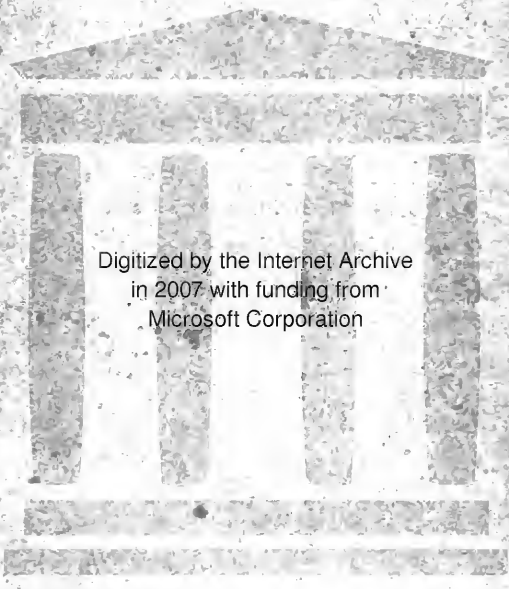
Scientific Reader

R. T. LINNINGTON.



THE

SCIENTIFIC READER

AND

PRACTICAL ELOCUTIONIST:

CONTAINING

ORIGINAL READINGS IN THE SCIENCES;

A NEW COLLECTION OF

MODERN POETRY, ORATIONS, AND DRAMATIC SCENES;

ACCOMPANIED BY AN

INTRODUCTION TO THE PRACTICE OF ELOCUTION, &c.;

A SERIES OF QUESTIONS FOR EXAMINATION IN THE SCIENCES;

TOGETHER WITH

A COPIOUS VOCABULARY OF SCIENTIFIC TERMS.

INTENDED AS A COMPANION TO THE "RHETORICAL SPEAKER."

BY R. T. LINNINGTON,

AUTHOR OF

THE "RHETORICAL SPEAKER," "COMPENDIUM OF ASTRONOMY," &c.

New Edition.

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PREFACE.

THE chief design of the writer, in compiling the present work, was to supply a School Book at a low price, which might contain a series of Readings on Scientific subjects, as well as a selection of Poetry calculated for Elocutionary Exercises.

It had been for a considerable time a subject of regret amongst the scholastic profession, that while Scientific and Literary Societies were so universal, and afforded adults such opportunities for acquiring information, there was no school book of cheap price, whose object was to initiate the more juvenile part of society into the science of Natural Philosophy. The "SCIENTIFIC READER," it is presumed, will form this *desideratum;* so that while the pupil is acquiring a correct method of reading, he will at the same time become acquainted with the principal facts and general phenomena of Philosophical Science.

The writer begs to acknowledge, that in drawing up the *Scientific Readings*, he has availed himself of assistance wherever he could obtain it: his principal aim has been to condense as much information in as few words as possible, and in language which cannot but be understood.

The QUESTIONS for EXAMINATION, which are numerous, and comprise the chief facts contained in the "READINGS,"

are in accordance with the Catechetical system which has been so long and so successfully practised.

The VOCABULARY of SCIENTIFIC TERMS, it is hoped, will be found of considerable utility, as it is both copious and comprehensive.

Under the head of Elocution, the youthful tyro will receive advice for the management of his voice and general deportment, in reading and speaking, together with an anatomical description of the organs of speech.

The POETICAL PART contains a new collection of the choicest poetry; Dramatic Scenes, Orations, &c., and those pieces which are more directly intended for Recitation, have notes and directions to guide the pupil in their delivery.

In conclusion, the writer begs to observe, that although he is aware that the "SCIENTIFIC READER" must, in the Elocutionary and Poetic department, yield the palm to the "RHETORICAL SPEAKER," yet he trusts that it will not be either an unworthy or an unprofitable Companion to its elder brother.

The present Edition has been carefully revised, and has received a considerable accession of fresh matter. The article GEOLOGY has been entirely rewritten; and a new subject, PHYSICAL GEOGRAPHY, has been introduced. The VOCABULARY of Scientific Terms has also been much enlarged.

8, Upper Fountain Place, City Road; and
Mare Street, Hackney.

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SCIENTIFIC READER.

ELOCUTION.

OF THE ADVANTAGES OF ORATORY.

Of the various arts cultivated by man, there is none more fascinating, nor possibly more useful to its possessor, than the capability of clothing his ideas in elegant and forcible language, and giving utterance to them in a graceful and effective manner. If we refer to the period when Athens was a popular government, we shall perceive that the course of public affairs was, in a great measure, directed by the orators, and the same was the case in Rome under the Consuls. The more eminent of these obtained the highest degree of honour, and their works and fame will be preserved to the end of time. The Grecian and Roman youth thought no labour too hard, no application too great, to become masters of this divine art, by which they might be enabled to possess unlimited sway over the passions of the multitude, and ultimately wield the destinies of the world. And why should not the British youth equal the youth of Greece and Rome? They are not inferior in talent, and have superior opportunities; and although they may not attain that pre-eminence in the State that the orators of old attained, yet in every station of life eloquence will be found to produce the greatest advantages.

To excel as an orator, it is not only necessary to be a perfect master of language, but to possess a fluency of utterance, and an elegant and forcible delivery with suitable action and gesture. It is true that some persons are peculiarly gifted with a flow of language; also that some have powers better calculated for speaking than others, their voices are more flexible, powerful, and harmonious; yet when it is recollected what Demosthenes effected with every physical disadvantage, no one need despair of becoming, by care and diligence, if not an eminent speaker, at least a respectable one.

It is not the province of the present work, to give rules for composition, or precepts for obtaining a fluency of elegant language; but to offer the juvenile speaker such directions as may lead to the attainment of a graceful and appropriate delivery, without which, the finest and most nervous language will be tame and unimpressive.

OF ARTICULATION AND PRONUNCIATION; WITH AN ANATOMICAL DESCRIPTION OF THE ORGANS OF SPEECH.

Good reading and speaking very particularly depend upon a just and clear articulation.* Articulation and Pronunciation, although sometimes confounded, are, to a considerable extent, dissimilar. *Articulation* is the linking together of the elementary sounds, so as to form them into syllables and words. *Pronunciation* refers to the vocal sound produced; and is either correct or incorrect, according as it conforms with, or deviates from, that which is considered the true standard. Unless the organs of speech are perfect, a person cannot articulate well: if his tongue is too large or too small, if his lips are too thick or too thin, if his teeth are too closely set or too few in number, his articulation will not be perfect. Before entering more particularly into the

* The power of articulation constitutes the chief difference between men and brutes; the latter, being unable to articulate, can only utter indistinct sounds.

subject of articulation, it may not be uninstructive to the youthful reader to consider briefly the nature of the voice and the different organs of speech.

Sound is generally attributed to the undulations of the air caused by some tremulous body; these undulations being received into the ear, are conveyed by the auditory nerve to the brain. The lungs, which are two spungy and vascular organs situated in the lateral part of the thorax or chest, are the principal cause both of respiration and of the voice. When we make an inspiration, or draw our breath, they become distended, and by their natural inclination to contract, they expel the air through the windpipe. As soon as this expulsion or expiration, as it is called, is completed, the air again rushes in, and is again expelled as before. The upper end of the windpipe is called the larynx, the superior opening of which, called the glottis, is the chief instrument in producing the voice. There are a great many muscles attached to the larynx, and their use is to move that organ either upwards or downwards, backwards or forwards. The size of the larynx varies according to age and sex; it is small in children and women, greater in young men, and still larger in adults. By means of the contractile power of the glottis, through the agency of the muscles, when the breath is forced through it, it causes a vibration so as to produce sound.

The intensity of the voice, like that of other sounds, depends on the extent of the vibrations; and the more voluminous the larynx is, the more considerable will be those vibrations. A strong person, therefore, with a capacious larynx, has generally a powerful voice. Children and women, whose larynxes are comparatively small, have a weaker voice. The sounds which the human larynx is capable of producing are very numerous, but how they are produced is not exactly known. The larynx is raised in forming acute sounds, and lowered in forming grave sounds; the vocal tube being shortened in the first case, and lengthened in the second. In breathing or whispering no sound is produced, because the opening is too wide, and the vocal chord too relaxed. The expression of the voice, its

intensity and tone, thus receive their various modifications by means of the larynx.

As there are two passages which communicate with the mouth, the œsophagus, or canal which leads to the stomach, and the larynx, or windpipe; and as the œsophagus is beyond the larynx, the food, in passing to the stomach, must necessarily pass *over* the windpipe; to prevent it from falling *into* it, there is a small valve called the epiglottis, which, in the action of swallowing, lies flat over the upper part of the larynx; and should the smallest crumb or drop insinuate itself under the epiglottis, it produces a kind of convulsive irritation and coughing in order to expel it, for were it to go down the larynx the result might be suffocation and death. After the breath has passed through the glottis, the harmony and modulation of the voice will depend principally on the *tongue*, the *palate*, the *teeth*, and the *nostrils*.

Of all the members the tongue is the most active, and by its surprising flexibility can accommodate itself to any position; it can contract or extend, be applied to the teeth or the palate, or assume any shape necessary for articulation. If the tongue be too large, the speech will be thick and indistinct. The palate, or roof of the mouth, collects and reverberates the voice, which is deep and sonorous in proportion to the size of its arch. By the teeth the breath is collected and retarded, and they, in conjunction, with the tongue and lips, give utterance to some of the consonants. The nostrils are also of much use in producing a pleasing and clear sound. If they are obstructed, the voice assumes a thick and disagreeable twang.

As it must be evident that no person can read or speak even moderately well without a clear and perfect articulation, the greatest care should be taken that children do not in their early infancy acquire faulty habits; for when confirmed, it will be scarcely possible to eradicate them.

In reading, every syllable, and almost every letter, in the word should be uttered distinctly, without muttering or suppressing any of the sounds.

Distinctness of expression will depend on the *force* of utterance, combined with a proper elevation of the voice, and *moderation* in the speed of pronouncing. The voice resembles a musical instrument, the key-note of which may be altered according to the inclination of the speaker. A tune may be played in a high key, although the volume of sound may be small: a tune may also be played in a low key, while the volume of sound is large. Just so it is with the voice; the strength of sound does not depend on the key of the voice, but on the force of the expulsion of the breath. A speaker should therefore be particularly careful to adapt his voice to the size of the room in which he is speaking, and not to give it either too great a degree of elevation or depression, which would cause it to be wearisome and painful to himself and his auditors.

Due moderation in the rate of utterance is also of the utmost consequence in regard to the distinctness of delivery. Although a monotonous drawl is of all things most disagreeable, yet speakers in general err in being too rapid in their delivery rather than in being too slow.

Some persons, from a defect in the vocal organs, are unable to articulate distinctly, but the number of these is few; indistinctness of utterance being more generally occasioned through early neglect. The chief impediment to articulation is stuttering. This is a most disagreeable habit, and difficult to cure, although in most instances a cure might be effected by care on the part of the stutterer. When a hesitation occurs, the speaker should stop entirely, and again commence a new effort. He should use the greatest degree of deliberation in ordinary discourse; and should inspire himself with confidence and self-command, for stuttering very generally proceeds from nervous irritability. He should also practise for a considerable time the vowel sounds, and then the different powers of the consonants, both singly, and in combination with the vowels; thus, by attention and resolute determination to overcome the habit, he will most probably succeed.

Another preventive to articulation is a habit of lisping, sometimes acquired through affectation. The lisper

generally gives the sound of *th* for that of *s*; this may be easily cured by a little attention to the position of the vocal organs in speaking.

There are certain other habits which are great enemies to articulation, as hissing, speaking through the nose, keeping the jaws too close, &c., all of which are generally caused through want of attention in early childhood, but which it is far from impossible to eradicate.

A faulty pronunciation likewise evinces neglect in early education. The mode of expression used by the polite and well-educated should be observed and strictly followed; and whenever a young person is doubtful as to the correct pronunciation of a word, recourse should be immediately had to a pronouncing dictionary. As speaking is a mechanical art, imitation and practice will always effect a correct Articulation and Pronunciation, provided there be no natural defect in the structure of the organs of speech.

RULES AND DIRECTIONS IN READING AND SPEAKING.

Although a speaker may articulate well and pronounce correctly, yet, without energy, grace, and pathos, he will have the appearance of a living statue; and though he may not absolutely disgust, he will be very far from giving pleasure, or exciting admiration.

One of the chief requisites for energetic delivery is a strong and flexible voice; and this, if not natural, may to a certain extent be acquired by cultivation. The degree of strength of the voice depends on many causes, one of which is the texture of the larynx. If the vocal chords do not possess sufficient tension, the voice will be weak; while on the contrary, if they are firm and elastic, *ceteris paribus*, the voice will be powerful. Persons that are asthmatic, or have any obstruction in the action of the lungs, have naturally a weak voice; but as the strength of the muscles of the body may be increased by exercise, so may the strength of the voice.

In public speaking and reading, but more particularly the former, an energetic mode must be cultivated. The

speaker must be animated, and must exert himself so as to convince his hearers that he is in earnest in what he says. A listless, languid, heavy manner, cannot, under any circumstances, render effective the most nervous language and the most exalted sentiment. A graceful delivery does not by any means imply an affected mincing utterance, but, on the contrary, an openness and roundness of delivery. While full liberty should be given to the motion of the jaws, a pompous and mouthing manner should be particularly avoided. Many persons err in this respect; when reading they use a tone different from what they do in conversation; they increase the number of accents and emphases, thinking that they thus increase the importance of the subject.

As in every word, except monosyllables, there is one syllable, and sometimes more, that receives a stronger percussion of the voice than the rest, which is called the *accented* syllable; so in every sentence there is one word at least, and sometimes more, that requires a particular stress of the voice, called the *emphasis*. The emphatic words must be those whose object is to express the chief design of the speaker; and the placing the emphasis on the proper word is not only necessary for a graceful and correct delivery, but the sense of the sentence often depends on it. The learner should avoid multiplying unnecessary emphatic words, and placing the emphasis on trifling monosyllables. A common error, particularly in reading, is a continued uniformity of tone, without emphasis or cadence. During the whole of any discourse, there never occurs a sentence which should be uttered in the same tone of voice. In common conversation nature dictates a mode of expression varied according to the subject; the same should be the case in reading and speaking.

As a proper emphasis is of so much consequence, the following directions require the particular attention of the student.

First. Words that are in opposition, so as to form a *contrast* or *antithesis*, require such an emphasis as may clearly mark the contrast.

Secondly. In a *climax*, or gradual increase of sense,

there should be an increase of emphasis, and at the same time a gradual elevation of voice.

Thirdly. When the sense of the sentence admits *a gradual swell of the voice,* it should be concluded with a graceful and easy cadence; although the voice should not by any means uniformly fall at the close of a sentence, for the contrary sometimes takes place, but this depends on the sense.

Another requisite for graceful delivery* is a proper attention to the *pauses.* The punctuation of a sentence does not, in impassioned language, moderate the time of rest, or suspension of utterance, in the delivery of such sentence; this depends on the sense, and with a proper tone of voice has the effect of emphasis. A pause prepares the ear for what is about to follow, and the length of the pause must depend on the degree of importance to be attached to the subject.

Force of argument, harmony and elegance of language, and gracefulness of delivery, however excellent, are ineffective without that which has been termed the heart and soul of eloquence—*pathos.*

Every animal gives expression to its feelings by appropriate tones. The hen, when the hawk is in sight, expresses her terror, and calls together her brood by a particular cluck. How different is the tone of the dog when he fawns on his master, to what it is when he gives notice of an intruder. In like manner, every animal expresses its various sensations, its apprehensions of danger, hunger, pleasure, pain, &c., in distinct and different tones. Man, in common conversation, gives an appropriate utterance to his feelings; if elated, he assumes an expression of joy; if depressed, of sorrow. It is then most natural and most proper, that when, in reading or speaking, we use the language of joy or sor-

* "I tell you truly and sincerely, that I shall judge of your parts by your speaking gracefully or ungracefully. If you have parts, you will never be at rest till you have brought yourself to a habit of speaking most gracefully; for I aver that is in your power. Take care to open your teeth when you speak; to articulate every word distinctly; and beg of any friend you speak to, to remind and stop you, if ever you fall into a rapid and unintelligible mutter."—*Lord Chesterfield.*

row, or of any other passion, to accompany such passion by a corresponding tone of voice and gesture. The tones of the passions are uniformly the same to every sex and people, and they cannot be expressed in any other way than by the voice. It is they which give a force and spirit to whatever we utter. How powerfully are we acted on by the earnest and pathetic delivery of a moving discourse; our feelings become roused, and like chords in unison respond to their kindred sound. A speaker will only affect his hearers in proportion as he is affected himself. He must, therefore, not only be a perfect master of the sense of his subject, but he must enter into the spirit of it; for no one can properly and thoroughly convey another's ideas unless he considers them his own. If he really feel what he utters, the tones of the voice and expression of countenance will obey such feeling.

