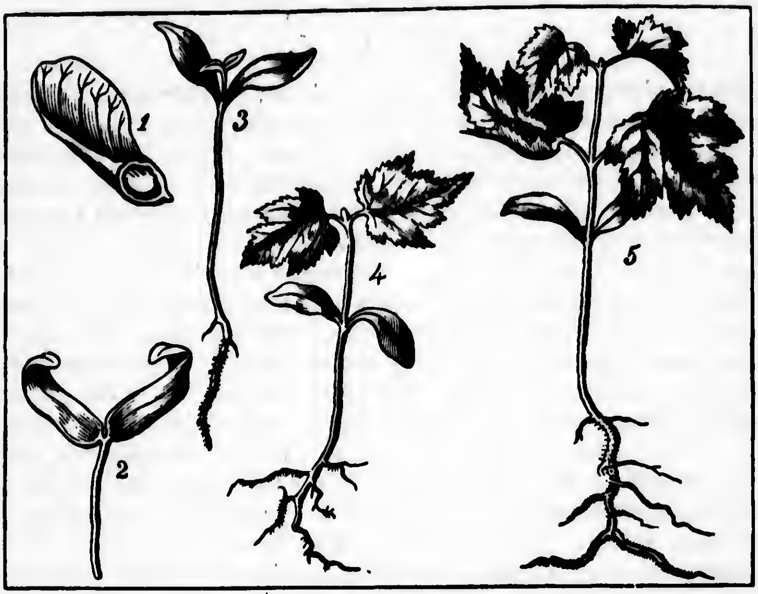
—Dr D. Wilson's *Prehistoric Man.*

BOTANY.

We see plants growing from the seed in spring-time, and gradually developing their parts: at length they blossom, bear fruit, and produce seeds like those from which they grew. Shall we commence the study of the plant with the full-grown herb or tree, adorned with flowers or laden with fruit? Or shall we commence with the seedling just rising from the ground? On the whole, we may get a clearer idea of the whole life and structure of plants if we begin at the beginning,—that is, with the plantlet springing from the seed, and follow it throughout its course of growth. This also agrees best with the season in which the study of botany is generally commenced,—namely, in the spring of the year, when the growth of plants from the seed can hardly fail to attract attention. Indeed, it is this springing forth of vegetation from seeds and buds, after the rigours of our long winter, clothing the earth's surface almost at once with a mantle of freshest verdure, which gives to spring its greatest charm. Even the dullest beholder, the least observant of nature at other seasons, can then hardly fail to ask, What are plants? How do they live and grow? What do they live upon? What is the object and use of vegetation in general, and of its particular and wonderfully various forms?

A reflecting as well as observing person, noticing the resemblances between one plant and another, might go on to inquire whether plants, with all their manifold diversities of form and appearance, are not all constructed on one and the same general plan. It will become apparent, as we proceed, that this is the case; that one common plan may be discerned, which each particular plant, whether herb, shrub, or tree, has followed much more closely than would at first view be supposed. The differences, wide as they are, are merely incidental. What is true in a general way of any ordinary vegetable will be found true of all, only with great variation in the details. In the same language, though in varied phrase, the hundred thousand kinds of plants repeat the same story,—are the living witnesses and illustrations of one and the same plan of Creative Wisdom in the vegetable world. So that the study of any one plant, traced from the seed it springs from round to the seeds it produces, would illustrate the whole subject of vegetable life and growth. It matters little, therefore, what particular plant we begin with.

Take, for example, a seedling maple. Sugar maples may be



THE MAPLE.

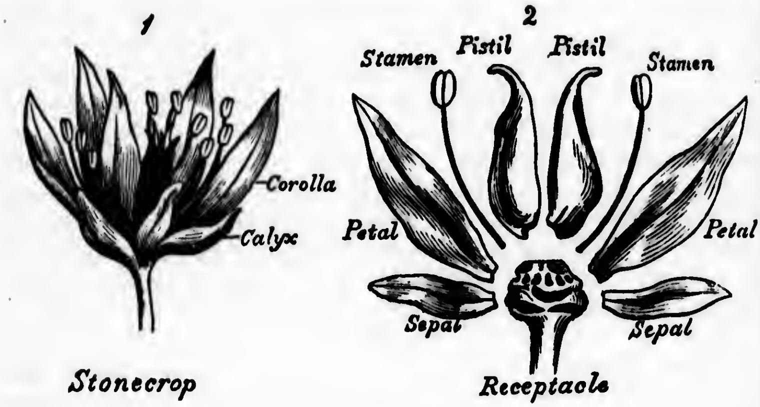
found in abundance in many places, starting from the seed or germinating in early spring, and red maples at the beginning of summer, shortly after the fruits of the season have ripened and fallen to the ground. A pair of narrow green leaves raised on a tiny stem make up the whole plant at its first appearance. Soon a root appears at the lower end of the stemlet; then a little bud at its upper end, between the pair of leaves, which soon grows into a second joint or stem bearing another pair of leaves, resembling the ordinary leaves of the red maple, which the first did not.

Was this plantlet formed in the seed at the time of germination, something as the chick is formed in the egg during the process of incubation? Or did it exist before in the seed, ready formed? To decide this question, we have only to inspect a sound seed, which in this instance requires no microscope, nor any other instrument than a sharp knife, by which the coats of the seed (previously soaked in water, if dry) may be laid open. We find within the seed, in this case, the little plantlet ready formed, and nothing else; namely, a pair of leaves like those of the earliest seedlings, only smaller, borne on a stemlet just like that of the seedling, only much shorter, and all snugly coiled up within the protecting seed-coat. The plant then exists beforehand in the seed in miniature. It was not formed, but only developed in germination; when it had merely to unfold and grow,—to elongate its rudimentary stem, which takes at the same time an upright position, so as to bring the leaf-bearing end into the light and air, where the two leaves expand; while from the opposite end, now pushed farther downwards into the soil, the root begins to grow. All this is true in the main of all plants that spring from real seeds, although with great diversity in the particulars. At least, there is hardly an exception to the fact, that the plantlet exists ready formed in the seed in some shape or other.

The rudimentary plantlet contained in the seed is called an *embryo.* Its little stem is named the *radicle,* because it was supposed to be the root, when the difference between the root and stem was not so well known as now. It were better to name it the *caulicle,* (little stem;) but it is not expedient to change old names. The seed-leaves it bears on its summit (here two in number) are technically called *cotyledons.* The little bud of undeveloped leaves which is to be found between the cotyledons before germination in many cases (as in the pea, bean, &c.) has been named the *plumule.*

In the maple, as also in the morning glory and the like, this bud or plumule is not seen for some days after the seed-leaves are expanded. But soon it appears in the maple as a pair of minute leaves, ere long raised in a stalk which carries them up to some distance above the cotyledons. The plantlet now consists, above ground, of two pairs of leaves—viz., 1. The cotyledons or seed-leaves, borne on the summit of the original stemlet, (the radicle); and 2. A pair of ordinary leaves, raised on a second joint of stem which has grown from the top of the first. Later, a third pair of leaves is formed, and raised on a third joint of stem, proceeding from the summit of the second, just as that did from the first, and so on, until the germinating plantlet becomes a tree.

So the youngest seedling, and even the embryo in the seed, is already an epitome of the herb or tree. It has a stem, from the lower end of which it strikes root; and it has leaves. The tree itself in its whole vegetation has nothing more in kind. To become a tree, the plantlet has only to repeat itself upwardly by producing more similar parts,—that is, new portions of stem, with new and larger leaves, in succession,—while beneath, it pushes its root deeper and deeper into the soil.



THE FLOWER.

The Flower.—The object of the flower is the production of seed. The flower consists of all those parts or *organs* which are subservient to this end. Some of these parts are necessary to the production of seed. Others serve merely to protect or support the more essential parts. The organs of the flower are, therefore, of two kinds; namely, first, the *protecting organs*, or *leaves of the flower*,—also called the *floral envelopes*,—and, second, the *essential organs*. The latter are situated within or a little above the former, and are enclosed by them in the bud. The floral envelopes in a complete flower are double; that is, they consist of two whorls, or circles of leaves, one above or within the other. The outer set forms the *calyx;* this more commonly consists of green or greenish leaves, but not always. The inner set, usually of a delicate texture, and of some other colour than green, and in most cases forming the most showy part of the blossom, is the *corolla.* Each leaf or separate piece of the corolla is called a *petal;* each leaf of the calyx is called a *sepal.* The sepals and the petals—or, in other words, the leaves of the blossom—serve to protect, support, or nourish the parts within. They do not themselves make a perfect flower.

Some plants, however, naturally produce, besides their perfect flowers, others which consist only of calyx and corolla, (one or both,)—that is, of leaves. These, destitute as they are of the essential organs, and incapable of producing seed, are called neutral flowers. We have an example in the flowers round the margin of the cyme of the hydrangea, and of the cranberry-tree, or snowball, in their wild state. By long cultivation in gardens, the whole cluster has been changed into showy, but useless, neutral flowers, in these and some other cases. What are called *double flowers*, such as full roses, buttercups, and camellias, are blossoms which, under the gardener's care, have developed with all their essential organs changed into petals. But such flowers are always in an unnatural or monstrous condition, and are incapable of maturing seed for want of the *essential organs*.

The essential organs are likewise of two kinds, placed one above or within the other,—namely, first, the *stamens*, or fertilising organs; and, second, the *pistils*, which are to be fertilised and bear the seeds. Taking them in succession, therefore, beginning from below, or at the outside, we have, first, the *calyx*, or outer circle of leaves, which are individually termed *sepals;* secondly, the *corolla*, or inner circle of delicate leaves called *petals;* then a set of *stamens;* and in the centre, one or more *pistils*. The end of the flower-stalk, or the short axis, upon which all these parts stand, is called the *torus*, or *receptacle*.

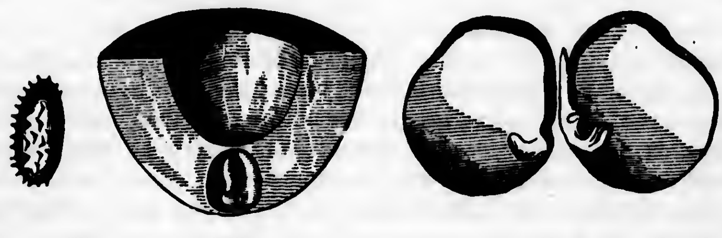
A stamen consists of two parts,—namely, the *filament*, or stalk, and the *anther*. The latter is the only essential part. It is a case, commonly with two lobes or cells, each opening lengthwise by a slit, at the proper time, and discharging a powder or dust-like substance, usually of a yellow colour. This powder is the *pollen*, or fertilising matter, to produce which is the sole office of the stamen.

A pistil is distinguished into three parts; namely,—beginning from below,—the *ovary*, the *style*, and the *stigma*. The *ovary* is the hollow case or young pod, containing rudimentary seeds called *ovules*. The *style* is the tapering part above, sometimes long and slender, sometimes short, and not rarely altogether wanting, for it is not an essential part, like the two others. The *stigma* is the tip or some other portion of the style, (or of the top of the ovary when there is no distinct style,) consisting of loose tissue, not covered, like the rest of the plant, by a skin or epidermis. It is upon the stigma that the pollen falls; and the result is, that the ovules contained in the ovary are fertilised and become *seeds*, by having an embryo formed in them. To the pistil, therefore, all the other organs of the blossom are in some way or other subservient: the stamens furnish pollen to fertilise its ovules; the corolla and the calyx form coverings which protect the whole.

These are all the parts which belong to any flower. But these parts appear under a variety of forms and combinations, some of them greatly disguising their natural appearance. To understand the flower, therefore, under whatever guise it may assume, we must study its plan. —Gray.

GENERAL DIVISION OF PLANTS.

A plant consists of certain parts which are called *organs*. The root, stem, and leaves are concerned in the nourishment of the plant, and are called *nutritive* organs; while the flowers are connected with the production of seeds, and are denominated *reproductive* organs. Some plants produce flowers and seeds, and are called *flowering* or *phanerogamous*, (Greek, visible reproduction;) while others do not produce flowers, but have peculiar organs which give origin to germs, equivalent to seeds, and they are hence called *flowerless* or *cryptogamous*, (Greek, hidden reproduction.) To the former division belong our ordinary trees, shrubs, and herbaceous flowering plants; to the latter belong ferns, mosses, lichens, sea-weeds, and mushrooms.



In flowering plants the seed contains the young or embryo plant, either alone, as in the bean, pea, and wall-flower, or associated with a separate store of nourishment, as in the cocoa-nut, the cereal grasses, and the pansy. When the skin of a bean or pea is removed, the young plant is found within, consisting of the rudimentary root and stem, with two large lobes called *cotyledons;* these cotyledons in the pea are thick and fleshy, and constitute the great bulk of the seed. In the case of the cocoa-nut, the seed, which is contained within the hard shell, consists principally of a mass of nourishing matter, (the white part used for food), in a cavity of which, at the end where the hole in the shell exists, the little embryo plant lies. The embryo is a small and somewhat club-shaped body; its parts are the rudimentary root, and the stem with a single cotyledon, which is wrapped round it.

In flowerless plants, in place of seeds little germs are formed, called *spores*, (Gr. seed,) which do not exhibit any separate parts, and have no cotyledons. Thus all the plants in the world are divided into three great classes, founded on the nature of their embryo—viz., 1, *Dicotyledonous* plants, having two cotyledons, or seed-lobes, or seed-leaves; 2, *Monocotyledonous* plants, in which there is one cotyledon; and, 3, *Acotyledonous* plants, in which there is no cotyledon. The first two divisions embrace flowering or phanerogamous plants, the last flowerless or cryptogamous. Here we see a natural division of the vegetable productions of the globe, and we observe to some extent the plan on which they were formed by the Creator.

—Balfour.

THE FERN AND THE MOSS.

There was a fern on the mountain, and moss on the moor;
And the ferns were the rich, and the mosses the poor.
And the glad breeze blew gayly; from heaven it came,
And the fragrance it shed over each was the same;
And the warm sun shone brightly, and gilded the fern,
And smiled on the lowly-born moss in its turn;
And the cool dews of night on the mountain fern fell,
And they glisten'd upon the green mosses as well.
And the fern loved the mountain, the moss loved the moor,
For the ferns were the rich, and the mosses the poor.

But the keen blast blew bleakly, the sun waxed high,
And the ferns they were broken, and wither'd and dry;
And the moss on the moorland grew faded and pale;
And the fern and the moss shrank alike from the gale.
So the fern on the mountain, the moss on the moor,
Were wither'd and black where they flourish'd before.

Then the fern and the moss, they grew wiser in grief,
And each turned to the other for rest and relief;
And they plann'd that wherever the fern-roots should grow,
There surely the moss should be sparkling below.

And the keen blasts blew bleakly, the sun waxed fierce;
But no wind and no sun to their cool roots could pierce;
For the fern threw her shadow the green moss upon,
Where the dew ever sparkled undried by the sun;
When the graceful fern trembled before the keen blast,
The moss guarded her roots till the storm-wind had pass'd;
So no longer the wind parch'd the roots of the one,
And the other was safe from the rays of the sun.

And thus, and for ever, where'er the ferns grow,
There surely the mosses lie sparkling below;
And thus they both flourish, where naught grew before,
And they both deck the woodland and mountain and moor.

—Eliza Cook.

A DISH OF VEGETABLES.

From the moss to the palm-tree the number of contributions made by the vegetable world towards the sustenance of man would make a bulky list of benefactors. We have not room to advert to them all, still less to talk about them all. It may be well, however, and only grateful in us, as human beings and recipients of vegetable bounty, to do a little trumpeting in honour of the great families of plants which have contributed with more especial liberality towards the colonisation of the world by man.

For example, there is, in the first place, the Potato family, famous for its liberal principles, and the wide sphere over which its influence is spread. The members of this family, with equal generosity, are prompt to place a luxury upon the rich man's gravy, or a heap of food beside the poor man's salt. The potato family has been for many years one of the noblest benefactors to the human colony; and when it was prevented lately, by ill-health, from the fulfilment of its good intentions, great was the anxiety of men, and many were the bulletins of health sought for and issued.

The family seat of the potatoes is well known to be in America. They are a comparatively new race in our own country, (England,) since they did not come over until some time after the Conqueror. The genealogists have nearly settled, after much discussion, that all members of this family spread over the world, are descended from the potatoes of Chili. Their town-seat is in the neighbourhood of Valparaiso, upon hills facing the sea. The potatoes were early spread over many portions of America, on missions for the benefit of man, who had not been long in discovering that they were friends worth cultivating properly. It is said that the first potato who visited Europe came over with Sir Francis Drake in 1573; it is said, also, that some of the family had accompanied Sir John Hawkins in 1563; it is certain that a body of potatoes quitted Virginia in 1586, and came to England with Sir Walter Raleigh. M. Duval, who has written an elaborate history of the potato family, shows it to be extremely probable that, before the time of Raleigh, a settlement of potatoes had been found in Spain. Reaching England in 1586, the benevolent potato family was welcomed into Belgium in 1590. In 1610, the first potatoes went to Ireland, where they eventually multiplied and grew to form one of the most important branches of this worthy race. The Scotch potatoes date their origin, as a distinct branch, from 1728. It was at dates not very different from this that other branches of the family settled in Germany. The potatoes of Switzerland first settled in 1730, in the Canton of Berne. In 1738, the thriving family extended its benevolent assistance to the Prussians; but it was not until 1767 that its aid was solicited in Tuscany. In France, the kindly efforts of this family were not appreciated until in the middle of the last century, there arose a man, Parmentier, who backed the introduction of potatoes into France with recommendations so emphatic, that it was designed to impute to him the interest of near relationship, not indeed by calling him potato, but by calling potatoes by his name, Parmentiers. The benevolent exertions made by the potato family on behalf of France, during the famine of 1793, completely established it in favour with the grateful people.

Potatoes, though so widely spread, are unable to maintain their health under too warm a climate. On the Andes, they fix their abode at a height of ten to thirteen thousand feet; in the Swiss Alps, they are comfortable on the mountain-sides, and spread in Berne to the height of five thousand feet, or not very much less. Over the north of Europe the potato family extends its labours further on into the cold than even barley, which is famous as the hardiest of grain. There are potatoes settled in Iceland, though that is a place in which barley declines to live. The potato is so nutritious, and can be cultivated with so little skill and labour, that it tempts some nations to depend solely on it for sustenance. The recent blight, especially in Ireland, consequently occasioned the most disastrous effects.

The BARLEY branch of the grass family has, however, a large establishment in Scotland, even to the extreme north, in the Orkneys, Shetland, and, in fact, even in the Faroe Islands. They who are in the secrets of the barleys, hint that they would be very glad to settle in the southern districts of Iceland—say about Reikiavik—if it were not for the annoyance of unseasonable rains. In Western Lapland there may be found heads of the house of barley as far north as Cape North, which is the most northern point of the continent of Europe. It has a settlement in Russia, on the shores of the White Sea, beyond Archangel. Over a great mass of Northern Siberia no barley will undertake to live; and as the potatoes have found their way into such barren districts only here and there, the country that is too far north for barley, is too far north for agriculture. There the people live a nomad life, and owe obligation in the world of plants, to lichens for their food, or to such families as offer them the contribution of roots, bark, or a few scraps of fruit.

It is not much that barley asks as a condition of its gifts to any member of the human colony. It wants a summer heat, averaging about forty-six degrees; and it does not want to be perpetually moistened. If it is to do anything at all in moist places, like islands, it must have three degrees added to the average allowance of summer heat, with which it would otherwise be content. As for your broiling hot weather, no barley will stand it. Other grasses may tolerate the tropics if they please; barley refuses to be baked while it is growing. The barleys are known to be settled as an old native family in Tartary and Sicily, two places very far apart. Their pedigree, however, and, indeed, the pedigrees of all the branches of the great grass family must remain a subject wrapped in uncertainty, buried in darkness, and lost in a great fog of conjecture.

We find OATS spread over Scotland to the extreme north point, and settled in Norway and Sweden to the latitudes sixty-three and sixty-five. Both oats and rye extend in Russia to about the same latitude of sixty-three degrees. The benevolent exertion of oats is put forth on behalf not only of men, but also of their horses. In

Scotland and Lancashire, in some countries of Germany, especially south of Westphalia, the people look to oats for sustenance. Scotch bone and muscle are chiefly indebted to oatmeal; for porridge (which consists of oatmeal and water, and is eaten with milk) is the staple—almost the only—food of the sturdy Scotch peasantry. South of the parallel of Paris, however, the friendship of oats is little cultivated. In Spain and Portugal nobody knows anything about oats, except as a point of curiosity.

The Rye branch of the grass family travels more to the north than oats in Scandinavia. In our own country we decline to receive gifts from rye. We succeed so well in the cultivation of more wealthy benefactors that we consider the rye poor friends, and, like good Britons, hold them at arms' length accordingly. In countries where the land is poor, poor rye is welcome to a settlement upon it. Rye is in great request in Russia, Germany, and parts of France, and one-third of the population of Europe look to its help for daily bread.

The most numerous and respectable members of the great grass family are those which bear the name of Wheat. There are an immense number of different wheats: as many wheats among the grasses as there are in this country Smiths among men. We know them best as summer and winter wheats. The family seat of the wheats most probably will never be discovered. There is reason to believe that Tartary and Persia are the native countries of wheat, oats, and rye. Strabo says that wheat is native on the banks of the Indus. Probably, wherever the old seats may be, all trace of them was destroyed in very ancient times, when, even a thousand years ago and more, the plough passed over them. The settlements of wheat in Scotland extend to the north of Inverness; in Norway, to Drontheim; in Russia, to St Petersburg. How far north the wheats would consent to extend the sphere of their influence in America it is not possible to tell, because enough attempt at cultivation has not yet been made there in the northern regions. Winter cold does not concern the wheats: the spring-sown wheat escapes it, and that sown in autumn is protected by a covering of snow. Wheat keeps a respectful distance of twenty degrees from the equator; indeed, in the warm latitudes, new combinations of heat and moisture, grateful to new and very beautiful members of the vegetable world, who suit their gifts more accurately to the wishes of the people whom they feed, would cause the kind offices of wheat to be rejected, even if they could be offered there. On the mountains in warm climates, settlements of wheat of course exist. On the north side of the Himalaya mountains, wheat and barley flourish at a height of thirteen thousand feet.

The well-known name of RICE carries our thoughts to Asia. The family seat is somewhere in Asia, doubtless; but all trace of it is lost. The family has always lived in Southern Asia, where it supplies food, probably, to more men than any other race of plants has ever had occasion to support. No rice can enjoy good health without much heat and much moisture. If these could be found everywhere, everybody would cultivate a valuable friend, that is supposed to scatter over a given surface of ground more than a common share of nourishment.

Most liberal of all vegetables, however, in this respect, are the BANANAS. Humboldt tells us that they spread over the same given extent of ground forty-four times more nutritive matter than the potatoes, and a hundred and thirty-three times more than any wheat.

Where the benevolent among our grasses cease to grow, because it is too far south, there it is just far enough north for the COCOA-NUTS, who, within their limited sphere, supply a vast contribution towards the maintenance of man, that very wise and very independent creature. Very nearly three millions of cocoa-nuts have been exported in one year from the Island of Ceylon.

Then there is in Brazil that excellent vegetable friend, MANIOC, a shrub whose roots yield almost the only kind of meal there used. An acre of manioc is said to yield as much food as six acres of wheat.

And, to come nearer home, there is a large-hearted plant bearing the name of MAIZE, and the nickname of Indian corn. Its native seat has not been fixed yet by the genealogist. It grows at a good height above the sea in tropical America, and it occurs in eastern Europe on the banks of the Dniester, in latitude forty-nine. Maize does not care about the winter; it wants nothing but summer heat in a country which it is to choose as a congenial habitation. It will do also with less heat than the vine; for it has been grown in the lower Pyrenees, at three thousand two hundred and eighty feet above the level of the sea, the vine stopping at two thousand six hundred and twenty.

We have here spoken only of a few of the great liberal families belonging to the world of plants; families to which the human colony looks for support; upon whose aid we, in fact, depend for our existence. The whole list of our vegetable patrons would be very long. Respectable names must crowd down upon every memory, and take us off to

> "Citron groves;
> To where the lemon and the piercing lime,
> With the deep orange, glowing through the green,
> Their lighter glories blend. Lay us reclined
> Beneath the spreading tamarind"—

in fact, take us a long dance among roots, and fruits, and vegetables. It must be enough, therefore, that we have here briefly expressed a general sense of obligation to our vegetable friends, and hinted at a fact which, in our high philosophy, we now and then forget, that the outer world may be a shadow, or a reflex of our own minds, or anything you please to call it; but that we, poor fellows, should be rather at a loss for dinner if the earth did not send up for us, out of a kitchen that we did not build, our corn, and wine, and oil.

—*Household Words.*

BOTANICAL GLEANINGS.

In entering a Botanic Garden it is all very well to see the fine plants, whether trees, shrubs, or flowers, assembled from every clime, and labelled with scientific nomenclature, at the public expense. But were it generally known of what much loved names and truly interesting histories many of the most strange in aspect and unpronounceable in title are possessed, we are convinced that a great and popular thirst for a more familiar acquaintance with botany would be universally excited.

It is not for the purpose of denying the advantage of scientific nomenclature, well settled and of universal acceptance, that we hazard these remarks; but it is because the scientific botanists have manifestly conspired to shut the avenues which admit the diffusion of a vast amount of useful knowledge, out of the arcana of their science, that we complain of their studious care to prevent its taking a popular form. There is only one way, indeed, in which this could be done with safety; and it is by combining the scientific with the popular explanation in so intimate a degree, that the ill-natured adage of Pope may as little hold good as his relative injunction—

> "A little learning is a dangerous thing—
> Drink deep, or taste not the Pierian spring."

The plea for a definite nomenclature and classification in Botany is founded upon the existence of upwards of 100,000 known species of plants; for species are held to include all the individuals separately formed at the creation of the world, and perpetuated ever since. Varieties, exhibiting only minor differences, not incompatible with a common origin, and arising from soil, exposure, and other causes, evince a constant tendency to return to the specific type. But cultivation has produced permanent varieties or *races*, varying much from the original type; as in the cases of the cereal grains—wheat, barley, oats, &c., and culinary vegetables, such as cabbage, cauliflower, turnips, radishes, peas. These permanent varieties were not established all at once, but only after a series of years, and by the art and skill of the gardener or cultivator; and even yet, on a poor soil, and in a neglected condition, there is still a tendency in their seeds to produce the original wild form. Many species, however, vary in a manner so remarkable, that external influences fail to account for it. This is the case with that beautiful and favourite plant the fuchsia. It has produced in successive years flowers differing so much in form and shape that, if they had not been known to be produced by the same plant, they would have been considered as belonging to distinct species. Some, indeed, have of late years advanced the doctrine of transmutation of species, or the conversion of one species into another. They have said that oats may be changed into rye, by being constantly cut down for a series of years before flowering; but there is no foundation for such an opinion. All the species, more nearly allied than others, are grouped together as a distinct kind or *genus*. Roses, for instance, compose a genus distinguished by marked characters. And it was amongst the highest titles Linnæus earned to fame, that he invented the device of giving, in the name of a plant, *the genus* as well as the *species*. *Rosa spinosissima* is a particular species of rose—*Rosa* being the generic; *spinosissima*, the specific, or, as Linnæus called it, the "trivial" name of the plant.

But, after all, it is in the multitude of minute and individual facts, rather than in the classification of names and the conflict of systems, that the value of knowledge in general, and of the knowledge of plants in particular, consists; and often, when the jargon of modern science has grated on our ear, have we longed to live back in the history of human intelligence, that we might, with Shakespeare, be "culling of simples" under the moon, instead of botanising with a microscope.

Let us descend, then, to particulars, and begin with the *Crowfoot* *family*—name familiar to the lover of field flowers. These plants are found in cold, damp climates, and in the elevated regions of warm countries. Europe contains one-fifth of them, and North America about a seventh. The clematis, anemone, ranunculus, or buttercup, hellebore, hepatica, columbine, &c., belong to them. They have narcotic and acrid properties, and are, usually, more or less poisonous. One of them, monkshood, contains a narcotic used as an anodyne, (a medicine which by its soothing qualities assuages pain,) and is chiefly employed where the nerves are affected. The May-apple of America is employed as a purgative; and many of the crow-flowers are marked by bitter tonic properties.

The *Magnolia* family, chiefly found in North America, (certain species also occurring in South America, China, Japan, New Holland, and New Zealand,) may perhaps be familiar in name, if not in appearance. The properties of the order are bitter, tonic, and often aromatic. Captain Winter brought from the Straits of Magellan, in 1579, the magnolia, which yields winter's-bark, employed medicinally as an aromatic stimulant. The bark of swamp-sassafras, or beaver-tree, is, in fact, used as a substitute for Peruvian bark; and the tulip-tree has similar properties.

The *Water-lily* family, to which botanists, with rare felicity, have given the lively name of Nymphacea, have very showy flowers. They adorn the ponds and rivers of North America, and are, generally, widely distributed throughout the northern hemisphere; yet it is in the waters of South America that the *Victoria regia*, one of the largest known aquatics, expands its great flowers, a foot in diameter, with its still larger leaves, which are in diameter from four to six and a half feet, and dispenses its delicious odour.

Of this plant there is a delightful reminiscence wafted from the poetry of L. E. L.:—

"There floats the water-lily, like a sovereign
Whose lovely empire is a fairy world;
The purple dragon-fly above it hovering,
As when its fragile ivory uncurl'd,
A long time ago."

The *Lotus*, figured on Egyptian and Indian monuments, is said to belong to the *Water-bean* family of aquatic plants, with showy flowers and floating leaves, found in the temperate as well as the tropical regions of the Old and New World.

The *Sidesaddle flower* family appear in North America and Guiana. To them belongs the remarkable *pitcher-plant* of our swamps, furnished with a leafy receptacle for water, in which are generally to be found the remains of unwary flies and other insects. It has been very extensively used in Nova Scotia, Canada, and Newfoundland, as a remedy for that most loathsome of diseases, the small-pox.

With the *Poppy* family we are, however, more familiar; though few will be prepared to learn that they are chiefly European. This, notwithstanding their extension over tropical America, Asia, China, New Holland, the Cape of Good Hope, &c., is, however, the case. They are distinguished by their milky or coloured juice, and the well-marked narcotic properties of their order. The concrete, milky juice from the unripe capsules of the somniferous poppy is, in fact, opium—the particular plant from which it is procured being a native of Western Asia, and not improbably of Southern Europe also, but now distributed over various other countries besides.

The *Cabbage* or *Cresswort* family are a very extensive order, chiefly European. Everything connected with them goes by fours, generally in the form of a cross. None of them are poisonous, but most of them are antiscorbutic and stimulant. In fact, they are cabbages, cauliflowers, turnips, radishes, cresses, horseradishes, and other garden stuffs most familiar to our readers. Sulphur and nitrogen are contained in them to such an extent, that their decaying odours are anything but agreeable. Not only the garden vegetables, but the more ordinary garden flowers, such as wallflowers, stocks, rockets, honesty, &c., belong to the order. One of the tribe, the rose of Jericho, is remarkable as a *hygrometer*—literally, a measure of the moisture in the surrounding atmosphere; its old withered, annual stems, which are rolled up like a ball in dry weather, and drifted about by the winds in the deserts of Syria and Egypt, resuming when rain falls their original form and direction, and continuing for many years thus to curl up and expand according to the state of the atmosphere. Woad, the plant yielding the well-known woad-blue colour when treated like indigo, and with which the ancient Britons used to dye their bodies, belongs to this order.

The *Caper* family is probably familiar to those who affect a boiled leg of mutton. Capers are the flower-buds of a plant of this order. Their properties are stimulant. The plant is a native of the south of Europe, and is considered by Royle to be the hyssop of Scripture.

Our sweet and pretty favourites, the *Mignonette* family, inhabit Europe and the adjoining parts of Asia. "The uses of the order," says the hard-hearted man of science, "are unimportant." And yet one kind, *weld*, yields a yellow dye; another is the fragrant mignonette. Ah! how many hearts has not that gentle fragrance solaced! In the lone garret it has blended with the inmates' sighs, and mingled with the quick, warm breathings of emotion on the lordly parterre. The mignonette is in France an object of such favourite culture that, by preventing the development of its blossoms, it is common to render it shrubby or woody, when it is known as the tree-mignonette. We shall conclude this short excursion into botany with a notice of the *Violet* family. They are natives of Europe, Asia, and America. They possess many valuable medicinal properties. The roots of the sweet-scented European violet have been employed as an emetic. Other species are used in South America as substitutes for ipecacuanha. The rich odour of the Eastern violets is almost entirely absent in those of the western hemisphere. The only North American species possessing any degree of fragrance is the tall *Viola Canadensis*, which flowers twice a year—in the spring and fall. The *Viola tricolor* (heart's-ease) is the origin of all the cultivated varieties of pansy.

—*Adapted from* W. W. FYFE.

LINNÆUS NAMING THE FLOWERS.

IT is pleasant to trace the steps of a genius like Linnæus going over completely new ground in the wide field of natural history; classing and naming birds, insects, and flowers, oftentimes according to a system which his own ingenuity and penetration had devised to supply the deficiencies of former naturalists. An active examination of the minuter parts of the object under his consideration, frequently enabled him to arrive at a juster conclusion as to the order or genus to which it belonged, than others who had preceded him; and sometimes, after having with indefatigable industry ascertained these points, he indulged himself in combining with his new discovery associations of friendship, or of historical or classical allusion. After this fashion he honoured several of his patrons and pupils. Thus the *Celsia* was so named after Celsui, one of his earliest benefactors; and the *Kalmia*, now so well known in our gardens, commemorated his friendship for Professor Kalm, his pupil and fellowlabourer. In his "Critica Botanica" he observes, concerning this habit of the appropriation of celebrated names to the genera of plants, that "a proper connexion should be observed between the habits and appearance of the plant and the name from which it has its derivation;" and as an emblem of himself he chose the *Linnæa*

LINNÆA BOREALIS.

borealis,* which he described as "a little northern plant flowering early, depressed, abject, and long overlooked." It was gathered by him at Lycksele, May 29, 1732. It is common in West Bothnia, and in almost all the great northern forests; but it may be easily overlooked, because it grows only where the woods are thickest, and its delicate twin-blossoms are almost hid among the moss, and interwoven with ivy. Their smell resembles that of the meadow-sweet, and is so strong during the night as to discover the plant at a considerable distance.

When he received his patent of nobility, Linnæus adopted this

* This little plant is to be found abundantly in the temperate regions of the North American continent.

floweret as a part of his crest—the helmet which surmounts the arms of his family being adorned with a sprig of Linnæa. One of those pupils who visited distant countries to add to the collections of his great master, sent from China a service of porcelain, manufactured purposely for him, having a representation of this plant as its only decoration; and the Cardinal de Noailles erected a cenotaph in his garden to the memory of the naturalist, and planted the Linnæa by its side as its most appropriate ornament. What lover of flowers but will regard with interest this little flower of the north, for the sake of him whose name it bears!

—C. L. BRIGHTWELL.

TO THE FRINGED GENTIAN.

THOU blossom, bright with autumn dew,
And colour'd with the heaven's own blue,
That openest when the quiet light
Succeeds the keen and frosty night;

Thou comest not when violets lean
O'er wandering brooks and springs unseen,
Or columbines, in crimson drest,
Nod o'er the ground-bird's hidden nest.

Thou waitest late and com'st alone,
When woods are bare and birds are flown,
And frosts and shortening days portend
The aged year is near its end.

Then doth thy sweet and quiet eye
Look through its fringes to the sky,
Blue,—blue—as if that sky let fall
A flower from its cerulean wall.

I would that thus when I shall see
The hour of death draw near to me,
Hope, blossoming within my heart,
May look to heaven as I depart.

—BRYANT.

TROPICAL SCENERY.

On leaving Ascension we sailed for Bahia, on the coast of Brazil, in order to complete the chronometrical measurement of the world. We arrived there on August 1st, and stayed four days, during which I took several long walks. I was glad to find my enjoyment in tropical scenery had not decreased from the want of novelty, even in the slightest degree. The elements of the scenery are so simple, that they are worth mentioning, as a proof on what trifling circumstances exquisite natural beauty depends.

The country may be described as a level plain of about three hundred feet in elevation, which in all parts has been worn into flat-bottomed valleys. This structure is remarkable in a granitic land, but is nearly universal in all those softer formations of which plains are usually composed. The whole surface is covered by various kinds of stately trees, interspersed with patches of cultivated ground, out of which houses, convents, and chapels arise. It must be remembered that within the tropics, the wild luxuriance of nature is not lost even in the vicinity of large cities; for the natural vegetation of the hedges and hill-sides overpowers in picturesque effect the artificial labour of man. Hence, there are only a few spots where the bright red soil affords a strong contrast with the universal clothing of green. From the edges of the plain there are distant views either of the ocean, or of the great Bay with its low-wooded shores, and on which numerous boats and canoes show their white sails. Excepting from these points, the scene is extremely limited; following the level pathways on each hand, only glimpses into the wooded valleys below can be obtained. The houses, I may add, and especially the sacred edifices, are built in a peculiar and rather fantastic style of architecture. They are all whitewashed; so that when illumined by the brilliant sun of mid-day, and as seen against the pale blue sky of the horizon, they stand out more like shadows than real buildings.

Such are the elements of the scenery, but it is a hopeless attempt to paint the general effect. Learned naturalists describe these scenes of the tropics by naming a multitude of objects and mentioning some charac eristic feature of each. To a learned traveller this possibly may communicate some definite ideas: but who else, from seeing a plant in an herbarium, can imagine its appearance when growing on its native soil? Who, from seeing choice plants in a hothouse, can magnify some into the dimensions of forest trees, and crowd others into an entangled jungle? Who, when examining in the cabinet of the entomologist the gay exotic butterflies, and singular cicadas, will associate with these lifeless objects, the ceaseless harsh music of the latter, and the lazy flight of the former,—the sure accompaniments of the still, glowing noonday of the tropics? It is when the sun has attained its greatest height that such scenes should be viewed: then the dense splendid foliage of the mango hides the ground with its darkest shade, whilst the upper branches are rendered, from the profusion of light, of the most brilliant green. In the temperate zones the case is different—the vegetation there is not so dark or so rich, and hence the rays of the declining sun, tinged of a red, purple, or bright yellow colour, add most to the beauties of those climes.

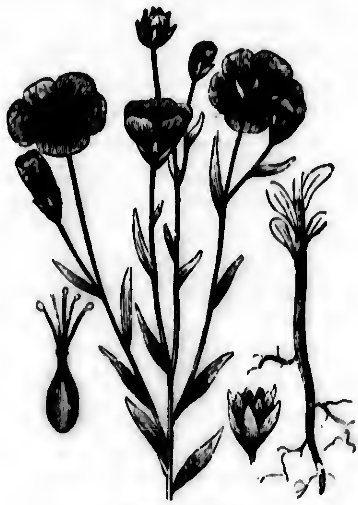
When quietly walking along the shady pathways, and admiring each successive view, I wished to find language to express my ideas. Epithet after epithet was found too weak to convey to those who have not visited the intertropical regions, the sensation of delight which the mind experiences. I have said that the plants in a hothouse fail to communicate a just idea of the vegetation, yet I must recur to it. The land is one great, wild, untidy, luxuriant hothouse, made by Nature for herself, but taken possession of by man, who has studded it with gay houses and formal gardens. How great would be the desire in every admirer of nature to behold, if such were possible, the scenery of another planet! yet to every person in Europe, it may be truly said, that, at the distance of only a few degrees from his native soil, the glories of another world are opened to him. In my last walk I stopped again and again to gaze on these beauties, and endeavoured to fix in my mind for ever an impression which, at the time, I knew sooner or later must fail. The form of the orange-tree, the cocoa-nut, the palm, the mango, the tree-fern, the banana, will remain clear and separate; but the thousand beauties which unite these into one perfect scene must fade away, yet they will leave, like a tale heard in childhood, a picture full of indistinct, but most beautiful figures.

—Darwin's *Journal.*

VEGETABLE CLOTHING—FLAX, HEMP, AND COTTON.

The *vegetable* matters employed for clothing are chiefly of two kinds: the fibres of plants, and the downy substance in which the seeds are sometimes embedded. The fibrous or stringy texture is very prevalent in vegetables. We see it in the bark and wood of trees, in the stalks of green or herbaceous plants, and in the leaves of all. The longer parallel fibres are held together by shorter cross ones, forming a network, cemented by a glutinous matter. The ingenious, though but half-civilised people of Otaheite have discovered a method of making tolerable cloth of the inner bark of certain trees, by steeping it in water, and then beating it with a wooden mallet. But the more artful way of employing vegetable fibres consists in an entire separation of them from the matter that held them together, reducing them to clean loose bundles, then twisting them into threads, and lastly interweaving them.

The plants selected in Europe for the purpose of making thread and cloth from their fibres are chiefly flax and hemp. *Flax* (in Latin *linum*, whence the word *linen*) is an annual plant, rising on a single stalk to a moderate height, and crowned with handsome blue flowers, succeeded by globular seed-vessels. It is suffered to grow till the seeds are ripe, and is then plucked up by the hand, laid in little bundles to dry, deprived of its seed-vessels, and then put into pits of water to rot. The purpose of this part of the process is to dissolve a mucilaginous matter, which holds the fibres together; and



FLAX PLANT.

it is the most disagreeable part of the management of flax, as the smell arising from it while rotting is extremely offensive, and prejudicial to the health. When the flax has lain long enough, it is taken out, washed, dried, then beaten with mallets, combed, and by various other operations so prepared, that the long fibres are got by themselves, clean and loose, in which state they are called *flax;* the shorter and coarser fibres, separated by the comb, are called *tow.* The operation of spinning, which it next undergoes, consists in drawing out, with the fingers, several of the fibres together, and twisting them. The product of spinning is thread, which is more or less fine according to the dexterity of the spinner and the nature of the material. Some thread closer twisted than the rest is kept for needlework, but the greater part is made up in bundles, called linen-yarn, and committed to the weaver.

Weaving may be regarded as a finer kind of matting. To perform it, the threads, which form the length of a piece of cloth, are first disposed in order, and strained by weights to a proper tightness; this is called the *warp.* These threads are divided by an instrument called a reed, into two sets, each composed of every other thread; and while, by the working of a treadle, each set is thrown alternately up and down, the cross-threads, called the *woof* or *weft*, are inserted between them, by means of a little instrument, sharp at both ends, called a shuttle, which is briskly shot from one of the weaver's hands to the other, placed on the opposite sides of the work, and carries the thread with it. This is the simplest kind of weaving; but numberless are the additional contrivances made for all the curious works wrought in the loom which have been the objects of human ingenuity for many ages.

The linen fabrics are of all degrees of fineness, from coarse sheeting to cambric, almost emulating a spider's web. They are brought to that extreme whiteness, which we so much admire, by the process of bleaching. This consists in their exposure to the action of the sun and air, with frequent watering, and often with the help of some acid liquor, which quickens the operation. The value that can be given to a raw material by manufacturing, is in few instances more strikingly exemplified than in the conversion of flax into Brussels lace, some of which sells for several guineas a yard. Indeed, if you look at a plant of flax growing, and then at the frill of your shirt, you cannot fail to be struck with admiration of human skill and industry.

Hemp is a much taller and stronger plant than flax. It has a square rough stalk, rising to the height of five or six feet, and sending off branches. Its fibrous part consists in the bark surrounding the main stalk. Hemp undergoes the same general preparation as flax before it is consigned to the weaver; but, being of a stronger and coarser texture, it requires more labour to get the fine fibres separate from the rest. Hence it is commonly employed in the more homely manufactures; it is the principal material of sailcloth, a fabric, the strength of which is required to be proportional to the violence it has to undergo from storms and tempests; and it is equally important to navigation, from its use in making cordage; for which purpose it is taken nearly in a raw state, and twisted into coarse twine, which is afterwards united to make rope.

Whilst the inhabitant of the northern and temperate regions is obliged to exercise much labour and contrivance in procuring his vegetable clothing from the stalks of plants, the native of the fruitful south enjoys the benefit of a material presented in greater abundance, and in a state requiring much less preparation before it is fitted for the manufacturer. This is *cotton*, a white woolly substance contained in the seed-pod of a family of plants, some of which are annual and herbaceous, others perennial and shrubby. The pods, when ripe, open of themselves, and the cotton is plucked

The figure represents a species of cotton plant found in India, and shows the manner in which the cotton escapes from the capsule.

out of them by the fingers, with the seeds sticking to it; these are separated by means of mills, which pull out and loosen the down. It is then in a state fit to be sent from the planter to the manufacturer. The farther operations it undergoes are picking, carding, and roving, which last brings off the fibres longitudinally in a continued loose line; these are next twisted and drawn out, so as to make thread or yarn, and the material is then consigned to the weaver. The vast extension of the cotton manufacture in this country has caused these preparatory operations to be performed by a system of complex machinery, the invention of the late Sir Richard Arkwright.

The fabrics made from cotton are probably more various and numerous than from any other material. They comprehend stuffs of all degrees of fineness, from the transparent muslin of a robe, or a turban, to the thick plush and warm bed-quilt. The commerce of Great Britain has, of late years, been peculiarly indebted to the cotton manufacture, which produces clothing for people of all ranks, from Russia to Guinea, and unites elegance with cheapness in an unusual degree. Great quantities of the native fabrics of the East are also imported into Europe. Some of these, from excellence in the material and incomparable manual dexterity and patience in the workmen, though made with very simple machinery, equal in fineness and beauty anything of European manufacture. The natives are said to perform their finest work in moist cool places under ground, which makes the cotton hold together so as to draw out to the thinnest threads; and the soft and delicate fingers of the Indian women give them the sense of feeling to a degree of nicety much beyond that of Europeans.

It is probable that cotton at present clothes more people in the world than any other substance. Its peculiar advantage, besides cheapness, is the union of warmth with lightness, whence it is fitted for a great variety of climates. To the hot it is better adapted than linen, on account of its absorbing quality, which keeps the skin dry and comfortable. The woolliness of cotton gives a kind of nap to the cloth made of it, which renders it soft to the touch, but apt to attract dust. In the fine muslins this is burned off, by passing them between heated cylinders with such velocity as not to take fire, which, considering the combustibility of cotton, must be a very nice operation.

—Dr Aikin.

LUMBERING.

The lumber trade is carried on to a greater or less extent on almost all the American rivers; but on the Mississippi and the St Lawrence it affords employment to a vast number of persons. The chief raftsmen, under whose directions the timber expeditions are conducted, are generally persons of very great intelligence, and often of considerable wealth. Sometimes these men, for the purpose of obtaining wood, purchase a piece of land, which they sell after it has been cleared, but more frequently they purchase only the timber from the

proprietors of the land on which it grows. The chief raftsman, and his detachment of workmen, repair to the forest about the month of November, and are occupied during the whole of the winter months in felling trees, dressing them into logs, and dragging them by teams of oxen to the nearest stream, over the hardened snow, with which the country is then covered. They live during this period in huts formed of logs. Throughout the whole of the newly cleared districts of America indeed, the houses are built of rough logs, which are arranged so as to form the four sides of the hut, and their ends are half-checked into each other in such a manner as to allow of their coming into contact nearly throughout their whole length, and the small interstices which remain are filled up with clay. About the month of May, when the ice leaves the rivers, the logs of timber that have been prepared, and hauled down during winter, are launched into the numerous small streams in the neighbourhood of which they have been cut, and are floated down to the larger rivers, where their progress is stopped by what is called a "boom." The boom consists of a line of logs, extending across the whole breadth of the river. These are connected by iron links, and attached to stone piers built at suitable distances in the bed of the stream.

The boom is erected for the purpose of stopping the downward

progress of the wood, which must remain within it till all the timber has left the forest. After this every raftsman searches out his own timber, which he recognises by the mark he puts on it, and, having formed it into a raft, floats it down the river to its destination. The boom is generally owned by private individuals, who levy a toll on all the wood collected by it. The toll on the Penobscot River is at the rate of three per cent. on the value of the timber.

The rafts into which the timber is formed, previous to being floated down the large rivers, are strongly put together. They are furnished with masts and sails, and are steered by means of long oars, which project in front as well as behind them. Wooden houses are built on them for the accommodation of the crew and their families. I have counted upwards of thirty persons working the steering oars of a raft on the St Lawrence; from this some idea may be formed of the number of their inhabitants.

The most hazardous part of the lumberer's business is that of bringing the rafts of wood down the large rivers. If not managed with great skill, they are apt to go to pieces in descending the rapids; and it not unfrequently happens that the whole labour of one, and sometimes of two years, is in this way lost in a moment. An old raftsman with whom I had some conversation on board of one of the steamers on the St Lawrence, informed me that each of the rafts brought down that river contains from 15,000 to 25,000 dollars' worth of timber, and that he, on one occasion, lost 12,500 dollars by one raft, which grounded in descending a rapid, and broke up. The safest size for a raft, he said, was from 40,000 to 50,000 square feet of surface; and when of that size they require about five men to manage them. Some are made, however, which have an area of no less than 300,000 square feet. These unwieldy craft are brought to Quebec in great numbers from distances varying from one to twelve hundred miles; and it often happens that six months are occupied in making the passage. They are broken up at Quebec, where the timber is cut up for exportation into planks, deals, or battens, at the numerous saw-mills with which the banks of the St Lawrence are studded for many miles, in the neighbourhood of the town. Sometimes the timber is shipped in the form of logs. The timber-rafts of the Rhine are, perhaps, the only ones in Europe that can be compared to those of the American rivers; but none of those which I have seen on the Rhine were nearly so large as those on the St Lawrence, although some of them were worked by a greater number of hands, a precaution rendered necessary, perhaps, by the more intricate navigation of the river. The principal woods exported from the St Lawrence are white oak, white pine, red pine, elm, and white ash.

—STEVENSON.

THE LINDEN TREE.

HERE 's a song for thee—of the linden tree!
 A song of the silken lime!
There is no other tree so pleaseth me,
 No other so fit for rhyme.

When I was a boy, it was all my joy
 To rest in its scented shade,
When the sun was high, and the river nigh
 A musical murmur made.

When floating along, like a winged song,
 The traveller-bee would stop,
And choose for his bower the lime-tree flower,
 And drink—to the last sweet drop.

When the evening star stole forth, afar,
 And the gnats flew round and round,
I sought for a rhyme beneath the lime,
 Or dream'd on the grassy ground.

Ah! years have fled; and the linden dead,
 Is a brand on the cottier's floor,
And the river creeps through its slimy deeps,
 And youth—is a thought of yore!

Yet—they live again, in the dreamer's brain,
 As deeds of love and wrong,
Which pass with a sigh, and seem to die,
 Survive in the poet's song.

—BARRY CORNWALL.

TIM LINKINWATER'S WINDOW.

(*From* " *Nicholas Nickleby.*")

"There is a double wallflower at No. 6 in the court, is there?" said Nicholas.

"Yes, there is," replied Tim, "and planted in a cracked jug without a spout. There were hyacinths there this last spring, blossoming in—but you 'll laugh at that, of course."

"At what?"

"At their blossoming in old blacking-bottles," said Tim.

"Not I, indeed," returned Nicholas.

Tim looked wistfully at him for a moment, as if he were encouraged by the tone of this reply to be more communicative on the subject; and sticking behind his ear a pen that he had been making, and shutting up his knife with a sharp click, said, "They belong to a sickly, bed-ridden, humpbacked boy, and seem to be the only pleasures, Mr Nickleby, of his sad existence. How many years is it," said Tim, pondering, "since I first noticed him, quite a little child, dragging himself about on a pair of tiny crutches? Well! well! not many; but though they would appear nothing, if I thought of other things, they seem a long, long time, when I think of him. It is a sad thing," said Tim, breaking off, "to see a little deformed child sitting apart from other children, who are active and merry, watching the games he is denied the power to share in. He made my heart ache very often."

"It is a good heart," said Nicholas, "that disentangles itself from the close avocations of every day, to heed such things. You were saying"——

"That the flowers belonged to this poor boy," said Tim, "that's all. When it is fine weather, and he can crawl out of bed, he draws a chair close to the window, and sits there looking at them, and arranging them all day long. We used to nod at first, and then we came to speak. Formerly, when I called to him of a morning, and asked him how he was, he would smile and say, 'Better,' but now he shakes his head, and only bends more closely over his old plants. It must be dull to watch the dark house-tops and the flying clouds for so many months; but he is very patient."

"Is there nobody in the house to cheer and help him?" asked Nicholas.

"His father lives there, I believe," replied Tim, "and other people, too; but no one seems to care much for the poor sickly cripple. I have asked him very often if I can do nothing for him; his answer is always the same—'Nothing.' His voice has grown weak of late, but I can see that he makes the old reply. He can't leave his bed now, so they have moved it close beside the window; and there he lies all day, now looking at the sky, and now at his flowers, which he still makes shift to trim and water with his own thin hands. At night, when he sees my candle, he draws back his curtain, and leaves it so till I am in bed. It seems such company to him to know that I am there, that I often sit at my window for an hour or more, that he may see I am still awake; and sometimes I get up in the night to look at the dull, melancholy light in his little room, and wonder whether he is awake or sleeping."

"The night will not be long coming," said Tim, "when he will sleep and never wake again on earth. We have never so much as shaken hands in all our lives, and yet I shall miss him like an old friend. Are there any country flowers that could interest me like these, do you think? Or do you suppose that the withering of a hundred kinds of the choicest flowers that blow, called by the hardest Latin names that were ever invented, would give me one fraction of the pain that I shall feel when these old jugs and bottles are swept away as lumber? Country!" cried Tim, with a contemptuous emphasis; "don't you know that I couldn't have such a court under my bedroom-window anywhere but in London?"

With which inquiry Tim turned his back, and, pretending to be absorbed in his accounts, took an opportunity of hastily wiping his eyes, when he supposed Nicholas was looking another way.

—Charles Dickens.

ANCIENT AND MODERN FARMING.

In early times, when the population was scattered widely over the land, and their wants were few and easily satisfied, the spontaneous products of the earth, scanty as they were, would amply suffice. But as the people increased in numbers, and civilisation progressed, attempts would be made to extend the products of the land by the efforts of industry and skill. The cereal crops would then be cultivated, and farinaceous food used to supplement the spontaneous herbage of the soil. But the system of culture this discovery inaugurated was confined solely to the preparing of the land to receive the seed, not to any attempts to stimulate its productiveness. What the land naturally yielded would be considered as the extent of its capability. The nature of all agricultural processes for ages was simple in the extreme, progress being retarded by the devastating wars and civil discords which for many ages afflicted all the nations of Europe. The husbandman reaped his tiny crop beneath the shade of the feudal castle, and was ready at the shout of the warder, or the trumpet call, to throw down the sickle and seize the sword; and it was long ere he left this sheltering shade, and cultivated the valleys, and crept up the hill-side; dotting the smiling landscape with his flocks of sheep and cattle, and adding to the beauty of the scene by the glistening glories of the summer corn. But long after intestine wars had ceased, when the rusty firelock or the notched sabre were the only relics of the troublous times we have alluded to, agriculture still presented the same torpid symptoms, and little evidence was shown of the desire to increase the natural productiveness of the soil by improved methods of treatment. It was very early discovered that the cereal crops were exhaustive ones—that is, if crop after crop of the same grain was raised from the same patch of soil, it was observed soon to be incapable of further production, at least to any amount. This proved that the crop withdrew certain properties of the soil. In districts where land was plentiful and easily obtained, this difficulty would be got rid of by cultivating new patches of soil, just in the same way now followed by the careless farmer in America, who crops until he exhausts his land, when he moves off to another "location," where virgin land, abounding in all the elements of fertility, is to be had, which in its turn undergoes the same process of exhaustion. In process of time, the lands which were discarded as exhausted and incapable of producing crops would be returned to, or taken into cultivation by other hands, the result being that crops would be raised as before. This necessarily attracting attention, and the fact becoming registered, that exhausted land would again become productive if allowed to remain uncultivated—that is, at rest—for a certain period, the "fallow" system was inaugurated. The old Roman system consisted in raising a crop of grain one year, allowing the land to remain at rest the next. In this country* a variety of circumstances tended to introduce a peculiar system of agriculture; the exigencies of a population concentrated in a much greater degree than in any other of the European states; the length of the winter, and the uncertainty even of the favourable months; the comparative scarcity and dearness of land, and the existence of a

* Britain; but applicable to British America in many particulars.

higher degree of exhaustive property in the cereals than in the southern countries; the natural richness of the herbage of the fields—all induced a comparatively peculiar system. As daily experience registered facts, the truth would soon become apparent that it was not necessary to wait for the land becoming again productive by allowing it to lie a comparatively long period idle; that the fertilising properties could be restored to it by the addition of manure, this being obtained from the stock of the farm—the cattle, sheep, horses, cows, &c. The increase, therefore, of the cereal productiveness of the land evidently depended upon the amount of manure placed at the disposal of the farmer; hence the efforts to increase the number of stock kept. At first the system was much aided by the spontaneous growth of large crops of grass—one of the peculiarities of our climate. The plan adopted, therefore, was to have half the farm devoted to pasture lands, and half to the cultivation of cereals, a portion of this latter half being kept in fallow. But the exigencies of our climate placed a limit to the number of cattle kept, and, in consequence, the amount of manure produced. For a large portion of the year the herbage is liable to be frozen or covered with snow; the animals are, in consequence, unable to partake of it. It became necessary, therefore, if the stock was to be increased on our farms, to provide a supply of food by which to maintain the animals during the severe weather of winter, these being housed, instead of starving in the open fields, as in the old system. The want being thus felt, it was in time supplied by the introduction of what are known as the *green crops*—artificial grasses, and roots, as turnips, exclusively raised for the maintenance of the stock. As this system was adopted, the breadth of land under fallow, and latterly that under the cereal crops, was diminished. In process of time the grand principle which completely revolutionised agriculture was introduced; we refer to the "Rotation of Crops," or the "Four Year Course System." This was founded upon the theory that forage plants derive the principal elements of their growth from the atmosphere giving to the soil more than they take from it, and afford in addition a large amount of manure when consumed by stock; thus they contribute in two ways to the refertilisation of the soil exhausted by the cereal crops, which derived their nutriment, to a great extent, from the inorganic or mineral constituents of the soil. This system once fairly established, all the other improvements of modern agriculture, such as drainage, subsoiling, irrigation, and steam cultivation, followed in comparatively quick succession.

—BURN'S *Outlines of Modern Farming.*

THE TOY OF THE GIANT'S CHILD.

(From the German of Chamisso.)

BURG Niedeck is a mountain in Alsace, high and strong,
Where once a noble castle stood—the giants held it long;
Its very ruins now are lost, its site is waste and lone,
And if you seek for giants there, they are all dead and gone.
The giant's daughter once came forth the castle-gate before,
And played with all a child's delight, beside her father's door;
Then sauntering down the precipice, the girl did gladly go,
To see, perchance, how matters went in the little world below.
With few and easy steps she passed the mountain and the wood;
At length near Haslach, at the place where mankind dwelt, she stood;
And many a town and village fair, and many a field so green,
Before her wondering eyes appeared, a strange and curious scene.
And as she gazed, in wonder lost, on all the scene around,
She saw a peasant at her feet, a tilling of the ground;
The little creature crawled about so slowly here and there,
And, lighted by the morning sun, his plough shone bright and fair.
"O pretty plaything!" cried the child, "I'll take thee home with me;"
Then with her infant hands she spread her kerchief on her knee,
And cradling horse, and man, and plough, all gently on her arm,
She bore them home with cautious steps, afraid to do them harm:
She hastes with joyous steps and quick, (we know what children are,)
And spying soon her father out, she shouted from afar—
"O father, dearest father, such a plaything I have found,
I never saw so fair a one on all our mountain ground."
Her father sat at table then, and drank his wine so mild,
And smiling with a parent's smile, he asks the happy child—
"What struggling creature hast thou brought so carefully to me?
Thou leap'st for very joy, my girl; come, open, let us see."
She opes her kerchief carefully, and gladly, you may deem,
And shows her eager sire the plough, the peasant, and his team;
And when she'd placed before his sight the new-found pretty toy,
She clasped her hands, and screamed aloud, and cried for very joy.
But her father looked quite seriously, and shaking slow his head,
"What hast thou brought me home, my child? This is no toy," he said;

"Go, take it quickly back again, and put it down below;
The peasant is no plaything, girl—how couldst thou think him so?
So go, without a sigh or sob, and do my will," he said;
"For know, without the peasant, girl, we none of us had bread;
'Tis from the peasant's hardy stock the race of giants are;
The peasant is no plaything, child—no, God forbid he were."