The effect resulting from the delivery of any impassioned subject, not only depends on the tone of the voice, but also on the easy and graceful manner of the speaker; a few observations are, therefore, here made relative thereto, which are intended for the more juvenile reader.

On the delivery of any impassioned piece, the speaker should stand perfectly erect, his weight inclining on his right foot, which should be a little in advance; and if the subject be of a solemn or dignified nature, his right hand should be extended, with the palm inclining upwards, the left hand remaining gracefully by his side. Any particular emphasis should be marked by a corresponding stroke of the hand, and at the conclusion of every sentence, at the last emphatic word the hand should be allowed to fall.

The expression of any passion will require also a corresponding action and manner. Joy demands a buoyancy of manner, with an animated action; Sorrow, on the contrary, requires a downcast look, with a plaintive utterance, interrupted occasionally by sighs and tears. Love is expressed by a most beautiful serenity of countenance, and liveliness of manner; while Anger clenches the fist, and strains the muscles as if they were about to burst. But he that can identify himself with his

subject, and follow the dictates of his own feelings in a judicious and well regulated manner, will not require set rules either for delivery or action, which are at best but inefficient; he will have nature herself for his guide, and under her direction he will not err.*

* For a more full and copious detail of the expression of the passions, and of the art of elocution generally, the reader is referred to the "Rhetorical Speaker."

SCIENTIFIC READINGS.

ATTRACTION.

Attraction defined—Different kinds of attraction—Gravitation, particular and general—Law of falling bodies—Electric, Galvanic, and Magnetic attractions—Attraction of Cohesion—Capillary attraction—Chemical affinity, simple and compound, &c.

ATTRACTION is a term used to denote that principle by which bodies have a mutual tendency to approach each other. Attraction may be divided into two kinds: that which extends to *sensible* distances, and affects bodies in the mass, as the attraction of gravitation, electric and magnetic attractions; and that which exists between the particles of bodies, as the attraction of cohesion and chemical attraction.

The attraction of gravitation is again divided into *particular* and *general* gravitation. Particular gravitation, or gravity, is that which respects the action of the earth on different bodies. All bodies, by virtue of this principle, appear to have a tendency towards a point in or near the centre of the earth, which point is necessarily fixed, otherwise its changing its position, in ever so trifling a degree, would cause the land to be overflowed by the ocean on that side of the globe to which it might approach. The force of gravity is found to be nearly equal at all places equidistant from the earth; it also affects all bodies in a like degree, the resistance of the air alone preventing bodies of a loose structure from falling with the same velocity as bodies of a more dense and compact nature. The power of gravity is greatest

at the earth's surface, whence it decreases both upwards and downwards, but not in a like ratio; it decreases upwards in proportion to the *square* of the distance from the centre of the earth, while it decreases downwards in a *direct* ratio of the distance from the earth's centre. Thus a body at the distance of *one* semidiameter of the earth above its surface, or at a *double* distance from the earth's centre, will be acted on by a force of only *one quarter* of what it would at the surface; while a body at *half* the distance of the earth's semidiameter from its centre will be acted on by a force of *one half* of what it would on the surface.*

General or Universal gravitation is that which relates to the attraction of the sun, moon, and planets, and other heavenly bodies, and by which they are preserved in their orbits. According to the Newtonian theory, the action of the sun upon the earth produces its centripetal force, and prevents it from flying off in a tangent to its orbit; while at the same time the earth produces a similar action on the sun. The earth also acts in a like manner towards the moon, and retains her in her orbit, while itself gravitates towards the moon. Thus all the secondaries gravitate towards their primaries, and the primaries towards their secondaries, and this in a degree proportioned to their mass combined with the squares of their distances. This action and reaction of the heavenly bodies have been found, by observations on the double stars, to extend to the most remote regions of the heavens.

* It has been found by experiment that the quantity of descent of a falling body, is in proportion to the square of the time; thus a body will fall 16 feet during *one* second, 64 feet during *two* seconds, 144 feet during *three* seconds, and so on in proportion. The quantity of descent during each second increases according to the ratio of the odd numbers 1, 3, 5, 7, &c.; thus it will be 16 feet during the 1st second, 48 feet during the 2d second, 80 feet during the 3d second, and 112 feet during the 4th second. A body will take the same time in travelling over a curve as it would in making a perpendicular descent; thus a ball propelled from a cannon planted on an eminence, will strike the ground, if level, at the same moment it would have done if dropped from the cannon's mouth.

Electricity has the property of causing bodies to possess an attractive influence. If a glass ruler, or stick of sealing wax, be rubbed with any soft warm substance, as flannel, fur, or woollen cloth, it becomes excited, and on being presented to any light body, as pith, paper, &c., it will cause it to fly towards it.

Galvanism is of a similar nature to electricity, but its influence is exerted rather in the way of decomposition. The *cause* both of electric and galvanic action has not yet been satisfactorily determined by philosophers.

Magnetic attraction is also of a similar character to electric attraction; indeed, electricity, galvanism, and magnetism, seem very intimately connected. The attractive power of the magnet was known to the ancients, although they were not aware that a needle, or thin piece of iron, rubbed with it, would give it the property, when suspended, of pointing towards the poles. The magnet, aided by galvanic action, has been recently found to possess enormous power; that in the Adelaide Gallery has been made to support a weight of more than 400 lbs.

The second kind of attraction is that which exists between the particles of bodies, as the attraction of Cohesion, and Chemical attraction, or affinity. When the force of attraction operates on atoms of the same species, it is called the attraction of cohesion, or of aggregation; and when on atoms of different substances, it is called chemical attraction, or affinity.

By Cohesion is meant that power by which the atoms of bodies are united together, of which there are different degrees. The atoms of a stone cohere more firmly than those of jelly, and the atoms of jelly more than those of water, and the atoms of water more than those of air. The cause of this has been reasonably attributed to the shape of the atoms; those that cohere most firmly being as it were of a dove-tailed shape, so as to render the mass compact and firm. The spherical shape of drops of water, as also of particles of quicksilver, has been attributed to this kind of attraction. The chief antagonist to the attraction of cohesion is heat.

The ascent of water or other liquid in small tubes,

called Capillary* attraction, has been considered by some a species of the attraction of cohesion. Thus, if a glass tube of very small bore, open at both ends, be immersed in a vessel of water, the water will be found to rise higher than its natural level. If a piece of sugar or salt be placed upon a drop or two of water, the water will, by virtue of this attraction, continue to rise in the sugar or salt until it be entirely wet. Also the ascent of water to the branches of trees by means of their roots, is attributed to this kind of action.

Chemical attraction, or affinity, is that principle on which the various operations of chemistry depend. The art of chemistry exerts itself to destroy the cohesion of bodies, and to form other substances by means of new attractions. Most bodies combine only in certain proportions, and with certain other bodies; and when combined they acquire new properties, and cannot be separated by mechanical means. There are two kinds of chemical attraction, *simple* and *compound* attraction.

Simple attraction, or affinity, is when two substances unite together in consequence of their mutual affinity; thus, spirits of wine will dissolve camphor, and hold it in solution, and the solution will be perfectly clear until some other substance be added for which it has a greater affinity than it has for the camphor; water is such substance, a little of which being poured into the solution, the spirits of wine will leave the camphor to unite with the water, and the camphor will fall down in flakes.

Compound affinity is when two compound substances decompose each other, and produce two or more new compounds. If a solution of muriate of baryta be mixed with a solution of sulphate of soda, the sulphuric acid of the sulphate of soda, by attracting the baryta of the muriate of baryta, will form a *sulphate* of *baryta*, while

* Sir Richard Phillips ascribes that which is generally called Capillary attraction to the pressure intercepted by the intervening sides of the immersed solid, and which is relatively increased on the intercepted side; and that it is this important principle of intercepted pressure which occasions a plumb-line to incline towards a mountain, and boats to congregate about a ship, and small corks about a bung.

the soda, by attracting the muriatic acid, will form *muriate of soda.*

There is, possibly, not a single operation in chemistry that is not dependent on affinity; and although the wisdom and power of God may afford a more sublime and grander display in the harmony and arrangement of the heavenly bodies, yet they are not less visible nor less wonderful in the more minute parts of the creation.

CALORIC, HEAT, FIRE.

Definition and properties of Fire—Conductors of Caloric—Expansive power of Caloric in different substances—Caloric divided into two kinds, *Free* and *Latent*—Sun the chief cause or source of Caloric—Affinity of different Colours for Caloric—Condensation of Solar Heat by Mirrors and Lenses—Caloric produced by Combustion, Percussion, Friction, Chemical Mixtures, Electricity, &c.

Of all the blessings mankind enjoy, those derived from the agency of fire may be truly considered to hold the first place. Were it not for fire, man would not have arrived at a state of civilization; manufactures could not have existed, nor could the arts have been cultivated; and instead of enjoying as we do the various comforts, luxuries, and elegancies of life, we should have been, in our habits and conduct, scarcely removed above the brute creation.

Fire used to be considered a real substance, but that doctrine is now exploded: the more philosophical and correct opinion is, that it is the result of a high degree of excitement of the atoms of the heated body. Heat is properly the sensation produced by the agency of caloric; the term *caloric* being now used to express the *cause* of heat, whether caloric be a distinct substance, or whether it be a peculiar motion of the particles of bodies.

Fire is found to penetrate all bodies, even the hardest, which forms a peculiar feature of its character. It is also particularly disposed to form an equilibrium, so that a heated body will continue to give out streams of caloric until it has acquired the temperature of the atmosphere or of any body with which it may be in contact. Thus, if we touch a body hotter than our hand, a portion of

caloric will pass from the body to our hand, and this will produce the sensation of heat: but if we touch a body colder than our hand, the contrary will take place; the caloric will be abstracted from our hand, and we shall experience the sensation of cold. Some bodies are found to transmit caloric more easily than others; they are thence called *conductors* of caloric: some do not transmit it at all, or in a very trifling degree, and these are called *non-conductors* of caloric. The best conductors are the metals; the worst conductors are fur and caoutchouc. Air is also a bad conductor, and so is water.

One of the principal effects of caloric is expansion; and this is evident in all kinds of bodies, whether solid or fluid, but varying in degree. Thus, as it regards solid bodies, lead is more expansible than iron, and iron than platina. In order to show the expansion of metals, let a round piece of iron, which has been made to fit a ring exactly when cold, be heated, and it will be found so increased in bulk as to be too large to pass through the ring. The expansion of fluids is prettily shewn by filling a Florence flask with cold water to about the middle of the neck, and suspending it over a lamp; as it grows hot it will be found to expand gradually, so as nearly to flow over the neck of the flask. The principle of the thermometer depends on the expansive power of caloric; in proportion as the temperature increases, the quicksilver or alcohol,* whichever it may contain, expands in proportion. Water in becoming frozen forms somewhat an exception to the above; for when it is cooled to a temperature of about 40° it begins to expand, and continues to do so until it becomes solidified into ice.† The wisdom of this contrivance it strikingly evident; for if water followed the general law, and when frozen became of less bulk, and consequently of a greater relative weight, it would sink to the bottom as it was formed on the surface, and in the course of time the ocean, to a considerable extent, in the higher latitudes, as well as the

* In the higher latitudes thermometers containing coloured alcohol are used, as in intense cold the quicksilver may become frozen.

† When water is frozen, the crystals form at an angle of 60°.

ponds and rivers, would become a solid mass. The expansive power of water, when converted into vapour or steam, is tremendously great.* It appears that solidity is the natural state of bodies; that when solids acquire a certain degree of caloric or atomic† motion, they become fluids or gases; and that fluids, by an increased degree of atomic motion, become vapour.

Caloric is popularly divided into two kinds, *free* caloric, and *latent* or *combined* caloric. By *free* caloric is meant caloric in a separate state, or, if attached to another substance, not chemically combined with it. *Latent* caloric is that which is chemically combined with any substance so as to make a part of it.

The chief source or cause of caloric is the sun; but the rays of the sun seem only to produce heat when they meet with an opaque substance, not when they pass through a transparent one, as glass, water, &c.

Colours have a striking difference in their affinity for caloric; it has been found by experiment that black has the greatest degree of affinity, then blue, next brown, white having the least: the black absorbs the rays of light, while the white reflects them. Although black has this particular affinity for heat, it radiates it, or distributes it to surrounding bodies sooner than any other colour; thus, a blackened vessel will become heated if placed over a fire sooner than a bright one; but when removed from the fire it will not retain its heat so long. If the surface of a metallic vessel be scratched or roughed, the radiation will be increased, and this is attributed to the exciting atoms which cause the heat having more points for distributing it to surrounding bodies.

Various experiments have been made in order to show the powerful effects of the sun's rays when condensed or multiplied. Archimedes appears to have been the first

* Steam at 590° is said to have the force of one hundred atmospheres, or in other words, to press at the rate of 1500 lbs. on a square inch.

† It is supposed that the cause which produces the sensation of heat consists in the peculiar motion or vibration of the particles or atoms of bodies. According as this motion is more or less rapid, a higher or lower temperature is produced.

who attempted this with any success; he so multiplied the sun's heat by means of mirrors, as to set fire to the Roman fleet at Syracuse. As one plane mirror, for instance, reflects a certain portion of the sun's heat, so two, or three, or any other number, will proportionally increase it if directed to the same object. Leonard Digges, who lived in the reign of Elizabeth, asserts, that by a combination of mirrors he fired bodies half a mile distant. Buffon, by a combination of forty plain glass mirrors, of *six* inches by *eight*, set on fire a tarred beach plank sixty-six feet distant; and with a combination of one hundred and sixty-eight, he performed the same at the distance of two hundred feet. He is said to have melted all the metals at thirty or forty feet. Concave mirrors concentrate or condense the sun's heat by reflection into a focus, and the effect is increased in proportion as the surface of the mirror exceeds that of the focus. A concave mirror of *four* feet in diameter, made of a mixture of copper and tin, melted a sixpence in less than *eight* seconds, and a half-penny in *twenty* seconds. Convex lenses, also, by concentrating the sun's heat into a focus, increase the heat in a similar proportion to concave mirrors. One of the largest and most powerful lenses of this nature was made some years since by a Mr. Parker, of Fleet-street; it was formed of flint glass, and when fixed in its frame exposed a clear surface of *two feet eight inches and a half* in diameter; its weight was 212 lbs; its focal length *six* feet *eight* inches, and the diameter of the focus *one* inch: a second lens was used to receive the focus of the first, which reduced it to *half an inch*. By these lenses the sun's rays were condensed in the ratio of *four thousand two hundred and twenty-five* to *one*, and the effects produced were astonishing. Iron, when exposed to the focus, melted in a moment; slates, tiles, &c., became red hot, and vitrified instantly; and wood, acted on under water, became burnt to a coal. Mr. Parker had the curiosity to try what the sensation of burning at the focus was, and having passed his finger through it, he described it to be like that of a cut with a lancet.

Caloric is also produced by *combustion*, through the

oxygen of the atmosphere becoming decomposed, and evolving or setting it at liberty. It may be observed, that oxygen owes its gaseous state to the caloric which it contains, and in the process of combustion the oxygen combines with the base of the body consumed and forms an oxide, while the caloric escapes. The strongest heat produced by combustion is that by means of the combination of the oxygen and hydrogen gases,* a small stream of which ignited, and made to fall on watch-spring or even platina wire, will make it to melt like wax.

Percussion and *friction* are well-known mechanical means of producing caloric. A blacksmith will, by hammering a piece of iron, very soon make it sufficiently hot to light a match. The heat produced is attributed to the compression of the particles of the body forcing out a portion of its latent caloric. In strong percussions the first blow produces the greatest degree of heat, which gradually decreases until it is exhausted; it will not again produce heat until it has been exposed to the fire, or has had some means of imbibing *free* caloric; when this is effected, the caloric will continue in a *latent* state until it is again acted upon. In the collision of the flint and steel, so much caloric is disengaged that the metallic particles struck off are actually melted; this is evident from the pear-like form that such particles assume. Friction is considered a continued series of percussions, and the heat sometimes arising therefrom is very great. Forests have been known to be fired by the friction of the branches of the trees; and coaches have been burnt by the friction of the wheels. Most savage nations produce fire by the friction of two pieces of wood. Count Romford, by boring cannon under water, so heated it by the friction that he made it boil, and actually boiled in it a piece of beef.