—Richardson.

ZOOLOGY.

Zoology, as you have already learned, is that branch of natural science which treats of animals, including not only the quadrupeds or four-footed beasts to which the name "animal" is generally applied, but all living creatures as distinguished from plants. Between the many different animals which inhabit the various portions of land and water that constitute our earth, there are points of resemblance more or less striking, making, what we may term, a family likeness; and the zoologist, taking advantage of these, arranges all the members of the animal kingdom under certain classes, divisions, and families. My object, in this lesson, is to introduce to your notice the five great divisions, or, as they are called, sub-kingdoms of the animal world.

The first and most important of these great divisions is the sub-kingdom *Vertebrata.* It comprises all those animals which possess an internal skeleton, of which the principal feature is a spine or backbone, composed of numerous smaller bones, called "vertebræ," fitting into one another with the greatest nicety. To this spine or main column all the other bones are attached by joints of different kinds, suited to the functions which the animal has to perform. While preserving the same general character, these bones or limbs differ greatly in appearance in different classes of animals; thus, if we take the fore pair of limbs which nearly all the vertebrates possess, we find them represented by the arms of man, the legs of the horse, the flappers of the whale, the wings of birds, and the fins of fishes. The tail also, which is almost or entirely wanting in some groups, is enormously developed in others. We must be careful not to mistake outward resemblance for real relationship; a humming-bird, for instance, is not unlike a dragon-fly, and a turtle has something the appearance of a crab; yet, while the humming-bird and the turtle are both members of the vertebrate sub-kingdom, the dragon-fly and the crab belong to one totally distinct from it. This important division of the animal kingdom has five subdivisions or classes, well known to you as *mammals*, *birds*, *reptiles*, *amphibians*, and *fishes*.

The second of the great provinces of zoology is occupied by the sub-kingdom *Articulata*. Under it are comprehended the numerous tribes of animals that, possessing no internal skeleton, wear their bones outside, in the shape of a hard or horny covering. Their bodies appear half-divided into segments, generally three in number; the name of the sub-kingdom, indeed, means *jointed*, and, like the word *vertebrate*, comes from the Latin. Each of these segments, as a rule, bears two pairs of members, such as wings, legs, and feelers, or antennæ. No individual of this great sub-kingdom possesses less than six legs, while in some of them these useful members may be counted by the hundred. Crabs, spiders, insects, and worms are some of the classes into which the Articulata are divided.

The third place on our list is reserved for the *molluscs*. The Mollusca are soft-bodied animals, having no skeleton either exterior or interior, but, to protect their pulpy bodies from injury, they are generally provided with a shell. This shell may either be all in one piece, like that of the common snail, or it may consist of two valves opening by a hinge, as in the case of the clam or oyster. Some molluscs—the slugs, for instance—have no shell, or, at any rate, so very small a one that it serves no useful purpose, being a mere ornament upon the tip of the poor animal's tail. To this interesting sub-kingdom belong the voracious cuttle-fish and the beautiful nautilus, snails, and barnacles, and all those fresh and salt water animals which we designate *shell-fish*.

Keeping still to the water, we are introduced to the fourth great division, which bears the name of *Radiata*. The radiates are so called because, their mouths being in the centre of the body, all the other parts radiate from it like spokes from the nave of a wheel. None of the animals of this sub-kingdom attain a great size, yet, strange to say, islands of considerable magnitude owe their origin to one of the smaller classes into which it is divided. This class you will at once recognise as the coral insects, although they are not insects at all, but marine animals, possessing a name of their own, *polypes*, which is a Greek work, signifying "many-footed." Besides the polypes, we find in this division horny star-fishes, prickly sea-urchins, transparent jelly-fish, that melt away when taken out of the water, and many other curious tribes.

Finally, we arrive at the very outskirts of the animal kingdom, where the minute *protozoa* call for a farewell notice. The name Protozoa is improperly given to an animal sub-kingdom, being Greek, while all the others—Vertebrata, Articulata, Mollusca, and Radiata—are Latin; it means "first animals," since the creatures comprehended under it are the lowest in the scale of animal life, and show the point at which it may be said to commence. The protozoa are very small, by far the larger number of them being microscopical; they seem to have no organs, and to be mere masses of floating jelly. Sponges, and animalcules inhabiting water of all kinds, are the principal members of the last of the animal sub-kingdoms.

Typical forms of the five animal sub-kingdoms—

The animal kingdom is divided into

Sub-kingdoms.
1. Vertebrata.
2. Articulata.
3. Mollusca.
4. Radiata.
5. Protozoa.

VERTEBRATE ANIMALS.

The Vertebrated sub-kingdom, including the classes of mammals, (animals which suckle their young,) birds, reptiles, batrachians, (or amphibians, the frog family,) and fishes, is characterised by the presence, in all its members, of an internal skeleton composed of bone or cartilage, and forming an envelope to the nervous centres. In the Articulated classes, there is no vestige of any such structure; and the only mollusca (some of the cuttle-fish tribe) in which there is the least approach to it are sufficiently distinguished by other characters. It is true that among many of the Radiata—such as a few of the jelly-fish tribe and a large proportion of the polypes—there is an internal skeleton, sometimes composed of a horny or cartilaginous tissue, and sometimes possessing even a stony hardness; but this gives equal support to the whole fabric, and is not arranged in such a manner as to give the least degree of peculiar protection to the nervous centres; so that, although it may be fancifully regarded as a kind of sketch or shadowing forth in this lowest group of the plan of structure which is characteristic of the highest, it cannot be said to have any real correspondence with it.

The animals of the Vertebrated series are, of all sentient beings, those whose faculties are the most varied and the most perfect. The principle of the division of labour is carried out in them to its highest degree; every function to be performed having its own separate organ whose operations are limited to it alone; consequently, the Vertebrata are, of all animals, those in which the distinct organs are the most numerous and the most complicated. We may encounter many among the lower tribes in which the number of parts is as great or even greater; but where this is the case, most of these parts are but repetitions of one another. It is by the variety existing in the form and structure of their several organs, and in the perfection with which each is adapted to perform its allotted function, that the Vertebrata are chiefly characterised. It is manifest that the structure of such animals must be regarded as more elaborate than that of beings in which the number of dissimilar parts is small, and every one of them capable of discharging a variety of offices; and that their functions must be performed with more energy and completeness, when carried into effect by instruments peculiarly adapted to each, than when several are the result of the actions of one organ. Hence we are justified in ranking the Vertebrata as the highest group in the animal scale, independently of its being the one which contains Man. But we are not justified in speaking of the animals composing it as more perfectly constructed than any others; since, in the eye of the Creator, they must be all equally perfect. In every one, the adaptation between the actions of its several parts must be complete; or it could not maintain its existence. And it should not be less wonderful to us to meet in the zoophyte with a simple structure capable of performing all the functions of absorption, assimilation, respiration, and secretion, than to contemplate the numerous and elaborately constructed organs by which these several operations are respectively performed in the Vertebrated animal.

—CARPENTER.

Sub-kingdom Vertebrata.

1. Mammals are: *a.* Two-handed—Man; *b.* Four-handed—Monkeys; *c.* Wing-handed—Bats; *d.* Insect-eating—Moles, &c.; *e.* Flesh-eating—beasts of prey; *f.* Fish-like—Whales, &c.; *g.* Gnawing—Squirrel, Rat, &c.; *h.* Toothless—Sloth, &c.; *i.* Ruminating—Ox, Sheep, &c.; *k.* Thick-skinned—Elephant, Horse, Pig, &c.; *l.* Pouched—Opossum, Kangaroo, &c.
2. Birds are: *a.* Birds of prey—Eagle, Owl, &c.; *b.* Perchers—Song-birds, &c.; *c.* Climbers—Woodpecker, Parrot, &c.; *d.* Scratchers—Fowls; *e.* Waders—Bittern, &c.; *f.* Swimmers—Geese, &c.; *g.* Runners—Ostrich, &c.
3. Reptiles are: *a.* Turtles, &c.; *b.* Crocodiles; *c.* Lizards; *d.* Serpents.
4. Batrachians are: *a.* Frogs, &c.; *b.* Salamanders, &c.; *c.* Sirens; *d.* and *e.* Footless and Fishlike Batrachians.
5. Fishes are: *a.* Enamelled—Sturgeons, &c.; *b.* Cartilaginous—Sharks, &c.; *c.* Spiny—Perch, &c.; *d.* Soft-finned—Salmon, &c.

NATURE IN MOTION.

MAMMALIA.

THE Mammalia do not roam and rove so much as the lighter birds and favoured fishes; they are generally bound to certain localities, and, at all events, chained to the soil. Still we find among them also travellers, now driven forth by hunger, and now by an overwhelming number of beasts of prey, to seek new pastures and new dwelling-places. Others, again, follow man in his migrations over the globe, and thus spread from country to country. To the former belong the horses which now roam wild on the plains of South America, and travel at times thousands of miles. The wild asses, also, in the wilderness, "which stand up in the high places and snuff the wind like dragons," travel in bands of two or three hundred, and leave, in winter, the tropics for a still warmer region in the south of Africa. They are called "the Bushman's harvest," for the wild Bushman hunts and consumes what has been left by the royal lion and the hungry vulture, who follow them in their march, and feast upon them for a season. Gazelles and antelopes migrate in like manner; and even huge elephants are seen wandering in large herds over the boundless plains of Africa. The shaggy buffalo roams in vast numbers over the prairies of the American continent, and migrates at regular intervals from the north to the south, and from the plain to the mountain. Salt springs are with them the great centre of attraction; but generally their movements seem to be regulated by the state of their pastures. As soon as the fire has spread over a prairie, and is succeeded by a fine growth of tender grass, immense herds are sure to appear. How they discover that their table is spread we know not; it has been surmised that stragglers from the main body, who have wandered away when food became scarce, may first notice the new growth, and by some mysterious means communicate the good news to their hungry brethren. Monkeys also wander from land to land, when driven by hunger or fierce enemies; they have even been suspected of passing through a tunnel under the Straits of Gibraltar, from Africa to Europe. Their mode of crossing rivers is a beautiful evidence of their ingenuity and instinct. A powerful male seizes a branch that projects over the banks of the stream, and suspends himself by his prehensile tail; another takes hold of him, and so on until they have a row as long as the river is wide. Then they begin to swing the living chain, and continue until the impetus is powerful enough to enable the last one to take hold of a tree on the opposite shore. Over this strange bridge the whole host passes safely; as soon as they are across, the first monkey lets go his hold, the chain swings again, and so they all safely get over large rivers.

The so-called domestic animals travel exclusively by the agency of man and in his company. It is thus that the horse, a native of the rude steppes of Central Asia, which was not known in America before the arrival of the Spaniards, now roams over it in vast herds from Hudson Bay to Cape Horn. To man we owe it that the goat climbs our rocky mountains, and white, woolly sheep graze on scanty mountain-sides, whilst the heavier, slower cattle fatten on rich low grounds, and remind us, in the far backwoods, by the sweet harmonies of their bells, of the neighbourhood of men. But here, also, the weeds have come with the good plants. Thus the domestic rat, a native of the Old World, was carried in ships to the Cape, to Mauritius and Bourbon, to the Antilles and Bermuda. An Antwerp ship brought them in 1544 first to America, where they astonished the good Peruvians so much that they obtained with them the name of "things that came out of the sea." Now they are rarer in Europe than in America.

The importance of the useful domestic animals cannot be overrated. The very existence of man is bound up with the horse, the ox, and the sheep. Brazil lives almost exclusively by means of her horses and her cattle; and Australia has developed her resources and progressed in civilisation only since sheep have been introduced. It is strange, surely, that like all the best gifts in the vegetable world, (the cerealia,) so these domestic animals also are presents which the East has sent to the West, and for which no return has been made. Here, also, an invisible but insurmountable barrier seems to prevent such an exchange.

—*Putnam's Magazine.*

FROM "WINDSOR FOREST."

SEE from the brake the whirring pheasant springs,
And mounts exulting on triumphant wings:
Short is his joy, he feels the fiery wound,
Flutters in blood, and, panting, beats the ground.
Ah! what avail his glossy, varying dyes,
His purple crest, and scarlet-circled eyes,
The vivid green his shining plumes unfold,
His painted wings, and breast that flames with gold?
  Nor yet, when moist Arcturus clouds the sky,
The woods and fields their pleasing toils deny.
To plains with well-breathed beagles we repair
And trace the mazes of the circling hare:
(Beasts, urged by us, their fellow beasts pursue,
And learn of man each other to undo,)
With slaughtering guns the unwearied fowler roves,
When frosts have whitened all the naked groves;
Where doves in flocks the leafless trees o'ershade,
And lonely woodcocks haunt the watery glade,
He lifts the tube and levels with his eye;
Straight a short thunder breaks the frozen sky:
Oft, as in airy rings they skim the heath,
The clamorous lapwings feel the leaden death:

Oft as the mounting larks their notes prepare,
They fall and leave their little lives in air.
In genial spring beneath the quivering shade,
Where cooling vapours breathe along the mead,
The patient fisher takes his silent stand,
Intent, his angle trembling in his hand;
With looks unmoved he hopes the scaly breed
And eyes the dancing cork and bending reed.
Our plenteous streams a various race supply,
The bright-eyed perch with fins of Tyrian dye,
The silver eel in shining volumes roll'd,
The yellow carp in scales bedropp'd with gold,
Swift trouts diversified with crimson stains,
And pikes, the tyrants of the watery plains.
Now Cancer glows with Phœbus' fiery car:
The youth rush eager to the silvan war,
Swarm o'er the lawns, the forest walks surround,
Rouse the fleet hart and cheer the opening hound.
The impatient courser pants in every vein,
And, pawing, seems to beat the distant plain:
Hills, vales, and floods appear already crossed,
And ere he starts, a thousand steps are lost.
See the bold youth strain up the threatening steep,
Rush through the thickets, down the valleys sweep,
Hang o'er their coursers' heads with eager speed,
And earth rolls back beneath the flying steed.
Let old Arcadia boast her ample plain,
The immortal huntress and her virgin train;
Nor envy, Windsor, since thy shades have seen
As bright a goddess and as chaste a queen;
Whose care, like hers, protects the silvan reign,
The earth's fair light, and empress of the main.

—Pope.

AN ELEPHANT HUNT.

We entered a most beautiful valley, abounding in large game. Finding a buffalo lying down, I went to secure him for our food. Three balls did not kill him, and, as he turned round as if for a charge, we ran for the shelter of some rocks. Before we gained them we found that three elephants, probably attracted by the strange noise, had cut off our retreat on that side; they, however, turned short off, and allowed us to gain the rocks. We then saw that the buffalo was moving off quite briskly, and, in order not to be entirely baulked, I tried a long shot at the last of the elephants, and, to the great joy of my people, broke his fore leg. The young men soon brought him to a stand, and one shot in the brain despatched him. I was right glad to see the joy manifested at such an abundant supply of meat.

On the following day, while my men were cutting up the elephant, great numbers of the villagers came to enjoy the feast. We were on the side of a fine green valley, studded here and there with trees, and traversed by numerous rivulets. I had retired from the noise to take an observation among some rocks of laminated grit, when I beheld an elephant and her calf at the end of the valley, about two miles distant. The calf was rolling in the mud, and the dam was standing fanning herself with her great ears. As I looked at them through my glass, I saw a long string of my own men appearing on the other side of them, and Sekwebu came and told me that these had gone off saying, "Our father will see to day what sort of men he has got." I then went higher up the side of the valley, in order to have a distinct view of their mode of hunting. The goodly beast, totally unconscious of the approach of an enemy, stood for some time suckling her young one, which seemed about two years old; they then went into a pit containing mud, and smeared themselves all over with it, the little one frisking about his dam, flapping his ears and tossing his trunk incessantly, in elephantine fashion. She kept flapping her ears and wagging her tail as if in the height of enjoyment. Then began the piping of her enemies, which was performed by blowing into a tube, or into the closed hands, as boys do into a key. They called out to attract the animal's attention. "O chief! chief! we have come to kill you. O chief! chief! many more will die besides you. The gods have said it," &c., &c. Both animals expanded their ears and listened, then left their bath as the crowd rushed toward them. The little one ran toward the end of the valley, but, seeing the men there, returned to his dam. She placed herself on the danger side of her calf, and passed her proboscis over it again and again, as if to assure it of safety. She frequently looked back to the men, who kept up an incessant shouting, singing, and piping; then looked at her young one and ran after it sometimes sideways, as if her feelings were divided between anxiety to protect her offspring, and desire to punish the temerity of her persecutors. The men kept about a hundred yards in her rear, and some distance from her flanks, and continued thus until she was obliged to cross a rivulet. The time spent in descending and getting up the opposite bank allowed of their coming up to the edge, and discharging their spears at about twenty yards' distance. After the first discharge she appeared with her sides red with blood, and, beginning to flee for her own life, seemed to think no more of her young.

I had previously sent off Sekwebu with orders to spare the calf. It ran very fast, but neither young nor old ever enter into a gallop; their quickest pace is only a sharp walk. Before Sekwebu could reach them, the calf had taken refuge in the water, and was killed. The pace of the dam gradually became slower. She turned with a shriek of rage, and made a furious charge back among the men. They vanished at right angles to her course, or sideways; and as she ran straight on, she went through the whole party without coming near any one, except a man who wore a piece of cloth on his shoulders. Bright clothing is always dangerous in these cases. She charged three or four times, and, except in the first instance, never went farther than a hundred yards. She often stood after she had crossed a rivulet, and faced the men only to receive more spears. It was by this process of spearing and loss of blood that she was killed; for at last, making a short charge, she staggered round, and sank down dead in a kneeling posture. I turned from the spectacle of the destruction of noble animals, which might be made so useful in Africa, with a feeling of sickness; and it was not relieved by the recollection that the ivory was mine, though such was the case. I regretted to see them killed, and more especially the young one, the meat not being at all necessary at that time; but it is right to add that I did not feel sick when my own blood was up the day before.

—Dr Livingstone.

CLOTHING FROM ANIMALS—FUR, WOOL, SILK, LEATHER.

In the hide of an animal, the hair and skin are two entirely distinct things, and must be considered separately as materials for clothing. The hair of quadrupeds differs much in fineness. It is chiefly the smaller species which are provided with those soft, thick, glossy coverings that bear the name of *fur*, and they are found in the greatest perfection where they are most wanted, that is, in the coldest countries. They form indeed the riches of those dreary wastes which produce nothing else for human use. The animals most esteemed for their fur are of the weasel kind: the glutton, the marten, the sable, and the ermine. Fur is used either growing to the skin, or separated from it. In its detached state, it is usually employed in making a stuff called *felt*. The scales of hair are so disposed, that they make no resistance to the finger drawn along the hair from the root to the point, but cause a roughness and resistance in a contrary direction. From this property, hairs, when beaten or pressed together, are disposed to twist round each other, and thus to cohere into a mass. It is in the manufacture of hats that felting is chiefly practised; and the fur used for this purpose is that of the beaver, the rabbit, and the hare.

Wool differs from common hair in being more soft and supple, and more disposed to curl. These properties it owes to a degree of unctuosity, or greasiness, which is with difficulty separated from it. The whole wool, as taken from the animal's body, is called a *fleece*. The first operation this undergoes is that of picking and sorting into the different kinds of wool of which it is composed. These are next cleansed from marks and stains, and freed from their offensive greasiness. The wool is then delivered to the wool-comber, who, by means of iron-spiked combs, draws out the fibres, smooths and straightens them, separates the refuse, and brings it into a state fit for the spinner. The spinner forms the wool into threads, which are more or less twisted, according to the manufacture for which they are designed; the more twisted forming *worsted*, the looser *yarn*.

The kinds of stuffs made wholly or partly of wool are extremely various; and Great Britain produces more of them, and in general of better quality, than any other country. A more perfect manufacture than our broad cloths, with respect to beauty and utility, cannot easily be conceived. The threads in it are so concealed by a fine nap or down raised on the surface, and curiously smoothed and glossed, that it looks more like a rich texture of nature's forming, than the work of the weaver. Wool, in common with other animal substances, takes a dye better than any vegetable matters. Our cloths are therefore made of every hue that can be desired; but, in order to fit them for the dyer, they are first freed from all greasiness and foulness by the operation of *fulling*, in which the cloths are beaten by heavy mallets as they lie in water, with which a quantity of fuller's earth has been mixed. This earth unites with the greasy matter, and renders it soluble in water; so that, by continually supplying fresh streams while the beating is going on, all the foulness is at length carried off. The operation of fulling has the farther effect of thickening the cloth, and rendering it more firm and compact, by mixing the threads with each other, something in the manner of a felt. The cloths of inferior fineness are mostly called narrow cloths. Some of those used for greatcoats, by their substance and shagginess, resemble the original fleece, or rather the fur of a bear, and render unnecessary the use of furred garments. Indeed, with the single material of wool, art has been able much better to suit the different wants of man in his clothing, than can be done by all the productions of nature. What could be so comfortable for our beds as blankets? What so warm and at the same time so light, for pained and palsied limbs, as flannel? The several kinds of the worsted manufacture are excellent for that elasticity which makes them sit close to a part without impeding its motions. This quality is particularly observable in stockings made of worsted. Even the thinnest of the woollen fabrics possess a considerable degree of warmth, as appears in shawls. The real shawls are made of the fine wool of Thibet, in the eastern part of Asia; but they have been well imitated by the product of some of our English looms. A very different article made of wool, yet equally appropriated to luxury, is carpeting. Upon the whole, Dyer's praise of wool seems to have a just foundation:—

> "Still shall o'er all prevail the shepherd's stores,
> For numerous uses known: none yield such warmth,
> Such beauteous hues receive, so long endure:
> So pliant to the loom, so various,—none."

Men must have been far advanced in the observation of nature before they found out a material for clothing in the labours of a caterpillar. China appears to have been the first country to make use of the web spun by the *silkworm*. This creature, which, in its perfect state, is a kind of moth, is hatched from the egg, in the form

EGGS—COCOON—CHRYSALIS—CATERPILLAR.

of a caterpillar, and passes from that state successively to those of a chrysalis, and of a winged insect. While a caterpillar, it eats voraciously, its proper and favourite food being the leaves of the different species of mulberry. By this diet it is not only nourished, but is enabled to lay up, in receptacles within its body formed for the purpose, a kind of transparent glue, which has the property of hardening as soon as it comes into the air. When arrived at full maturity, it spins itself a web out of this gluey matter, within which it is to lie safe and concealed during its transformation into the helpless and motionless state of a chrysalis.

The silkworm's web is an oval ball, called a cocoon, of a hue varying from light straw colour to full yellow, and consisting of a single thread wound round and round, so as to make a close and impenetrable covering. The thread is so very fine, that, when unravelled, it has been measured to 700 or 1000 feet, all rolled within the compass of a pigeon's egg. In a state of nature, the silkworm makes its cocoon upon the mulberry tree itself, where it shines like a golden fruit among the leaves; and in the southern parts of China, and other warm countries of the East, it is still suffered to do so, the cocoons being gathered from the trees without farther trouble. But, in even the warmest climates of Europe, the inclemencies of the weather in spring, when the worms are hatched, will not permit the rearing them in the open air. They are kept, therefore, in warm but airy rooms, constructed for the purpose; and are regularly fed with mulberry-leaves till the period of their full growth.

As this tree is one of the latest in leafing, silkworms cannot advantageously be reared in cold climates. During their growth, they several times shed their skins, and many die under this operation. At length they become so full of the silky matter, that it gives them a yellowish tinge, and they cease to eat. Twigs are then presented to them upon little stages of wicker-work, on which they immediately begin to form their webs. When the cocoons are finished, a small number, reserved for breeding, are suffered to eat their way out in their butterfly state; the rest are killed in the chrysalis state, by exposing the cocoons to the heat of an oven.

The next business is to wind off the silk. After separating a downy matter from the outside of the cocoons, called *floss*, they are thrown into warm water; and the ends of the threads being found, several are joined together, and wound in a single one, upon a reel. This is the silk in its natural state, called *raw silk*. It next undergoes some operations to cleanse and render it more supple; after which it is made into what is called *organzine*, or *thrown silk*, being twisted into thread of such different degrees of fineness as are wanted in the different manufactures. This is done in the large way by mills of curious construction, which turn at once a vast number of spindles, and perform at the same time the processes of unwinding, twisting, reeling, &c. The largest and most complicated machine for this purpose, in England, is at Derby, the model of which was clandestinely brought from Italy, where all the branches of the silk manufacture have long flourished.

The excellence of silk, as a material for clothing, consists in its strength, lightness, lustre, and readiness in taking dyes. When little known in Europe, it was highly prized for its rarity; it is now esteemed for its real beauty and other valuable qualities. As it can never be produced in great abundance, it must always be a dear article of clothing. The fabrics of silk are very numerous, and almost all devoted to the purposes of show and luxury. In thickness they vary from the finest gauze to velvet, the pile of which renders it as close and warm as a fur. Some of the most beautiful of the silk manufactures are the glossy satin; the elegant damask, of which the flowers are of the same hue with the piece, and only show themselves from the difference of shade; the rich brocade, in which flowers of natural colours, or of gold and silver thread, are interwoven; and the infinitely varied ribands. It is also a common material for stockings, gloves, buttons, strings, &c., in which its durability almost compensates for its dearness. Much is used for the purpose of sewing, no other thread approaching it in strength.

Silk, in short, bears the same superiority among clothing materials that gold does among metals; it gives an appearance of richness wherever it is employed, and confers a real value. Even the refuse of silk is carefully collected, and serves for useful purposes. The down about the cocoons, and the waste separated in the operations raw silk undergoes, are spun into a coarser thread, of which very serviceable stockings are made; and the interior part of the cocoon is reckoned to be the best material for making artificial flowers.

Whilst the covering of the skins of animals thus affords a valuable material for clothing, the skin itself is not less useful. It requires, however, greater previous preparation. It is necessary to impregnate it with a matter capable of preserving it from putrefaction, and at the same time to keep it in a state of flexibility and suppleness. When this is effected, skin becomes *leather*,—a substance of the highest utility, as well in clothing as for numerous other purposes. The principal operation in the preparation of leather is called *tanning*.

The hide, taken off with due care by the skinner, is first thrown into a pit with water alone, in order to free it from dirt. After lying a day or two, it is placed upon a solid half-cylinder of stone, called a *beam*, where it is cleared of any adhering fat or flesh. It is then put into a pit containing a mixture of lime and water, in which it is kept about a fortnight. The intent of this is to swell and thicken the hide, and to loosen the hair. Being now replaced upon the beam, the hair is scaped off, and it is next committed to the *mastering-pit*. The contents of this are some animal dung (pigeons' is preferred) and water; and its operation is to reduce that thickening which the lime had given. After this is effected, it is again cleansed on the beam, and is then put into the proper tanning liquor, called the *ooze*, which is an infusion of coarsely-powdered oak-bark in water. The bark of the oak, as well as every other part of it, abounds in a strongly astringent matter; and it is the thorough impregnation with this which preserves the hide from decay or putrefaction. When at length it is thought to have imbibed enough of the astringent matter, the hide is taken out and hung upon a pole to drain, after which it is put upon a piece of wood with a convex surface, called a *horse*, on which it is stretched and kept smooth and even. Finally, it is taken to the *drying-house*, a covered building with apertures for the free admission of air; and it is there hung up till it becomes completely dry; and thus the process of tanning is finished.

From the tanner the hide or skin is consigned to the *currier*, whose art is farther necessary in order to make it perfect leather. He first soaks it thoroughly in water, and then places it upon a *beam*, made of hard wood, with one side sloping and polished. He lays it with the grain-side, or that on which the hair grew, inwards, and the flesh-side outwards. He then, with a broad two-edged knife, having a handle at each end, shaves or pares the hide on the latter side, till all its inequalities are removed, and it is reduced to the degree of thinness required for use. After this operation it is again put into water, then scoured and rubbed with a polished stone. It is next besmeared with a kind of oil procured from sheep or deer-skin, or made by boiling train-oil and tallow together, with a view to soften or supple it. A great part of its moisture is then evaporated by hanging it up in a drying-house for some days; and it is farther dried by exposure to the sun, or to the heat of a stove. It is then differently treated, according as it is meant to be blacked or stained, or not. Without entering into minute particulars, it is enough to observe, that the astringent principle with which the leather has been impregnated in the tanning renders nothing necessary except the application of a solution of vitriol of iron, at once to strike a good black. This is laid on with a brush, generally on the grain-side of the leather; and it afterwards undergoes the operation of giving it that roughness which is called the *grain*. This is performed by rubbing it in all directions with a fluted board. When leather is blackened on the flesh-side, the colour is given by a mixture of lampblack and oil.

It is in the manner above described that leather is prepared for the making of shoes and boots, which is one of the principal uses of this material; and certainly no other substance could so well unite strength and suppleness with the property of keeping out water. The hides principally used in the shoe-manufacture are those of neat-cattle; or the ox-kind. For the more delicate work, the skins of the goat, dog, seal, and some other animals, are employed.

—Dr Aikin.

THE PIED PIPER OF HAMELIN.

I.

Hamelin town's in Brunswick,
By famous Hanover city;
The river Weser, deep and wide,
Washes its wall on the southern side,
A pleasanter spot you never spied;
But when begins my ditty,
Almost five hundred years ago,
To see the townsfolk suffer so,
From vermin, was a pity.
Rats!

II.

They fought the dogs, and killed the cats,
And bit the babies in the cradles,
And ate the cheeses out of the vats,
And licked the soup from the cook's own ladles,
Split open the kegs of salted sprats,
Made nests inside men's Sunday hats,
And even spoiled the women's chats,
By drowning their speaking
With shrieking and squeaking,
In fifty different sharps and flats.

III.

At last the people, in a body,
To the Town Hall came flocking:
"'Tis clear," cried they, "our Mayor's a noddy;
And as for our corporation,—shocking
To think we buy gowns lined with ermine
For dolts that don't or won't determine
What's best to rid us of our vermin!
You hope, because you're old and obese,
To find in the furry civic robe ease?
Rouse up, sirs! give your brains a racking,
To find the remedy we're lacking;
Or, sure as fate, we'll send you packing!"
At this the Mayor and Corporation
Quaked with a mighty consternation.

IV.