Caloric is also *sometimes* produced by *chemical* mixture, although *not always;* for in some instances chemical mixture produces cold. It may, however, be taken as a general rule, that when substances become more *con-*

* See article *Gaseous Bodies.*

densed by mixture heat is evolved; and when they become more *expanded* cold is produced. If *one* ounce of sulphuric acid be mixed with *four* ounces of cold water, a degree of heat greater than that of boiling water will be produced; but if the mixture be measured, it will be found, for the above reason, *not* to amount to so much as *five* ounces. Bodies, in changing from a liquid to a solid form, always evolve heat. In slaking lime, or in mixing plaster of Paris, a considerable degree of latent caloric is evolved, from the water changing its fluid for a solid state. Water, in becoming ice, gives out its latent caloric, and that so freely as to render the progress of freezing comparatively slow.

Electricity will also produce caloric; but the most intense heat known has been obtained from galvanism. By means of the galvanic battery of the Royal Institution the most powerful and surprising effects have been produced. To say nothing of the metals, quartz, the sapphire, magnesia, fragments of the diamond, charcoal, plumbago, &c., seem to evaporate and disappear rapidly under its influence. The most insoluble compounds, the most compact substances with which we are acquainted, are by its means decomposed and resolved into their simplest forms.

COMBUSTION.

Simple and Compound Combustibles—Supporters of Combustion—Theory of Combustion—Result of Combustion—Combustion simply Decomposition—Sir Richard Phillips's Theory of Combustion—Different states of Combustion, &c.

COMBUSTION is that evolution of heat and light which accompanies certain chemical combinations and decompositions. Until late years the nature of combustion was not at all understood; and even at present it can not be said to be perfectly known.

All bodies may be divided into two kinds, *combustibles* and *incombustibles*. Combustible bodies are again divided into *simple* and *compound*. Simple combustibles are those which cannot be decomposed; they are hydrogen, (the base of water), carbon (the base of charcoal), sul-

phur,* phosphorus,† boron,‡ and the metals; of these hydrogen and carbon are the principal. Compound combustibles are those which are formed by the union of two or more simple combustibles. A candle is a compound combustible, and so is coal, being composed of hydrogen and carbon.

There are also certain substances called supporters of combustion, which are not in themselves combustible, but whose presence is necessary for the act of combustion: the chief of these is oxygen; chlorine§ and iodine‖ are also supporters of combustion, but unlike oxygen, they are not supporters of life. Combustion is a play of affinities between the combustible¶ body and the supporter of combustion; the combustible body has a stronger affinity for the supporter of combustion than

* Sulphur is the only simple combustible which nature offers pure and in abundance. It is found in the earth, and also in depositions on the surface of the earth, but most plentifully in the neighbourhood of volcanoes. It is also found in combination with most of the metals. It is said that 15,000 tons have been imported annually for the purpose of making gunpowder and sulphuric acid.

† Phosphorus abounds in the mineral, vegetable, and animal kingdoms. In the mineral kingdom it is found in combination with lead and iron, and more particularly with calcareous earths. In Spain there are whole mountains composed of lime, combined with this substance. The vegetable kingdom abounds with it, but it is principally found in plants that grow in marshy places. It is also found in wheat, seeds, potatoes, &c. In the animal kingdom almost every part of the body contains it; but it chiefly abounds in the bones, and it is this which gives them firmness. It is also found in milk; whence may be seen the wisdom and arrangement of Providence, that this and bread should form the first food of an infant, the phosphate of lime they contain being indispensable in forming and strengthening the osseous parts of the body.

‡ Boron is a dark-coloured powder, and the base of various salts called *borates*. The sub-borate of soda, commonly called borax, is a useful ingredient in the fusion of metals.

§ For the nature of Chlorine, see the article *Gaseous Bodies*.

‖ Iodine is a simple substance procured from sea-weed, and was first discovered in 1812. It is of a dark grey colour, and metallic lustre; it melts and evaporates at a low heat, and its vapour is of a beautiful violet-colour.

¶ A combustible body will not burn if dipped in a solution of phosphate of lime, or of muriate, sulphate, or phosphate of ammonia, with borax; the alkaline substances preventing the hydrogen combining with the oxygen.

the supporter has for caloric, which keeps it in a gaseous state; it therefore unites with the ignited body, and allows the caloric to escape. The rapidity of combustion is also found to be in proportion to the quantity of its supporter; this is evident from a common culinary fire, which increases in intensity in proportion to the supply of air it receives.

In combustion in common air the oxygen is always consumed; and the weight of the products of every combustion is equal to the weight of the body before combustion, together with that of the oxygen consumed; so that instead of a body being destroyed or burnt away, as it was formerly termed, it is found to increase in weight, and that in some instances to an almost inconceivable amount. One ounce of phosphorus, for instance, if properly burnt, will produce very nearly two ounces of phosphoric acid; and 100 lbs. of metallic lead, when made into red lead, which it is by being caused to imbibe oxygen through the medium of a reverberatory furnace, will weigh 112 lbs.

It used to be thought that the light evolved during combustion came from the oxygen; but it has been latterly supposed to come from the combustible body, as the colour of the light depends in all cases on the nature of the body. The combustible body is, according to this theory, said to afford *light* and the *base*, oxygen gas, *oxygen* and *caloric;* the oxygen will then, in combustion, unite with the base, and *generally* form an *oxide*, and the caloric of the oxygen will unite with the light and form *fire* and *light*. Although the product of combustion is *generally* an oxide, it is not *always* so; sometimes it is an acid, as phosphorus and sulphur, when burnt in oxygen gas or atmospheric air, produce phosphoric and sulphurous acid. The product of potassium*

* Potassium is considered a metal, and is the lightest known, being lighter than water. It does not exist naturally in a metallic state, but is formed by voltaic action on an hydrate of potash. It is of a perfectly white colour, and has the brilliancy of silver, but through its affinity for oxygen, which is greater than that of any other known body, it cannot be exposed an instant to the atmosphere without being oxidized. If a small piece be laid upon water, it will attract the

and sodium* when burnt is an alkali; but alkalies are now considered metallic oxides.

The nature of combustion will be rendered further intelligible by simply considering the burning of a common candle. In lighting a candle, which must be done by the application of flame, a small portion of the wick is first decomposed or burnt, the tallow becomes gradually melted, ascends the wick by capillary attraction, is decomposed, and exhibits itself in flame. The component parts of tallow are *hydrogen* and *carbon;* the hydrogen unites with a portion of the oxygen, and forms water, which is carried off in vapour; and the carbon, when the combustion is perfect, unites with another portion of the oxygen, and is carried off in a gaseous state. In common tallow candles the top of the wick is always black, from the flame preventing the air from oxidizing it, and forms a support, if the candle be not snuffed, for an accumulation of carbon, which is produced through the imperfect combustion. In wax candles, and also in Palmer's patent metallic-wicked candles, the wick is made so as to lean aside out of the flame; the combustion is then complete, and the wick neither collects soot, nor requires to be snuffed.†

oxygen of the water with such rapidity as to decompose it and ignite the hydrogen. This is a very interesting experiment, as the potassium swims about on the surface of the water, apparently burning with a beautiful bright flame. Potassium is the basis of potash, the vegetable alkali, which latter is properly an oxide of potassium, and together with its salts is of much use in the arts, medicine, &c. Potash is formed from the ashes of burnt wood by lixiviation; it is also prepared in wine countries from the wine lees.

* Sodium is also considered a metal, and although heavier than potash it is lighter than water. It has a great affinity for oxygen, and will decompose water, yet not with that violence as to produce flame. Sodium is the base of the mineral alkali Soda, which, like potash, together with its salts, is very much used in the arts, medicine, &c. The two alkalies potash and soda, particularly the latter, are indispensable to the *soap-maker*, the *glass-maker*, and the *dyer*. Soda is obtained from sea-weed, and also from salt, which is a chloride of sodium; it is also found in great plenty combined with various substances.

† If a common candle be inclined more than 30° from a perpendicular, it will not require to be snuffed.

The argand lamp is so constructed that the combustion is complete, and consequently it does not smoke. This is effected by the wick being of a circular shape, and so contrived that a constant supply of air is admitted to every part of it, which affords sufficient heat to burn the smoke as it is formed.

Sir Richard Phillips explains the theory of combustion in the following manner:*—"Combustion," he observes, "is a case of decomposition and recomposition, and the intermediate effects or accidents are heat and light. A combustible body contains hydrogen and carbon. The air in which the combustion takes place consists of oxygen and nitrogen; and if a definite bulk of air is employed, the oxygen disappears, and may be found in the products of the combustion. To understand the process it is necessary to affix a precise idea to *gas*, which, in a word, is atoms in intense orbit motions resulting from primary force in right lines, and the reaction of other atoms in the space. Oxygen then consists of such atoms, and of course if they are fixed, they transfer their momenta to bodies fixing them: if to atoms of hydrogen, they condense as water, with heat to surrounding bodies; and if to carbon, they form carbonic acid, with heat to surrounding bodies. Combustion begins by applying heat or excitement, as lighted paper, or a taper, to the combustible. This melts the tallow, and raises into gas the latent hydrogen in excitement, that is, in orbits too large for the space; and a vacuum is created, which the oxygen fills with eight times the force, becoming fixed by the hydrogen both in atoms of water, and by the carbon in carbonic acid. The oxygen is thus fixed, and the air so far decomposed, but the friction at the wick raises an intense local heat, which, unable otherwise to escape, acts on the atoms of air, and creates in them a general propulsion, which we call light, the heat being the concentrated motion at the spot."

Inflammation, Ignition, and Detonation or Explosion, are terms used to express the different states of com-

* See "*A Million of Facts*," by Sir R. Phillips.

bustion. Inflammation is when the combustion takes place while the combustible is in an aëriform state, as the flame of a candle. Ignition is when the combustible remains in a solid state, as charcoal. Detonation, or Explosion, is caused by the combustible being suddenly converted into a gaseous state, and thereby giving a violent impulse to the surrounding air.

LIGHT.

Action of Light on the Animal and Vegetable Kingdoms—Nature of Light—Its Velocity—Direction — Refraction — Reflection—The Eye described—Vision explained—Colours, &c.

LIGHT consists either of small particles emanating from a luminous body, or it is an excitement produced by undulations or vibrations of a highly elastic medium, filling all space. Although the sun is the chief fountain or cause of light, it is produced in various ways independent of that luminary. Combustion produces light,* and so does the friction of various substances; it is also emitted from *phosphori* of different kinds.

Light is one of the most useful agents in nature, and one that particularly affects the animal and vegetable kingdoms. The action of light on vegetables causes them to give out oxygen gas, by which means the air becomes purified, and the vital principle restored, which had been vitiated by respiration or other ways. Vegetables depend on light for their colour: if a vegetable grow in the dark it will be white and sickly, or *etiolated*, as it is termed. Gardeners blanch certain vegetables by depriving them of light; and such parts of vegetables as are shaded from the light, as the hearts of lettuces, of cabbages, &c., are generally white. Vegetables in tropical regions flourish in a manner far superior to what they do with us; and discous vegetables, as the sunflower, always turn towards the sun.

* A piece of lime of the size of a pea, acted on by an ignited stream of the mixed gases, oxygen and hydrogen, will produce a light equal to 120 wax candles, and with a reflector will cast a shadow ten miles distant. The most intense light is that produced by galvanism in an exhausted receiver.

The colour of the animal creation, as well as of the vegetable, depends on light. In the polar regions, animals and birds are generally white, while they become more variegated as they approach the tropics. The inner feathers of birds, to which the air has no access, are generally white, and so are their bellies. The bellies of fish are white for the same reason. Man deprived of light soon droops, becomes sallow, dropsical, and dies.

If light consists of particles of matter—but this, notwithstanding the opinion of Sir Isaac Newton, is far from being generally entertained—they must be most minute, else, from the rapidity of their motion, they would seriously affect the sight. They, however, do not cause the slightest pain to the eye; nor when condensed by the most powerful burning glass, and thrown on the most delicate balance, do they affect it, although they would travel at the rate of nearly *twelve millions* of miles in a minute. In illustration of the smallness of the particles of light, supposing light to be a *material* body, if a candle be lighted, and so placed that no object shall obstruct its rays, they will be diffused over a space of more than two miles in every direction, before the candle is apparently diminished in the slightest degree.

In reference to the velocity of light, it was thought for a long period that light was propagated instantaneously; but from observations by Roëmur on the eclipses of Jupiter's satellites, which regularly undergo occultations at stated periods, it was found that they were visible about sixteen minutes earlier when the earth was in that part of its orbit nearest Jupiter, than when in the opposite part; showing that light is about sixteen minutes in passing across the diameter of the earth's orbit, a distance of nearly 190 millions of miles. Circumstances of daily occurrence tend to illustrate the velocity of light. The flash of a gun is seen for a considerable time (if the distance is at all remote) before the report is heard; as also the lightning's flash before the thunder.

The rays of light always proceed in straight lines, except when they pass *obliquely* through media of different densities. Those rays of light from the sun that fall *perpendicularly* on the atmosphere, pass in a straight line to

the earth, while those that fall *obliquely* undergo *Refraction*, or are bent as it were downwards out of their direct course. It is this refractive power of the atmosphere that causes twilight, and so gradually introduces in the morning the light of the sun, which, were it not for this, would blaze suddenly out from the thickest gloom; and at night, instead of quitting us so gradually and gently, would leave us all at once enveloped in darkness. Through the same cause the heavenly bodies appear higher in the heavens than they really are, and that in proportion to their proximity to the horizon; and when near the edge of the horizon, they appear above it, when they are in reality below it; so that when the lower limb of the sun or moon apparently just touches the horizon, although the whole body appears above it, it is in reality below it, as the upper limb is at that instant just beginning to touch the horizon. Rays of light become refracted in passing obliquely through water, glass, or any other diaphanous or transparent body, as well as through the atmosphere; and in passing from a *rare* to a *denser* medium, as from air into water, they are refracted *towards* a perpendicular to the surface; while on the contrary, in passing from a *dense* into a *rarer* medium, they are refracted farther *from* a perpendicular. If a stone be thrown obliquely into the water, when it strikes the water it will begin to fall more perpendicularly towards the bottom; just so is the direction of light in passing into water. The refractive nature of water may be seen by putting a stick partly into it, and observing the apparent change of the line of direction of the stick, both in and out of it: at the surface of the water it will appear broken. It is on the principle of the refractive power of light that the science of *Dioptrics* depends; which is one of the most useful and pleasing sciences, for by its means the most remote objects are brought fully into our view, and the most minute are so magnified as to show every part of them distinctly.

When rays of light fall on an opaque body, through which they cannot pass, they either become absorbed by the body, or are *reflected* back again. It is by means of *Reflection* that bodies are rendered visible. Every body

reflects particles of light, or vibrations, from every point of its surface, which move in straight lines and in all directions, and which by their action on the eye cause the body to be seen. The quantity of the rays of light reflected depends upon the nature of the body, the state and colour of the surface, and the angle of incidence. Under all these circumstances, the angle of reflection is equal to the angle of incidence. Of the various bodies which reflect light, metals possess this property in the greatest degree, and the lightest colours reflect the most. The difference in the two extremes, white and black, are rendered evident by laying a slip of white cloth, and another of black, on the snow in the sunshine; the black will be found to sink soon into the snow, by absorbing the light, and with it the heat; while the white piece will retain its place on the surface of the snow. While the science of *Dioptrics* depends on the *refraction* of light, and explains the construction of telescopes, microscopes, &c., that of *Catoptrics* depends on the *reflection* of light, and explains its laws and properties as reflected from mirrors or specula of all kinds, whether plain, concave, or convex.

It has been already observed that bodies are seen by the reflection of the rays of light from their surfaces; but the contrivance by which the idea of the body seen is conveyed to the mind, so as to form a correct judgment of it, is at once most wonderful and most effective. The *Eye* is the instrument for this purpose, and it is composed of such parts as best to answer the object for which it is designed.

Vision, or sight, is performed by rays of light reflected from the body seen passing through the humours of the eye, and painting the object on the *retina* at the back of the eye, whence it is conveyed by the optic nerve to the brain. The eye must for this purpose necessarily be of a *convex* figure, and of such a degree of convexity as the refractive powers of the several humours demand for forming the image at the given focal distance. The external part of the eye-ball is called the *cornea*, or *horny* coat, from its resemblance to a piece of transparent horn. Immediately behind this coat, there is a fine, clear humour, which from its similarity to water, is called the

aqueous humour. In this there is a membrane called the *uvea*, with a hole in the middle, termed the *pupil*, of a muscular texture, for altering the dimensions of the hole so as to regulate the quantity of light to be admitted. Behind this membrane is a substance of considerable consistency, and formed like a lens, called from its transparency the *crystalline* humour; this is contained in a fine tunic, called the *choroides*, and by means of a set of muscles may be moved a little nearer to the bottom of the eye, or further from it, to alter the focal distance, as necessity may require. The remaining part of the eye is filled with a jelly-like substance called the *vitreous* humour; and at the back is the *retina*, which is an expansion of the optic nerve, on which every thing that is seen is painted, and conveyed by means of the optic nerve to the brain. The delineation of objects on the retina is prettily demonstrated by taking a bullock's eye quite fresh, and, having stripped off the skin and the fat from the back part until only the thin membrane behind remains, placing it before any object, and the picture of the object will appear on the membrane, which is the retina—or the membrane may be taken away, and a piece of white paper substituted in its stead; the object will then appear on the paper, but in either case it will be inverted in the same manner as it would have been had the animal been alive. As the object seen is always painted in an *inverted* position on the retina, it very probably becomes again *reverted* as it ascends the optic nerve. It is most wonderful that a prospect of many miles in extent, diversified with hill and dale, houses and fields, men and animals, can be painted on so small a space as the retina of the eye. It may be observed, that the magnitude of the object seen, depends on the angle subtended by the object; consequently, were it not for the judgment, we should not have any correct idea of the relative size of bodies. As the angles under which bodies are seen increase and decrease in a direct ratio, according to the distance, a man fifty yards distant is depicted on the retina twice* as large as a man one hundred yards dis-

* It would be probably more correct to say *four* times, as he will appear *twice* as high, and *twice* as broad.

tant; and were it not for the judgment, the nearer might be supposed to be a man, and the more distant a little boy.

As only a very small part of an object can be seen distinctly at once, the eye is forced to turn itself successively to the different parts it is desirous of viewing. When an object is seen with both eyes, the axes of both eyes are directed to the object, and meet there; and the optic nerves are so formed, that the correspondent parts of each eye lead to the same spot in the brain, and produce but one sensation. If the axes of both eyes be not directed to the same object, the object will appear double, as the pictures do not fall on similar parts of the retina in both eyes. This may be perceived by holding the finger before any object, a lighted candle for instance, and by looking steadfastly at the object there will seem to be *two* fingers, and by looking at the finger the object will appear *double*. The smallest visual angle is about *half a minute* of a degree, and at a medium not less than *two* minutes. To most eyes, the nearest distance for distinct vision is *seven* or *eight* inches.

The external shape of the eye is found to affect the sight. The eyes of some persons are naturally too convex; some acquire too great a convexity of the eye by close reading, which alters the shape of the crystalline humour; the image then becomes formed too soon, from the rays meeting in a focus before they reach the retina, unless the object be brought near the eye, in which case the image will be cast farther back. Shortsighted persons, therefore, use *concave* glasses to view objects at a distance, which diverge or spread the rays, and render the vision distinct. The eyes of persons in the wane of life generally become less and less convex, the image will not then be formed soon enough on the retina; *convex* glasses will therefore be used, by which means the rays of light are converged, and the image is clearly delineated.

According to Sir I. Newton, Light is not a body of a homogeneous nature, but consists of rays of different kinds or colours,* each of which, in passing from one

* Colour is considered a property inherent in light, by which it excites different vibrations in the optic nerve, which being conveyed to the brain affect the mind with different sensations. According to Sir

medium to another, differs in refrangibility. A ray of light is found to contain seven colours, *red, orange, yellow, green, blue, indigo,* and *violet:* these are called primary colours, but these seven are reduceable to three, *red, blue,* and *yellow*. If a hole be made in a shutter in a darkened room, and a ray of light be made to pass through a prism held obliquely, and received on a screen at a proper distance, the ray will be found to be divided into the seven primary colours just named; and if the image of the rays (called a *spectrum*) be divided into 360 equal parts, the red will be found to occupy 45 of these parts, the orange 27, the yellow 48, the green 60, the blue 60, the indigo 40, and the violet 80. The rainbow, which is formed by the refraction and reflection of the rays of the sun in drops of falling rain, most beautifully exhibits the natural separation of the colours of Light.

Of the seven primary colours, the red is the least refrangible, and the violet the most refrangible. The strength of the red rays is visible on a hazy morning; the other rays being unable to penetrate the mist, the sun appears of a deep crimson colour. When all the rays are equally refrangible, light is said to be *homogeneous;* and when some rays are more refrangible than others, it is said to be *heterogeneous*. The colours of homogeneous light are not altered by refraction, and anything viewed in homogeneous light will appear of the colour of the rays which fall upon it. Red lead or yellow ochre, for instance, in a homogeneous green light will appear green, and so would any other substance.

The colours of bodies are said to arise from their disposition to reflect one sort of rays and to absorb the others; thus a red substance absorbs all the rays but the red, which it reflects. The *whiteness* of bodies arises from their reflecting all the rays of light promiscuously, and the *blackness* of bodies from their absorbing all the rays of light thrown on them. That white is a compound of all the primary colours, is prettily shown by painting on

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R. Phillips, different colours are different perceptible effects on the optic nerves by the different forces or action of the rays, the red being the most forcible, and the violet the least.

a circular board the seven colours in the proportion in which they are on the spectrum, and by whirling the board round with great velocity, the whole will be so blended together as to appear of a white colour, which will be more or less perfect as the colours are more or less perfectly laid on.

COLD.

Effects of Cold—How produced artificially—Fatal results from exposure to extreme Cold, &c.

Cold is that sensation which accompanies a transition of the fine vessels of the human body from an expanded to a contracted state. As heat is said to be caused by a particular motion of the particles of a hot body, so cold is its opposite, or the absence of such motion. Although contraction is the general result of cold, yet some bodies, under peculiar circumstances, expand as they cool: thus iron expands by heat, yet when melted it is found to expand in cooling. Water expands as it is heated, and contracts as it cools; yet just before it begins to freeze, it gradually expands again. The expansive force of water is most astonishing; it is capable of rending rocks, or of bursting asunder very thick shells of metal. It has been found by experiment, that the expansive power of a spherule of water of *one* inch in diameter, in freezing, is capable of overcoming a resistance of 27,000lbs.

Cold may be produced artificially, although it cannot be made to increase itself as heat will do. The greatest degree of cold that has been produced artificially has been eighty degrees below *zero* or 0 on Fahrenheit's thermometer. Even snow and common salt mixed will sink a thermometer from the freezing point to *zero;* and if a little water be poured on a table in a warm room near a fire, and the vessel containing the mixture be put on it, it will become in a very little time completely frozen to the table.

The effects of extreme cold are very surprising: rivers and lakes become frozen several feet deep: metallic substances blister the skin like red-hot iron: the air, when

drawn in by breathing, hurts the lungs and excites a cough: even the effects of fire, in a great measure, seem to cease; and it has been observed, that though metals are kept for a considerable time before a strong fire, they will freeze water when thrown upon them. When the French mathematicians wintered at Tornea, in Lapland, the external air, when suddenly admitted into their rooms, converted the moisture of the internal air into flakes of snow. The same circumstance occurred to our hardy seamen under Captain Parry when wintering in the Frozen Ocean.

Extreme cold often proves fatal in those countries where the winters are very severe; thus 7000 Swedes perished at once, in the year 1719, in attempting to pass the Dofrafield mountains to attack Drontheim. But it is not necessary that the cold, in order to destroy human life, should be so very intense; it is only requisite to be a little below thirty-two degrees of Fahrenheit, or the freezing point, accompanied with snow or hail from which shelter cannot be obtained. The snow which falls upon the clothes, or the uncovered parts of the body, melts, and by a continual evaporation carries off the animal heat to such a degree, that a sufficient quantity is not left for the support of life. In these cases the person first feels himself extremely chilled and uneasy; he becomes listless, unwilling to walk, or to use exercise to keep himself warm; and at last feels drowsy, sits down to refresh himself with sleep, but awakes no more.

A striking illustration of the effect of cold is related by Captain Cook in an occurrence during a botanical excursion of Sir Joseph Banks and Dr. Solander among the hills of Terra del Fuego. The party, consisting of *eleven* persons, were overtaken by darkness during extreme cold; and Dr. Solander, who had more than once crossed the Dofrafield mountains, well knew that extreme cold, especially when united with fatigue, produces a torpor and sleepiness that are almost irresistible; he therefore conjured the company to keep in motion, at whatever pains it might cost them: "Whoever sits down," said he, "will sleep; and whoever sleeps will wake no more." Being thus admonished, they set for-

ward; but while they were still upon the naked rock, the cold became suddenly so intense as to produce the effect they had so much dreaded. Dr. Solander was himself the first who found the inclination, against which he had warned the others, irresistible, and insisted upon being suffered to lie down. Mr. Banks entreated and remonstrated in vain; he lay down upon the ground, although it was covered with snow, and it was with great difficulty that his friend kept him from sleeping. Richmond also, one of the black servants, began to linger, having suffered from the cold in the same manner as the Doctor. Mr. Banks, therefore, sent five of the company forward to get a fire ready at the first convenient place they could find, and himself, with three others, remained with the Doctor and Richmond, whom, partly by persuasion and partly by force, they made to proceed; but when they had gone some distance, they both declared they could go no farther. When Richmond was told that if he did not go on he would in a short time be frozen to death, he answered that he wished to lie down and die. The Doctor was desirous of taking some sleep before he proceeded farther, although he had before told the company that to sleep was to perish. Mr. Banks and the rest found it impossible to carry them; and there being no remedy, they were both suffered to sit down, and they almost instantly fell into a profound sleep. Soon after, some of the people who had been sent forward returned with the welcome news that a fire was kindled about a quarter of a mile further on the way. Mr. Banks then endeavoured to wake Dr. Solander, and happily succeeded; but though he had not slept *five* minutes he had almost lost the use of his limbs, and the muscles were so shrunk that his shoes fell from his feet; he consented to go forwards with such assistance as could be given him, but no attempts to relieve poor Richmond were successful. He, together with another black left with him, died. Several others began to lose their sensibility, having been exposed to the cold and snow for nearly an hour and a half, but the fire recovered them.

PNEUMATICS.

Air a compound body—Figure, Height, Weight, Pressure, &c. of the Atmosphere—Air the supporter of animal and vegetable life—Expansion and condensation of Air—Refractive and Reflective power—The Air-Pump—Air-Gun—Condensing Syringe—Barometer, &c. explained.

THIS science treats of the weight, pressure, elasticity, and other phenomena of that invisible fluid that surrounds our globe. It used to be supposed that the atmosphere consisted only of two distinct substances; air, and water in a state of vapour. But it is now known that atmospheric air is a compound of two distinct gases,* oxygen, and nitrogen or azote, in proportion of about twenty-two parts of the former, to seventy-eight parts of the latter; it also contains about *one* part in *one thousand* of carbonic acid gas, and one part in *seventy* of aqueous vapour. There is also in the atmosphere hydrogen formed from the decomposition of water, and other gases, together with particles of different kinds of bodies constantly floating in it.

The *figure* of the atmosphere, if the earth were at rest, would be spherical; but as the earth is in motion, as also because of the action of the sun heating and expanding the parts about the equatorial regions, it assumes that of a flattened spheroid.

The extreme *height* of the atmosphere may be nearly fifty miles, but at this distance from the earth it must be exceedingly rare; so much so as to have no sensible effect on the rays of light as to refraction or reflection; for at the height of *two* miles, it is seldom sufficiently dense to support the clouds, although an aëronaut has ascended as high as *four* miles and a *third*. It has been calculated that at the height of three miles and a half the air is only *one-half* of the density of what it is on the surface of the earth; at seven miles it is *one-fourth*, at fourteen miles *one-sixteenth*, and so on decreasing in density in a *quadruple* ratio, while the distance increases in a *duplicate* ratio, so that at the height of forty-nine miles it will be

* See the article *Gaseous Bodies*.

more than 16,000 times rarer than at the earth's surface. At the tops of high mountains, through the rarity of the air, a most violent oppression is felt at the chest, sometimes attended with spitting of blood, and with blood gushing from the ears and nose: the external air being unable to counterbalance the internal pressure.

That the air has *weight*, was granted by the ancients; but it has been proved beyond a doubt by the air-pump, which is a modern invention, and also by the barometer, and the exact quantity of its weight has been ascertained. Because the atmosphere will balance in an hermetically sealed tube a column of quicksilver of about thirty inches in height, as also it will sustain in a sucking pump a column of water of about thirty-two or thirty-three feet high, it follows that the weight or pressure of the atmosphere is equal to a column of quicksilver or water of the above height and of a like base, and this is found to be in the proportion of fifteen pounds nearly on every square inch of surface,* or of *one* ton on every square foot; whence it has been computed that the whole weight of the atmosphere is equal to a globe of lead of sixty miles in diameter.

Air, like other fluids, presses in all directions, both perpendicularly, laterally, and upwards. The upward pressure of the air may be shown as follows. Fill a wine-glass with water, and place over it a piece of writing-paper; if the paper be pressed firmly over the glass by the palm of the hand and the glass be inverted, the water will still remain suspended in the glass by the pressure of the atmosphere, although the hand be removed.

Air is the support of animal and vegetable life, but if it be closely pent up for a considerable time it will become vitiated by being deprived of its vivifying principle. Any means whereby the oxygen or pure part of the air is destroyed, must tend to render it unfit for respiration; whence it is highly unwholesome to sleep, or to remain shut up, in a newly plastered or whitewashed room, from the lime imbibing the oxygen. When it is considered that a man consumes or fixes more than a cubic foot of

* A Cubic foot of air weighs very nearly one ounce and a quarter, and its specific gravity compared with water is as 800 to *one*.

oxygen in an hour, and consequently destroys the vital principle of five times that quantity, the necessity of proper ventilation will be perceived in order to procure a constant and fresh supply. Air is sometimes rendered very deleterious by vapours escaping from the earth. In Campania the air is impregnated with sulphur, and it has also been found to contain arsenic, and millions of fishes are said to be destroyed by it. At a certain part of Sweden, noted for its copper-mines, the air is so affected by the exhalations as to tarnish the silver in the pocket.

Air becomes expanded by heat and condensed by cold, in the proportion, according to Laplace, of one *four-hundred and fiftieth* for every degree of Fahrenheit's thermometer. To this property may be attributed those currents of air called winds: the heat of the sun expanding the air, and causing it to become lighter, it consequently ascends, while the circumambient air rushes in to supply its place. The following experiments will show the effect of heat in rarefying the air: Hold a bladder partly filled with air to the fire, and the air will become so expanded by the heat as to burst the bladder with a considerable report. Again, take a wine glass and hold it over a piece of lighted paper for about a second, then suddenly clap it firm upon the palm of the hand, the glass will remain tightly fixed on the hand from the inner pressure being diminished through the rarefaction of the air, and the flesh will be pressed into the glass by means of the opposite pressure. Fire-balloons are made on the principle of the rarefaction of the air by heat. A piece of sponge, soaked either in turpentine or in spirits of wine, is suspended by means of a wire at the bottom of the balloon, which when ignited so rarefies the air within the balloon as to cause it to ascend. The first balloons were thus made. M. Montgolfier, a Frenchman, in the year 1783, made one of canvass, seventy-four feet high and forty-eight in diameter, weighing in the whole 1000 pounds; and notwithstanding it was of this immense weight, it was filled in ten minutes with rarefied air, when its power of ascension was equal to more than *six hundred weight*.

Air has a *refractive* and *reflective* power. By its power of refraction the rays of light are bent out of their direct course, as in the case of the twilight; by which means

darkness comes on slowly and gradually, instead of rapidly and at once. The reflective power of the atmosphere has also its benefits, for without this quality the appearance of things would be much altered. We should most probably be only able to see that side of anything on which the sun shone, which would be attended with the greatest inconvenience. We should also have a most sudden transition from daylight to darkness, on the rising and setting of the sun. The light of the sun itself would be also too fierce for our comfort, if our eyes were directed towards it; while at that part of the heavens opposite to the sun it would be dark and dismal, and the planets and stars would be visible if there were no clouds to prevent it.

The principal instruments used to exhibit the weight, elasticity, and other phenomena of the atmosphere, are the *Air-Pump*, the *Air-Gun*, the *Condensing Syringe*, and the *Barometer*; a brief description of which is here annexed.