An hour they sat in council.
At length the Mayor broke silence:
"For a guilder I'd my ermine gown sell;
I wish I were a mile hence!
It's easy to bid one rack one's brain.
I'm sure my poor head aches again,
I've scratched it so, and all in vain.
Oh for a trap, a trap, a trap!"
Just as he said this, what should hap,
At the chamber-door, but a gentle tap?
"Bless us," cried the Mayor, "what's that?"
(With the Corporation as he sat,
Looking little, though wondrous fat;
Nor brighter was his eye, nor moister
Than a too-long-opened oyster,
Save when at noon his paunch grew mutinous,
For a plate of turtle green and glutinous,)
"Only a scraping of shoes on the mat?
Anything like the sound of a rat
Makes my heart go pit-a-pat!"

V.

"Come in!" the Mayor cried, looking bigger:
And in did come the strangest figure.
His queer long coat from heel to head,
Was half of yellow, and half of red;
And he himself was tall and thin,
With sharp blue eyes, each like a pin;
And light loose hair, yet swarthy skin;
No tuft on cheek, nor beard on chin,
But lips where smiles went out and in.
There was no guessing his kith and kin!
And nobody could enough admire
The tall man and his quaint attire.
Quoth one: "It's as my great-grandsire,
Starting up at the trump of doom's tone,
Had walked this way from his painted tombstone."

VI.

He advanced to the council table:
And, "Please your honours," said he, "I'm able,

By means of a secret charm, to draw
  All creatures living beneath the sun,
  That creep, or swim, or fly, or run,
After me, so as you never saw!
And I chiefly use my charm
On creatures that do people harm:
The mole, and toad, and newt, and viper;
And people call me the Pied Piper."
(And here they noticed round his neck
  A scarf of red and yellow stripe,
To match with his coat of the self-same check;
  And at the scarf's end hung a pipe.
And his fingers, they noticed, were ever straying,
As if impatient to be playing
Upon this pipe, as low it dangled
Over his vesture so old-fangled.)
"Yet," said he, "poor piper as I am,
  In Tartary I freed the Cham,
Last June, from his huge swarms of gnats;
  I eased in Asia the Nizam
Of a monstrous brood of vampire bats;
  And as for what your brain bewilders,
If I can rid your town of rats,
  Will you give me a thousand guilders?"
"One? fifty thousand!"—was the exclamation
Of the astonished Mayor and Corporation.

VII.

Into the street the Piper stept,
  Smiling first a little smile,
As if he knew what magic slept
  In his quiet pipe the while;
Then, like a musical adept,
  To blow the pipe his lips he wrinkled,
  And green and blue his sharp eyes twinkled,
  Like a candle-flame where salt is sprinkled;
And ere three shrill notes the pipe uttered,
You heard as if an army muttered;
And the muttering grew to grumbling;
And the grumbling grew to a mighty rumbling;
And out of the houses the rats came tumbling.

Great rats, small rats, lean rats, brawny rats,
Brown rats, black rats, gray rats, tawny rats,
Grave old plodders, gay young friskers,
  Fathers, mothers, uncles, cousins,
Cocking tails and pricking whiskers;
  Families by tens and dozens,
Brothers, sisters, husbands, wives,
Followed the Piper for their lives.
From street to street he piped advancing,
And step for step they followed dancing,
Until they came to the river Weser,
  Wherein all plunged and perished;
Save one, who, stout as Julius Cæsar,
  Swam across, and lived to carry
(As he the manuscript he cherished)
  To Rat-land home his commentary,
Which was, "At the first shrill notes of the pipe,
I heard a sound as of scraping tripe,
And putting apples, wondrous ripe,
Into a cider-press's gripe:
And a moving away of pickle-tub-boards,
And a leaving ajar of conserve cupboards,
And a drawing the corks of train-oil flasks,
And a breaking the hoops of butter casks;
And it seemed as if a voice
  (Sweeter far than by harp or by psaltery
Is breathed) called out, O rats, rejoice!
  The world is grown to one vast drysaltery!
So munch on, crunch on, take your nuncion,
Breakfast, supper, dinner, luncheon!
And just as a bulky sugar puncheon,
All ready staved, like a great sun shone
Glorious, scarce an inch before me,
Just as, methought, it said, 'Come, bore me!'
I found the Weser rolling o'er me."

VIII.

You should have heard the Hamelin people
Ringing the bells till they rock'd the steeple:
  "Go," cried the Mayor, "and get long poles!
  Poke out the nests, and block up the holes!

Consult with carpenters and builders,
And leave in our town not even a trace
Of the rats!" When suddenly up the face
Of the Piper perked in the market-place,
With a "First, if you please, my thousand guilders!"

IX.

A thousand guilders! The Mayor looked blue;
So did the Corporation, too.
For Council dinners made rare havoc
With claret, moselle, vin-de-grave, hock;
And half the money would replenish
Their cellar's biggest butt with Rhenish.
To pay this sum to a wandering fellow
With a gipsy coat of red and yellow!
"Beside," quoth the Mayor, with a knowing wink,
"Our business was done at the river's brink;
We saw with our eyes the vermin sink,
And what 's dead can't come to life, I think.
So, friend, we 're not the folks to shrink
From the duty of giving you something to drink,
And a matter of money to put in your poke;
But as for the guilders, what we spoke
Of them, as you very well know, was in joke.
Besides our losses have made us thrifty:
A thousand guilders! Come, take fifty!"

X.

The Piper's face fell, and he cried,
"No trifling! I can't wait, beside!
I 've promised to visit by dinner-time
Bagdad, and accept the prime
Of the head-cook's pottage, all he 's rich in,
For having left, in the Caliph's kitchen,
Of a nest of scorpions no survivor.
With him I proved no bargain driver—
With you, don't think I 'll bate a stiver!
And folks who put me in a passion
May find me pipe to another fashion."

XI.

"How!" cried the Mayor, "d'ye think I'll brook
Being worse treated than a cook?
Insulted by a lazy ribald,
With idle pipe and vesture piebald?
You threaten us, fellow? Do your worst—
Blow your pipe there till you burst!"

XII.

Once more he stepped into the street;
And to his lips again
Laid his long pipe of smooth straight cane;
And ere he blew three notes (such sweet,
Soft notes as yet musician's cunning
Never gave the enraptured air)
There was a rustling, that seemed like a bustling
Of merry crowds justling, at pitching and hustling;
Small feet were pattering, wooden shoes clattering,
Little hands clapping, and little tongues chattering,
And like fowls in a farm-yard when barley is scattering,
Out came the children running.
All the little boys and girls,
With rosy cheeks and flaxen curls,
And sparkling eyes and teeth like pearls,
Tripping and skipping, ran merrily after
The wonderful music, with shouting and laughter.

XIII.

The Mayor was dumb, and the Council stood
As if they were changed into blocks of wood,
Unable to move a step, or cry
To the children merrily skipping by;
And could only follow with the eye
That joyous crowd at the Piper's back.
But how the Mayor was on the rack,
And the wretched Council's bosoms beat,
As the Piper turned from the High Street
To where the Weser rolled its waters
Right in the way of their sons and daughters!
However he turned from south to west,
And to Koppelberg hill his steps addressed,

And after him the children pressed:
Great was the joy in every breast.
"He never can cross that mighty top!
He's forced to let the piping drop,
And we shall see our children stop!"
When, lo! as they reached the mountain's side,
A wondrous portal opened wide,
As if a cavern was suddenly hollowed!
And the Piper advanced, and the children followed.
And when all were in to the very last,
The door in the mountain-side shut fast.
Did I say all? No! one was lame,
And could not dance the whole of the way;
And in after years, if you would blame
His sadness, he was used to say:
"It's dull in our town since my playmates left;
I can't forget that I'm bereft
Of all the pleasant sights they see,
Which the Piper also promised me;
For he led us, he said, to a joyous land,
Joining the town, and just at hand,
Where waters gushed and fruit-trees grew,
And flowers put forth a fairer hue,
And everything was strange and new:
The sparrows were brighter than peacocks here,
And their dogs outran our fallow-deer,
And honey-bees had lost their stings,
And horses were born with eagles' wings;
And just as I became assured
My lame foot would be speedily cured,
The music stopped, and I stood still,
And found myself outside the hill,
Left alone against my will,
To go on limping as before,
And never hear of that country more!"

XIV.

Alas, alas! for Hamelin!
There came into many a burgher's pate
A text which says that heaven's gate
Opes to the rich at as easy rate

As the needle's eye takes a camel in!
The Mayor sent east, west, north, and south,
To offer the Piper by word or mouth,
   Wherever it was men's lot to find him,
Silver and gold to his heart's content,
If he'd only return the way he went,
   And bring the children behind him.
But when they saw 'twas a lost endeavour,
And piper and dancers were gone for ever,
They made a decree that lawyers never
   Should think their records dated duly,
If, after the day of the month and year,
These words did not as well appear:
   "And so long after what happened here
   On the twenty-second of *July*,
   Thirteen hundred and seventy-six:"
And the better in memory to fix
The place of the children's last retreat,
They called it the Pied Piper's Street—
Where any one playing on pipe or tabor
Was sure for the future to lose his labour.
Nor suffered they hostelry or tavern
   To shock with mirth a street so solemn;
But opposite the place of the cavern
   They wrote the story on a column;
And on the great church window painted
The same to make the world acquainted
How their children were stolen away;
And there it stands to this very day.
And I must not omit to say
That in Transylvania there's a tribe
Of alien people, that ascribe
The outlandish ways and dress,
On which their neighbours lay such stress,
To their fathers and mothers having risen
Out of some subterraneous prison,
Into which they were trepanned
Long time ago, in a mighty band,
Out of Hamelin town in Brunswick land,
But how or why they don't understand.

XV.

So, Willy, let you and me be wipers
Of scores out with all men—especially pipers;
And whether they pipe us free from rats or from mice,
If we've promised them aught, let us keep our promise.
—ROBERT BROWNING.

THE PASSENGER PIGEON.

ONE of their curious roosting places on the banks of the Green River in Kentucky I repeatedly visited. It was, as is always the case, a portion of the forest where the trees are of great magnitude, and where there was little underwood. I rode through it upwards of forty miles, and found its average breadth to be rather more than three miles. My first view of it was about a fortnight subsequent to the period when they had made choice of it, and I arrived there nearly two hours before sunset.

Few pigeons were then to be seen, but a great number of persons with horses and waggons, guns and ammunition, had already established encampments on the borders. Two farmers from the vicinity of Russelsville, distant more than a hundred miles, had driven upwards of three hundred hogs to be fattened on the pigeons that were to be slaughtered. Here and there the people employed in plucking and salting what had already been procured, were seen sitting in the midst of large piles of these birds. Many trees, two feet in diameter I observed, were broken off at no great distance from the ground; and the branches of many of the largest and tallest had given way, as if the forest had been swept by a tornado. Everything proved to me that the number of birds resorting to this part of the forest must be immense beyond conception. As the period of their arrival approached, their foes anxiously prepared to receive them; some were furnished with iron pots containing sulphur—others with torches of pine-knots,—many with poles, and the rest with guns. The sun was lost to our view, yet not a pigeon had arrived. Everything was ready, and all eyes were gazing on the clear sky which appeared in glimpses amidst the tall trees.

Suddenly there burst forth a general cry, "Here they come."

The noise which they made, though yet distant, reminded me of a hard gale at sea, passing through the rigging of a close reefed vessel. As the birds arrived and passed over me, I felt a current of air that surprised me. Thousands were soon knocked down by the pole-men; the birds continued to pour in; the fires were lighted, and a most magnificent as well as wonderful and almost terrifying sight presented itself. The pigeons, arriving by thousands, alighted everywhere, one above another, until solid masses as large as hogsheads were formed on the branches all round. Here and there the perches gave way with a crash, and, falling on the ground, destroyed hundreds of the birds beneath, forcing down the dense groups with which every stick was loaded.

It was a scene of uproar and confusion; no one dared venture within the line of devastation; the hogs had been penned up in due time, the picking up of the dead and wounded being left for next morning's employment. The pigeons were constantly coming, and it was past midnight before I perceived a decrease in the number of those that arrived. Toward the approach of day, the noise in some measure subsided; long before objects were distinguishable, the pigeons began to move off in a direction quite different from that in which they had arrived the evening before, and at sunrise all that were able to fly had disappeared. The howlings of the wolves now reached our ears, and the foxes, lynxes, cougars, bears, racoons, and opossums were seen sneaking off, whilst eagles and hawks of different species, accompanied by a crowd of vultures, came to supplant them, and enjoy their share of the spoil.

—Audubon.

TO A WATERFOWL.

Whither, midst falling dew,
While glow the heavens with the last steps of day,
Far through their rosy depths dost thou pursue
Thy solitary way?

Vainly the fowler's eye
Might mark thy distant flight to do thee wrong,
As, darkly painted on the crimson sky,
Thy figure floats along.

Seek'st thou the plashy brink
Of weedy lake, or marge of river wide,
Or where the rocking billows rise and sink
On the chafed ocean-side?

There is a power whose care
Teaches thy way along that pathless coast,—
The desert and illimitable air,—
Lone wandering, but not lost.

All day thy wings have fanned,
At that far height, the cold, thin atmosphere:
Yet stoop not, weary, to the welcome land,
Though the dark night is near.

And soon that toil shall end;
So shalt thou find a summer home, and rest,
And scream among thy fellows; reeds shall bend
Soon o'er thy sheltered nest.

Thou 'rt gone;—the abyss of heaven
Hath swallowed up thy form: yet on my heart
Deeply hath sunk the lesson thou hast given,
And shall not soon depart.

He, who from zone to zone,
Guides through the boundless sky thy certain flight,
In the long way that I must tread alone,
Will lead my steps aright.

—Bryant.

THE CHEQUERED SNAKE.

Charles. There is a snake crossing the road. Are there many species of snakes found in this country?

Father. I have never seen any but this species, the common chequered snake, but it is possible there may be more.*

C. Is it venomous?

F. No, perfectly harmless; as I have proved by examining the mouth: all venomous serpents have two or more large curved fangs in the upper jaw, which are wanting in harmless ones. "In general it may be said that innocent serpents have four rows of teeth in the upper jaw; two on the palate, and one on each side; but that poisonous serpents have no other outward or side-teeth but the fangs." When attacked, this snake, like many other harmless kinds, rears itself up in a threatening attitude, dilates its body, brightens its colours, and darts in and out and vibrates its red, forked tongue: this organ, called by the vulgar, "its sting," and supposed to be the weapon of offence, is considered an undoubted token of its venomous nature. But in reality, all these motions are but menaces; there is no power to do hurt, though they no doubt often serve as a protection. In common with the whole serpent race, it is the object of universal enmity: every person seems to consider it a sort of duty to kill snakes whenever they can be met with, perhaps in consequence of the curse entailed on the serpent that beguiled Eve.

C. The snake becomes torpid during winter, I believe.

*** More than possible; over twelve species are found in many parts of Canada.**

F. Yes; it conceals itself in the fall, in some convenient spot, such as under logs, often in heaps of stones, and sometimes, I have reason to think, in the earth; for in ploughing late in the autumn, I once turned up a chequered snake; it was inert and dull, but not torpid.

C. At what period of the year does it cast its skin?

F. I believe that is the first operation performed, after its revivification in spring, and before it leaves its winter concealment. An intelligent neighbour informed me that once in turning over a heap of stones early in spring, before the snow had all disappeared, he discovered a snake in the very act of sloughing its skin; the skin was stripped off from the head to about the middle of the body; the displaced part lay around it in close folds or wrinkles; even the eyes were skinned. If I recollect aright, in Bingley's "Animal Biography," it is intimated that the snake crawls among the stalks of plants, in order that the skin may be rubbed off by friction, and that it is turned inside out, as we draw off a stocking. My neighbour's account appears far more probable; besides, it is supported by analogy, for it is exactly the mode in which all caterpillars slough their skins, as I have many times witnessed. The food of the snake is frogs, toads, lizards, and probably insects. I once killed a snake which I found in the field, (supposing then that it was poisonous,) by dashing it against the ground; and something protruded which I supposed was its bowels, but on examination, I found it to be the pretty olive-spotted frog, with an orange-coloured belly; it, too, was torn, but whether this was done by the snake, or by the shock against the ground, I don't know; I suspect the latter, and that it had been swallowed whole, and probably alive. A friend of mine informed me that he once saw a snake of unusually large size, and determined to kill and open it, which he accordingly did, and found a very large green frog, which was dead of course, but unbroken. It seems impossible that so slender an animal as a snake can swallow or contain so large a creature as a frog, but the jaws, throat, and body, are capable of prodigious distension.

C. I have read that the sloughs of snakes are an object of superstition with some Indian tribes, and are used in their pretended magical rites.

F. They are also an indispensable article in the nests of some birds; perhaps from their softness, as they are extremely thin and smooth.

—GOSSE's *Canadian Naturalist.*

THE TAIL OF A TADPOLE.

A BLADE of grass is a world of mystery, "would men observingly distil it out." When my erudite friend, Dr Syntax, glancing round my workroom, arrested his contemptuous eye on a vase abounding in tadpoles, and asked me with a sniffing superiority: "Do you really mean to say you find any interest in these little beasts?" I energetically answered, "As much as you find in books." "Hem," grunted Syntax.

"Very absurd, isn't it? But we have all our hobbies. I can pass a bookstall, on which I perceive that the ignorance of the bookseller permits him to exhibit an edition of Persius among the rubbish at 'one shilling each.' The sight gives me no thrill—it does not even slacken my rapid pace. But I can't so easily pass a pond in which I see a shoal of tadpoles swimming about, as ignorant of their own value as the bookseller is of Persius. I may walk on, but the sight has sent a slight electric shock through me. Why, sir, there is more to me in the tail of one of those tadpoles than in all the poems of that obscure and dreary Persius. But I won't thrash your Jew unless you thrash mine."

"Why, what on earth can you do with the tail?"

"Do with it? Study it—experiment on it—put it under the microscope, and day by day watch the growth of its various parts. At first it is little but a mass of cells. Then I observe some of these cells assuming a well-known shape, and forming rudimentary blood-vessels. I also observe some other cells changing into blood-cells. Then the trace of muscles becomes visible. These grow and grow, and the pigment-cells, which give their colour to the tail, assume fantastic shapes."

"Very interesting, I dare say."

"You don't seem to think so by your tone. But look in this vase:—Here are several tadpoles with the most apologetic of tails; mere stumps, in fact. I cut them off nine days ago."

"Will they grow again?"

"Perfectly; because, although the frog dispenses with a tail, and gradually loses it by resorption, (drawing in by suction,) as he reaches the frog form, the tadpole needs his tail to swim with; and Nature kindly supplies any accident that may deprive him of it."

"Yes, yes," added Syntax, glad to feel himself once more in the region of things familiarly known; "just like the lobster or the crab, you know. They tear off their legs and arms in the most reckless manner, yet always grow them again."

"Would you like to know what has become of these tails?"

"Arn't they dead?"

"Not at all. Alive and kicking."

"Alive after nine days? Oh! oh!"

"Here they are in this glass. It is exactly nine days since they were cut off, and I have been watching them daily under the microscope. I assure you that I have seen them grow, not *larger*, indeed, but *develop* more and more, muscle-fibres appearing where no trace of fibre existed."

"Come, now, you are trying my gullibility!"

"I am perfectly serious. The discovery is none of mine. It was made by M. Vulpian in Paris. He says that the tails constantly live many days—as many as eighteen on one occasion; but I have never kept mine alive more than eleven. He says, moreover, that they not only grow, as I have said, but manifest sensibility, for they twist about with a rapid swimming movement when irritated. I have not seen this, but M. Vulpian is too experienced a physiologist to have been mistaken; and with regard to the growth of the tails, his observations are all the more trustworthy, because he daily made drawings of the aspect presented by the tails, and could thus compare the progress made."

"Well, but I say, how *could* they live when separated from the body? Our arms or legs don't live; the lobster's legs don't live."

"Quite true; but in these cases we have limbs of a complex organisation, which require a complex apparatus for their maintenance; they must have blood, the blood must circulate, the blood must be oxygenated."

"Stop, stop; I don't want to understand why our arms can't live apart from our bodies. They *don't*. The fact is enough for me. I want to know why the tail of a tadpole can live apart from the body."

"It *can*. Is not the fact enough for you in that case also? Well, I was going to tell you the reason. The tail will only live apart from the body so long as it retains its early immature form; that is to say, so long as it has not become highly organised. If you cut it off from a tadpole which is old enough to have lost its external gills a week or more, the tail will not live more than three or four days. And every tail will die as soon as it reaches the point in its development, which requires the circulation of the blood as a necessary condition."

"But where does it get food?"

"That is more than I can say. I don't know that it wants food. The power of abstinence of reptiles is amazing."

"Really I begin to think there is more in these little beasts than I suspected. But you see it requires a deal of study to get at these things."

"Not more than to get at any of the other open secrets of nature. But since you are interested, look at these tails as the tadpoles came bobbing against the side of the glass. Do you see how they are covered with little white spots?"

"No."

"Look closer. All over the tail there are tiny cotton-like spots. Take a lens, if your unaccustomed eye isn't sharp enough. There, now you see them."

"Yes; I see a sort of *fluff* scattered about."

"That fluff is an immense colony of parasites. Let us place the tadpole under the microscope, and you will see each spot turn out to be a multitude of elegant and active animals, having bodies not unlike a crystal goblet supported on an extremely long and flexible stem, and having round their *rim*, or mouth, a range of long delicate hairs, the incessant motion of which gives a wheel-like aspect, and makes an eddy in the water which brings food to the animal."

"Upon my word, this is really interesting! How active they are! How they shrink up, and then, unwinding their twisted stems, expand again! What's the name of this thing?"

"*Vorticella*. It may be found growing on water-fleas, plants, decayed wood, or these tadpoles. People who study the animalcules are very fond of this vorticella."

"Well, I never could have believed such a patch of fluff could turn out a sight like this; I could watch it for an hour. But what are those small yellowish things sticking on the side of these parasites?"

"Those, my dear Syntax, are also parasites."

"What! parasites living on parasites?"

"Why not? Nature is economical. Don't you live on beef, and mutton and fish? Don't these beefs, muttons, and fish, live on vegetables and animals? Don't these vegetables and animals live on other organic matters? Eat and be eaten is one law: live and let live is another."

The learned doctor remained thoughtful; then he screwed up one side of his face into frightful contortions, as with the eye of the other he resumed his observations of the vorticella.

—G. H. Lewes.

THE NEWFOUNDLAND FISHERIES.

The banks of Newfoundland, the most extensive submarine elevation on the globe, in their full extent occupy 16 degrees of longitude, and nearly 10 degrees of latitude; they are between 600 and 700 miles in length; the depth of water on them varies from 4 to 160 fathoms. The temperature of the water on the Great Bank is 10 or 12 degrees lower than in the surrounding ocean.

The outer bank, also called the False Bank, extends from 44° 10′ to 47° 30′ N. lat., and from 44° 15′ to 45° 25′ W. long. The Great Bank, which lies 2½° west of the False Bank, occupies more than 9° of latitude and 5° of longitude. Whale Bank, Green Bank, and St Peter's Bank, to the south of the island, are of much smaller dimensions.

Cod-fish is found on the Great Bank in the greatest abundance; but there are so many disadvantages attending the fishing-ground, as compared with the harbours and shores of the island, that bank-fishing has of late years been much neglected by the English, although it is still prosecuted by the American and French fishermen. The bank is covered by continual fogs; rain and sleet are also frequent, and in the early part of the season much inconvenience is experienced from ice. Besides avoiding these inconveniences, the fishermen who remain near to the shore have better opportunities for curing and drying their fish, the quality of which is therefore preferred.

FISHING ON THE BANKS.

The following description is by Lieutenant Chappell, R.N. :— "There are a number of boats fitted with masts and sails belonging to each fishery, two or four men being stationed to a boat. At the earliest dawn of day the whole of these vessels proceed to that part of the coast where the cod are most plentiful, for they move in shoals, and frequently alter their position, according to the changes of the wind. When the resort of the fish has been ascertained, the boats let fall their anchors, and the men cast over their lines. Each man has two lines to attend, and every line has two hooks affixed to it, which are baited either with caplin (*a small fish swarming upon the banks*) or herrings. The men stand upon a flat flooring, and are divided from each other by bins, like shop-counters, placed athwart the centre of the boat. Having drawn up the line, they lay the cod upon the bin, and strike it upon the back part of the head with a piece of wood in the shape of a rolling-pin; this blow stuns the fish, and causes it to yawn its jaws widely asunder, by which means the hook is easily extracted. Then the fish is dropped into the bin and the line again thrown over, whilst the fisherman, instantly turning round, proceeds to pull up the opposite line, so that one line is running out and the other pulling in at the same instant. Thus the boatmen continue until their vessel is filled, when they proceed to discharge their cargo at the fishing-stage. The cod are pitched from the boat upon the stage with a pike, care being taken to stick the pike into their heads, as a wound in the body might prevent the salt from having its due effect, and thereby spoil the fish. When the boats are emptied, the fishermen procure a fresh quantity of bait, and return again to their employment on the water, whence, in the course of an hour or two, perhaps, they again reach the stage with another cargo."

The curing is managed as follows :—

"Each salting-house is provided with one or more tables, around which are placed wooden chairs and leathern aprons for the cut-throats, headers, and splitters. The fish having been thrown from the boats, a boy is generally employed to bring them on the stage, and place them on the table before the cut-throat, who rips open the bowels; and having also nearly severed the head from the body, he passes it along the table to his right-hand neighbour, the header, whose business it is to pull off the head and tear out the entrails; from these he selects the liver, and in some instances the sound. The head and entrails being precipitated through a bunk into the sea, the liver is thrown into a cask, where it distils in oil; and the sounds, if intended for preservation, are salted. After having undergone this operation, the cod is next passed across the table to the splitter, who cuts out the backbone, as low as the navel, in the twinkling of an eye. From hence the cod are carried in hand-barrows to the salter, by whom they are spread in layers upon the top of each other, with a proper quantity of salt between each layer. In this state the fish continue for a few days, when they are again taken in barrows to a stout wooden box full of holes, which is suspended from the stage in the sea. The washer stands up to his knees in this box and scrubs the salt off the cod with a soft mop. The fish are then taken to a convenient spot and piled up to drain, and the heap thus formed is called a 'water-horse.' On the following day the cod are removed to the fish-flakes, where they are spread in the sun to dry; and from thenceforward they are kept constantly turned during the day, and piled up in small heaps, called 'flackets,' at night. The upper fish are always laid with their bellies downward, so that the skins of their backs answer the purpose of thatch to keep the lower fish dry. By degrees the size of these flackets is increased, until at length, instead of small parcels, they assume the form of large circular stacks, and in this state the cod are left for a few days, as the fishermen say, 'to sweat.' The process of curing is now complete, and the fish are afterwards stored up in warehouses, lying ready for exportation.

"With such amazing celerity is the operation of heading, splitting, and salting performed, that it is not an unusual thing to see ten cod-fish decapitated, their entrails thrown into the sea, and their back-bones torn out, in the short space of one minute and a half. The splitter receives the highest wages, and holds a rank next to the master of a fishery; but the salter is also a person of great consideration, upon whose skill the chief preservation of the cod depends.

"There are three qualities of cured cod-fish in Newfoundland. They are distinguished by the different titles of *merchantable fish*, those of the largest size, best colour, and altogether finest quality; *Madeira fish*, which are nearly as valuable as the former; this sort is chiefly exported to supply the Spanish and Portuguese markets; *West India fish*, the refuse of the whole. These last are invariably sent for sale to feed the negroes of the Caribbee Islands."

The cod-fishery does not commence until the 10th of June; previous to which the hardy Newfoundland fishermen occupy themselves in the seal-fishery. The 17th of March is the day fixed for the departure of the vessels employed in this business. At this time the harbours are frozen, and it is necessary for the crews to cut a channel through the ice sufficiently wide for the passage of the vessels, which are usually schooners of from 40 to 70 tons, or decked boats of from 25 to 35 tons' burthen, very strongly built, and fortified against the pressure of the ice by strong poles suspended over their sides. The crews of the larger vessels usually consist of from thirteen to eighteen men, who are all partners in the expedition, receiving a certain proportion of the vessel's earnings at the conclusion of the fishing. When a channel has been cut to the sea, the vessels make their way to the field-ice, pushing through the opening which it presents until they meet with a herd of seals, or what is whimsically called a seal-meadow. The hunters contrive, if possible, to surprise the seals while sleeping in the sun. When thus enabled to approach their prey, the men strike them on the nose with a bludgeon, which speedily kills them. The practice of shooting seals is not willingly resorted to, as the skin is thus likely to be injured. The skins are stripped off, together with the fat, and conveyed to the vessels,

SEAL-FISHING IN NEWFOUNDLAND.

where they are packed away in the hold. When the vessels are thus loaded, they return to port and dispose of their cargoes to the merchants. If they are successful, the vessels are generally able to make a second trip before the melting of the ice.

The merchant separates the fat or blubber from the skin. This fat is cut into small pieces and thrown into vats, which are exposed to the heat of the sun. In three or four weeks the oil will have separated itself. A small quantity of inferior oil is then procured by boiling the blubber. The oil which separates without the aid of fire is of a pale colour, and is frequently used for the adulteration of sperm-oil, its price being much lower. The boiled oil, being partially burnt, is of a dark colour, and cannot well be used for this purpose. When the fat has been removed, the skins are carefully stretched and laid up in piles with layers of salt between. They are shipped in bundles of five skins each for the convenience of stowage.

—*Geography of America.*

SUMMER LONGINGS.

Ah! my heart is weary waiting,
 Waiting for the May—
Waiting for the pleasant rambles,
Where the fragrant hawthorn brambles,
 With the woodbine alternating,
 Scent the dewy way.
Ah! my heart is weary waiting,
 Waiting for the May.

Ah! my heart is sick with longing,
 Longing for the May—
Longing to escape from study,
To the young face fair and ruddy,
 And the thousand charms belonging
 To the summer's day.
Ah! my heart is sick with longing,
 Longing for the May.

Ah! my heart is sore with sighing,
 Sighing for the May—
Sighing for their sure returning,
When the summer beams are burning,
 Hopes and flowers that dead or dying,
 All the winter lay.
Ah! my heart is sore with sighing,
 Sighing for the May.

Ah! my heart is pained with throbbing,
 Throbbing for the May—
Throbbing for the sea-side billows,
Or the water-wooing willows;
 Where in laughing and in sobbing,
 Glide the streams away.
Ah! my heart, my heart is throbbing,
 Throbbing for the May.