The AIR-PUMP is more properly a machine than an instrument; and is so constructed as to exhaust the air out of a proper receiver, or rather to rarefy it, and the principle of its action depends on the elasticity of the air. The air-pump was first invented by Otto Guericke, of Magdeburg, in the middle of the seventeenth century. A single-barrelled air-pump consists of a plate of brass, having a small hole in its centre, and connected by a tube to a cylindrical barrel, in which a piston with a proper valve is made to work, similar to a common sucking-pump. If a receiver be placed on the brass plate, and rendered air-tight, by raising the piston a quantity of air will be exhausted from the receiver, when the remaining air will, by means of its elasticity, become rarefied, and occupy the whole of the receiver: by repeatedly working the piston upwards and downwards, the air will become proportionately rarefied, when, by a series of interesting experiments, the nature and properties of the air are beautifully exemplified. The single-barrelled air-pump is the most simple of its kind. Air-pumps are now generally made with double barrels to work with a winch, but the principle is the same.

When the air is exhausted—or more properly, consi-

derably rarefied—the receiver will remain so fixed by means of the downward pressure of the atmosphere as to render it almost impossible to be removed without re-admitting the air. The downward pressure is also shown by putting a piece of wet bladder over the top of an open receiver, and on exhausting the receiver, the bladder will be pressed violently down so as ultimately to burst. If a thin phial hermetically sealed be placed within the receiver, and the air exhausted from the receiver, the air within the phial, by means of its expansive force, will burst the phial. If a cup of water, just below the boiling point, be placed within the receiver, and the air rarefied, it will begin to boil, and the violence of the ebullition will be in proportion to the rarefaction of the air. On this principle it is that water will boil sooner on the tops of high mountains, than it will in the valleys; as also that it will take longer to boil at the bottom of a deep mine, than on the earth's surface. The mean boiling point at the surface of the earth is 212 degrees; of Fahrenheit; on the top of a mountain, where the weight of the air is diminished *one-tenth*, it is 207 degrees, while at the bottom of a deep mine it is 214 degrees. The weight of bodies is found by the air-pump not to depend on the nature of the body, but on the resistance of the air; thus a piece of metal and a feather will fall with equal rapidity in an exhausted receiver.

There are various other phenomena exhibited by means of the air-pump, which it is impossible here to particularize fully. Thus in an exhausted receiver a bell will not sound, a siphon will not run, vegetation stops, and animals in general in a very short time die. The glow-worm loses its light in proportion as the air is exhausted; gunpowder and sulphur will not burn; smoke descends instead of ascending, together with many other interesting results.

The AIR-GUN is an instrument for propelling bullets by condensed air. Air-guns are constructed in various ways; the more common one is made like a fowling-piece, having under the lock a round steel tube with a small moveable pin in the inside, which is pushed out when the trigger is pulled; to this tube a hollow copper ball, having a suitable valve, is made to screw, being perfectly

air-tight. The copper ball being charged with condensed air, by means of a condensing syringe, and screwed on; by pulling the trigger, the valve in the ball is struck with the pin, when a quantity of air rushes into the barrel of the gun, and forcibly acts on the bullet, sending it to a very considerable distance. As only a portion of the air escapes from the ball, the gun may be loaded and discharged several times successively without recharging the ball. It is said that air condensed but *ten* times will discharge a ball with a velocity equal to gunpowder. The writer of this article has propelled a ball through an inch deal for several times successively with the original charge. Air-canes are on the same principle as air-guns; they are made to resemble walking-sticks, and unscrew in the middle, the upper part forming a chamber for the condensed air, which, when charged, is again screwed on to the other part, when it may be loaded, cocked, and fired.

The CONDENSING SYRINGE consists of a solid piston moving in a tube which must, of course, be perfectly air-tight: when the syringe is screwed on to the ball, and the piston forced up, the air which was in the tube is propelled into the ball, and retained there by a valve. The piston is then drawn down, and creates a vacuum in the tube, until it arrives at a certain part where there is a hole, through which the air rushes and fills the tube, which is again forced into the ball: this action is repeated until the ball is sufficiently charged. By the condensation of the air, a very considerable degree of heat is generated. Tinder and fungus may be lighted in a proper condenser, by the sudden stroke of the air.

The BAROMETER, a well-known instrument for exhibiting the approaching change of the weather, which has been already referred to, requires a slight explanation. In its most simple form, it is a tube of glass, of about 30 inches long, hermetically sealed at one end, filled with quicksilver, and inverted into a vessel of the same metal, when the quicksilver in the tube will descend until it arrives at from between 28 to 31 inches above that in the vessel, according to the state of the atmosphere. If the quicksilver in the tube falls or becomes low, it indicates rain; if it rises, it indicates fine weather. The principle, which

has been already alluded to, is, that a column of air, of the whole height of the atmosphere, will balance a column of quicksilver of from 28 to 31 inches, according to the state of the air. When the atmosphere is loaded with aqueous vapour, it becomes lighter, aqueous vapour being considerably lighter than atmospheric air; consequently it will not balance so large a quantity of quicksilver, and the quicksilver of course sinks. When the aqueous vapour is condensed into rain, and yields its place to the common atmospheric air, the quicksilver again rises. Barometers are made in different ways, but the principle is invariably the same. Barometers are used to ascertain the height of mountains or other elevated situations, the mercury sinking *one-tenth* of an inch at about every *hundred* feet of ascent.

WATER.

Water a compound body—Different states of water—Water universally diffused—Salt-water — Snow-water — Rain-water —River-water—Spring-water—Expansive power of water converted into steam—Theory of boiling, &c. &c.

WATER is a clear colourless liquid, and if pure, is without either taste or smell. It used to be imagined by the ancients that water was an element or simple body; but it is now well known to be a compound of two gases, *oxygen* and *hydrogen*, in the proportion of about 85 parts of the former to 15 of the latter by weight.*

Water exists in four distinct states: in *Ice*, *Water*, *Vapour*, and in *combination with other bodies*. Ice is the simplest state of water, it being water deprived of the greatest portion of its caloric. When water receives an excess of caloric, it becomes *vapour* or *steam*.

Water is most universally diffused, for there is scarcely any body in nature that does not contain it: wherever there is matter there appears to be water. Hartshorn kept *fifty* years, so as to be as dry and hard as any metal, and even capable of producing sparks like steel when struck with a flint, will, if distilled, produce *one-eighth* of

* Water contains air holding a larger quantity of oxygen than atmospheric air; fishes breathe this air, which if deprived of they die.

its weight of water; and bones that have been dried for *twenty-five* years have produced one-half of their weight of water. The hardest stones ground and distilled discover a portion of water; and it has been said that even fire itself is not without it.

The grand reservoir of water is the *Ocean:* this covers nearly *three-fifths* of the earth's surface, and extends to an unfathomable depth. The most striking property of sea-water is its saltness, the cause of which philosophers have endeavoured to account for in various ways. Dr. Halley supposed that the sea was originally fresh, and that its saltness proceeded from the salts of the earth conveyed into it by rivers. Others have supposed that there are vast rocks of salt at the bottom of the sea, whence it derives its saltness; and this is rendered more plausible from the numerous and extensive salt-mines known to exist in different parts of the earth. Others, again, have supposed that the sea was created salt to keep it from putrefaction; but it appears to be kept from putrefaction by the agitation of the winds and tides, for stagnant salt-water will in time become corrupt. Although the sea is universally salt, yet it is salter within the tropics than at the arctic regions; this is accounted for by the quantity of snow, and the large rivers, that fall into the northern seas; to which may be added, that evaporation is infinitely less in those seas than between the tropics, consequently a proportionately less quantity of fresh water is carried off.

Of the various kinds of water, *Snow*-water, when collected clean, is the purest. *Rain*-water may be considered the purest distilled water, but in its passage through the air, it becomes impregnated with putrescent matter, which, while it renders it superior to any other for fertilizing the earth, renders it inferior to spring and river water for various purposes. The manner in which rain-water is generally obtained, viz., from gutters placed under the roofs of houses, adds to its impurity, and renders it in a short time quite putrid.

River-water is next in purity to rain-water, particularly where it runs over a clean, stony bottom, and is superior to it for domestic purposes. River-waters putrefy sooner

than spring-waters, but they soon throw off their heterogeneous matter, and become sweet, and purer than before, and continue so for a long time. On this account it is that the Thames water is generally preferred for long voyages.

Spring-water is impregnated with a portion of neutral salts, which makes it hard; it is also occasionally impregnated with iron. It is, however, preferred as a beverage, for its coolness and pleasantness, though it is less wholesome than good river-water. Springs are formed by the intervention of clay and sand strata, the former holding water, and the latter allowing it a free passage; so that no water is found, in digging wells, until clay is penetrated. Springs of fresh water are found to exist even under the sea. It is said that *thirty* have been discovered under the sea on the south of the Persian Gulf. St. Winifred's Well, in Flintshire, is said to throw up 120 tons of water in a minute, and to turn eleven mills in the space of about a mile and a half. There are *hot* springs in various parts of the world, of which the Great Geyser, in Iceland, is the most remarkable. The chief hot-springs in England are those of Bath and Bristol: the hot baths of Bath are as high as 115° of Fahrenheit.

The specific gravity of water is constantly changing with the temperature of the atmosphere. At a mean rate, it is 820 times heavier than air; so that a cubic foot of water will weigh 1000 ounces avoirdupois—*very nearly*.

Water is of a very volatile nature, and soon raised to vapour. If exposed to the action of the fire in an open vessel, it would entirely go off in vapour, and consequently occupy a space infinitely greater than it did before.* The expansive force which water acquires when converted into steam is greater than that of gunpowder:† thus a pound of water, converted into steam, may be made to displace or raise a greater weight than a pound of gunpowder would. It is to this principle that the mighty

* According to Count Rumford, steam at 212° is 3000 times rarer than water; but with a great heat, it may be made to occupy more than 10,000 times the space of water.

† This is strikingly evident in Perkins's steam-gun, which will discharge seventy balls in four seconds.

power of the steam-engine* is indebted; and volcanic eruptions and earthquakes are supposed to be often caused by water meeting with subterraneous fires, and being suddenly converted into steam. It is through the expansive power of steam that that well-known motion called *boiling* is caused. The theory of heating and boiling is as follows:—When a vessel of cold water, for instance, is placed over the fire, that layer of water nearest the fire will become heated first, and will consequently, through its expansion, acquire a specific gravity different from that of the mass: the heated portion will ascend, and its place will be occupied by another portion, and thus the whole mass will be brought successively into contact with the heated bottom of the vessel, and continue to have its temperature increased until the caloric or heat generates vapour so rapidly and violently that it rushes up and causes the boiling. So that, in this operation, there is a constant circulation of the water about the vessel; that which was nearest the bottom, being converted into vapour, ascends, giving way to that which was immediately above it. The degree of heat to produce boiling depends on the weight or pressure of the atmosphere. When the barometer is at 29 inches, water boils at about 210°. When the barometer is at 31 inches, the boiling point is rather more than 215°. It is not through the *conductive* power of water that its temperature so soon becomes raised; water being so bad a conductor of heat, that a portion of water, in a glass tube containing ice, may be made to boil without even melting the ice.

Water is the most penetrative of all bodies, and the most difficult to confine; passing through leather, and even bladders, which will confine air. It used to be supposed that water is incompressible: from recent experiments, it is found that water may be compressed, but not to any considerable extent.

* Some steam-engines are sufficiently powerful to raise a weight equal to forty millions of pounds *one* foot, and that with a single bushel of coals.

HYDROSTATICS AND HYDRAULICS.

Hydrostatics and Hydraulics defined—Pressure of Fluids, and peculiar properties—Specific gravity of Bodies—Motion of water in pipes—Sucking Pump—Forcing Pump—Siphon—Jets, &c.

HYDROSTATICS is that science which treats of the nature, gravity, and equilibrium of fluids, and of the weighing of bodies therein. Hydraulics treats of the force and velocity of fluids in motion.

Fluids are those bodies which possess a perfect freedom of motion, and whose parts yield to any impression. They are divided into *elastic* and *non-elastic*. Air, vapour, and gases, are *elastic*, as their volume may be diminished by pressure. Mercury, water, &c. are *non-elastic* or incompressible, except to an inconsiderable amount.*

It is peculiar to fluids, that they do not press only in a perpendicular direction, like solids, but upwards, laterally, and in every direction. The sides of canals are on this account sometimes *blown up*, as it is termed; the water, by gradually washing away the earth, in time forms a kind of hollow, the pressure becomes too great for the bank to withstand, and it is forced up and falls into the canal.

The pressure of fluids is not according to their bulk, but according to their perpendicular height, combined with the area of the base. If two vessels be filled with water or any other fluid, the one of a cylindrical and the other of a conical shape, provided the bases and perpendicular heights are equal, the perpendicular pressure of the liquid will be equal: should it happen that their contents become frozen, then the pressure on the bottom of the cylindrical vessel will be three times as great as that on the bottom of the conical vessel, the volume of a cylinder being equal to three times that of a cone of the same base and height. If a long tube of only half an inch in diameter be inserted into a large cask of water and made air-tight, by pouring water into

* Perkins is said to have compressed water *one-twelfth* with 2000 atmospheres.

the tube the pressure will become so astonishingly great as to rend the cask asunder, as if with gunpowder. The pressure, notwithstanding the smallness of the diameter of the tube, being equal to a body of water of the height of the pipe, whose base is equal to the base of the cask. Bramah's press is made on this principle; and a column of water of *half an inch* in diameter is made to produce a pressure of several hundreds of tons. Various amusing experiments have been invented to exemplify this peculiar property of fluids, which are detailed in most works expressly on this science.

If a body swims in a fluid, it is known to displace as much of that fluid as is equal to its weight; if it sink or be immersed in a fluid, it will displace as much as is equal to its bulk; if it be suspended in a fluid, it will lose as much of what it weighed in air as is equal in weight to its bulk of the fluid. On this latter axiom depends that which is termed the Specific Gravity of bodies, or the relative weight of equal bulks of different bodies. Bodies are generally compared with water, and their specific gravity is usually found by weighing them in water. If a cubic inch, or cubic foot, for instance, of any body, be twice the weight of a cubic inch or cubic foot of water, its specific gravity is said to be *two*, or *twice* that of water; and this is found by weighing the body first in air, in the common way, and then in water,* and dividing the weight in air, by the loss of weight in water. Thus, if a guinea be found to weigh 129 grains in air, and on its being suspended in water it weighs $7\frac{1}{4}$ grains lighter, it shows that a quantity of water of equal bulk with the guinea weighs $7\frac{1}{4}$ grains: 129 being divided by $7\frac{1}{4}$, the quotient will be 18 *nearly*, which is its *Specific Gravity*. If a body be lighter than water, as wood, cork, &c., it is first weighed in air, and then it is attached to some heavier body that will cause it to sink in the water, the weight of which body has been counterbalanced in the opposite scale; these being immersed together will

* This is done by the Hydrostatic Balance, an instrument like a common balance, only one of the scales has a hook underneath to suspend a body so as to let it dip into a glass of water.

cause the balance to rise; then, by observing the loss of weight, and proceeding as before, the specific gravity may be obtained. Fragments of diamonds, &c., are put into a glass bucket, and suspended from the scale. For finding the specific gravity of fluids, a solid glass bubble is used.

From the near connexion between Hydrostatics and Hydraulics, many writers have considered them one science; yet it appears more systematic to treat of them separately, and to rank under the head of Hydraulics whatever is effected by the motion of water, as mills, pumps, fountains, &c.

One of the first principles of the science of Hydraulics is, that fluids rise to their own level; and thus they may be conveyed over hills and valleys, by means of pipes, to any height not greater than the level whence they flow. With this property the ancients were unacquainted, or they would not have formed those immense aqueducts, the remains of which still exist in many places. If the ancients wanted to convey water from one hill to another, they often connected the hills by archways, and contrived that the water should flow over them; while we should effect the same by simply laying down a pipe or series of pipes. A very great part of London is supplied with water by pipes from the reservoir at Pentonville. Jets, or fountains, are on this principle; the water, by endeavouring to rise to its level, spouts out in the pleasing manner often witnessed. It will not rise quite as high as its source, from its being impeded by the resistance of the air, and the friction at the opening of the pipe.

If it be required to raise water above its level, it is done either with a common *Sucking Pump*, by removing the atmospheric pressure, or by the *Forcing Pump*. A column of air of the height of the atmosphere of any base, will counterbalance a column of water of the same base, and of about 32 or 33 feet high; the weight of each being alike. On this principle it is that the sucking pump acts; the air is exhausted from the bore of the pump by means of a piston, acting in a manner similar to a syringe; the water rises, and passing through

a valve in the piston which will allow it to go through but not to return, it is thus made to issue from the spout of the pump.

In the *Forcing Pump*, the water is made to rise in a manner similar to what it does in the sucking pump, and by means of a fixed valve it is also prevented from returning; but the piston being solid, unlike that of the sucking pump, by the action of the piston the water is forced through a tube contrived for that purpose, and may be thus thrown to a very considerable height. It is by means of a forcing pump, worked by a steam-engine, that the water is raised from the New River into the reservoir at Pentonville, above named. Fire-engines are on the principle of the Forcing Pump.

There is a small hydraulic instrument called a *Siphon*, which requires to be noticed; it is merely a bent tube, having one leg shorter than the other: its chief use is for drawing off liquors from one vessel to another. The shorter leg is immersed in the liquor to be drawn off, and by exhausting the air from the tube, which, if small, may be done by the breath, the liquor will then rise in the tube, and flow through the longer leg; or the tube may be filled with the liquor, and immersed in the vessel with both ends stopped, on removing the stoppage the liquor will flow off as before. The principle on which the Siphon acts is as follows: When the tube is exhausted of air, the pressure of the atmosphere forces the liquor up the shorter pipe, and as the upward atmospheric pressure on the outside is somewhat less than that on the liquor, it flows down, and will continue to do so until the vessel is emptied. If the legs of the Siphon, were equal, or if the longer leg were immersed in the liquor, the upward pressure of the atmosphere would prevent the liquor from flowing down the tube, by overcoming the perpendicular pressure.

ACOUSTICS.

Sound defined and explained—Air chief conductor of Sound—Intensity of Sound depending on the density of the media—Cause of the vibrations of a sounding body—Velocity of Sound—Conductors of Sound—Echo—Speaking and Hearing Trumpets—Invisible Girl, &c.

THIS science treats of the nature, laws, and phenomena of sound. Sound has been defined as a sensation of the mind communicated by the ear, or it is the effect of some external collision of bodies which produces a tremulous motion or vibration, and which is communicated to the mind by means of the ear. It is generally understood that the surrounding air or atmosphere is the medium of sound: but air is not the *sole* conductor of sound; fluids in general, and solids of all kinds, will transmit it, though not to a like extent.*

That air is the chief conductor cannot but be acknowledged; and that without that or some other fluid, as a medium, no sound would be heard, is evident from the fact of a bell rung under an exhausted receiver being inaudible, and becoming gradually audible as the air is admitted.

The *intensity* of sound is found to be in proportion to the *density* of the air; so that it has been ascertained by experiment that sound can be heard half as far again in carbonic acid gas as in common atmospheric air, while in hydrogen gas it can scarcely be heard at all. On the tops of high mountains the voice is considerably less audible than in valleys; as also the report of a gun is much less in strength and more acute in tone.

Sound appears to be communicated to the air in circular undulations, similar to the small waves produced on the surface of water when a stone is thrown into it; and this is evident to the ear in the tones of a church-bell while its sounds are dying away.

When a sonorous body is struck it becomes in a state

* It has been supposed that there is some subtle fluid, probably of an electrical nature, in the composition of bodies whose office is to transmit sound; and that bodies transmit sound in proportion to the quantity of this fluid contained in them.

of vibration, which is communicated to the air; and Euler was of opinion that no sound making fewer vibrations than 30 in a second, or more than 7520, is distinguishable by the human ear; the former being the most grave, and the latter the most acute tone that can be possibly sounded. The vibrations of a sounding body depend on its elasticity, and are governed by certain laws: if a musical string be divided into two parts, the sound of each half will be an octave of the whole string.

The ear is evidently the most direct instrument for the reception of sound in order to convey it to the brain, which it does by means of the *auditory* nerve; yet the palate, teeth, and nostrils lend their assistance; so that the deaf may often be made to hear by holding one end of a piece of metal between their teeth while the other end is in contact with the mouth of the speaker.

Sound travels in air at the rate of 1142 feet in a second, or 13 miles in a minute; and the softest whisper is transmitted as rapidly as the loudest thunder. From a knowledge of the rate of velocity of sound, the distance of a ship at sea, or of a thunder-cloud, may be easily ascertained. If the report of a gun be heard half a minute after the flash* is seen, the object will be about *six* miles and *a half* distant, and so in proportion: the same holds good in regard to the distance of a thunder-cloud. As the pulse of a full grown man in health beats seconds *nearly*, the number of pulsations multiplied into 1142 feet, will give the distance pretty accurately.

The best conductor of sound is *water*. On a still night, a conversation may be heard at a very great distance over water. The fire of the English, on landing at Egypt some years since, was heard more than 130 miles at sea; and it has been asserted that every word of a sermon was distinctly heard *two* miles distant over water. The influence that water has in propagating sound, is evident from the difference caused by a canal of water laid some years ago under the pit floor of the theatre of Argentino, at Rome, the voice having been since heard distinctly at the remotest part of the theatre, where it was before

* Light travels so rapidly, that at the distance of a few miles it may be said to be instantaneous.

scarcely distinguishable. Sound is said to travel *in water* at the rate of nearly 5000 feet in a second; and a bell sounded under water may be heard at a very considerable distance: it does not produce a tone, but a noise like the clashing of knives.

Stone is, next to water, the best conductor of sound. Brick is nearly as good a conductor: a soft whisper has been conveyed by a garden-wall, so as to be distinctly heard at the distance of 200 feet. Wood is also a good conductor; and its vibratory nature renders it peculiarly fit for musical instruments, as well as for the lining of theatres, &c.

Sound, like light, may be collected into one point as a focus, and will be more audible there than at any other point. In buildings of an elliptical shape, a whisper in one of the foci may be distinctly heard in the other focus.

The concert-rooms at Edinburgh are of an elliptical shape, and are so contrived that the musicians sit in one focus of the ellipse, and the audience in the other. A person speaking in the lowest tone, in the whispering-gallery of St. Paul's, is distinctly heard on the opposite side: also a person in one of the recesses of Westminster Bridge readily hears another person speaking on the opposite side.

When sound strikes any object, and is reflected back, it forms an *Echo*. Caverns, mountains, and buildings are favourable to this reverberation; but unless a person stands more than 60 feet from the reflecting object, he will not be able to hear the echo of his own voice distinctly. The echo is in some situations repeated several times successively. Near Milan there is an echo that returns the sound of a pistol more than 50 times. An echo in Woodstock Park returns 17 syllables in the day-time, when the air is brisk, and 20 in the night-time. The air at night being denser, the vibrations become slower, and a repetition of more syllables is heard.

For the purpose of the augmentation of sound, an instrument called a *Speaking-trumpet* has been invented, by means of which the sound is reflected from the sides of the tube, and prevented from spreading in the open air: it is much used at sea for hailing vessels at a distance.

Hearing-trumpets collect and condense the sound, and thus convey it to the ear.

Many amusing experiments and exhibitions have been at various times shown, depending on the peculiar nature of this branch of natural philosophy. The most striking of these was that termed the *Invisible Girl*, and which, in the beginning of the present century, was exhibited at different parts of England with considerable *eclat*. As a description of this *lady* may not be uninteresting to the youthful reader, it is attempted; although, being given quite from memory, after a period of more than 30 years, it is feared that it may be, in some respects, defective. On entering the exhibition-room, the spectator saw an instrument having the appearance of *four* brass trumpets, at right angles, communicating with a brass globe in the centre, about ten inches or more in diameter. This was suspended by small cords or ribbons from four small pillars about *one* inch in diameter, with a cross-rail near the top and bottom, standing unsteadily in the centre of the room. The exhibiter directed the attention of the spectators to the brass globe, representing to them that the lady was in the inside of it, and that, by addressing her in any one of several languages, she would return an answer. Various questions were put in English, French, and Italian, to each of which an answer was heard from the trumpets, in a weak, feminine voice, issuing apparently from the globe in the centre; and as there was no visible communication between the globe and any other thing whatever, it was at the time a source of surprise how the voice was conveyed there. It subsequently appeared that a communication was made by a pipe in an adjoining apartment, in which was a female properly instructed; the pipe being passed under the floor, and up one of the pillars, its orifice was placed directly opposite one of the *trumpets*, and the voice was thus conveyed backwards and forwards between the *lady* and her visiters.

METEOROLOGY.

Constituent parts of the Atmosphere—Evaporation—Rain—Fog or Mist—Dew—Snow—Hail—Coronæ, or Haloes—Parhelia, or Mock-suns—Fiery Meteors—Aeroliths—Aurora Borealis—Ignis Fatuus, or Jack with a Lantern—Wind—Meteorological Instruments, &c.

METEOROLOGY is that part of Natural Philosophy which explains the various phenomena of the atmosphere, as the clouds, rain, hail, dew, &c.

The Atmosphere is a vast body of air surrounding the earth, and extending to about 45 miles above its surface. It has been found when decomposed, as was observed under the article *Pneumatics*, to consist of two gases, oxygen and azote, containing at the same time about *one* part in *seventy* of Aqueous Vapour independent of other substances. One cubic foot of air near the sarface of the earth is found to weigh about *one ounce and a quarter*, being about 800 times lighter than water.

A certain process called *Evaporation* is continually going on, which supplies the air with aqueous vapour, ultimately to form rain, dew, &c. It is calculated that five thousand millions of tuns of water are carried off from the Mediterranean Sea alone in a summer's day, and that twenty millions of tuns are carried off the Thames in the same time; also that one hundred thousand cubic miles of water are by this process annually taken up by the atmosphere, the greatest part of which, when it has arrived at a certain height, being condensed into clouds.

As it is through the agency of caloric that water becomes suspended in the air, it is natural to expect that when the caloric is by any means abstracted, a condensation will take place, and that the aqueous particles will form drops. Something more than the mere parting with the caloric, is now thought necessary for the production of rain; and as it is known that electricity is carried off the earth by evaporation, it is generally understood that rain is in great measure an electrical phenomenon; so that when the clouds part with their electricity, which they may do in various ways, the result is a conversion of the aqueous vapour into drops of water,

which the atmosphere being incapable of supporting, falls in *Rain*.

Under the idea that Rain is caused by the disturbance of the electricity of the clouds, Sir Richard Phillips, many years ago, published a plan for fertilizing barren districts by erecting metallic rods on elevated spots, thus arresting the clouds and producing rain. It is well known that more rain falls in mountainous countries than in plains; it is also surmised that the leaves of vegetables, particularly of trees, have a tendency to attract the electricity of the atmosphere, from the fact that woody countries receive most rain. Sir Richard attributes the sterility of certain countries to the cutting down of trees, and conceives that to this may be ascribed the present sterility of the once fertile but now desert regions of Syria, Chaldea, and Barbary; and he ascribes the *oases* of the desert to the circumstance of a few trees having been accidentally suffered to grow in them.

In our own country, as well as in others, most rain falls in places near the sea-coast, so that while the mean annual depth of rain at London is 23 inches, it is somewhat more than *twice* as much near the western coast. A greater quantity of rain falls in most countries during the summer months, than during the winter months, and the mean annual quantity is greatest at or near the equator, and diminishes towards the poles. In Grenada the annual depth of rain has been found to be 126 inches, when in England* it was 32 inches, and at Petersburg 16 inches.

The whole of the vapours which are exhaled from the surface of the earth are not formed into clouds: sometimes, through an imperfect condensation, they remain suspended in the form of *Fog* or *Mist*; sometimes, through the coolness of the air, a more perfect condensation takes place, and they fall in *Dew*.

Dews are found to be more copious in clear than in cloudy weather, also in spring than in any other season, there being then more vapour than at any other time.

* It is calculated that from 300 to 400 tuns of rain fall annually on an average on every acre in England.

It is also necessary for the deposition of dew, that the temperature of the body on which it may be formed should be below that of the atmosphere; the vapour in contact thus becomes condensed, and the aqueous particles settle thereupon. Egypt and many other countries very much abound with dews, for the air is too hot in the day-time to constipate the vapours into clouds; it, therefore, never rains, but the nights being remarkably cold, the vapours are condensed in *Dews*.

If the temperature of the air be low, the vapours will sometimes become frozen before they are formed into drops; their specific gravity is then greater than that of the air, and they descend in *Snow*.

If the vapours are united into drops, and become frozen in falling, they are called *Hail*.* As Hail is often found to accompany thunder and lightning, it is considered an electrical phenomenon. Showers of hailstones of extraordinary magnitude have occasionally taken place, more particularly on the Continent, which have carried with them death and devastation to an incredible amount. A most violent storm of hail fell on the army of Edward III., near Chartres, in France, when the hailstones were so large that they killed 6000 of his horses, and 1000 of his best troops. At Antwerp, in Holland, in 1776, hailstones fell as large as hens' eggs, and weighed *three quarters of a pound*; horses were killed, and the fruits of the earth destroyed. In France, in 1785, one hundred and thirty-one villages and farms were laid waste by a dreadful storm of this nature. In order to prevent the destruction occasioned by hail-storms, which often destroy the vintage in the south of France, an instrument called a *paragrele* has been invented, by means of which the electricity of the atmosphere is said to be disturbed, and hail-storms rendered less severe.

Sometimes a luminous circle appears round the body of the sun and moon, this is called a *Corona* or *Halo*, and is attributed to the refraction of the rays of light in passing through the *vesiculæ* of a thin vapour.

* Hailstones are said to fall with a rapidity of at least 60 feet in a second.

These Coronæ are sometimes accompanied by *Parhelia* or *Mock-suns*, which latter are formed by the reflection of the sunbeams, in a cloud appropriately situated for that purpose. The Mock-suns appear of a bright white, and of the same size as the true sun; when many of them appear together, some of them are brighter than others. They are sometimes tinged with the colours of the rainbow, and often appear to have one or more fiery tails. These phenomena have been repeatedly observed in North America, where they have remained visible for several hours. They have made their appearance in England, but their visits are very rare and uncommon. According to our old chroniclers *five* suns were seen at once in the year 346; *three* also were seen in 812; *three* in 953, and *five* in 1233. Lilly mentions *three* seen in 1644, and *three* in 1648. Of late years they have not been seen in England at all. A similar phenomenon sometimes attends the moon; this is called a *Paraselene*.

Fiery meteors of a very wonderful and striking appearance often visit our atmosphere, but their origin is unknown.* A meteor appeared in 1783, which, from its having been seen nearly at the same instant over the whole of Europe, was calculated to be more than 100 miles high, and as large as Great Britain. A meteor as large as the moon appeared in the western counties of England in 1832; its light for a short time was intense. Luminous clouds are often seen, but their origin is unknown; one in Java, in 1772, destroyed a district twenty miles round, and killed 2000 persons.

A meteor like a falling star, sometimes appears darting rapidly through the air; this is supposed to be an electrical phenomenon, as it takes place when the air is in a state of electric excitement.

Stones called *Aeroliths* sometimes fall from the atmosphere, concerning which there are various opinions,

* Myriads of Meteors have appeared within these few years at stated periods, viz. on the 12th and 13th of November, which have illuminated the heavens for hours; sometimes apparently of the size of Venus, Jupiter, and even of the full moon; these are not only visible to particular places, but have been seen nearly over the whole of America and Europe, and also on the Red Sea.

although it seems not improbable that they are impelled from the lunar volcanoes. There are records of more than 300 instances of Aeroliths of all sizes, from a few ounces to some hundreds of pounds weight, falling in different parts of the earth. They strike the earth obliquely with a great force, penetrating it to a considerable depth. An Aerolith of fifty-six pounds weight fell in Yorkshire in 1795. Immense masses of iron of a meteoric nature have been found in different parts of the earth; from a portion of a mass which was found near the Cape of Good Hope, a sword was some years since manufactured and presented to Alexander, the late Emperor of Russia, by Mr. Sowerby, a gentleman then well known in the scientific world, but since deceased.

One of the most beautiful meteoric appearances is the *Aurora Borealis*, which, though rarely seen in our latitude, is a constant visitor of the Arctic regions; sometimes covering the whole heavens, and eclipsing by its splendour the stars and planets. The Aurora Borealis is often accompanied with a rustling snapping noise, and its appearance has been described as terrifically grand. There have been various opinions relative to the cause of this phenomenon, but it is generally ascribed to the combustion of inflammable air by means of electricity; although, from recent observations of the polar voyagers, it appears to be in some way connected with the magnetism of the earth.

The *Ignis Fatuus*, or *Jack with a Lantern*, is a meteor that is often seen in marshy places, and is supposed to be of the nature of phosphuretted hydrogen gas. This meteor is never seen on hills or other elevated places, because they do not sufficiently abound with moisture to produce this gas.

When the air is put into motion through any cause, it becomes *Wind*. The principal cause of Wind is the rarefaction of the air through heat; the rarefied air ascending, the unrarefied rushes in to supply its place. Evaporation is another cause of Wind, by producing an increase of volume in the atmosphere; and Rain is considered a third cause. Although the Wind in our climate is considered very changeable and uncertain, yet even in

England there is a degree of regularity, for the *easterly* wind usually prevails from about the Vernal Equinox to somewhat beyond the Summer Solstice, and then the *westerly* wind prevails for the remainder of the year. This is of course subject to exceptions. Within the tropics a very great regularity in the wind prevails; it blows at various places, for six months in one direction, and six months in the opposite direction, throughout the year. The velocity of the wind varies from *one* mile in an hour to 100 miles; from a scarcely perceptible breath to a terrific hurricane.