Waiting sad, dejected, weary,
 Waiting for the May.
Spring goes by with wasted warnings—
Moon-lit evenings, sun-bright mornings—

Summer comes, yet dark and dreary
Life still ebbs away;
Man is ever weary, weary,
Waiting for the May!

—*Anon.*

AMERICAN INSECTS.

There are few among the insect tribes of Europe capable of producing sounds of any volume. The hum of bees and wasps, the buzzing of innumerable small flies, the piping of the gnat, the chirp of the grasshopper, the cry of the cricket, the tick of the death-watch—are the greater number of those an Englishman would enumerate. In southern Europe sounds are added sharper, louder, and more incessant; and I remember having been both amused and astonished, by the effect produced by the mole-crickets of France and the Jura, and yet more by the *cicada* of Italy, as, sitting among the thick foliage of the Roman pine, they would fill the ear of the panting traveller for minutes before he reached the place of their luxurious enjoyment.

But what are these scattered and solitary sounds, to the din which fills the ear at certain times and seasons from the insect tribes in the Transatlantic forest or swamp? The main agents in its production are, nevertheless, members of the same families of Gryllus and Cicada. The latter consists of many species, and affords some of the most laborious and successful musicians among the insect tribes. Every traveller has dilated upon the singular effect produced by one of them called the Catydid, as, sitting in little coteries among the trees, they fill the ear of night with their sharp and incessant wrangling; and my notice regards at present one of the same family.

When we returned from Mexico to the United States, in the summer of last year, 1834, among many points of interest, political, domestic, and foreign, which our re-entrance into the high-road of civilisation brought to our ears, was the fact that this was the "locust year."

The observation of a past century had shown the inhabitants of Pennsylvania and Maryland, that every seventeenth year they were visited by a countless horde of insects of the Cicada tribe, hence called *Septendecim*, distinct in aspect and habits from those whose annual appearance and mode of life were understood. Though of a different tribe, and with perfectly different habits from the locust of the East, the fact of its occasional appearance, as though by magic, in such vast swarms, had caused it to be familiarly alluded to by that name. Its last appearance had been in 1817, and its re-appearance was thus confidently predicted for the third or fourth week in May this year. (1834.)

Nature, true to her impulses, and the laws by which she is so mysteriously governed, did not fail to fulfil the prediction. On the 24th of May, and following day, the whole surface of the country in and about the city of Philadelphia, suddenly teemed with this singular insect. The subject interested me, and as during these days I had every opportunity of being daily, I may say hourly, attentive to the phenomena connected with it, both here and in Maryland, I send you the result of my observations.

The first day of their appearance, their numbers were comparatively few,—the second, they came by myriads; and yet a day or two might pass before they reached their full number. I happened to be abroad the bright sunny morning which might be called the day of their birth. At early morning, the insect, in the pupa state, may be observed issuing from the earth in every direction, by the help of a set of strongly barbed claws on the forelegs. Its colour is then of a uniform dull brown, and it strongly resembles the perfect insect in form, excepting the absence of wings, ornament, and antennæ. The first impulse of the imperfect insect, on detaching itself from its grave, is to ascend a few inches, or even feet, up the trunks of trees, at the foot of which their holes appear in the greatest number; or upon the rail-fences, which are soon thickly sprinkled with them. In these positions they straightway fix themselves firmly by their barbed claws. Half-an-hour's observation will then show you the next change which is to be undergone. A split takes place upon the shell, down from the back of the head to the commencement of the rings of the abdomen, and the labour of self-extrication follows. With many a throe and many a strain, you see the tail and hind-legs appear through the rent, then the wings extricate themselves painfully from a little case in the outer shell, in which they lie exquisitely folded up, but do not yet unfurl themselves; and, lastly, the head, with its antennæ, disengages itself, and you behold before you the new-born insect freed from its prison. The slough is not disengaged, but remains firmly fixed in the fibres of the wood; and the insect, languidly crawling a few inches, remains as it were in a dose of wonder and astonishment. It is rather under an inch in length, and appears humid and tender; the colours are dull, the eye glazed, the legs feeble, and the wings for a while after they are opened, appear crumpled and unelastic. All this passes before the sun has gained his full strength. As the day advances, the colours of the insect become more lively: the wings attain their full stretch, and the body dries and is braced up for its future little life of activity and enjoyment.

Between ten and eleven, the newly-risen tribes begin to tune their instruments; you become conscious of a sound, filling the air far and wide, different from the ordinary ones which may meet your ear. A low distinct hum salutes you, turn where you will. It may be compared to the simmering of an enormous cauldron,—it swells, imperceptibly changes its character, and becomes fuller and sharper—thousands seem to join in, and by an hour after mid-day, the whole country far and wide rings with the unwonted sound. The insects are now seen lodged in or flying about the foliage above: a few hours having been thus sufficient to give them full strength and activity, and bring them into full voice.

Well may the school-boy and the young curly-headed negro rejoice at the sound, for their hands will never want a plaything for many days to come. Well may the birds of the forest rejoice, for this is the season of plenty for them—the pigs and poultry too, they fatten on the innumerable swarms which, before many days, will cover the ground in the decline of their strength.

The pretty insect, for it is truly such, with its dark body, red eyes, and its glassy wings interlaced by bright yellow fibres—enjoys but a little week; and that merry harping which pervades creation from sunrise to sundown, for the time of its continuance, is but of some six days' duration. Its character would be almost impossible to describe, though it rings in my ears every time I think of the insect. Like all those of its tribe, the sound produced is not a voice, but a strong vibration of musical chords produced by the action of internal muscles upon a species of lyre, or elastic membrane, covered with network, and situated under the wings, the action of which I have often witnessed. The female insect may utter a faint sound, but I do not know how—it is the male who is endowed with the powerful means of instrumentation which I have described.

Though the sound is generally even and continuous as long as the insect is uninterrupted, yet there is a droll variety observable at times—but what it expresses, whether peculiar satisfaction or jealousy, or what other passion, I cannot divine. It has been well described by the word *Pha——ro!* the first syllable being long and sustained, and connected with the second, which is pitched nearly an octave lower, by a drawling descent.

During the whole period of their existence, the closest attention does not detect their eating anything; and with the exception of the trifling injury received by the trees consequent upon the process observed by the female in laying her eggs—which I will describe immediately—they are perfectly innoxious. The end to which they seem to be sent to the upper day is purely confined to the propagation of their species. A few days after their first appearance the female begins to lay her eggs. She is furnished with an ovipositor, situated in a sheath on the abdomen, composed of two serrated, hard parallel spines, which she has the power of working with an alternate perpendicular motion. When her time comes, she selects of the outermost twigs of the forest trees or shrubs, and sets to work and makes a series of longitudinal jagged incisions in the tender bark and wood. In each of these she lays a row of tiny eggs, and then goes to work again. Having deposited to her heart's content, she crawls up the twig a few inches yet further from the termination, and placing herself in a fitting position, makes two or three perpendicular cuts into the very pith. Her duty is now terminated. Both male and female become weak;—the former ceases to be tuneful; the charms of their existence is at an end; they pine away, become blind, fall to the ground by myriads, and in ten or fifteen days after their first appearance, they all perish. Not so, however, their seed. The perforated twigs die, the first wind breaks them from the tree, and scatters them upon the ground. The eggs give birth to a number of small grubs, which are thus enabled to attain the mould without injury; and in it they disappear, digging their way down into the bosom of the earth. Year goes after year—summer after summer, the sun shines in vain to them—they "bide their time!" The recollection of their existence begins to fade: a generation passes away; the surface of the country is altered—lands are reclaimed from the forest—streets are laid out and trampled on for years—houses are built, and pavements hide the soil.

Still, though man may almost forget their existence, God does not. What their life is in the long interval none can divine. Traces of them have been found in digging wells and foundations, eight and ten feet below the surface. When seventeen years have gone by, the memory of them returns, and they are expected. A cold, wet spring may retard their appearance, but never since the attention of man has been directed to them, have they failed—but at the appointed time, by one common impulse, they rise from the earth, piercing their way through the matted sod, through the hard trampled clay of the pathways, through the gravel, between the joints of the stones and pavements, and into the very cellars of the houses,—like their predecessors, to be a marvel in the land, to sing their blithe song of love and enjoyment under the bright sun, and amidst the verdant landscape; like them to fulfil the brief duties of their species, and close their mysterious existence by death. We are still children in the small measure of our knowledge and comprehension, with regard to the phenomena of the natural world!

—LATROBE.

SNAILS.

We will open the case by claiming for the snails the respect that is always accorded to old and long-established families. There were snails before the Flood—before Adam even—in those far remote eras of the past, when the lower orders of the animal creation had the world all to themselves. The family seems to have "come in" somewhere about the time when the huge Dinotherium wallowed in the rivers of central Europe; and it is not at all improbable that some of the earliest members of it may have banqueted on the self-same herbage which sustained the enormous bulk of that unwieldy monster. Later down, in the classic days of Greece and Rome, the snails were not only known, but held in great repute, and regularly had the honour of appearing at the tables of wealthy epicures, fresh from contact with a silver gridiron. It was in those days, indeed, that the tribe derived the family name by which it has ever since been known—Helix, a spiral, being the name that was given to the dainty morsel; while the same term, metamorphosed into Helicidæ, now stands, all the world over where the science of zoology obtains, as the distinctive appellation of the wide-spread family. All that by the way, however: what we want to impress upon our readers is, that if there be any honour attached to long descent and distinguished connexions, then that honour can fairly be claimed by the snail family.

It may be as well, too, to observe at once, that though the representatives of the family which make themselves at home in our fields and hedges have nothing particularly attractive in their appearance, that is not by any means the case with those branches of the family that reside abroad. In "foreign parts" there are snails to be found as far exceeding our own in delicacy and beauty of colouring, as there are birds and insects that excel in brilliancy the winged tribes of our woods and fields.

But these gaily-coloured individuals belong, of course, to the rich pastures and the sunny skies of tropic regions; and we do not mean to call in their aid just yet, in order to make good our position as to the claims of the family. Let us come back, therefore, to the little fellow with the dusky spotted shell, that crawls across our garden path, and to his somewhat prettier companions of the hedgerow. And, now observe, that they make their way in the world by means of an expanded disc or foot, which, as it is in close contact with the ventral region of the body, has procured for the tribe a place amongst the great class of *Gasteropods*, or belly-footed molluscs. The foot itself is a very curious organ, and consists of a nearly uniform mass of muscular fibres, interwoven much in the same way as those of the human tongue. The regular gliding motion with which the common snails crawl along, is due to a pair of muscles extending along the centre of the foot; but in some of the species the surface of the foot is divided by a longitudinal line along the centre, the muscles on the two sides of which act in rotation, and so cause the animals to progress in a perpetual zigzag. The glistening slimy tracks which they leave behind—"the silver slimy trails," as poor Clare calls them—are produced by a discharge of mucus, designed to protect their tender bodies, and smooth the asperities of their way. It must be a very comfortable thing for the snails to be able to carpet their path in this easy, off-hand manner, and we confess we like to see the silvery line on posts and pailings, or gravelly walks; but when, as happens sometimes, the little fellows pay us a visit in our parlour, where the place is carpeted beforehand, they might be considerate enough to wipe their feet before coming in.

A good deal of discussion has taken place amongst naturalists, as to whether snails have any eyes or not. The popular notion, of course, is that the little knobs at the extremity of their long feelers or horns are eyes; and though several writers have questioned or boldly denied the truth of this opinion, it seems to be now pretty generally conceded, that the little club-shaped projections are true visual organs. Swammerdam, indeed, long ago demonstrated the matter to his own satisfaction, and pointed out the five distinct parts of which the eye consists.

It would be a difficult matter, probably, to find a person anywhere who had never seen a snail draw in its horns on their being touched;

but how many, we should like to know, have ever closely watched the snail's manner of doing it? The thing is easily seen, and any schoolboy may ascertain how it is done, the next time he stops a snail in his travels across the footpath, and admonishes him in the words of the old doggerel, "to shut up his house and go away home." The secret is, that the *tentacle* or horn is a hollow tube, and in being withdrawn, it is simply inverted and retracted like the finger of a tight glove; only that the extremity, with the eye-spot upon it, is always the first part to disappear. The manner of it is here seen, perhaps, when after the tentacle has been withdrawn, it is again protruded; as you can then readily discern that the organ is lengthened, not by being pushed out from its base, but by gradually unfolding itself; or being everted at the extremity till the clubbed point appears, and the tentacle is fully extended. One cannot but admire the wisdom which thus gives the little mollusc such a ready and effectual means of defending its rather oddly located visual organs. We speak of the wonderful contrivances connected with the human eye, but surely there is something here that is not much less wonderful.

—KEARLEY.

THE CORAL INSECT.

TOIL on! toil on! ye ephemeral train,
Who build in the tossing and treacherous main,
Toil on—for the wisdom of man ye mock,
With your sand-based structures and domes of rock;
Your columns the fathomless fountains lave,
And your arches spring up to the crested wave;

Ye 're a puny race, thus boldly to rear
A fabric so vast in a realm so drear.

Ye bind the deep with your secret zone,
The ocean is seal'd, and the surge a stone;
Fresh wreaths from the coral pavement spring,
Like the terraced pride of Assyria's king;
The turf looks green where the breakers roll'd;
O'er the whirlpool ripens the rind of gold;
The sea-snatch'd isle is the home of men,
And mountains exult where the wave hath been.

But why do you plant, 'neath the billows dark
The wrecking reef for the gallant bark?
There are snares enough on the tented field,
'Mid the blossom'd sweets that the valleys yield;
There are serpents to coil, ere the flowers are up;
There 's a poison-drop in man's purest cup,
There are foes that watch for his cradle-breath,
And why need ye sow the floods with death?

Ye build—ye build—but ye enter not in,
Like the tribes whom the desert devour'd in their sin;
From the land of promise ye fade and die,
Ere its verdure gleams forth on your weary eye;
As the kings of the cloud crown'd pyramid
Their noteless bones in oblivion hid,
Ye slumber unmark'd 'mid the desolate main,
While the wonder and pride of your works remain.

—SIGOURNEY.

CORAL REEF.

1. Anguillula fluviatilis.
2. Cyclops quadricornis.
3. Actinophrys Sol.
4. Coleps hirtus.
5. Vorticella.
6. Amœba princeps.
7. Acineta mystacina.
8. Oxytrycha.
9. Triophthalamus dorsalis.
10. Polyarthra.

LIFE IN A WATER-DROP.

The sun is reflected in the ocean as in the water-drop, and in both are called into existence beings the most varied in size and form. We admire the myriads of creatures which inhabit the depths of the ocean, from the monstrous whale to the tiniest specimen of the finny tribe. But if the size, the power, and the variety of the denizens of the deep excite our admiration, how much more do we find ourselves carried away by that feeling while looking into the water-drop.

Clear and transparent it lies before us: vainly our eye endeavours to discover the least evidence of life, or the smallest creature, in that which seems in itself too small to contain any living object; the breath of our mouth is strong enough to agitate it, and a few rays of the sun are sufficient to convert it into vapour. But we place this drop of water between two clean squares of glass, beneath the microscope, and lo! what life suddenly presents itself: we scarcely trust our senses. The little drop has expanded into a large plain, wonderful shapes rush backwards and forwards, drawing towards and repulsing each other, or resting placidly and rocking themselves, as if they were cradled on the waves of an extensive sea. These are no delusions; they are real, living creatures, for they play with each other, they rush violently upon one another, they whirl round each other, they free and propel themselves, and run from one place in order to renew the same game with some other little creature; or madly they precipitate themselves upon one another, combat and struggle until the one conquers and the other is subdued; or carelessly they swim side by side, until playfulness or rapacity is awakened anew. One sees that these little creatures, which the sharpest eye cannot detect without the aid of the microscope, are susceptible of enjoyment and pain; in them lives an instinct which induces them to seek, and enables them to find, sustenance, which points out and leads them to avoid and to escape the enemy stronger than themselves. Here one tumbles about in mad career and drunken lust, it stretches out its feelers, beats about its tail, tears its fellows, and is as frolicsome as if perfectly happy. It is gay, cheerful, hops and dances, rocks and bends about upon the little waves of the water-drop. There is another creature; it does not swim about—remains upon the same spot—but it contracts itself convulsively, and then stretches itself palpitatingly out again. Who could not detect in these motions the throes of agony; and so it is; for only just now it has freed itself from the jaws of a stronger enemy. The utmost power has it exerted in order to get away; but he must have had a tight hold, severely wounded it, for only a few more throes, each becoming weaker and more faint, it draws itself together, stretches out its whole length once more, and sinks slowly to the bottom. It was a death struggle. It has expired.

On one spot a great creature lies, apparently quiet and indifferent. A smaller one passes carelessly by, and, like a flash of lightning, the first dashes upon it. Vainly does the weaker seek to escape its more powerful enemy; he has already caught it, embraces it, the throes of the vanquished cease—it has become a prey.

This is only a general glance at the life in a water-drop, but how *great* does even this already show the *small*; how wondrously does everything shape itself within that, of which we had formerly not the least conception. These are creatures which Nature nowhere presents to the eye upon an enlarged scale, so marvellous, odd, and also again so beautiful, so merry, happy in their whole life and movements; and although defective, and, in some respects, only one step removed from vegetable life, they are yet animated and possessed of will and power. It would be impossible here to give a description of all, or even of a great part of the ephemerous world in all its varied aspects, but we propose to take a nearer survey of some few at least, in order to display the life which exists in a single drop of water taken from a pond.

Slowly and gracefully through the floods of this small drop of water comes glidingly, swimming along, the little swan animalcule, turning and twisting its long, pliant neck, swaying itself comfortably, and moving in every direction, sucking whatever nourishment or prey may present itself. This animalcule has its name from its likeness to the swan; it carries its neck just as proudly and gracefully-arched, only the head is wanting, for at the end there is a wide opening mouth, surrounded by innumerable beam-like lashes. The entire little creature is transparent, and it seems impossible that any species of nutriment could possibly pass through the thin throat, for even water seems too coarse a material for this small tube; but scarcely does one of the variously formed *monads*, (single cells,) which exist in all waters, and of which many thousands could move and tumble freely about in the hollow of a poppy seed, approach its mouth, ere it gulps them down, we see them gliding through the throat, and see the green, gray, or white monad lying in the little, but for this animalcule, great stomach. This monad is itself an animalcule, a living atom; and possibly a still smaller animalcule serves for its nourishment; but the human eye has not yet penetrated thus far, possibly it may never do so, for the Creator has hidden from the material vision of man the limits of His creating power, alike in the infinitely great as in the infinitesimally small.

Whirling along comes swimming by the side of the swan animalcule, the *Bell*. Here Nature has retained a form out of the vegetable kingdom, for the body of this animalcule is similar to the bell-shaped blossom of a Mayflower, fastened to a long stem; this stem, through which passes a spiral-formed vein, a fine dark tube, is easily movable; it closes itself, screw-like, together and stretches itself out again—this is the tail of the bell animalcule; at the end there is a little knot, and soon this knot becomes attached to the bottom, or to a blade of grass, or to a piece of wood, and the little animalcule is like a ship at anchor in a bay or harbour; its tail extends and turns itself, and the body of the animalcule, the little bell, whose opening is at the top, begins to whirl itself round and round, and this movement is so quick and powerful that it creates, even in the billows of the water-drop, a whirlpool, which keeps ever going round wilder and more violently; it grows to a *Charybdis*, which none of the little monads who are caught within it can escape; the whirlpool is too fierce, they get drawn into it and find a grave in the jaws of the bell animalcule. The bell closes, the tail rolls together, but soon it stretches itself out again; the bell whirls, the whirlpool goes round, and in it many a quiet and thoughtless passing monad is drawn down. But the bell animalcule is also about meeting its punishment; again it whirls its bell violently, the tail breaks from the body, and the bell floats without control hither and thither on the waves of the water-drop; but it knows how to help itself; Nature has provided for such a catastrophe in its creation. The bell sinks to the bottom, and soon the missing tail grows again, and if death even comes, Nature has been so liberal in the creation of this little world—new life and new creatures arise so quickly out of those which have passed away, and so great is their number—that the death of one is less than a drop in the ocean, or a grain of sand in the desert of Sahara.

The lives of innumerable animalcules pass away as a breath, but they rise into existence in equally infinite numbers. The animalcules multiply in every variety of way, but the most curious is that of dividing, and out of the severed parts new animalcules are formed, which, in a few hours, again divide themselves into parts, forming new creatures; and this process of increase proceeds to infinity. Numbers alone are able in some measure to give an idea of this infinite increasing power. An animalcule requires for its parting process about five hours, after which time the new creatures stand then perfect, and these again require the same time for their increase. At this rate of increase, one single animalcule would, by the process of separation, be increased to half a million in four days, and after a month it would be inconceivable where this innumerable quantity of animalcules, which are, singly, imperceptible to the naked eye, can possibly be placed. But Nature has limited even this vast increasing power, and she freely sacrifices millions in order to preserve their species always in their proper quantities. What are, compared with these numbers, the quantities of herrings, sprats, and other fish which crowd the sea in such mighty masses? They vanish into nothingness.

—*Sharpe's Magazine.*

METEOROLOGY—THE AIR-OCEAN.

Enveloping this solid globe of ours are two oceans, one partial, the other universal. There is the ocean of water, which has settled down into all the depressions of the earth's surface, leaving dry above it all the high lands, as mountain ranges, continents, and islands; and there is an ocean of air, which enwraps the whole in one transparent mantle. Through the bosom of that ocean, like fishes with their fins, and whales with their flippers, birds and other winged creatures swim; whilst, like crabs and many shell-fish, man and other mammalia creep about at the bottom of this aerial sea.

The air-ocean, which everywhere surrounds the earth, and feeds and nourishes it, is even more simple, more grand, and more majestic than the "world of waters;" more varied and changeful in its moods of storm and calm, of ebb and flow, of brightness and gloom. The atmosphere is, indeed, a wonderful thing, a most perfect example of the economy of nature. Deprived of air no animal would live, no plant would grow, no flame would burn, no light would be diffused. The air, too, is the sole medium of sound. Without it mountains might fall, but it would be in perfect silence—neither whispers nor thunders would ever be heard.

The atmosphere is supposed to extend from the earth to a height of between forty and fifty miles.

A philosopher of the East, with a richness of imagery truly oriental, thus describes it:—"It surrounds us on all sides, yet we see it not; it presses on us with a load of fifteen pounds on every square inch of surface of our bodies, or from seventy to one hundred tons on us in all, yet we do not so much as feel its weight. Softer than the softest down, more impalpable than the finest gossamer, it leaves the cobweb undisturbed, and scarcely stirs the lightest flower that feeds on the dew it supplies; yet it bears the fleets of nations on its wings round the world, and crushes the most refractory substances with its weight. When in motion, its force is sufficient to level the most stately forests and stable buildings with the earth—to raise the waters of the ocean into ridges like mountains, and dash the strongest ships to pieces like toys. It warms and cools by turns the earth and the living creatures that inhabit it. It draws up vapours from the sea and land, retains them dissolved in itself, or suspended in cisterns of clouds, and throws them down again as rain or dew when they are required. It bends the rays of the sun from their path, to give the twilight of evening and of dawn; it disperses and refracts their various tints to beautify the approach and the retreat of the orb of day. But for the atmosphere sunshine would burst on us and fail us at once, and at once remove us from midnight darkness to the blaze of noon. We should have no twilight to soften and beautify the landscape; no clouds to shade us from the scorching heat, but the bald earth, as it revolved on its axis, would turn its tanned and withered front to the full and unmitigated rays of the lord of day. It affords the gas which vivifies and warms our frames, and receives into itself that which has been polluted by use, and is thrown off as noxious. It feeds the flame of life exactly as it does that of fire; it is in both cases consumed, and affords the food of consumption; in both cases it becomes combined with charcoal, which requires it for combustion, and is removed by it when this is over."

"It is only the girdling, encircling air," says another philosopher, "that flows above and around all, that makes the whole world kin. The carbonic acid with which to day our breathing fills the air, to-morrow seeks its way round the world. The date-trees that grow around the falls of the Nile will drink it in by their leaves; the cedars of Lebanon will take of it to add to their stature; the cocoa-nuts of Tahiti will grow rapidly upon it; and the palms and bananas of Japan will change it into flowers. The oxygen we are breathing was distilled for us some short time ago by the magnolias of the Susquehanna, and the great trees that skirt the Orinoco and the Amazon; the giant rhododendrons of the Himalayas contributed to it, and the roses and myrtles of Cashmere, the cinnamon tree of Ceylon, and the forest older than the flood, buried deep in the heart of Africa. The rain we see descending was thawed for us out of the icebergs which have watched the polar star for ages, and the lotus lilies have soaked up from the Nile, and exhaled as vapour snows that rested on the summits of the Alps."

"The atmosphere which forms the outer surface of the habitable world is a vast reservoir, into which the supply of food designed for living creatures is thrown; or, in one word, it is itself the food, in its simple form, of all living creatures. The animal grinds down the fibre and tissue of the plant, and the nutritious store that has been laid up between its cells, and converts these into the substance of which its own organs are composed. The plant acquires the organs and nutritious store, thus yielded up as food to the animal, from the air surrounding it."

"But animals are furnished with the means of locomotion and of seizure—they can approach their food, and lay hold of and swallow it; plants must wait till their food comes to them. No solid particles find access to their frames; the restless ambient air, which rushes past them loaded with the carbon, the hydrogen, the oxygen, the water, everything they need in the shape of supplies, is constantly at hand to minister to their wants, not only to afford them food in due season, but in the shape and fashion in which alone it can avail them."

There is no employment more ennobling to man and his intellect than to trace the evidences of design and purpose in the Creator, which are visible in all parts of the creation. Hence, to him who studies the physical relations of earth, sea, and air, the atmosphere is something more than a shoreless ocean, at the bottom of which he creeps along. It is an envelope or covering for the dispersion of light and heat over the surface of the earth; it is a sewer into which, with every breath we draw, we cast vast quantities of dead animal matter; it is a laboratory for purification, in which that matter is recomponnded and wrought again into wholesome and healthful shapes; it is a machine for pumping up all the rivers from the sea, and conveying the waters from their fountains in the ocean to their sources in the mountains; it is an inexhaustible magazine, marvellously adapted for benign and beneficient purposes.

—Maury.

ATMOSPHERIC PHENOMENA.

Moisture—Evaporation—Dew—Mists and Clouds—Rain, Snow, and Hail.

Plants derive the moisture which is necessary for their support and growth mainly from the moisture held in the atmosphere as vapour. Evaporation is well illustrated by the gradual disappearance of a pool of water, and by the drying of wet bodies. Thus water is diffused through the air as an invisible vapour. The capacity which the air has of holding vapour increases with its temperature; hence the greater rapidity of evaporation in warm than in cold air. Beyond the capacity of the surrounding air, evaporation will not go on; and hence when the air is as highly saturated with vapour as its temperature admits of, it is said to be fully charged; if it holds fifty per cent., it is said to be half charged; if twenty-five per cent., one quarter charged, and so on. The degree of charge, therefore, shows only the amount of moisture in the air *as compared with its capacity at its then temperature*, so that the air is generally moister in winter than in summer, though less saturated with vapour.

If the air is by any cause cooled down below the temperature at which the moisture which it holds will be its full charge, a part of its vapour will necessarily separate from it in the form of water. Thus we see that cold bodies placed in the open air became studded with drops of water—*dew-drops*—because they cool down the surrounding air below its point of full charge. The same phenomenon is daily witnessed in the windows of inhabited rooms. The cold panes cool down the warm moist air of the room, lessen the amount of moisture which it is capable of containing, and cause it to part with its superabundance in the form of water.

Dew, after sunset, is caused by the temperature of moist, solid bodies falling below that of the air, the extent to which the cooling is carried depending on the power which the substances have of radiating or parting with the heat which they have absorbed during the day. Plants radiate better than stones or soil, and these again better than metals. Dew is deposited most plentifully in cloudless, starry nights, because, in these circumstances, radiation goes on more quickly than when the sky is clouded. Under the clear skies of the tropics the effect of the fall of dew is like that of a smart shower of rain. When the dew is frozen it is called hoar-frost.

Mists and Clouds.—The dew-deposits of which we have been speaking are brought on by means, and on the surface, of bodies surrounded by the air; but if a large mass of the air is cooled down throughout below dew-point, (that is, below the point at which it is overcharged with moisture, and consequently begins to deposit dew-drops,) the water that separates from it does not run together into drops, but forms little vapour-vesicles, or cloud-bubbles, which float in the air, containing within these thin bulbs air fully charged with moisture. This state of the atmosphere causes mists. Clouds are only masses of mist in the upper air, caused by the cooling of the higher layers of the atmosphere.

Rain, Snow, Hail.—If, being on a mountain while it rains, you enter the region of clouds, you will find yourself suddenly surrounded with thick masses of fog, and will perceive the fine droplets of the falling mists. But these little drops become larger as they fall; for, just as happens when any other cold body is plunged into moist air, water is thrown down upon the surfaces of these little drops on their way down through the lower, warmer, and vapour-charged layers of the atmosphere. The rain, therefore, which comes down to the earth is derived not only from the clouds floating in the higher atmosphere, which are only its first sources, but also from the lower regions between them and the earth, the whole of which contribute to its increase as it descends. A great difference may, therefore, be found between the amount of rain which falls on the top of a mountain, or even of a high tower, and that which is caught during the same time at the foot of either. Thus the yearly rain-fall on the roof of the Royal Palace at Berlin is eighteen inches in depth, while that on the pavement of the Palace-Place amounts to twenty inches.

When the moist air in the upper regions is cooled down below the freezing-point, the water that it lets fall solidifies and comes down as snow. It is often remarked that it rains on the low-lying lands while it is snowing on the mountains. In such case the rain was withdrawn from the moist, cold air, in the form of snow, but was melted during its fall through the lower and warmer regions. This thawing is often imperfect; it then rains and snows at once, or the snow-flakes, only softening, cling together, and come down as sleet, which falls so often when winter is passing into spring. Sleet is met with in summer only on high mountains. It is probable that hail consists of flakes of snow or sleet, which have been formed in the upper regions, and round which, on their way down, the clear crust of ice was formed, which in almost all hail-stones, surrounds a core of white within.