A most exceedingly rapid and impetuous wind moving in a spiral manner, called a *Whirlwind,* sometimes takes place. This usually occurs after very hot weather, and in the warmer climates, and has by some been attributed to a stream of elastic matter rushing violently out of the earth. Whirlwinds and Water-spouts most probably arise from the like cause, which is intimately connected with Electricity.

The following are the principal instruments used in Meteorology. The *Anemometer,* which measures the force of the wind; the *Atmometer,*—the quantity of water evaporated in a given time; the *Barometer,*—the weight, or pressure of the air; the *Cyanometer,*—the intensity of the blue colour in the atmosphere; the *Drosometer,*—the quantity of dew that falls; the *Eudiometer,*—the pureness of the air; the *Hygrometer,*—the humidity of the air; the *Ombrometer,*—the quantity of rain that falls; and the *Thermometer,*—the temperature of the air.

ELECTRICITY AND GALVANISM.

Origin of Electricity—Electrics—Conductors or Non-electrics—Mode of exciting Electricity—Electric Machine and Apparatus described—Electric Battery—Electrophorus—Electrometer—Electricity identified with Lightning—Paratonneres or Conductors—Electric Fish—Galvanism or Voltaic Electricity—Voltaic Pile described—Galvanic Excitement of the Body, &c. &c.

THE origin of the science of Electricity may be traced to Thales the Milesian, who flourished about 600 years before the Christian era, and was particularly celebrated for his improvements in the different sciences. He first

discovered the attractive power of amber; and as the Greek name for amber is *electron*, this science thence obtained the name of Electricity.

Although it was soon discovered that other substances besides amber possess an attractive power, yet so little attention was paid to the subject, that it was not until the last century that electricity could be deemed a science.

From its having been found that only certain substances could be excited so as to produce electric effects, these substances were called *electrics*; and as those substances which cannot be excited have the property of transmitting the electric excitement, they received the name of *conductors*; so that *conductors* are *non-electrics*, and *electrics* are *non-conductors*.*

The principal electrics are glass, resinous substances, silk, hair, feathers, baked wood, and atmospheric air. The principal conductors are the metals and fluids, living animals and vegetables, most of the earths and stones.

The usual mode of exciting electricity is by friction. The process of heating will sometimes produce electricity, but heating may be considered a species of friction.

It may be naturally asked, what is electricity? In reply, no satisfactory answer can be given. By some it is considered a fluid *sui generis*; by others a peculiar affection of the surfaces of bodies. Electricity is identified with lightning, but it is only from the results produced by it that its existence is known.†

As the effects of electricity appeared to differ by the excitement of different substances—of glass and sealing-wax, for instance—some philosophers imagined that there were two different kinds of electricity, and these they distinguished by the terms *vitreous* and *resinous*. Others supposed there to be but one kind of electricity, the difference in the effects being caused by the substance excited possessing more or less than its natural share.

* Although all bodies are considered to belong to one or other of these classes, there are none that are either *perfect* conductors or *perfect* electrics; also many *conductors* may be made to be *electrics*, and many *electrics* to be *conductors*.

† Sir Richard Phillips imagines electricity to be an affection of the air, or medium intervening between the surfaces of bodies.

The former they called *positive* electricity, the latter *negative*. If a glass tube or ruler be excited by friction, it will attract light bodies, as pith or feathers; also if a stick of sealing-wax be similarly excited, it will attract in a similar manner. Here different causes conspire to produce the like effects. According to the former theory, which is known by the name of the theory of Du Fay, although the two fluids exist in bodies in a state of intimate union, yet, when separated, they become repulsive with regard to themselves, and attractive of each other. Thus the friction of the glass tube will separate the fluids, and the vitreous electricity will attach itself to the glass, which becomes attractive in order to restore the equilibrium; or rather the *vitreous* electricity of the glass attracts the *resinous* of the body, and at the same time carries the body with it. According to the latter, which is called the Franklinian theory, and which assumes that there is but one kind of fluid, and that all bodies continue in an electrified state as long as they retain a natural share of it; but, when the equilibrium is disturbed, as when the electric is excited by friction, the electricity becomes conveyed either from the rubber to the electric, or from the electric to the rubber, according to the peculiar nature of the electric employed. In the former case, the electric is said to have a *positive* excitement, and will attract light bodies in order to throw off its superabundance of electricity; in the latter it is said to have a *negative* excitement, and will attract for the purpose of obtaining its natural share. Philosophers of the present day still continue divided as to the nature of electricity, and its mode of action, some following the theory of Du Fay, and some that of Franklin.

Although writers on this subject generally state that there are *two* kinds of electricity, yet it appears that either kind may in some instances be produced from the same body, by varying the nature of the rubber. Thus sealing-wax excited by fur becomes *negatively* electrified; but excited by tinfoil, it will be *positively* electrified.

To exhibit the most striking and important phenomena of electricity, it is necessary to have an extensive apparatus, which, in a work like the present, it is impossible

to describe minutely. The principal article of the electrical apparatus is that which is usually called the Electrical Machine. A brief description of that used at the present day is here subjoined.

An *Electric Machine* consists of a glass cylinder or plate, turned by a winch, and so contrived, that as it is made to revolve, it rubs against a cushion, by which means the glass is excited. An instrument called the *prime conductor*, generally made of metal, and without points or corners in itself, but having a piece of iron, of several points, inserted at one end (points attracting the fluid much more readily than knobs), and the whole being insulated by means of a glass stand, is placed very near the cylinder or plate, and attracts the electricity to itself as it is excited. On presenting a knob of brass, the knuckle, or any other round conductor, to the *prime conductor*, at the distance of about an inch, a spark will issue, accompanied with a snapping noise; if a point be presented, the electricity will be abstracted silently, and the point will in the dark have the appearance of a star. A glass jar, coated on both sides with tinfoil to within about *two* inches of its top, called the *Leyden Jar*, is connected to the prime conductor by means of a chain communicating with a wire or chain which passes to the bottom of the jar. The use of the Leyden jar is to collect the fluid which is conducted into it through the prime conductor, as it is excited by the friction of the cylinder. A jar charged in this manner has a redundancy of the fluid in the inside;* then if a knuckle or any other round conductor not insulated be presented to the tinfoil coating on the outside, and a knuckle of the other hand, or any other un-insulated conductor be presented to the knob of the wire at the top of the jar which communicates with the tinfoil coating in the inside, a sudden contraction of the muscles, called a *shock*, will be experienced, accompanied with a flash of light. The cause of the shock is the sudden rush of the electricity from the inside to the outside of the jar, in order to obtain its equilibrium. If the jar

* According to the Franklinian theory, electrics always contain an equal quantity of this fluid; so that there can be no surcharge on one side without a proportional decrease on the other.

had been discharged by points, instead of knobs, there would have been no shock; as the rush would not have been so sudden. If a jar be held to the *negative* conductor, or that part of the machine to which the cushion is usually attached, the conductor being insulated, by turning the winch, the electricity will be abstracted from the jar, and it will then be said to be charged *negatively;* when, by applying the knuckle as before, a similar shock will be experienced by the electric fluid rushing from the *outside* to the *inside* of the jar. Sometimes a number of jars are connected, called a *battery*, a shock from which, well charged, has been made to kill a large dog. There are numerous amusing and instructive experiments which may be performed by an electrical machine* and proper apparatus, which are described in works that treat expressly on this science.

The *Electrophorus*, an instrument invented by M. Volta, of Coma, in Italy, must not be passed by without notice. This instrument consists of two circular plates, one of which is made either of glass coated with sealingwax, or it is a composition of resinous substances without glass, but it must neither have points nor projections of any kind. The other plate may be of brass, or even tin, or it may be a common board of about a quarter of an inch thick, coated with tinfoil, having a glass handle in the centre. The first-named plate must be well rubbed either with new flannel quite warm, or with prepared fur, or it may be well beaten with a fox's tail, it will then become *negatively* electrified; place the other plate upon it,

* A very cheap and simple apparatus, capable of giving a considerable shock, may be made as follows:—Take a six or eight ounce phial, and having filled it about two-thirds with brass filings or turnings, fix into it a cork, having a brass wire, with a knob at the end, inserted in it, taking care that the extremity of the wire, or a small chain attached to it, may reach the filings. Then procure a satin ribbon of about a yard in length, and varnish it well on both sides; also a piece of prepared fur, so contrived as to fasten round the finger and thumb of the left hand; when, by drawing the ribbon through the finger and thumb, it will become excited, and by placing the phial in such a position that the knob may be touched by the ribbon, while made to pass through the fingers, the electricity will be conveyed to the phial, which, after the operation has been repeated eight or ten times, will be sufficiently charged.

using the glass handle, and touch the outside of the plate with the finger, then if the outside plate be raised by the handle, it will be found to be electrified, but with a contrary electricity to the other, and will give a spark to the knuckle, or any other conductor presented to it. By replacing the plate, touching it with the finger, and raising it by the handle, as before, it will be again electrified, and by this means a small coated phial may be charged. The same phenomenon may be exhibited repeatedly without any fresh excitement of the electric plate: when the electric has been well excited, it has been known to continue so for several weeks. Its action is said to be caused through the principle of an excited electric repelling the electricity of another body, and giving it a contrary electricity. Thus the outside plate being touched by a conductor when in contact with the under plate which is *negatively* electrified, it acquires an additional quantity from the conductor; but if it were in contact with a plate electrified *positively*, it would part with its electricity to the conductor.

The quantity of electricity in any body is measured by an instrument called an *Electrometer*. This may consist of a pair of pith-balls or pieces of gold-leaf suspended by a thread, and by diverging or collapsing, it will indicate the degree and *quality* of the excited body.

It has been already stated that electricity is of the same nature as lightning. Franklin was the first who proved this; for by means of a kite he drew the electric fluid from the clouds, and found it by experiment to produce the like results. In speaking of lightning, it may be observed that instruments called *Paratonneres* or *Conductors* are used for the purpose of preventing the dreadful effects sometimes produced by this most destructive element on ships and buildings.

A conductor, when used to protect a building, generally consists of a copper rod, pointed with iron at the top, and so fixed that its extremity may be at some distance above the highest point of the edifice, and connected by a wire with the ground at some distance from its foundation, when, in the event of a storm of lightning, the fluid will probably (if within its range) be attracted

by the point, and conveyed to the ground, without any mischievous effects.

Electricity has been used as a medical agent, and with very beneficial results, its effect being to rouse into action any dormant condition of the muscles.

There are certain fishes that have the property of giving electrical shocks; these are the *torpedo*, the *gymnotus electricus*, and the *silurus electricus*. The shock given by the *gymnotus electricus*, or electrical eel, is particularly violent; fishes are killed by it instantly, and occasionally much larger and more powerful animals.

An Italian professor of philosophy, named Galvani, accidentally discovered, at the latter end of the last century, that the action of electricity on the limbs of a frog caused them to contract. As this action took place in a cold-blooded animal, it was called by Galvani *animal electricity*, he considering it a property of living matter, and imagining that these contractions were caused by something in the nerves and muscles of the animal. Soon after he discovered that a similar effect might be produced without any visible electrical agent, but by the mere action of metallic substances of different kinds. Volta, another eminent Italian professor at the beginning of the present century, applied himself to the investigation of this subject; but instead of supposing that the electricity belonged to the animal, he attributed it to the metals, and therefore concluded that by increasing their number he should in like proportion increase their effect. He therefore repeated the experiments of Galvani, and found that when two pieces of metal of different kinds were placed in different parts of an animal, and these metals were brought into contact, or were connected by a metallic arc, contraction ensued, and that as often as the contact between them took place. He also found that the best metals for the purpose were zinc and silver, and that the effect was increased in proportion to the number of pairs used, each pair being separated by means of moistened cloth. A series of plates of this nature is called the Voltaic Pile, and by its means various chemical discoveries have been made; in honour, therefore, of Volta, this science has received the name of

Voltaic Electricity, and the term Galvanism is confined to that part of the subject which relates to animal motion.

A Voltaic pile, capable of giving a pretty smart shock, may be made as follows :—Procure 30 or 40 pieces of copper of the size of a penny piece, a penny piece will do, (copper has been found to answer the purpose nearly as well as silver), as many pieces of zinc of the same size, and as many pieces of cloth or leather, rather less in diameter than the metallic plates. Having soaked the cloth or leather in a solution of sal ammoniac, and squeezed them out, erect the pile in the following order: first, a piece of zinc, on this a piece of copper, and again on this a piece of the moistened cloth ; continue to do this until the pile is completed, and then by touching the top and bottom of the pile with moistened fingers, a shock will be perceived, and will be repeated as often as the fingers are applied. By connecting several of these piles by wires, taking care that each pile commences with the contrary metal to that with which the other is terminated, the effect will be proportionately increased ; water may be decomposed, and other chemical truths developed.

An improvement in the Voltaic pile was made by an Englishman named Cruickshanks, who soldered together the zinc and copper plates, and cemented them into grooves in a mahogany trough. The cells between the metals he filled with a mixture of some mineral acid and water.* This arrangement was found not only much more convenient, but it also increased the intensity of the shock. A combination of these troughs, called a Galvanic battery, has been found to produce the most astonishing effects, burning and reducing to vapour the firmest and most compact bodies in nature. The cause of this action is attributed to the metals being of different electricities ; thus zinc is said to possess a *positive* electricity, and silver and copper a *negative* electricity.

There are various experiments in order to produce a Galvanic excitement of the human body ; for instance,

* A weak mixture of nitric and sulphuric acid and water is now generally used for this purpose.

if a plate of *silver*, as a halfcrown, be placed upon the tongue, and a plate of *zinc*, of about the same size, be placed under the tongue, on bringing the edges of the metals into contact, a sharp and singular taste will be experienced. If the zinc be placed beneath the tongue, and the silver between the lips and gums, near the eye-tooth, and the two metals be brought into contact, a distinct flash of light will be visible.*

Various facts in common life are explained by Galvanism. The superior flavour of porter when drunk from a pewter pot has been attributed to this action, the pewter being a mixture of two different metals; as also snuff having a different flavour when taken from a tin box in which part of the iron has become exposed, from that which it has when in contact with tin alone.

Electricity and Voltaism are probably the most interesting of all the sciences, from the numerous and splendid experiments which may be performed by their means, as also from their intimate connexion with the various operations of nature;† yet, notwithstanding the most unwearied investigations of men of the highest science and talent, much yet remains undiscovered and unknown.

MECHANICAL POWERS.

Origin and advantage of Mechanical Powers—The different kinds of Levers—Wheel and Axle—Pulley—Inclined Plane—Wedge and Screw, each explained, with the principle of its action—Examples, &c. &c.

THE Mechanical Powers are engines used for raising great weights, moving heavy bodies, &c., without the aid

* This is caused by the irritation of the optic nerve, in a manner similar to that produced by a blow on the eye.

† At the meeting of the British Association, held a few years since at Bristol, Mr. Crosse, of Broomfield, Somerset, stated that he had kept the Voltaic power in force for twelve months by water alone. He had obtained water from a crystallized cave, and by the action of the Voltaic Battery he had produced from that water numerous rhomboidal crystals resembling those of the cave. He had also obtained carbonates of copper, phosphate of soda, and 20 or 30 other specimens; and imagined that diamond itself might be produced by Voltaic action.

of which many stupendous erections, as massive statues, lofty buildings, and various similar works of art, could not have been effected. Man, in the early stage of society, may be supposed to have soon discovered his weakness, and to have directed his attention to the attainment of artificial aid. It is natural to suppose that the *Lever* would be the first power of which he availed himself, as it is the most simple, and it is also that on which all the other mechanical powers depend.

The Mechanical Powers are *six* in number; viz., the *Lever*, the *Wheel* and *Axle*, the *Pulley*, the *Inclined Plane*, the *Wedge*, and the *Screw:* in the various combinations of these, all machines exist.

The *Lever* is chiefly used to raise heavy weights to small heights, as a handspike or crow, and is divided into three kinds. A lever of the *first* kind, is when the weight to be raised is at one end and the power at the other, and the *fulcrum*, or prop, is between the two. Thus, if a man be required to raise or remove a heavy log of wood, he will thrust a handspike, or any similar instrument, under the wood, and by placing another piece of wood or stone as a fulcrum under the handspike, and pressing down at the further end, he will probably effect his purpose. If the log to be raised be *five* hundred weight, and he can press with the force of *one* hundred weight, he will be able to raise it by placing a lever *six* feet long over a fulcrum at *one* foot from the weight to be raised, and pressing with the above-named weight at the other end. For, as the distance of the *weight* from the *fulcrum* is to the distance from the *fulcrum* to the *power*, so is the *force* applied to the *effect* produced.