On the crests of very high mountains—for instance, on the Alps—single clouds are often seen to hang for days apparently motionless. They are, however, in ceaseless motion, just as is the moist air from which they are formed, as it sweeps over the cold and perhaps, snow-capped peaks. With this air they travel on, and vanish again as soon as they are out of reach of the cooling influence; not, however, generally without leaving behind a part of their moisture as a fall of rain or snow. Thus the Alps are often, for many days together, shrouded in dense clouds, from which rain pours heavily every day, while over the warm valley of the Po, notwithstanding the constant south-wind, the sky has never been clouded for a moment. In the same manner all high mountains are withdrawing the waters from the air, even when it does not rain on the plains. Thus they are, in all parts of the world, the spots which form the chief points for the settlement of the moisture of the air, and are the main feeders of the rivers.

The wide plains of Northern India are, as you know, burning hot and dry during the summer. The currents of air rising up from the heated soil hinder the fall of wet from the air. The waters of the air, which are brought in unceasingly from the Indian Ocean by the south wind, (the summer monsoon,) cannot, therefore, be set down before they reach the Himalaya mountains, which, stretching for a length of nearly fourteen hundred miles, almost due east and west, form the boundary of India. Here, however, the moisture is so thoroughly arrested, that the south wind having passed the mountain-range, is almost completely dry before it reaches Inland Asia. Thus the steppes of arid Asia form, for the most part, dry, barren wastes, with very hot summers and severe winters.

—Constable's *Sixth Reader*.

THE CLOUD.

I bring fresh showers for the thirsting flowers,
From the seas and the streams;
I bear light shade for the leaves when laid
In their noonday dreams;
From my wings are shaken the dews that waken
The sweet birds every one,
When rocked to rest on their mother's breast,
As she dances about the sun.
I wield the flail of the lashing hail,
And whiten the green plains under;
And then again I dissolve it in rain,
And laugh as I pass in thunder.

I sift the snow on the mountains below,
And their great pines groan aghast;
And all the night 'tis my pillow white,
While I sleep in the arms of the blast.
Sublime on the towers of my skiey bowers,
Lightning, my pilot, sits;
In a cavern under is fettered the thunder—
It struggles and howls by fits:

Over earth and ocean, with gentle motion,
This pilot is guiding me,
Lured by the love of the genii that move
In the depths of the purple sea;
Over the rills, and the crags, and the hills,
Over the lakes and the plains,
Wherever he dream, under mountain or stream,
The spirit he loves remains;
And I all the while bask in heaven's blue smile,
While he is dissolving in rains.

The sanguine sunrise, with his meteor eyes,
And his burning plumes outspread,
Leaps on the back of my sailing rack,
When the morning star shines dead;
As on the jag of a mountain crag,
Which an earthquake rocks and swings,
An eagle, alit, one moment may sit,
In the light of its golden wings.
And when sunset may breathe, from the lit sea beneath,
It ardours of rest and love,
And the crimson pall of eve may fall
From the depth of heaven above;
With wings folded I rest, on mine airy nest,
As still as a brooding dove.

That orbed maiden, with white fire laden,
Whom mortals call the moon,
Glides glimmering o'er my fleece-like floor,
By the midnight breezes strewn;
And wherever the beat of her unseen feet,
Which only the angels hear,
May have broken the woof of my tent's thin roof,
The stars peep behind her and peer;
And I laugh to see them whirl and flee,
Like a swarm of golden bees,
When I widen the rent in my wind-built tent,
Till the calm rivers, lakes and seas,
Like strips of the sky fallen through me on high,
Are each paved with the moon and these.

I bind the sun's throne with a burning zone,
  And the moon's with a girdle of pearl;
The volcanoes are dim, and the stars reel and swim,
  When the whirlwinds my banners unfurl.
From cape to cape, with a bridge-like shape,
  Over a torrent sea,
Sunbeam proof I hang like a roof,
  The mountains its columns be.
The triumphal arch through which I march,
  With hurricane, fire, and snow,
When the powers of the air are chained to my chair,
  Is the million-coloured bow;
The sphere-fire above its soft colours wove,
  While the moist earth was laughing below.

I am the daughter of earth and water,
  And the nursling of the sky;
I pass through the pores of the ocean and shores;
  I change, but I cannot die.
For, after the rain, when, with never a stain,
  The pavilion of heaven is bare,
And the winds and sunbeams, with their convex gleams,
  Build up the blue dome of air,
I silently laugh at my own cenotaph,
  And out of the caverns of rain,
Like a child from the womb, like a ghost from the tomb,
  I arise and unbuild it again.

—SHELLEY.

A STORM AMONG THE ALTAI MOUNTAINS.

THE ascent of the Cholsoun from the north side is not abrupt, though the last half verst is steep and rocky: nevertheless, we rode our horses to the summit, or rather to the foot of the large rocky peaks that shoot far above the rounded mountain top. These are bare granite, without a blade of grass upon them, and do not form a continuous ridge or crest on the mountain, but stand up in isolated masses, often at a considerable distance from each other. Having ascended with some difficulty to the top of one of these peaks, I saw our little caravan, composed of the men I had left to proceed by another route, skirting the mountain lower down. I knew that they would cross the summit seven or eight versts to the east, go straight to the Cholsoun pass, and descend into a valley on the south, which I had arranged should be our place of rest for the night.

The views from this part of the chain are very grand. On one side, Nature exhibits her most rugged forms, peaks and crags of all shapes rising up far into the clear blue vault of heaven; while on the other, mountain rises above mountain, vanishing into distance, until they melt into forms like thin gray clouds on the horizon. It was impossible to spare much time going from place to place, looking to the north, south, or west, to decide which view I should sketch first. The chains to the north happened to be beautifully lighted up, some in sunshine, others in shade, producing a wonderful effect of distance and space. This induced me to sit down to work in right good earnest, and I was soon so absorbed in my occupation, that I thought neither of time, distance, nor the country we had to ride over. Our horses had been secured and left to feed, and my men were much interested in my work, until at last, as I supposed, they grew weary. First one would leave, and go to the south side of the rocks under which I was sketching. Soon after he returned the other went; yet they said nothing. I had now been at work more than two hours, and this going to and fro had occurred several times. At length I was certain that they wished to speak to me. I looked at them, and waited for the communication. Then one of them said in his native language, "It will thunder soon," and made a sign for me to go with him. I put down my sketch, and hurried to the other side of the peak, when I beheld the cause of their alarm: evidently a frightful storm was coming toward us, for the high peaks to the west were just being wrapped in a terrible black mantle. There was not a moment to lose; the men ran to bring the horses, and I hastened to pack up my sketching materials. This was but the work of a few minutes. We then mounted and rode past the rocks to see if the storm was approaching. Several of the peaks were already obscured, and now the clouds were wheeling round a very high summit, which I supposed to be eight, or, at most, ten versts distant, across a deep valley. To be caught on this summit in such a storm was something fearful, and the men were really alarmed. There was only one place on the south side by which we could descend: it was the Cholsoun pass, and that was, perhaps, more than eight versts distant. Having watched the storm two or three minutes, we heard the distant thunder, and then knew that the conflict of the elements had begun.

Without speaking a word, we turned our horses, and started off at a gallop. It was a race for the pass, as it was only in this ravine that we could hope for shelter. Every few minutes the thunder rolled nearer and nearer, and on we galloped; the horses, with an instinctive dread of what was following, putting forth their full powers without either whip or spur. Road or track there was none; only some high rocky peaks pointed out to my companions the head of the pass. Our course was straight toward these; sometimes over fine mossy turf, then over ground rough and stony, which would, under any other circumstances, have caused both horse and rider to hesitate before dashing onward at the speed at which we were going. The storm was still behind us, for as yet we had only seen the flash, but not the streams of lightning that were descending every two or three minutes in our rear, followed by claps of thunder, which resounded among the mountains until the distant echo was lost in another loud roar. At a short distance in front of us I beheld huge pillars of rock rising up fifty or sixty feet, which reminded me of Stonehenge, but on a most gigantic scale. My men turned a little to the left to avoid this labyrinth of rocks. I looked at the place with intense interest, determined to visit it, if possible, on the morrow. We were within a couple of versts of the head of the pass when we heard a great rushing sound behind us. Instantly our heads were turned to see what was coming, when we beheld branches of cedar torn up from the valley, carried over the rocky peaks, and whirled high into the air: this was the blast before the storm, which now swept on with terrific force. Fortunately for us, the rocky pillars broke the fury of the gust, or we should have been hurled down to a certainty; for, at a short distance to each side of us, the dwarf cedars which creep over the rocks were torn up, and carried along by the hurricane. We found it difficult to sit our horses, as they swerved and bounded on when the fearful squall rushed past.

The storm was now near, but for the last few minutes there had not been a flash. This was even more appalling than the loud thunder. I turned my head, and saw a thick red stream strike among the rocks we had just passed; at the same instant there were three reports like the firing of a heavily-loaded musket over our heads, and then came a crash which made our horses shudder, although in a gallop. Now came hailstones so thick, that for a moment they almost blinded us; the lightning flashed in quick succession, and the thunder was incessant.

We reached the pass, and turned into its rugged jaws with a delight known only to a mariner when he runs his sinking craft into a safe haven. In about ten minutes we were quietly standing under the shelter of some friendly rocks, our tired horses trembling with fear. The men crossed themselves; nor did I forget to offer up my thanks for our preservation. The storm still raged above us with terrific fury and awful grandeur; but the overhanging masses under which we crouched afforded us complete protection, and I listened to the dreadful tempest with mingled feelings of awe and pleasure. In a very few minutes the ground was covered with a thick coating of hail, giving a wintry aspect to the scene which had been so calm and beautiful two short hours before. The storm rolled on: in about an hour we could only hear its murmurings in the distance. Presently the clouds were dispersed; the sun shone out in all his splendour, rendered still more brilliant by the intensely black masses of vapour which enveloped the distant crags. My companions now discovered that we were not in the Cholsoun pass, but in a small ravine down which it was impossible to proceed even on foot, for at a very short distance below our sheltering place the precipices were perpendicular to the depth of at least three hundred feet, over which a little stream was leaping, to be dispersed in vapour before reaching the bottom. It was the dashing of the water which drew my attention to it; from below, no doubt, it must have appeared exceedingly pretty.

It was now quite time to descend, as our people were encamped somewhere in the valley beneath. One of my men found that we had missed the pass, and gone considerably beyond it during the storm. We therefore rode back and turned into a ravine, which he said would lead us to the right track lower down. This proved correct; and in about two hours we were quietly seated by our camp-fire, under some magnificent cedars, on the bank of a roaring torrent greatly swollen by the storm. Our companions had heard the thunder in the distance, and there had been a few drops of rain, but not even enough to wet the ground. The forest was so thick around our camp that they could not see the mountains; it was only the rising and thundering of the torrent that told them what had happened there.

After taking sufficient refreshment, and writing up my journal by

the light of a blazing fire, I turned down at the root of a magnificent cedar, wrapped myself in my cloak, and slept soundly until morning.
—ATKINSON.

AMONG THE ICE.

BY Saturday morning it blew a perfect hurricane. We had seen it coming, and were ready with three good hawsers out a-head, and all things snug on board. Still it came on heavier and heavier, and the ice began to drive more wildly than I thought I had ever seen it. I had just turned in to warm and dry myself during a momentary lull, and was stretching myself out in a bunk, when I heard the sharp twanging snap of a cord. Our six-inch hawser had parted, and we were swinging by the two others; the gale roaring like a lion to the southward.

Half a minute more, and "twang, twang!" came a second report. I knew it was the whale line by the shrillness of the ring. Our noble ten-inch manilla still held on. I was hurrying my last sock into its sealskin boot, when M'Garry came waddling down the companion-ladders:—"Captain Kane, she wont hold much longer: it's blowing tremendously, and I am afraid to surge."

The manilla cable was proving its excellence when I reached the deck; and the crew, as they gathered round me, were loud in its praises. We could hear its deep Æolian chant, swelling through all the rattle of the running gear and moaning of the shrouds. It was the death song! The strands gave way with the noise of a shotted gun; and, in the smoke that followed their recoil, we were dragged out by the wild ice, at its mercy.

We steadied, and did some petty warping, and got the brig a good bed in the rushing drift; but it all came to nothing. We then tried to beat back through the narrow ice-clogged water-way, that was driving, a quarter of a mile wide, between the shore and the pack. It cost us two hours of hard labour, skilfully bestowed I thought; but at the end of that time, we were at least four miles off, opposite the great valley in the centre of Bedevilled Reach. Ahead of us, further to the north, we could see the strait growing still narrower, and the heavy ice-tables grinding up, and clogging it between the shore-cliffs on one side, and the ledge on the other. There was but one thing left for us;—to keep in some sort the command of the helm, by going freely where we must otherwise be driven. We allowed her to scud under a reefed foretopsail; all hands watching the enemy, as we closed in silence.

At seven in the morning, we were close upon the piling masses. We dropped our heaviest anchor with the desperate hope of winding the brig; but there was no withstanding the ice-torrent that followed us. We had only time to fasten a spar as a buoy to the chain, and let her slip. So went our best bower!

Down we went upon the gale again, helplessly scraping along a lee of ice seldom less than thirty feet thick; one floe, measured by a line as we tried to fasten to it more than forty. I had seen such ice only once before, and never in such rapid motion. One upturned mass rose above our gunwale, smashing in our bulwarks, and depositing half a ton of ice in a lump upon our decks. Our staunch little brig bore herself through all this wild adventure as if she had a charmed life.

Now a new enemy came in sight ahead. Directly in our way, just beyond the line of floe-ice against which we were alternately sliding and thumping, was a group of bergs. We had no power to avoid them; and the only question was, whether we were to be dashed in pieces against them, or whether they might not offer us some providential nook of refuge from the storm. But, as we neared them, we perceived that they were at some distance from the floe edge, and separated from it by an interval of open water. Our hopes rose as the gale drove us toward this passage, and into it; and we were ready to exult, when, from some unexplained cause,—probably an eddy of the wind against the lofty ice-walls,—we lost our headway. Almost at the same moment we saw that the bergs were not at rest; that with a momentum of their own they were bearing down upon the other ice, and that it must be our fate to be crushed between the two.

Just then, a broad sconce-piece, or low water-washed berg, came driving up from the southward. The thought flashed upon me of one of our escapes in Melville Bay; and as the sconce moved rapidly close alongside us, M'Garry managed to plant an anchor on its slope, and hold on to it by a whale line. It was an anxious moment. Our noble tow-horse, whiter than the pale horse that seemed to be pursuing us, hauled us bravely on; the spray dashing over his windward flanks, and his forehead ploughing up the lesser ice, as if in scorn. The bergs encroached upon us as we advanced: our channel narrowed to a width of perhaps forty feet: we braced the yards to clear the impending ice-walls.

We passed clear, but it was a close shave;—so close that our quarter-boat would have been crushed if we had not taken it in from the davits;—and we found ourselves under the lee of a berg, in a comparatively open lead. Never did heart-tried men acknowledge with more gratitude their merciful deliverance from a wretched death.

The day had already its full share of trials; but there were more to come. A flaw drove us from our shelter, and the gale soon carried us beyond the end of the lead. We were again in the ice, sometimes escaping its onset by warping; sometimes forced to rely on the strength and buoyancy of the brig to stand its pressure; sometimes scudding wildly through the half-open drift. Our jibboom was snapped off in the cap; we carried away our barricade stanchions, and were forced to leave our little Eric, with three brave fellows and their warps, out upon the floes behind us.

A little pool of open water received us at last. It was just beyond a lofty cape that rose up like a wall, and under an iceberg that anchored itself between us and the gale. And here, close under the frowning shore of Greenland, ten miles nearer the Pole than our holding ground of the morning, the men turned in to rest.

I was afraid to join them, for the gale was unbroken, and the floes kept pressing heavily upon our berg,—at one time so heavily as to sway it on its vertical axis toward the shore, and make its pinnacle overhang our vessel. My poor fellows had but a precarious sleep before our little harbour was broken up. They hardly reached the deck, when we were driven astern, our rudder splintered, and the pintles torn from their boltings.

Now began the nippings. The first shock took us on our port-quarter; the brig bearing it well, and, after a moment of suspense, rising by jerks handsomely. The next was from a veteran floe, tongued and honey-combed, but floating in a single table of over twenty feet in thickness. Of course no wood or iron could stand this; but the shoreward face of our iceberg happened to present an inclined plane, descending deep into the water; and up this the brig was driven, as if some great steam screw-power was forcing her into a dry dock.

At one time I expected to see her carried bodily up its face, and tumbled over on her side. But one of those mysterious relaxations, which I have elsewhere called the pulses of the ice, lowered us quite gradually down again into the rubbish, and we were forced out of the line of-pressure toward the shore. Here we succeeded in carrying out a warp, and making fast. We grounded as the tide fell; and wonld have heeled over to seaward, but for a mass of detached land-ice that grounded alongside of us; and, although it stove our bulwarks as we rolled over it, shored us up.

—Kane's *Arctic Explorations.*

A SONG FOR ST CECILIA'S DAY, 1687.

From harmony, from heavenly harmony,
  This universal frame began;
When nature underneath a heap
  Of jarring atoms lay,
And could not heave her head,
The tuneful voice was heard from high,
  Arise, ye more than dead.
Then cold and hot and moist and dry,
  In order to their stations leap,
  And Music's power obey.
From harmony, from heavenly harmony,
  This universal frame began:
  From harmony to harmony,
Through all the compass of the notes it ran,
  The diapason closing full in Man.

What passion cannot Music raise and quell?
When Jubal struck the chorded shell,
His listening brethren stood around,
And, wondering, on their faces fell
To worship that celestial sound.
Less than a God, they thought, there could not dwell
Within the hollow of that shell,
That spoke so sweetly and so well.
What passion cannot Music raise and quell?

The trumpet's loud clangour
Excites us to arms,
With shrill notes of anger
And mortal alarms.
The double double double beat
Of the thundering drum
Cries, Hark! the foes come;
Charge, charge, 'tis too late to retreat.
The soft complaining flute
In dying notes discovers
The woes of hopeless lovers,
Whose dirge is whispered by the warbling lute.

Sharp violins proclaim
Their jealous pangs and desperation,
Fury, frantic indignation,
Depth of pains, and height of passion,
For the fair, disdainful dame.

But oh! what art can teach,
What human voice can reach,
The sacred organ's praise?
Notes inspiring holy love,
Notes that wing their heavenly ways
To join the choirs above.

Orpheus could lead the savage race,
And trees uprooted left their place,
Sequacious of the lyre:
But bright Cecilia raised the wonder higher:
When to her organ vocal breath was given,
An angel heard and straight appeared,
Mistaking earth for heaven.

GRAND CHORUS.

As from the power of sacred lays
  The spheres began to move,
And sung the great Creator's praise
  To all the blessed above;
So, when the last and dreadful hour
This crumbling pageant shall devour,
The trumpet shall be heard on high,
The dead shall live, the living die,
And Music shall untune the sky.

—DRYDEN.

CHEMISTRY.

THE science of Chemistry has for its object the study of the nature and properties of the different substances of which the earth, the waters, the air, and their inhabitants, (namely, plants and animals,) are composed. In a word, it embraces the study of everything under heaven accessible to man. In its highest branches it aims at discovering the laws or rules which regulate the formation of chemical compounds generally, and in its useful applications it has been already exceedingly serviceable in directing and improving the various arts of common life, as agriculture, the working of metals, dyeing, and many other pursuits. It serves also to guide the medical man in the preparation of his remedies, and also occasionally in distinguishing between diseases which are in other respects much alike. There is, indeed, scarcely a situation in life in which a knowledge of chemistry may not prove directly useful. Lastly, it is a science, the study of which, from its simplest beginnings to its highest attempts, is rendered delightful by the constant succession of new and interesting things brought before the eye and the mind.

Almost all the substances just spoken of as the objects of chemical study, namely, the various rocks, clays, sands, and soils which compose the solid earth; the water of seas and rivers; the materials of plants and animals, are of a compound nature, that is, are made up of two or more other substances united or combined together in a manner so close and intimate as not to be generally separable by any common means; and the compound so produced is almost always different in properties and appearance from the substances of which it is really composed. These latter may themselves be of a compound nature, and each formed in like manner by the union of two or more other substances very strongly joined together, but still capable of separation by proper chemical means. Such an act of separation is called by the name of *chemical decomposition*, and the original compound substance is in such a case said to be chemically decomposed into its *components* or *constituents*.

As an example:—A piece of limestone, coral-rock, or chalk, heated red-hot for half an hour, loses nearly half its weight, and becomes quicklime. The loss is caused by the separation from the limestone of another substance (called carbonic acid) which is carried off by the vapours of the fire, but which could be easily caught and collected by proper means. The limestone is therefore decomposed by the action of heat into its components, lime and carbonic acid, which, by their union, formed the limestone, or, as it is called in chemical speech, carbonate of lime.

Both the carbonic acid, however, and the lime, are themselves of a compound nature; the first may be decomposed into two other substances, carbon and oxygen, and the second into a metallic matter, calcium and oxygen. Mere heat, indeed, will not produce this effect, which can only be brought about by very powerful means of decomposition.

In this manner a limit or boundary is sooner or later reached, and substances obtained which completely defy the efforts of the chemist to decompose them further; the carbon, oxygen, and calcium of the limestone arrived at by two successive steps of decomposition are found to resist all further attempts at decomposition; such substances are called *simple* or *elementary*, or sometimes, *chemical elements*.

The number of these elementary substances known to exist, alters with the progress of chemical science; substances which at one period resisted decomposition gave way when new and more powerful means for that purpose were applied: besides which, minerals and waters containing new elements are met with from time to time. At present they amount to over sixty. Very many of them, however, are exceedingly rare, the compounds containing them being found in very small quantities.

Elementary substances are always divided by chemists into two classes, namely, *metals* and *non-metallic substances*. The well-known and abundant metals, gold, silver, copper, iron, tin, and lead, together with a great number of rarer and less familiar substances, will stand in the first class. The components of the atmosphere, oxygen and nitrogen, hydrogen, sulphur, phosphorus, and several others, belong to the second class. Several of the elements, however, possess properties which render it difficult to decide in which class to place them.

It is very important to understand what in science is called a *physical state* or *condition* of a substance, simple or compound, as contrasted with its chemical nature. There are three such states, the *solid*, *fluid* or *liquid*, and *gaseous*, which one and the same substance may assume, passing from one to the other, backwards and forwards, without the slightest change of chemical nature. For example, water, as commonly met with, is liquid, but when cooled sufficiently it takes the solid form, and becomes ice; and, on the other hand, when sufficiently heated, boils and becomes steam or vapour, which is the gaseous condition of water. By cooling this vapour, it again becomes liquid, and, by still further cooling, it freezes to ice, and all this without the least chemical change or decomposition of any kind. The metal zinc melts easily when heated to a moderate extent, and, when still further heated, vaporises, or becomes converted into vapour, which, by cooling again, becomes liquid; and lastly, solid. In fact, very many substances, simple and compound, behave in the same manner, and have the power of existing in all three states, and a still greater number in two of them, the solid and the liquid, or the liquid and the gaseous.

Although a gas or vapour (which is the same thing in reality) is very frequently invisible to the eye, it is as much substance or matter as a solid or a fluid; it fills vessels, and possesses weight, and can be handled and experimented with, by proper means, with as much ease and certainty as a solid or a liquid. Some gases, however, are coloured yellow, violet, or red, and then they become, of course, evident to the eye.

The physical state of a substance is, in fact, dependent upon its relations to heat; a subject which must be considered in a future lesson. —FOWNES.

THE CHEMISTRY OF A CANDLE.

The Wilkinsons were having a small party—it consisted of themselves and Uncle Bagges—at which the younger members of the family, home for the holidays, had been just admitted after dinner. Uncle Bagges was a gentleman from whom his affectionate relatives cherished expectations of a testamentary nature. Hence the greatest attention was paid by them to the wishes of Mr Bagges, as well as to every observation which he might be pleased to make

"Eh! what? you sir," said Mr Bagges, facetiously addressing himself to his eldest nephew, Harry—"eh! what? I am glad to hear, sir, that you are doing well at school. Now—eh? now, are you clever enough to tell me where was Moses when he put the candle out?"

"That depends, uncle," answered the young gentleman, "on whether he had lighted the candle to see with at night, or by daylight to seal a letter."

"Eh? very good, now! 'Pon my word, very good," exclaimed Uncle Bagges. "You must be Lord Chancellor, sir—Lord Chancellor, one of these days."

"And now, uncle," asked Harry, who was a favourite with the old gentleman, "can you tell me what you do when you put a candle out?"

"Clap an extinguisher on it, you young rogue, to be sure."

"Oh, but I mean, you cut off its supply of oxygen," said Master Harry.

"Cut off its ox's—eh? what?"

"He means something he heard at the Royal Institution," observed Mrs Wilkinson. "He reads a great deal about chemistry, and he attended Professor Faraday's lectures there on the chemical history of a candle, and has been full of it ever since."

"Now, you sir," said Uncle Bagges, "come you here to me, and tell me what you have to say about this chemical, eh?—or comical; which?—this—comical chemical history of a candle."

"Harry, don't be troublesome to your uncle," said Mr Wilkinson.

"Troublesome? Oh, not at all. I like to hear him. Let him teach his old uncle the comicality and chemicality of a farthing rushlight."

"A wax candle will be nicer and cleaner, uncle, and answer the same purpose. There's one on the mantle-shelf. Let me light it."

"Take care you don't burn your fingers, or set anything on fire," said Mrs Wilkinson.

"Now, uncle," commenced Harry, having drawn his chair to the side of Mr Bagges, "we have got our candle burning. What do you see?"

"Let me put on my spectacles," answered the uncle.

"Look down on the top of the candle around the wick. See, it is a little cup full of melted wax. The heat of the flame has melted the wax just round the wick. The cold air keeps the outside of it hard, so as to make the rim of it. The melted wax in the little cup goes up through the wick to be burned, just as oil does in the wick of a lamp. What do you think makes it go up, uncle?"

"Why—why, the flame *draws* it up, doesn't it?"

"Not exactly, uncle. It goes up through little tiny passages in the cotton wick, because very, very small channels, or pipes, or pores, have the power in themselves of sucking up liquids. What they do it by is called cap—something."

"Capillary attraction, Harry," suggested Mr Wilkinson.

"Yes, that's it; just as a sponge sucks up water, or a bit of lump-sugar the little drop of tea or coffee left in the bottom of a cup. Now I'll blow the candle out; not to be in the dark, though, but to see into what it is. Look at the smoke rising from the wick. I'll hold a piece of lighted paper in the smoke, so as not to touch the wick. But see, for all that, the candle lights again. So this shows that the melted wax sucked up through the wick is turned into vapour, and the vapour burns. The heat of the burning vapour keeps on melting more wax, and that is sucked up too within the flame, and turned into vapour and burned, and so on till the wax is all used up, and the candle is gone. So the flame, uncle, you see, is the last of the candle, and the candle seems to go through the flame into nothing, although it doesn't, but goes into several things; and isn't it curious, as Professor Faraday said, that the candle should look so splendid and glorious in going away?"

"How well he remembers, doesn't he?" observed Mrs Wilkinson.

"I daresay," proceeded Harry, "that the flame of the candle looks flat to you; but if we were to put a lamp-glass over it, so as to shelter it from the draught, you would see it is round—round sideways, and running up to a peak. It is drawn up by the hot air; you know that hot air always rises, and that is the way smoke is taken up the chimney. What should you think was in the middle of the flame?"

"I should say fire," replied Uncle Bagges.

"Oh, no. The flame is hollow. The bright flame we see is something no thicker than a thin peel or skin, and it does not touch the wick. Inside of it is the vapour I told you of just now. If you put one end of a bent pipe into the middle of the flame, and let the other end of the pipe dip into a bottle, the vapour or gas from the candle will mix with the air there; and if you set fire to the mixture of gas from the candle and air in the bottle, it would go off with a bang."

"I wish you 'd do that, Harry," said Master Tom, the younger brother of the juvenile lecturer.

"I want the proper things," answered Harry. "Well, uncle, the flame of the candle is a little shining case, with gas in the inside of it and air on the outside, so that the case of flame is between the air and the gas. The gas keeps going into the flame to burn, and when the candle burns properly none of the gas ever passes out through the flame, and none of the air ever gets in through the flame to the gas. The greatest heat of the candle is in this skin, or peel, or case of flame."

"Case of flame!" repeated Mr Bagges. "Live and learn. I should have thought a candle-flame was as thick as my poor old noddle."

"I can show you the contrary," said Harry. "I take this piece of white paper, look, and hold it a second or two down upon the candle flame, keeping the flame very steady. Now I 'll rub off the black of the smoke, and—there—you find that the paper is scorched in the shape of a ring, but inside the ring it is only dirtied, and not singed at all."

"Seeing is believing," remarked the uncle.

"But," proceeded Harry, "there is more in the candle flame than the gas that comes out of the candle. You know a candle will not burn without air. There must be always air around the gas, and touching it like, to make it burn. If a candle has not got enough air it goes out, or burns badly, so that some of the vapour inside of the flame comes out through it in the form of smoke, and this is the reason of a candle smoking. So now you know why a great clumsy dip smokes more than a neat wax candle: it is because the thick wick of the dip makes too much fuel in proportion to the air that can get to it."

"Dear me! Well, I suppose there is a reason for everything," exclaimed the young philosopher's mamma.

"What should you say, now," continued Harry, "if I told you that the smoke that comes out of a candle is the very thing that makes a candle burn with a bright light? Yes; a candle shines by consuming its own smoke. The smoke of a candle is a cloud of small dust; and the little grains of the dust are bits of charcoal, or carbon, as chemists call it. They are burned the moment they are made, and the place they are made in is the case of flame itself, where the strongest heat is. The great heat separates them from the gas which comes from the melted wax, and, as soon as they touch the air on the outside of the thin case of flame, they burn."

"Can you tell how it is that the little bits of carbon cause the brightness of the flame?" asked Mr Wilkinson.

"Because they are pieces of solid matter," answered Harry. "To make a flame shine, there must be always some solid—or at least liquid—matter in it."

"Very good," said Mr Bagges; "solid stuff necessary to brightness."

"Some gases and other things," resumed Harry, "that burn with a flame you can hardly see, burn splendidly when something solid is put into them. Oxygen and hydrogen—tell me if I use too hard words, uncle—oxygen and hydrogen gases, if mixed together and blown through a pipe, burn with plenty of heat, but with very little light. But if their flame is blown upon a piece of quicklime, it gets so bright as to be quite dazzling. Make the smoke of oil of turpentine pass through the same flame, and it gives the flame a beautiful brightness directly."

"I wonder," observed Uncle Bagges, "what has made you such a bright youth."

"Taking after my uncle, perhaps," retorted his nephew. "Don't put my candle and me out. Well, carbon or charcoal is what causes the brightness of all lamps, and candles, and other common lights, so of course there is carbon in what they are all made of."

"So carbon is smoke, eh! and light is owing to your carbon. Giving light out of smoke, eh! as they say in the classics," observed Mr Bagges.

"But what becomes of the candle," pursued Harry, "as it burns away? where does it go?"

"Nowhere," said his mamma, "I should think. It burns to nothing."

"Oh dear, no!" said Harry; "every thing—everybody goes somewhere."

"Eh? rather an important consideration that," Mr Bagges moralised.

"You can see it goes into smoke, which makes soot for one thing," said Harry. "There are other things it goes into, not to be seen by only looking, but you can get to see them by taking the right means: just put your hand over the candle, uncle."

"Thank you, young gentleman, I would rather be excused."

"Not close enough down to burn you, uncle; higher up. There; you feel a stream of hot air, so something seems to rise from the candle. Suppose you were to put a very long, slender gas-burner over the flame, and let the flame burn just within the end of it, as if it were a chimney, some of the hot steam would go up and come out at the top, but a sort of dew would be left behind in the glass chimney, if the chimney was cold enough when you put it on. There are ways of collecting this sort of dew, and when it is collected it turns out to be really water. I am not joking, uncle. Water is one of the things which the candle turns into in burning—water coming out of fire. In some lighthouses, Professor Faraday says, they burn up two gallons of oil in a night; and if the windows are cold, the steam from the oil clouds the inside of the windows, and in frosty weather freezes into ice."

"Water out of a candle, eh!" exclaimed Mr Bagges. "As hard to get, I should have thought, as blood out of a post. Where does it come from?"

"Part from the wax, and part from the air; and yet not a drop of it comes either from the air or the wax. What do you make of that, uncle?"

"Eh? oh! I'm no hand at riddles. Give it up."

"No riddle at all, uncle. That which comes from the wax is a gas called hydrogen. We can obtain it from water by passing the steam of boiling water through a red-hot gun-barrel which contains a quantity of iron wire or turnings, and change them to rust; and the other part, which comes out of the end of the barrel, will be hydrogen gas, and this part of the water we can set on fire."

"Eh?" cried Mr Bagges. "Upon my word! One of these days we shall have you setting the river on fire."

"Nothing more easy," said Harry. "When pure hydrogen burns, we get nothing but water. I would like to show you how light this hydrogen is; and I wish I had a small balloon to fill with it and make it go up to the ceiling, or a bagpipe full of it to blow soap-bubbles with, and show how much faster they rise than common ones blown with the breath."

"So do I," interposed Master Tom.

"And so," resumed Harry, "hydrogen, you know, uncle, is part of water, and just one ninth part."

"As hydrogen is to water, so is a tailor to an ordinary individual, eh?" Mr Bagges remarked.

"Well, now, then, uncle, if hydrogen is the tailor's part of the water, what are the other parts?"

"There must be eight of them, to be sure."

"Good again, uncle; and these eight parts are a gas also, that is called oxygen. This is a very curious gas. It won't burn in air at all itself, like gas from a lamp, but it has a wonderful power of making things burn that are lighted and put into it. A lighted candle put into a jar of oxygen blazes up directly, and is consumed before you can say Jack Robinson. Charcoal burns away in it as fast, with beautiful bright sparks; phosphorus with a light that dazzles you to look at; and a piece of iron or steel, just made red-hot at the end first, is burned in oxygen quicker than a stick would be in common air. The experiment of burning things in oxygen beats any fire-works."

"How funny that must be!" exclaimed Tom.

"Now we see, uncle," Harry continued, "that water is hydrogen and oxygen united together; that water is got wherever hydrogen is burned in common air; that a candle won't burn without air; and that, when a candle burns, there is hydrogen in it burning and forming water. Now, then, where does the hydrogen of the candle get the oxygen from to turn into water with it?"

"From the air, eh?"

"Just so. It is the oxygen in the air that makes things burn; but if the air were nothing but oxygen, a candle would not last above a minute."

"What a tallow-chandler's bill we should have!" remarked Mrs Wilkinson.

"'If a house were on fire in oxygen,' as Professor Faraday said, 'every iron bar, or, rather, every pillar, every nail and iron tool, and the fireplace itself; all the zinc and copper roofs, and leaden coverings, and gutters, and pipes, would consume and burn, increasing the combustion.'"

"That would be, indeed, burning 'like a house on fire,'" observed Mr Bagges.

"But there is another gas, called nitrogen," said Harry, "which is mixed with the air, and it is this which prevents a candle from burning out too fast."

"Eh?" said Mr Bagges. "Well, I will say I do think we are under considerable obligations to nitrogen."

"I have explained to you, uncle," pursued Harry, "how a candle, in burning, turns into water. But it turns into something else besides that. The little bits of carbon that I told you about, which are burned in the flame of a candle, and which make the flame bright, mingle with the oxygen in burning, and form still another gas, called carbonic acid gas, which is so destructive of life when we breath it. So you see that a candle flame is vapour burning, and that the vapour, in burning, turns into water and carbonic acid gas."

"Haven't you pretty nearly come to your candle's end?" said Mr Wilkinson.

"Nearly. I only want to tell uncle that the burning of a candle is almost exactly like our breathing. Breathing is consuming oxygen, only not so fast as burning. In breathing we throw out water in vapour and carbonic acid from our lungs, and take oxygen in. Oxygen is as necessary to support the life of the body as it is to keep up the flame of a candle."

"So," said Mr Bagges, "man is a candle, eh? and Shakespeare knew that, I suppose, (as he did most things,) when he wrote,

'Out, out, brief candle!'

Well, well; we old ones are moulds, and you young squires are dips and rush-lights, eh? Any more to tell us about the candle?"

"I could tell you a great deal more about oxygen, and hydrogen, and carbon, and water, and breathing, that Professor Faraday said, if I had time; but you should go and hear him yourself, uncle."

"Eh? well, I think I will. Some of us seniors may learn something from a juvenile lecture, at any rate, if given by a Faraday. And now, my boy, I will tell you what," added Mr Bagges, "I am very glad to find you so fond of study and science; and you deserve to be encouraged; and so I'll give you a—what-d'ye-call-it? a galvanic battery on your next birthday; and so much for your teaching your old uncle the chemistry of a candle."

Adapted from Household Words.

COMPOSITION OF SOILS.

Soils adapted to the growth of plants consist of two principal portions—the organic and the inorganic. The organic portion or *humus*, as it is sometimes called, from a Latin word meaning *moist earth*, consists of the decayed remains of animal and vegetable matter, and varies greatly in quantity in different soils. In peaty soils it forms from 50 to 70 per cent. of the whole weight. In rich and long cultivated soils, it has been known to amount to 25 per cent.; but in general the proportion is much smaller. Oats and rye will grow on a soil which contains only 1½ per cent. of humus; barley will flourish with only 2 to 3 per cent; good wheat soils require from 4 to 8 per cent. In stiff clayey soils, from 10 to 12 per cent. have been found.

Now it must not be supposed that a soil is fertile in proportion as it is rich in humus. Humus supplies plants with food in the form of carbonic acid by the roots; dissolved in water, humus acts injuriously; a very small quantity imparts to water a yellow or brown colour, a state in which manures cease to be beneficial to cultivated plants, because this colouring matter indicates a deficiency of oxygen to complete the conversion of the humus into carbonic acid. In a soil impregnated with this matter in solution, the roots of plants are deprived of oxygen, without which they cannot exist; for a similar reason, the stagnant water of a marshy soil excludes air; but if the marsh be thoroughly drained, so as to admit the air freely, a fruitful meadow takes its place.

The inorganic portion of the soil consists of two subdivisions, the *soluble saline* portion, from which the plant obtains nearly all the saline ingredients contained in the ash, and the *insoluble earthy* portion, which forms the great bulk of most soils, being rarely less than 95 lbs. in a hundred of their whole weight.

This earthy constituent consists of three main ingredients:—1, *Silica*, in the form of *sand;* 2, *Alumina*, mixed or combined with sand, as *clay;* and 3, *Lime*, in the form of carbonate, as chalk, limestone, &c. Soils are named according to the proportions in which these three ingredients are mingled together. According to Johnston, 100 grains of dry ordinary soil, containing only 10 of clay, would form a *sandy soil;* if it contained from 10 to 40 grains of clay, it would make a *sandy loam;* from 40 to 70, a *loamy soil;* from 70 to 85, a *clay loam;* from 85 to 95, a *strong clay* fit for making tiles and bricks; if it contain no sand, it would be pure agricultural clay or pipe-clay. With respect to alumina, it rarely happens that arable land (land fit for the plough,) contains more than from 30 to 35 per cent. of that substance. If a soil contain more than 5 per cent. of carbonate of lime, it is called a *marl;* if more than 20 per cent., *a calcareous soil.* Oxide of iron forms 2 or 3 per cent. of sand soils, and in red soils much more.

The sand, lime, clay, oxide of iron, and organic matters mingled in various proportions, give rise to soils of various colours. In chalk districts the soil is white; in the coal fields the land is black; in the central part of England dark-red soil prevails; in other districts, the prevailing character of the soil is derived from yellow, white, and brown sands and clays.

The subsoil is of variable character; in some places consisting of porous sand or gravel; in others a light loam; in a third a stiff clay. On removing the soil we get to the solid rock, such as sandstone, limestone, slate-clay, &c. All kinds of rock by their disintegration will furnish either sandstone, limestone, or clays of different degrees of hardness, or a mixture of two or more of these in different proportions. By the action of winds, rain, and frost, rocks become disintegrated at the surface, seeds get deposited by means of winds, waters, and sometimes animals, and a soil slowly accumulates, partaking necessarily of the chemical character of the rock on which it rests. Thus, on a sandstone rock the soil is sandy; on a claystone, it is more or less a stiff clay; on limestone, it is more or less calcareous; and if the rock be a mixture of these, a similar mixture will be observed in the soil formed by its crumbling. Geology has furnished the important observation, that if the soil be bad on each of two contiguous rocks, it is generally of better quality at the place where the two rocks meet. Thus, where the plastic clay comes in contact with the top of the chalk, there is much better soil than either on the clay or on the chalk; so also where the chalk and the upper green sand mingle, there are fertile patches celebrated for their wheat crops, in the production of which the phosphates in the marls are supposed to have an influence.

—Weale.

MEN OF SCIENCE.

Sir Humphrey Davy, when an apothecary's apprentice, performed his first experiments with instruments of the rudest description. He extemporised the greatest part of them himself, out of the motley materials which chance threw in his way. The pots and pans of the kitchen, and the phials and vessels of his master's surgery, were remorselessly put in requisition. It happened that a French vessel was wrecked off the Land's End, and the surgeon escaped, bearing with him his case of instruments, among which was an old-fashioned glyster apparatus; this article he presented to Davy, with whom he had become acquainted. The apothecary's apprentice received it with great exultation, and forthwith employed it as a part of a pneumatic apparatus which he contrived, afterward using it to perform the duties of an air-pump in one of his experiments on the nature and sources of heat.

In like manner, Professor Faraday, Sir Humphrey Davy's scientific successor, made his first experiments in electricity by means of an old bottle, while he was still a working bookbinder. And it is a curious fact that Faraday was first attracted to the study of chemistry by hearing one of Sir Humphrey Davy's lectures on the subject at the Royal Institution. A gentleman, who was a member, calling one day at the shop where Faraday was employed in binding books, found him poring over the article "Electricity" in an Encyclopedia placed in his hands to bind. The gentleman having made inquiries, found he was curious about such subjects, and gave him an order of admission to the Royal Institution, where he attended a course of four lectures delivered by Sir Humphrey. He took notes of the lectures, which he showed to the lecturer, who acknowledged their scientific accuracy, and was surprised when informed of the humble position of the reporter. Faraday then expressed his desire to devote himself to the prosecution of chemical studies, from which Sir Humphrey at first endeavoured to dissuade him; but the young man persisting, he was at length taken into the Royal Institution as an assistant; and eventually the mantle of the brilliant apothecary's boy fell upon the worthy shoulders of the equally brilliant bookbinder's apprentice.

The words which Davy entered in his note-book, when about twenty years of age, working away in Dr Beddoes' laboratory at Bristol, were eminently characteristic of him:—"I have neither riches nor power, nor birth to recommend me, yet, if I live, I trust I shall not be of less service to mankind and my friends than if I had been born with all these advantages." Davy possessed the capability, as Faraday does, of devoting all the powers of his mind to the practical and experimental investigation of a subject in all its bearings; and such a mind will rarely fail, by dint of mere industry and patient thinking, in producing results of the highest order. Coleridge said of Davy, "There is an energy and elasticity in his mind which enables him to seize on and analyse all questions, pushing them to their legitimate consequences. Every subject in Davy's mind has the principle of vitality. Living thoughts spring up like turf under his feet." Davy, on his part, said of Coleridge, whose abilities he greatly admired, "With the most exalted genius, enlarged views, sensitive heart, and enlightened mind, he will be the victim of a want of order, precision, and regularity."

Cuvier, when a youth, was one day strolling along the sands near Fiquamville, in Normandy, when he observed a cuttle-fish lying stranded on the beach. He was attracted by the curious object, took it home to dissect, and began the study of the mollusca, which ended in his becoming one of the greatest among natural historians. In like manner, Hugh Miller's curiosity was excited by the remarkable traces of extinct sea animals in the old red sandstone on which he worked as a quarryman. He inquired, observed, studied, and became a geologist. "It was the necessity," said he, "which made me a quarrier, that taught me to be a geologist."

—SMILES' *Self-Help.*

FROM "THE DESERTED VILLAGE."

IN all my wanderings round this world of care,
In all my griefs—and God has given me share—
I still had hopes my latest years to crown,
Amidst these humble bowers to lay me down;
To husband out life's taper at the close,
And keep the flame from wasting by repose.
I still had hopes, (for pride attends us still,)
Amidst the swains to show my book-learned skill;
Around my fire an evening group to draw,
And tell of all I felt and all I saw.

And, as a hare whom hounds and horns pursue,
Pants to the place from whence at first he flew,
I still had hopes, my long vexations past,
Here to return—and die at home at last!
O blest retirement! friend to life's decline!
Retreat from care, that never must be mine!
How blest is he who crowns, in shades like these,
A youth of labour with an age of ease;
Who quits a world where strong temptations try,
And since 'tis hard to combat, learns to fly.

For him no wretch is born to work and weep,
Explore the mine or tempt the dangerous deep:

No surly porter stands in guilty state,
To spurn imploring Famine from the gate.
But on he moves to meet his latter end,
Angels around befriending virtue's friend;
Sinks to the grave with unperceived decay,
While resignation gently slopes the way;
And all his prospects brightening to the last,
His heaven commences ere the world be past!

—Goldsmith.

KNOWLEDGE.

"What an excellent thing is knowledge!" said a sharp-looking, bustling little man to one who was much older than himself. "Knowledge is an excellent thing! Knowledge is power!" repeated he; "my boys know more at six and seven years of age than I did at twelve."

"They can read all sorts of books, and talk on all sorts of subjects. The world is a great deal wiser than it used to be. Everybody knows something of everything now. Do you not think, sir, that knowledge is an excellent thing?"

"Why, sir," replied the old man, looking gravely, "that depends entirely upon the use to which it is applied. It may be either a blessing or a curse. Knowledge is only an increase of power, and power may be a bad as well as a good thing." "That is what I cannot understand," said the bustling little man. "How can power be a bad thing?"

"I will tell you," meekly replied the old man; and thus he went on: "When the power of a horse is under restraint, the animal is useful in bearing burdens, drawing loads, and carrying his master; but when that power is unrestrained, the horse breaks his bridle, dashes his carriage to pieces, or throws his rider." "I see! I see!" said the little man.

"When the water of a pond is properly conducted by trenches, it renders the fields around fertile; but when it bursts through its banks, it sweeps everything before it, and destroys the produce of the field." "I see! I see!" said the little man; "I see!"

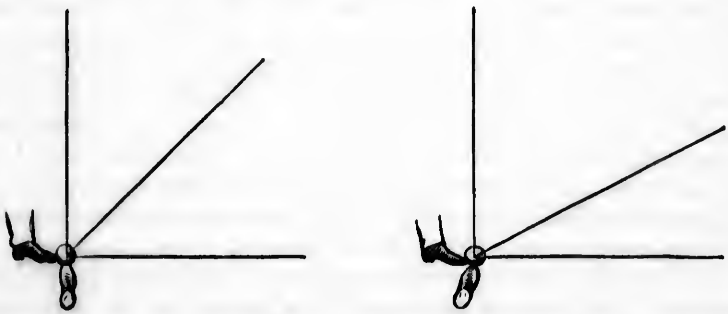
"When a ship is steered aright, the sail that she hoists enables her the sooner to get into port; but if steered wrong, the more sail she carries, the further she will go out of her course." "I see! I see!" said the little man; "I see clearly!"

We have seen in a former lesson, that the immense variety of objects, with which a bountiful Creator has enriched and beautified the world, can be reduced to systems of knowledge under five great heads, commonly called the Natural Sciences. It is true that there exists upon our earth no substance which is not included under two of these sciences, being classed as belonging either to Geology, Botany, Zoology, or Meteorology, and also to Chemistry. But although substance or matter is thus, as it were, exhausted, we must always remember that it alone does not make a world. As man would be nothing without mind, so would matter be actually nothing without power. It is power or force, call it what you will, that first brought together the atoms of which our earth is composed, and that still continues to hold them bound in one; it is power which makes this globe circle through the heavens on its course around the revolving sun, and that sends down to us the light and heat which that great luminary bestows: it is power, mysterious power, that excites in the atmosphere the whirlwind and the zephyr, that causes the great sea waves to toss and foam, and that brings to our ears the wonderful thing we call sound. Power, then, is not to be despised. Try to imagine a world without it. You cannot; for if there were no power added to matter, the atoms—which you will remember reading about in the paragraph on chemistry—the particles, I say, of which everything in the world consists, would have nothing to hold them together. You think, perhaps, that the millions of atoms composing the world would fly about in space. Not at all; for there would be no force to make them fly. Then they would stand still in the place where they were created. Not even that; for there would be no power to separate them from surrounding space, no force to hinder them from falling away into nothingness. There is no such thing, therefore, in this world, whatever may be the case in others, as matter unaccompanied by force. Nobody ever saw force, or felt it; it is invisible and intangible like the human mind; but, like that mind also, we can see and feel its effects daily, hourly, momentarily, at all times and in all places. It is visible in the motion of the heavenly bodies, in the ship sailing before the wind, and in the river dashing over its rocky bed. Every day that we live we feel that it dwells within us by the actions it enables us to perform; and the resistance of the solid earth, the upward growth of the flower, the many motions of the animal creation, all attest the existence of that wonderful agent,—force.

If power or force can neither be handled nor seen, how are we to describe it and its operations? How can we study it systematically as we would the objects of the Natural Sciences? What can be said about it? We cannot speak of a red or a blue, a wet or a dry, a hard or a soft force; but there is one way by which we can characterise it, and that is by quantity. We can say of a stone which is thrown only half as far as another, that it is projected with half the force of the other, or, if we are speaking of two walls of unequal strength, we may remark that it would require twice as much force to knock down the one as it would to demolish the other. Thus, we make use, in the first place, of the fraction $\frac{1}{2}$, and, in the second, of the whole number 2, in describing one force as compared with another. These belong to the science of Arithmetic, a Greek word meaning *pertaining to numbers*.

At other times it is convenient to make a different kind of calculation. Suppose that two boys kick a football at the same moment, and in the same direction. We wish to know how much force each boy exerted in kicking the ball. But it might happen that we would often require to make such a calculation; and, therefore, we find a convenient form that will apply to all boys, forces, and footballs, at all times and places. We call the force of one boy's kick *a*, that of the other boy's *b*, and the distance the ball was kicked altogether *c*. Now we can make ever so many forms or *formulæ* (the plural of *formula*, a *form* or *model*) out of these three letters, which cannot fail to be correct, whatever the numbers may be that they stand for. Thus we can say, the force *a* added to, or *plus* (a Latin word meaning *more*) the force *b* is equal to *c*, the distance the ball travelled. So, if we take away the force *a* from *c*, we will know what the force *b* is; or if we take *b* from *c*, we will find the value of the force *a*. This we express by saying, c *minus* (a Latin word meaning *less*) the force *a*, or with *a* subtracted from it, is equal to *b*, and *c minus b* is equal to *a*. Instead of using the words *plus* and *minus*, however, we put between the letters the signs + (plus) and − (minus.) These letters and signs belong to the science of Algebra. Algebra is an Arabic word of uncertain meaning; the Arabians being the first to introduce into Europe the knowledge, which they acquired from the Hindoos, of the science that reasons about quantities by means of letters, signs, and symbols.

There is still another method of calculation which can be employed to describe a force, both as to its quantity and its direction. Suppose that our two boys were to strike the football with equal force, but in different directions; the one forward, and the other sideways. The ball would naturally go neither forward nor sideways, but exactly half-way between the two directions, making with each of them what is called an angle, thus (Fig. 1.)—



If, instead of striking with equal force, one of the boys were to hit harder than the other, the ball would go more in his direction, (Fig. 2,) thus making a smaller angle between the course in which he wishes to send it and that which it really takes, while, of course, the angle between the ball's direction and that in while the other boy wished it to go would be greater. If, therefore, we could learn the proportions of angles to one another, we could find how much greater the force of the one stroke would be than that of the other. But all this depends upon the science which deals with the measurement of lines, angles, and all figures made up of them; this science is Geometry. The word Geometry, like other names of sciences, is from the Greek, and signifies *land-measuring*,—the science of Geometry being, in early times, first applied to that purpose, which is now called the Art of Mensuration, or measuring.

We have thus seen that forces are described by Arithmetic, Algebra, and Geometry; but these are all included under one great science called Mathematics. The word Mathematics comes to us from the Greek, and may be fairly translated as *the Science*, so called, because the ancients, who were devoted to the study of it, looked upon Mathematics as the only true science and the basis or groundwork of all others. Everything belonging to form and position, quantity and number, is embraced by this science. Mathematics are of two kinds: pure, and mixed or applied. When they are called pure, it is in the same sense as we speak of water being pure, that is, without any mixture of other ingredients. Now we not only speak of 2 books, 3 lessons, 4 scholars, but of the numbers 2, 3, and 4, without referring to anything apart from the numbers themselves. In Algebra, you know that the letters *a*, *b*, *c*, &c., stand for anything at all; and in Geometry we can speak of an angle, a straight line, or a circle without alluding to any particular angle, line, or circle. Such are Pure Mathematics. But Mathematics are applied to numberless uses; to keep accounts and to measure fields, to direct the sailor in his course, and to teach the soldier how to fire a rifle or point a cannon. These, however, are not sciences, they are arts; for an art is a science put into practice. There are applications of the science of Mathematics which are sciences themselves: namely, the application of it to the many objects which nature exhibits to our gaze, and, more especially, to the description of force, that force which lives and moves in everything in the world. Thus mixed up with solids and liquids and gases, weighing the earth, sounding the sea, numbering the stars, and measuring the speed of light and sound, they are no more Pure, but become Applied Mathematics, and give birth to several systems of knowledge which may be called the Mathematical Sciences. In the following short sketch of these you will meet with little or nothing of a mathematical nature; not till you begin to study these sciences in earnest will you have to do with that system which, in many respects, deserves the title of *The Science.*

The six sciences to which Mathematics are applied are generally ranked under the one great head of Physics, from a Greek word signifying *things pertaining to nature*, or, as it is oftener called, Natural Philosophy. Natural Philosophy has to deal with the whole of Nature's wide domain, viewing it, not as a passive field for contemplation, but as a scene of restless activity, and attempting to explain the causes to which that activity is due. Endeavour, now, to grasp with your mind this wide domain; strive to include in your thoughts the earth we live upon; the sky above us, with the sun, moon, and stars shining in it; land and water; plants and animals, and the atmosphere with all that it contains. These are all composed of matter that may be seen and felt, whether it be solid matter, as stone and wood; liquid, as oil and water; or gaseous, as air and coal gas. If we regard matter as one thing, we find that the Natural World, which is to be carefully distinguished from the Spiritual World, contains but two great elements—matter and force. I have already said that we cannot see force; we can, however, see its effects. When force is applied to a body at rest, the body begins to move, and when a similar force is applied to it in an opposite direction it stops; we thus see the effects of force not only in *motion* but also in *rest*. Force is frequently called by the name of one of its effects, and in many books we see the first laws of Physics treated of under the title of Matter and Motion.

Let us enter now upon the consideration of the Mathematical Sciences, and, in order to do so aright, let us first reflect upon the two great subjects of thought, matter and motion. We look up into the heavens, and see the planets moving through space in their paths around the sun; we know, also, that our own earth revolves along with them, while the moon, wheeling round the earth, accompanies it on its course. We ask ourselves the question: what is the reason that the heavenly bodies thus move in regular order through the sky, without anything visible to support or keep them in their places? Upon this globe, the round ball which we inhabit, there are continents, seas, and islands, that constantly revolve with it in all directions, now up and now down, so that we speak of those who live upon the other side of the world as being at our antipodes, or opposite our feet. Why do not these people fall off? What hinders the earth from flying to pieces with so much whirling about? How is it that the water of oceans, lakes, and rivers, does not flow out of the world, when the parts of the earth in which these are situated are turned upside down? There are many other questions suggested by our daily experience. When we throw a stone up in the air, why does it return to the ground and not remain aloft, like the stars? How is it that a ball will not continue to roll along the ground in the same way as the stars perpetually circle round in the sky? These questions are all very important, notwithstanding that they appear so simple, and have engaged the attention of some of the greatest men that ever lived. The science which answers these and similar questions, which describes the properties or qualities of matter, and explains the laws that govern the *force* which acts upon it, is called Mechanics. Mechanics is a Greek word, and its primary, or first, signification was, *that which pertains to machines or contrivances*, because it first denoted the explanation of that power or force which man exerts upon natural objects by means of his arms, hands, and other natural or artificial machines. Now, however, it embraces all the contrivances of nature as well, and, as we have seen, is applied to the science which investigates forces and powers, and their action upon bodies, or the laws which govern matter and force. There are three kinds of matter; solid matter, such as earth, stone, wood, and flesh; fluid, as water, quicksilver, sap, and blood; and gaseous or elastic, because it contracts and expands, such as air, gas, vapour, &c. Each of these kinds of matter has a separate division of mechanics allotted to it. Thus we have three sciences instead of one; namely, mechanics of solids, mechanics of fluids, and mechanics of elastic bodies. Let us first examine the mechanics of solids. We have already learned that wherever there is matter, force is also present and acting upon it. Now, we observe that by far the greater portions of this earth, such as its mountains and rocks, the buildings which men have erected upon it, and many similar things, do not move at all. The earth certainly moves and they go along with it, but they do not alter their positions on the earth. If we set down a chair, a book, or other inanimate object, in any place, we naturally expect to find it in the same spot, unless moved by some person. But if force is constantly acting upon objects, (and we have seen that force reveals its existence by motion,) why do not these objects move? The reason simply is, that they are beset, as it were, by equal forces on every side, and are thus prevented from shifting their position. That division of the science of the mechanics of solids, which treats of solid bodies in a state of rest, and of the forces that keep them so, is called Statics, a Greek word which means *bringing to a standstill.* But solid bodies do not always stand still. The world revolves through space, snow and hail fall from the clouds, a hand-sleigh slides down a hill, and if we strike a ball it will fly forward with greater or less velocity, according to the force with which it is struck. There must, therefore, be a division of the science treating of the motions of solid bodies, and of the influence of moving bodies upon one another. This division is called Dynamics, also from the Greek, and signifying *that which pertains to power or force.*

When we turn our attention to fluids, we find that water or any other liquid, whether in seas, lakes, and rivers, or in an open vessel,

such as a basin, tub, or pail, is always level on the surface, whatever inequalities may exist in the bottom or sides of that which contains it. If we take away the sides of the vessel which uphold the liquid, it will immediately give way and flow evenly over the surface of the ground, or, as it is scientifically expressed, will seek its own level. This case is very different from that of solid bodies, which are of all shapes, square and round, rough and smooth, and can stand alone, even if they are as high as the pyramids of Egypt. There must be some good reason for this, and every one who wishes to know what that reason is, will study the science of Hydrostatics, which is another Greek word equivalent to *bringing fluids to a standstill.* But this is not all we have to learn concerning fluids. We have seen already, that water moves to find its own level, whether, in order to do so, it has to spread equally over the ground, or to rise through a pipe to the distance of many feet. It can also be made to move upwards, far beyond its own level, in pumps and similar machines. Naturally, however, it moves downwards, and seeks the lowest ground. What causes these varieties of motion? To answer this question satisfactorily, you must consult some work upon the science of Hydrodynamics, or *water-power.*

There still remains another department of mechanics; namely, that which deals with gaseous or elastic bodies. This department has a name of its own, Pneumatics, which in the Greek signifies *things pertaining to air or wind.* Like the mechanics of solids and fluids, it has two divisions. The first of these treats of the properties of air at rest; such as its pressure, which is about fourteen tons' weight to a man of average size; its weight, which is from eight to nine hundred times less than that of water, and which decreases the higher we ascend in the atmosphere; its elastic nature, so plainly shown by an ordinary pop-gun; and its power of supporting other substances, as in the case of a column of quicksilver in a barometer. This division is called Aerostatics, being applied, not to air alone, but to all gaseous bodies, and bearing in Greek a meaning similar to that of Hydrostatics, merely altering the word *fluids* to *gases.* The second division deals with the motions of gases, particularly with air and its mechanical effects, such as the action of wind, exhibited in the turning of windmills, the sailing of ships, blowing down trees, dispersing clouds, and other natural and artificial employments. It sometimes encroaches upon the Science of Meteorology, which was described among the natural sciences. This part of Pneumatics is denominated Aerodynamics, or *air-power.*

Thus far we have briefly examined the three departments of mechanics with their subdivisions, in all of which the prevailing idea is that of *force*, a something that can only be described by the one great science of Mathematics. There remain no other natural objects than those included under these three departments, to which force can be applied. Whence, then, do we get our other sciences? One we find dealing with those bodies which lie beyond our atmosphere, outside of the earth; another treats of that light which all of them, but one in particular, send down to our eyes; and the third, of that application of force to our ears which we call sound.

Who has not, many a time, gazed upon the majestic, light-giving sun, the pale moon, and the countless host of stars that spangle the sky, with feelings of wonder and admiration? How often have we not asked ourselves what all these bright specks in heaven were, how far it was to them, how large they were, how they moved, and what kept them from falling out of their places? These and a thousand other questions are answered already, while the discoveries that are constantly being made by means of the telescope are satisfying even more curious inquirers than ourselves. The science which possesses so vast a domain, extending millions and millions of miles beyond this little earth, and including immense worlds and systems of worlds with which our small planet would hardly bear comparison, is that already well known to you as Astronomy. The Greek word Astronomy signifies *the law of the stars*, a law, or rather a series of laws, which could never have been discovered but for the existence of the science of Mathematics.

The sun is the great source of light to the system of which our earth forms a part. How great must that force be which sends down the cheering sunbeam through ninety-five millions of miles, in eight minutes of time, to illumine our earth! You wonder, perhaps, how men could calculate the time that such a very subtle body as light takes to travel. It is not, however, my intention to tell you in this lesson, which is only designed to stimulate your curiosity with regard to the Mathematical Sciences. All such information you will find in books written upon the science of Optics, or, as the Greek term may be translated, of *things pertaining to sight or vision*, for our eyes are the instruments with which we see and study light. This science embraces everything connected both with light in itself and our perception of it. It tells us what light is, how it moves, through what substances it will pass, and from what bodies it is reflected. It also explains the nature of all optical instruments, natural and artificial;

the eye, the telescope, the microscope, spectacles and looking-glasses. Under it also is included the wonderful phenomena or appearances which we know as *colours;* for a single white ray of light is composed of seven smaller rays, *red*, *orange*, *yellow*, *green*, *blue*, *indigo*, and *violet*, such as you have seen separated by a glass prism. This science consists of three divisions: Dioptrics, the science of light passing through any medium, as air, water, and glass; Catoptrics, the science of reflected light, as from a mirror; and Chromatics, or the science of colour. All these are Greek names appropriate to the objects of the optical sciences.

We have now arrived at the last of the Mathematical Sciences; that, namely, which investigates the nature and properties of sound. If, by means of a machine called the air-pump, we empty a glass vessel of the air which you know pervades everything, and ring a bell in the empty jar, no sound will be heard. From this it is plain that the presence of air, or some other medium, is necessary in order to constitute sound. The science of Acoustics, a Greek word meaning *things pertaining to the sense of hearing*, teaches that sound is produced in consequence of the waves excited in the atmosphere or other medium (for water will carry sound) by the moving body, such as a bell, a falling tree, or a gunshot, striking upon the ear in rapid succession. To this science belongs the whole theory of music, vocal and instrumental, with many other interesting subjects of a similar nature. Acoustics are of two kinds: Diacoustics, or the science which treats of sound conveyed through a medium, as air, water, &c.; and Catacoustics, dealing with reflected sounds, such as an echo. These words are derived, like most of those with which we have become acquainted in this lesson, from the language of the ancient Greeks, who first studied the subjects to which they are applied; and, as you will at once perceive, are analogous to those denoting two of the divisions of the science of Optics.

We have now completed our view of the Mathematical Sciences. They are not so easily understood, nor so evident to our senses, as the five Natural Sciences, but the objects with which they have to do are those we meet with every day in our lives, and which, if we be true searchers after knowledge, we will not neglect to look into. Before doing so, however, we must apply ourselves diligently to the study of Pure Mathematics, and, when we have fairly mastered their various branches, we will find their application to matter and force one of the most ennobling of pursuits and agreeable of all recreations.

The Mathematical Sciences.

I. Pure Mathematics.		
II. Mixed or Applied Mathematics, Physics, or Natural Philosophy.	Mechanics of Solids, ...	Statics. Dynamics.
	Do. of Fluids, ...	Hydrostatics. Hydrodynamics.
	Do. of Gases, or Pneumatics, ...	Aerostatics. Aerodynamics.
	Astronomy.	
	Optics, ...	Dioptrics. Catoptrics. Chromatics.
	Acoustics, ...	Diacoustics. Catacoustics.

MATTER AND MOTION.

All things, of the existence of which we are informed by our senses, bear the general appellation of *matter.* The earth which we inhabit, the air which we breathe, the distant planets and suns, and probably the whole of that space in which the heavenly bodies move, are matter, though some are much more solid or dense than others. A stone, for instance, is denser than water; water again is denser than cork; yet all are alike matter. The earth is more solid than the planet Jupiter, which has been ascertained to be as light as water; but still both are alike material.

Matter, in all its forms, is subject to various fixed rules or laws, which have been established by the Creator for very important ends. By one of these it is ordered that every particle or mass of matter possesses a power of *attracting* other particles or masses. The attractive power of masses of matter is in proportion to their respective sizes, when their densities and distances are the same. Thus, one of those globules of ink which sometimes start from our pen, and settle lightly upon a hair of the paper, will be found to be drawn up towards a larger drop which we carefully bring near to it. Thus, also, we often observe that a little stalk of tea, floating in our cup, no sooner approaches the side than it is suddenly drawn towards it, and settles as closely as it can alongside. All pieces of matter would be observed to exercise the same attractive influence over each other, if in circumstances equally favourable to allow of a movement.

The attraction of a body is greatest in its own immediate neighbourhood. The attraction has also a reference, not to the surface of the body, but to its whole mass, the centre being the point where the influence is strongest. At a point twice as far from the centre as the surface is, the attraction is diminished to a fourth of what it is at the surface; at three times the distance it is only a tenth; at four times a sixteenth; at five times a twenty-fifth; and so on, the diminution being always as the *squares* of the distances; that is, the distances multiplied by themselves. The distance from the centre of any mass of matter to its surface is called its *semi-diameter;* that is, the half of its diameter or thickness. When we wish, therefore, to ascertain the relative amount of the attraction which any mass of matter exercises over another, we have to inquire how many semi-diameters of the larger the smaller is distant from it, and to multiply that number by itself. The result shows how many times the attraction at this distance is less than at the surface. The moon, for instance, is distant 240,000 miles from the earth, or as much as sixty semi-diameters of the earth; 60 multiplied by 60 gives 3600; consequently, the attraction exercised by the earth upon the moon is a 3600th part of what it would exercise upon the same mass at its own surface.

When the particles of a body can be suspended in the air in a fluid state, they will, if not under the attractive influence of some other body, arrange themselves, by virtue of the same law, around a centre, and take a spherical form. Thus a small quantity of dew suspended on the point of a thorn or leaf becomes a globule, because, in that case, the attraction of the particles towards their own centre is greater than the attraction of any neighbouring body. In consequence of this law of nature, it is considered probable that the globes of space, including our own earth, were originally in a fluid state—that, in that state, they unavoidably assumed a spherical shape, and were then hardened into their present consistency.

Attraction also bears the name of *gravitation*, from a word signifying weight, for weight is entirely a result of the laws of attraction. The attractive influence of the earth pulls down and holds bodies to it. Thus the falling of a body to the earth is only an effect of attraction, and the weight of a body is only a pressure downwards, in obedience to the same law of gravitation. As gravitation acts upon all the particles or atoms of matter in a body, and not upon the mere surface or superficial bulk, those bodies in which matter is most dense, or have the greatest number of particles, are the heaviest. All falling bodies tend in a direct line to the centre of the earth, which is the centre of the earth's attractive power; and therefore, whenever we let fall a body from our hand, it proceeds in a straight line down to the surface, where it is arrested. This is well exemplified by the act of dropping a ball from our hands as we stand upon a slope or mountain side. The ball does not fall towards the centre of the mountain, but in the direction of the earth's centre. What we call *down* and *up* are merely relative terms. That which is down to us is up in respect to those who live on the opposite side of the globe, and that which is up to us is down to them.

Attraction, as already stated, is strongest when the bodies are near each other. As we proceed upwards from the earth, it becomes weaker. For this reason it has not so much strength at the top of high mountains as at the level of the sea. Weight, consequently, differs in different situations. A ball of iron, weighing a thousand pounds at the level of the sea, if weighed in a spring balance on the top of a mountain four miles high, will be found to have lost two pounds of its weight, in consequence of the attractive power of the earth being diminished to that extent at that greater remoteness from the centre. In consequence of its having begun to revolve when in a state of fluidity, the earth at its equator has a diameter exceeding that of its poles by twenty-six miles; consequently the surface at the poles is thirteen miles nearer the centre than the surface at the equator, a proportion being observed in all intermediate places. Objects are therefore found to weigh more heavily in a spring balance as we advance from the equator to the poles. From the same cause objects fall more rapidly at the poles than at the equator. Pendulums, being similarly affected, swing more actively at the poles than at the equator. For this reason pendulums for regulating the motion of clocks require to be adjusted in length according to the distance of the place where they are used from the equator; because the longer the rod of the pendulum is, it vibrates the slower. A pendulum in Edinburgh would require to be a little longer than one in London, in order to vibrate exactly sixty times in a minute.

Gravitation, as already mentioned, does not act on the mere surface of bodies, or according to their bulk, but is exerted in reference to all the particles or atoms individually which compose the mass of a body. In the case of liquids, in which the atoms slightly cohere, the atoms have liberty to spread themselves over the earth, and to seek the lowest situation for repose. In the case of solids a different operation is observable. In them the particles of matter stick so closely together that they are not at liberty to obey the laws of gravitation individually, but rally, as it were, round a common centre, upon which the force of attraction may be considered to act for the general behoof. This common centre, or point, is scientifically called the *centre of gravity*. This point in bodies always seeks the lowest level, in the same manner that water seeks the lowest level.

The centre of gravity in round, square, or other regular shaped bodies, of uniform density in all their parts, is the centre of these bodies. When a body is shaped irregularly, or when there are two or more bodies connected, the centre of gravity is the point about which they will balance each other. The disposition which the centre of gravity in bodies has to seek the lowest level is the cause of the tumbling or overturning of bodies. Unless the base be made sufficiently broad to prop up the bodies, their heaviest part will fall over. Heavily and highly-loaded coaches and carts frequently overturn from the raising of their centre of gravity too high, and from the base or wheels of the vehicle not being wide enough to support them when any jar occurs. In the various natural structures displayed in the animal and vegetable kingdoms, the centre of gravity is always so situated as to produce a just balance and harmony of parts.

Another of the laws of matter relates to its movements. Rest and motion are equally natural to matter, and both alike result from certain circumstances. Thus, for instance, if a cricket-ball be allowed to lie upon the ground, it naturally remains at rest. If it be put into motion, it is natural for it to continue in that motion, in a straight line, until stopped by some resisting force. In the case of a cricket-ball driven by a bat, the air, which is another, though rarer kind of matter, presents a certain amount of resisting force. It encounters another obstruction in the friction or rubbing of its body on the ground; this obstruction being the greater in proportion to the roughness or unevenness of the ground. When at length as much force has been exerted in stopping it as was exerted in setting it in motion, it comes to a pause. Being ourselves placed in circumstances where the forces just described are constantly operating, we cannot well conceive that it is equally natural for a piece of matter to remain in motion as to remain at rest, for, on account of those forces, we always see motion sooner or later brought to a stop. But when we conceive a mass of solid matter set in motion through a space entirely free of all resisting forces, we readily perceive how natural it is for it to continue in motion, seeing that, in such circumstances, an amount of obstruction equal to the impulse is not to be found.

When a body revolves on a centre, the outer parts of course acquire motion. The tendency of the motion of these parts is, in reality, to go in a straight line. They are only kept within the circle of revolution because they are fixed. If any piece of the revolving body were suddenly detached or let loose, it would be seen to fly off in a straight line, being forced or impelled to do so by the motive power or force already exerted upon it. We may observe this law operating when we whirl a stone round in a sling. The stone is then felt to have an inclination to start away, and if we suddenly let slip the string, it does start away with great speed. For the same reason, when a mop is twirled, we see each of the threads flying straight out, and they only cease to do so when the twirling is stopped. Motion thus produced is called *centrifugal* (that is, centre-flying) *force*, in distinction from the power of attraction, which is sometimes called *centripetal* (centre-seeking) *force*.

In consequence of centrifugal force, the planets, in wheeling round the sun, have a tendency to fly away into space; and they would fly away if they were not retained in a particular path or orbit by the attractive power. Thrown outwards by one power, and drawn inwards by another, they have settled into paths where the two forces balance each other, so that they can neither go farther from the sun nor come nearer to him than they do. In each case the size of the planet, the rate of its speed, and its distance from the sun are circumstances exactly suiting each other; and were there the least change in one, the rest would need to be changed to preserve the economy of the planet. Were the earth, for instance, made a little larger, and its attraction to the sun thus increased, it would require either to move quicker or to remove to a greater distance, in order to keep from falling into the sun. Or were the distance of the earth from the sun to be lessened, the earth would equally require to move quicker in order to keep itself away from the sun. In fact, the earth is, at one time of the year, a little nearer the sun than at another time, and, when nearer, it does move more quickly, and thus maintains itself in its appointed course.

There are many other equally nice arrangements in the planetary system, which show that it must have originated in accordance with fixed laws in nature, and that by these laws it is still sustained. It is supposed that the planets and the sun were originally one soft mass; and that the planets were portions disengaged from the mass, which, by the law of attraction, necessarily assumed a globular shape, and, by the laws of attraction and motion together, began a circular revolution in certain orbits. The laws by which these results are supposed to have been brought about appear very simple, for we see them operating in many familiar things on earth; but this apparent simplicity only serves the more expressively to show the greatness of that power which created both matter and its laws.

All objects connected with moving bodies possess a motion in common with these bodies. Thus, all things on the earth, including the atmosphere, have a motion in common with the earth; a person driving in a chaise has a motion in common with the chaise; a person in a moving vessel at sea has a motion in common with the vessel. In all cases, the motion which is given to any large body passes also into the smaller bodies about or connected with it. This participation of motion in all bodies moving in connected masses forms one of the most remarkable phenomena in nature. In consequence of it, all objects whatever keep their proper places in or about the large moving bodies with which they are in contact, and hence no confusion arises in the relative situation of objects on the earth from its motion.

For example, when we leap straight upwards from the ground, the earth does not slip away from below us; we fall on the spot whence we arose. Sitting in the cabin of a moving vessel, if we let a small object drop from our hand to the floor, it falls on a point in the floor immediately below; the floor does not leave it behind. The reason is, that the small objects possess an onward motion which is derived from the larger, and which is retained during their descent. This onward motion remains in the disengaged bodies till they meet some new impression of force—something to stop them. If we attempt to leap from a moving body, such as a coach or boat, we continue to possess the motion which we previously had until we reach the earth, when we receive a shock by the destruction of the motion we possessed. If the motion of the vehicle be very quick at the time, it is scarcely possible, in making such a leap, to avoid being pitched forward, by the upper part of our bodies retaining the motion which our feet lose on resting on the ground. The motion we possess in common with the earth, and the perfect smoothness of the earth's motion, render us incapable of feeling our own motion, or of seeing the earth move along with us. Also, in driving in a coach, and looking at the road-side, we feel as if it were not the coach which was running but the road, which seems to be moving past us.

By the application of a *motive* or *moving* force to solid objects, such as instruments, tools, or machines, very wonderful results are effected; as, for example, when we see a man using a bar or beam to raise a block of wood or stone, which he could not lift by his hands alone. The bar which is used for purposes of this nature is called a *lever*, from a French word signifying to raise. The object which supports the lever where it presses against the ground is called the prop or *fulcrum*. By lengthening the lever betwixt the prop and the handle, we can increase the effect, or the power of lifting to any extent; but the longer or more powerful we make the lever, the longer time is occupied in working it. In this manner power is gained by a sacrifice of time, or a loss of quickness; and if we wish quickness, we must exert the greater force in proportion. Practically, the loss of time is of no importance, because it would often be quite impossible to raise heavy weights by the united efforts of men's hands, without the aid of some kind of instruments or machines. The purpose of machinery, therefore, is to lesson and aid human labour. At an inconsiderable expense, and with a small degree of trouble in attending to it, a machine may be made to do the work of ten, fifty, or perhaps as many as five hundred men; and the work so simply effected by inanimate mechanism serves to cheapen and extend the comforts and luxuries of life to the great body of the people.

The operations of motive forces in connexion with solid bodies form the subject of the science of MECHANICS.

—*Introduction to Sciences.*

THE INVENTIONS OF ARCHIMEDES.

IT is scarcely possible to view the vast steam-ships of our day without reflecting that to a great master of mechanics, upwards of 2000 years since, we in part owe the invention of the machine by which these mighty vessels are propelled upon the wide world of waters. This power is an application of "the Screw of Archimedes," the most celebrated of the Greek geometricians. He was born in Sicily, in the Corinthian colony of Syracuse, in the year 287 B.C., and, when a very young man, was fortunate enough to enjoy the patronage of his relative Hiero, the reigning prince of Syracuse.

The ancients attribute to Archimedes more than forty mechanical inventions—among which are the endless screw; the combination of pulleys; an hydraulic organ, according to Tertullian; a machine called the *helix*, or screw, for launching ships; and a machine called *loculus*, which appears to have consisted of forty pieces, by the putting together of which various objects could be framed, and which was used by boys as a sort of artificial memory.

Archimedes is said to have obtained the friendship and confidence of Hiero by the following incident. The king had delivered a certain weight of gold to a workman to be made into a crown. When the crown was made and sent to the king, a suspicion arose in the royal mind that the gold had been adulterated by the alloy of a baser metal, and he applied to Archimedes for his assistance in detecting the imposture: the difficulty was to measure the bulk of the crown without melting it into a regular figure; for silver being, weight for weight, of greater bulk than gold, any alloy of the former in place of an equal weight of the latter would necessarily increase the bulk of the crown; and at that time there was no known means of testing the purity of metal. Archimedes, after many unsuccessful attempts, was about to abandon the object altogether, when the following circumstance suggested to his discerning and prepared mind a train of thought which led to the solution of the difficulty. Stepping into his bath one day, as was his custom, his mind doubtless fixed on the object of his research, he chanced to observe that, the bath being full, a quantity of water of the same bulk as his body must flow over before he could immerse himself. He probably perceived that any other body of the same bulk would have raised the water equally; but that another body of the same weight, but less bulky, would not have produced so great an effect. In the words of Vitruvius, 'as soon as he had hit upon this method of detection, he did not wait a moment, but jumped joyfully out of the bath, and running forthwith towards his own house, called out with a loud voice that he had found what he sought. For as he ran he called out, in Greek, Eureka! Eureka! 'I have found it out! I have found it out!' When his emotion had sobered down, he proceeded to investigate the subject calmly. He procured two masses of metal, each of equal weight with the crown—one of gold, and the other of silver; and having filled a vessel very accurately with water, he plunged into it the silver, and marked the exact quantity of water that overflowed. He then treated the gold in the same manner, and observed that a less quantity of water overflowed than before. He next plunged the crown into the same vessel full of water, and observed that it displaced more of the fluid than the gold had done, and less than the silver; by which he inferred that the crown was neither pure gold nor pure silver, but a mixture of both. Hiero was so gratified with this result, as to declare that from that moment he could never refuse to believe anything Archimedes told him.

Travelling into Egypt, and observing the necessity of raising the water of the Nile to points which the river did not reach, as well as the difficulty of clearing the land from the periodical overflowings of the Nile, Archimedes invented for this purpose the screw which bears his name. It was likewise used as a pump to clear water from the holds of vessels; and the name of Archimedes was held in great veneration by seamen on this account. The screw may be briefly described as a long spiral with its lower extremity immersed in the water, which, rising along the channels by the revolution of the machine on its axis, is discharged at the upper extremity. When applied to the propulsion of steam-vessels, the screw is horizontal; and, being put in motion by a steam engine, drives the water backwards, when its reaction, or return, propels the vessel.

The mechanical ingenuity of Archimedes was next displayed in the various machines which he constructed for the defence of Syracuse during a three years' siege by the Romans. Among these inventions were catapults for throwing arrows, and balistæ for throwing masses of stone; and iron hands or hooks attached to chains, thrown to catch the prows of the enemy's vessels, and then overturn them. He is likewise stated to have set their vessels on fire by burning-glasses; this, however, rests upon modern authority, and Archimedes is rather believed to have set the ships on fire by machines for throwing lighted materials.

After the storming of Syracuse, Archimedes was killed by a Roman soldier, who did not know who he was. The soldier inquired; but the philosopher, being intent upon a problem, begged that his diagram might not be disturbed; upon which the soldier put him to death.

To Archimedes is attributed the apothegm: "Give me a lever long enough, and a prop strong enough, and with my own weight I will move the world." This arose from his knowledge of the possible effects of machinery; but however it might astonish a Greek of his day, it would now be admitted to be as theoretically possible as it is practically impossible. Archimedes would have required to move with the velocity of a cannon-ball for millions of ages to alter the position of the earth by the smallest part of an inch. In mathematical truth, however, the feat is performed by every man who leaps from the ground; for he kicks the world away when he rises, and attracts it again when he falls back.

Under the superintendence of Archimedes was built the renowned Galley for Hiero. It was constructed to half its height, by 300 master workmen and their servants, in six months. Hiero then directed that the vessel should be perfected afloat; but how to get the vast pile into the water the builders knew not, till Archimedes invented his engine called the Helix, by which, with the assistance of very few hands, he drew the ship into the sea, where it was completed in six months. The ship consumed wood enough to build sixty large galleys; it had twenty tiers of oars, and three decks; the middle deck had on each side fifteen dining apartments, besides other chambers, luxuriously furnished, and floors paved with mosaics of the story of the *Iliad*. On the upper deck were gardens with arbours of ivy and vines; and here was a temple of Venus, paved with agates, and roofed with Cyprus wood; it was richly adorned with pictures and statues, and furnished with couches and drinking vessels. Adjoining was an apartment of box-wood, with a clock in the ceiling, in imitation of the great dial at Syracuse; and here was a huge bath set with gems called Tauromenites. There were also, on each side of this deck, cabins for the marine soldiers, and twenty stables for horses; in the forecastle was a fresh-water cistern, which held 253 hogsheads; and near it was a large tank of sea-water, in which fish were kept. From the ship's sides projected ovens, kitchens, mills, and other offices, built upon beams, each supported by a carved image nine feet high. Around the deck were eight wooden towers, from each of which was raised a breastwork full of loopholes, whence an enemy might be annoyed with stones; each tower being guarded by four armed soldiers and two archers. On this upper deck was also placed the machine invented by Archimedes to fling stones of 300 pounds' weight, and darts eighteen feet long, to the distance of 120 paces; while each of the three masts had two engines for throwing stones. The ship was furnished with four anchors of wood, and eight of iron; and "the Water-Screw" of Archimedes, already mentioned, was used instead of a pump for the vast ship; by the help of which one man might easily and speedily drain out the water, though it were very deep. The whole ship's company consisted of an immense multitude, there being in the forecastle alone 600 seamen. There were placed on board her 60,000 bushels of corn, 10,000 barrels of salt fish, and 20,000 barrels of flesh, besides the provisions for her company. She was at first called the *Syracuse*, but afterwards the

Alexandria. The builder was Archias, the Corinthian shipwright. The vessel appears to have been armed for war, and sumptuously fitted for a pleasure-yacht, yet was ultimately used to carry corn. The timber for the mainmast, after being in vain sought for in Italy, was brought from England. The dimensions are not recorded; but they must have exceeded those of any ship of the present day: indeed, Hiero, finding that none of the surrounding harbours sufficed to receive his vast ship, loaded it with corn, and presented the vessel with its cargo to Ptolemy, king of Egypt; and on arriving at Alexandria, it was hauled ashore, and nothing more is recorded respecting it. A most elaborate description of this vast ship has been preserved to us by Athenæus, and translated into English by Burchett, in his "Naval Transactions."

Archimedes has been styled the Homer of Geometry; yet it must not be concealed that he fell into the prevailing error of the ancient philosophers—that geometry was degraded by being employed to produce anything useful. "It was with difficulty," says Lord Macaulay, "that he was induced to stoop from speculation to practice. He was half ashamed of those inventions which were the wonder of hostile nations, and always spoke of them slightingly, as mere amusements, as trifles in which a mathematician might be suffered to relax his mind after an intense application to the higher parts of this science."

—Timbs.

FAME.

Ah! who can tell how hard it is to climb
The steep where Fame's proud temple shines afar;
Ah! who can tell how many a soul sublime
Has felt the influence of malignant star,
And waged with Fortune an eternal war;
Checked by the scoff of Pride, by Envy's frown,
And Poverty's unconquerable bar,
In life's low vale remote has pined alone,
Then dropped into the grave, unpitied and unknown!

And yet the languor of inglorious days
Not equally oppressive is to all;
Him, who ne'er listened to the voice of Praise,
The silence of neglect can ne'er appal.

There are, who, deaf to mad Ambition's call,
Would shrink to hear the obstreperous trump of Fame;
Supremely blest, if to their portion fall
Health, competence, and peace. Nor higher aim
Had he, whose simple tale these artless lines proclaim.

—BEATTIE.

SPRINGS AND FOUNTAINS.

THE quantity of water evaporated by the agency of heat from the broad surface of seas, lakes, and rivers, is thought to be sufficient to account for the existence of our multitudinous springs. It first hangs suspended in mid-air as invisible vapour: then, by the operation of other wonderful forces of nature, electricity, a lowering of the temperature, &c., this floating vapour becomes condensed into the perceptible forms of cloud, mist, fog, or into the sterner shapes of snow, hail, and rain. This constant precipitation is undoubtedly proportioned to the general amount of evaporation; and thus the beautifully adjusted balance between demand and supply is perfect. In order to account for the force with which natural fountains break forth and claim the name of springs, it must be remembered that if the water condensed on the surface of lofty regions find its way through a porous soil, it may filter downward to a great depth, until it meets with some opposing barrier of impenetrable hardness. The pressure from above now becomes irresistibly great; and the water at length forces for itself a way of escape, bounding out to the surface as a sparkling and living spring.

There is one beautiful phenomenon which may here be alluded to—the "Fountain Tree" of Ferro, the most westerly of the Canary Islands. This particular island is entirely destitute of springs, and, therefore, Nature is taught by the kind Creator to supply the fatal deficiency by means of a remarkable tree which grows in a fissure of the rocks. A moisture-laden cloud is often seen hovering above the branches; these attract the vapours; they are distilled into drops, and a little series of sparkling runlets falls off from the points of the long, straight, evergreen leaves. The natives of the island constantly resort to this graceful natural fountain, just as the inhabitants of other lands flock to the springs with their empty urns, pitchers, and pails.

And now for man's share in the work. A hidden force of water has been pressing downward from a great height. It has encountered an opposition of more than common sternness. Man comes and bores a way down into the natural reservoir, and the emancipated stream quickly rises to the surface as a sober, steady *well*, or, impelled by the intense pressure from the heights, gushes eagerly forth as a leaping and glistening *fountain*. It is with this last division of our subject that we have now to deal. Men are only too glad to receive this bountiful gift from the heart of the hills, whether the fountain be one of Nature's own forming, or whether artificial aid has intervened; and various have been the contrivances both for its reception and for its guidance into the right channel. The acting principle is the same in all, that *water, flowing from a superior height through a confined channel, always seeks its own level.* The ancient Romans were not ignorant of this universal principle, which they applied to the supply of their cities with water; but they overlaid it with a cumbrous machinery, which shows that any engineer of our numerous water companies might have given the most skilful of these masters of the world an instructive lesson in hydrostatics. He would have told them that the magnificent and costly aqueduct which they were laboriously leading from the bursting urn of some fabled Naiad in the distant ravine of the purple hills was wholly unneeded, and that he could lay down such arteries beneath the "scarf-skin" of their plains as would make an abounding stream overflow the long ranges of their mosaic-paved public baths, fill every private bath in their thousand marble homes, and leap out in the sculptured fountains which often adorned the central court in their houses. That the Romans had some small foretaste of the system of conveying water by pipes is proved amid the ruins of Pompeii, where a considerable number of leaden pipes has been found, while the almost perfect remains of some of their public fountains, and even the frescoed designs upon the walls, show that the principle of the ascending tendency of water, when flowing from a higher source, was not wholly unknown to these luxurious citizens of Magna Græcia. Bronze figures have been disinterred from the buried city, which had evidently taken their part in spouting water from the ornamental fountains. In Rome there was an officer of high rank who was appointed to superintend the supply of water; and the citizens appear to have paid a high price for the privilege of having it conveyed into their houses. Agrippa is recorded to have presented to his city 105 fountains in a single year, besides 70 ponds of water, and 130 reservoirs. Even the provinces, which were remote from the capital, were endowed with splendid aqueducts and their attendant luxuries of baths and fountains; for it was the wise policy of Rome to insure the willing submission of her prostrate conquests by making the people sharers in the benefits of her own more advanced civilisation. Many of the beautiful cities of Greece were sparkling with fountains. At Corinth, a statue of Pegasus was perpetually bathing its light feet in a flow of water; and a bronze Neptune, seated on the scaly back of a dolphin, superintended a gushing fountain which spouted from the creature's mouth.

This paper may be closed by a reference to a brilliant illustration of the universal law by which water struggles to attain its own level. A great aqueduct has been made to convey a whole river of water into the city of New York. This river, the Croton, called by the Indians "The Clear Water," is dammed up at its source, forty miles from the city, and forms there a vast reservoir amid its native hills and woods. A great water-course, built of squared stones, and mounted on piers of stone-work, traverses these forty intervening miles, now striding boldly across a valley, now penetrating a hill, and again stepping bravely over a river. The channel is covered over throughout its adventurous course, and it pours "a mile and a half of fine water" into New York every hour. This is truly a Roman-like work; but now for the impromptu fountain. Just where the aqueduct steps across a valley, the engineer perforated the water-course by making an opening of about seven inches in diameter; and instantly there leaped up toward the sky a magnificent column of water, 115 feet high, forming, perhaps, the very grandest *jet d'eau* (water-spout) which has ever been beheld. The pillar of water spread itself out like a tree waved by the winds, and shivered itself into a thousand leaflets of diamond spray, shaking its glittering boughs amongst the quiet woods and the sleeping hills. —*Leisure Hour.*

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