It is a general rule in mechanics that what is *gained in power* is *lost in time;* so in the above there will be a gain of power in proportion of *five* to *one*, but then the hand of the operator will go over a space *five* times that of the log. The steelyard, used in weighing hay, meat, and other things, is a lever of this kind. Pincers, snuffers, scissors, &c., are also compound levers of this kind, the joint round which they move being the fulcrum.

A Lever of the *second* kind is when the fulcrum is at

one end, the power at the other end, and the weight to be raised between the two. This is exemplified by a man drawing a plug; he thrusts the end of the handspike through the ring, and resting it on the ground, he elevates the end he holds, and thus draws the plug. The advantage gained is in the same proportion as in the former lever. Cutting-knives used by patten-makers, doors, oars of a boat, the rudder of a vessel, &c., are levers of this kind. A pair of bellows is a compound lever of the second kind. This lever shows how two men carrying a weight on a pole, as brewers' men do a cask, or chairmen a sedan-chair, may bear an unequal proportion of the weight. If the weight be exactly in the middle of the two, each will support an equal share of the burden; but if it be nearer the one than the other, he to whom it is nearest will have the heaviest weight, and that in inverse proportion to his distance from it, as compared with that of the other man.

The *third* kind of lever is when the power is between the fulcrum and the weight. A ladder raised by a man against a wall is a lever of this kind, and so is the human arm, and the limbs of animals generally. In this kind of lever there is a loss of power in proportion to the distance between the power and the fulcrum, compared with the distance between the power and the weight. The muscles of the human arm for this reason exert a force of *one hundred* pounds to raise a weight of *ten* pounds, the distance from the acting muscles to the elbow being about *one-tenth* of the distance from the muscles to the hand. The disadvantage is here made up by the compactness and convenience of the motion, the muscles being sufficiently powerful to produce the effect required.

The *Wheel* and *Axle* consist of a wheel fixed to the end of an axle, so that they both turn round together. This power is sometimes named the perpetual lever, it being in reality a lever on whose arms the power and weight may always act perpendicularly, although the lever turns round its fulcrum. Cranes are of this nature; church-bells are moved by the wheel and axle, as also are the helms of ships. The advantage gained is as the diameter or circumference of the wheel is to the diameter

or circumference of the axle: thus, if the diameter of the axle be *one* foot, and that of the wheel be *ten* feet, a man with a force of *one hundred* weight will be able to raise *ten hundred* weight.

The *Pulley* is a small wheel turning on an axis with a rope passing over it. In a single *fixed* pulley there is no advantage except convenience; for, as the weight is at one end of the rope and the power at the other, a person will be able to use only his weight in raising a body, and not his strength. As no advantage is obtained, this cannot be correctly said to be a mechanical power. In a single *moveable* pulley the advantage is as *two* to *one*. In a system of pulleys the advantage is found by multiplying the number of moveable pulleys by *two*.

The *Inclined Plane* is usually made by a plank laid aslope, by means of which a heavy body may be easily raised or lowered. The advantage obtained in the inclined plane is as the length of the plane is to its height: thus, if a person who can use a force of *one* hundred weight has to raise a weight of *ten* hundred weight *one* foot, he can effect it by means of a plank *ten* feet long, but the body will have to travel over *ten* times the space. A body moving down an inclined plane acquires the same velocity as in falling perpendicularly through the height of the plane, and its rate of moving is in proportion to the square of the time: thus, it moves *four* times as far in *two* seconds as in *one*. The Chisel, the Adze, and similar instruments, are referred to this power.

The *Wedge* may be considered a double inclined plane, and is useful in cleaving blocks of wood and stone. The advantage gained by the wedge is as the thickness of the back is to the length of the two sides. The wedge possesses a great superiority over the other mechanical powers, as it is capable of being impelled by percussion, so that by the simple blow of a heavy mallet an immense resistance may be overcome. To the wedge may be referred the Axe, the Spade, Knives, Needles, and all sorts of instruments which begin from edges or points, and become gradually thicker as they lengthen. Birds flying are of a wedge-like shape, and so are Fish swimming, for the purpose of cleaving their respective ele-

ments. The ancients occasionally drew up their armies in the shape of a wedge, in order to break the line of their opponents.

The *Screw* is a kind of inclined plane wound round a cylinder, the power of which is increased by a handle or lever. The uses to which the screw is applied are various; bodies are pressed together by it, as with the common table cloth and napkin press, the bookbinder's press, &c. The screw is also sometimes used to raise the parts of a building that may have settled or sunk, through the foundation giving way; and if the material be sufficiently strong, one man with a good leverage may raise an immense weight. The power gained by the screw is as the circumference made by the moving power is to the distance between the threads of the screw: thus, if the distance between the threads of the screw be *half* an inch, and the lever used be *three* feet, the circumference made by the moving power will be *eighteen* feet, or 216 inches. The advantage obtained will then be as 216 are to *one-half*, or as 432 to *one*, so that a man who can push with the force of a hundred weight may produce a power (setting friction aside) nearly equal to 22 tons.

In the screw and the wedge there is a very great friction to overcome, independent of the weight, sometimes as much as nearly amounts to the weight raised; but then the friction is of use to retain the weight and the machine in their places after the power is removed. If machines could be made without friction, the least degree of power beyond that which balances the weight, would be sufficient to raise it.

In the *lever*, the friction is very little, as also in the *wheel* and *axle*; in *pulleys* it is very considerable, and in the *inclined plane*, *wedge*, and *screw*, it is very great. In machines in general *one-fourth*, and sometimes *one-third*, is allowed for friction. Mr. Wyatt considers one-fourth lost in a steam-engine by friction. In pulleys, friction may be reduced one-half by grease. The least friction is produced when polished iron moves on brass.

The mechanical arts are of the greatest importance to mankind, and the extent to which machinery has been carried is truly wonderful. It is by a skilful combination

of the mechanical powers that such astonishing effects are produced, as are witnessed in the manufactory of different articles, and which have raised England so much above other nations. At Stroud, in Gloucestershire, there is a machine which will make 19 millions of pins in a week. Brunel's block machine will make 1420 blocks in a day; and his saw-mill at Chatham, with the assistanee of 10 or 12 persons, will perform the labour of 50 saw-pits: it takes the timber from the vessels, and delivers the sawn planks to the stacks. At Weovil, near Portsmouth, *eight* men and *two* boys will manufacture in *one hour and a half*, by means of machinery, *ninety hundred-weight* of biscuits. The advantage obtained in spinning, weaving, &c., are equally wonderful and effective.

GASEOUS BODIES.

Nature of Gaseous Bodies—Component parts of Atmospheric Air—Oxygen—Nitrogen and Carbonic Acid Gas—Peculiar properties of each—How obtained for experiment, &c.—Component parts of Water—Oxygen and Hydrogen—Properties of Hydrogen, &c. &c.—Carburetted Hydrogen—Sulphuretted Hydrogen—Phosphuretted Hydrogen—Chlorine—Nitrous Oxide, or Laughing Gas—Their properties—How obtained for experiment, &c.

A GASEOUS body is an elastic, transparent, and permanently aeriform fluid. All gases are said, chemically, to be a compound of solid matter and caloric; the caloric by its repulsive action separating the particles of the solid, and giving it a gaseous form. The difference between gas, and vapour or steam, consists in the former constantly retaining its aeriform state, while the latter will return to a fluid or solid state when the caloric is abstracted. The affinity between the caloric and the base of the gas is so intense, as to resist any means of separating them, and the gas is consequently rendered perfectly aeriform.* As the kinds of gases are so numerous, it is intended here to notice the most important of this class of bodies, of which those that enter into the

* This is to be understood in a general sense, as many of the gases have been condensed to a liquid state.

composition of atmospheric air and water claim the chief consideration.

The atmosphere, as has been already observed,* is a mixture of three gases, *oxygen*, *nitrogen*, and *carbonic acid gas*.

Oxygen takes its name from a Greek word, and literally means a *generator of acidity*, from the fact of acids being generally a combination of oxygen with a base. Oxygen gas is an invisible fluid, without taste or colour, and capable of expansion and compression, similar to atmospheric air. It is a supporter of life and light; for it has been found, by experiment, that an animal will die, and light will become extinguished, when the atmosphere is deprived of its oxygen; even fruit will not ripen in an atmosphere deprived of oxygen. In the process of respiration the oxygen, as it passes through the lungs, combines with the blood, which it changes from a purple to a red colour, and renders it a stimulus to the action of the heart and arteries, and is the cause of animal heat. Oxygen combines with all combustible bodies, disengaging at the same time its caloric, and producing a strong light and flame. It also combines with metals, which act of combination is called oxidizement; the oxide, therefore, or rust of any metal, is the metal combined with oxygen, and it may be observed that the greatest number, if not all such combinations, with the exception of the oxide of iron, are highly poisonous. The specific gravity of oxygen is somewhat greater than that of atmospheric air.

Oxygen may be obtained for experiment in many ways; the more general way is from the black oxide of manganese. The manganese is powdered coarsely, and put into an iron or stone retort, and heated to redness, when the gas will come off, and may be collected over water in a gasometer or other receiver. If the magnanese be mixed with sulphuric acid until it becomes a thin paste, the heat of a lamp will be sufficient to disengage it. It may be also obtained in a very pure state from the chlorate of potash. Vegetables are found to give out

* See article *Pneumatics*.

oxygen gas in the day-time, undoubtedly a design of Providence to renovate the atmosphere, and form a supply for that fixed by respiration and combustion. Oxygen never exists in a separate state, it is always in a gaseous form, or in combination with other substances.

Nitrogen gas, or *Azote*, will neither support flame nor animal life. It has neither taste nor smell, and its specific gravity is somewhat less than that of atmospheric air. It may be obtained from atmospheric air, by abstracting its oxygen, which may be effected by burning phosphorus in a jar, inverted over water; the oxygen will unite with the phosphorus and form phosphoric acid, while the nitrogen will remain. If an equal quantity of iron filings and sulphur be made into a paste with water, and put into a vessel over water, as on the stand of a pneumatic trough, and a jar of common air be inverted over it, in a day or two the mixture will have imbibed the oxygen, which may be seen by the water rising in the jar, when the remainder will be nitrogen. It may be also obtained from the lean of meat, particularly beef, by pouring over it, in a retort, very diluted nitric acid; the heat of a lamp will disengage the gas, which may be collected over water. Nitrogen, like oxygen, is never in a separate state, but always in combination: it combines with hydrogen, and forms ammonia; it combines with oxygen in various proportions, and forms different acids, as nitric acid, &c.; it also enters into several other combinations.

Carbonic acid gas, similar to nitrogen, will neither support life nor flame; if attempted to be but slightly breathed, it produces so violent a constriction of the *glottis* as to threaten suffocation; it is called *choke-damp* by miners, who are frequently suffocated by it. Its specific gravity is considerably greater than that of atmospheric air, it consequently occupies the lower part of caverns and mines. The Grotto del Cano, a cavern in the kingdom of Naples, has been celebrated for ages for a stratum of this gas covering its bottom; so that if a dog, or any animal which holds its head down, enters the cavern, it becomes suffocated, while a man will not feel it. In consequence of its weight it may be poured out of one vessel into another; so that if a taper be placed

at the bottom of a deep vessel, and a small quantity of this gas be poured upon it, it will become extinguished, although from the transparency of the gas the eye will not perceive it. This gas is given out in large quantities during the process of fermentation ; the bubbles which are thrown up from beer recently brewed contain this gas. In several instances, men that have been employed to clean out large vats in breweries, when emptied of their contents, have been suffocated, by entering them without having taken the proper precaution. It is usual to let down a candle, when, if the candle burns, it is considered respirable ; the same precaution is generally taken before descending a well, which, if carried through a chalky soil, is very likely to be charged with carbonic acid gas. Champagne and cider owe their sparkling qualities to this gas, and so do all fermented liquors. Bottled porter contains it in large quantities. Water contains a small quantity of it naturally, but by means of a forcing pump it may be made to absorb two or three times its bulk. Soda-water is water impregnated with it, and that very grateful beverage, ginger-beer, is indebted to it for its briskness and pleasant taste. Carbonic acid gas is considered to possess much utility in promoting vegetation. It is probably decomposed by the organs of plants, and its base furnishes the carbon which they retain while they give out the oxygen. Carbonic acid gas abounds in the mineral world : chalk, or carbonate of lime, marble, spars, and other calcareous substances, contain nearly *one-half* of their weight of it. It may be extricated from either of these bodies by heat, heat being the grand antagonist to affinities of all kinds. In the process of making lime, for instance, the carbonic acid gas is driven off from the limestone (carbonate of lime) in the kiln, leaving the lime uncombined. Carbonic acid gas may be best obtained for experiment from carbonate of ammonia, by putting a small quantity of it into a glass retort, and applying the heat of a lamp ; the carbonate of ammonia then becomes decomposed, the water imbibes the ammonia,* and allows the carbonic acid gas to escape.

* This is called the *Volatile alkali*, and exists, when uncombined,

It may be observed that while oxygen is in many instances so beneficial to the lungs and revivifying, and in combination is so injurious to the stomach and system; carbonic acid gas produces death, if attempted to be breathed, while some of its compounds, as the carbonates of potash, of magnesia, of ammonia, &c., are occasionally most beneficial to the system.

This gas * very strongly resists putrefaction, so that meat has been kept in it for years without becoming even tainted.

Water is a compound of *Oxygen* and *Hydrogen*, consisting of about 85 parts by *weight* of the former, and 15 of the latter, or of about *one* part by *measure* of the former, and *two* parts of the latter.

Hydrogen, like oxygen, takes its name from a Greek word, and implies a *generator of water;* it is only known in a gaseous form, or in combination with other bodies. Hydrogen, when in an aerial state, or hydrogen gas, is the lightest of all known substances, being *fourteen* times lighter than common air. From its extreme buoyancy, aeronauts formerly used it to fill their balloons; but from the facility with which coal-gas is obtained, the latter is now generally used, though not so buoyant.

Hydrogen gas will not support life, as animals, when obliged to breathe in it, die almost instantaneously; neither will it support flame, as a burning body is instantly extinguished when immersed in it, but when in contact

in a state of gas. Ammoniacal gas is of a very volatile nature, has an extremely pungent smell, and will neither support life nor flame. When combined with water, for which it has a great affinity, it forms liquid ammonia, and in this state it is used in our manufactories, and in medicine. Animal and vegetable substances in a state of putrefaction give out this gas; it may be procured by the distillation of bones, and also from the gas-works. Ammonia forms various combinations; it combines with muriatic acid gas, and forms muriate of ammonia or sal ammoniac, a substance much employed by dyers, braziers, and others, as well as in medicine. It was from this substance—sal ammoniac—being dug out of the earth near the temple of Jupiter Ammon, that it received its name.

* Charcoal also, which has carbon for its base, is noted for its antiseptive properties. For this reason vessels are charred which are intended to contain water in sea voyages. Meat, also, slightly tainted, may, by the application of charcoal, be almost instantly made sweet,

with atmospheric air or oxygen, it is highly inflammable. A mixture of *two* parts by measure of hydrogen with *one* part of oxygen will explode most violently if ignited, and a small jet of it in a state of ignition produces a most powerful heat,* causing steel and platinum to melt instantly like wax. A jet of this gas, ignited on lime, produces that intense light called Drummond's Signal Light, and is that by which objects seen in the oxy-hydrogen microscope are illuminated.

Hydrogen gas is frequently found combined with carbon in mines and coal-pits, and is by the miners called *fire-damp*. It sometimes generates very suddenly, when, on the introduction of a light, an explosion takes place, producing the most fatal effects. Sir Humphry Davy, in order to prevent the dreadful results above alluded to, invented some years since a lamp called a *safety-lamp*, which miners may use without risk. The safety-lamp is a lamp surrounded with fine wire gauze, and is so formed through the fact that flame will not pass through small apertures in metallic substances. A stream of hydrogen gas from a small orifice made to fall upon a piece of spongy platinum will render the platinum red hot, and ignite the gas.

Hydrogen gas is easily obtained for experiment by pouring a mixture of *one* part of sulphuric acid with *four* or *five* parts of water, over iron filings, or, what is much better, over granulated zinc in a retort; by the action of the acid the water becomes decomposed, the oxygen unites with the metal and forms an oxide, while the hydrogen escapes. This gas, in combination with carbon, similar to the *fire-damp* above named, may be obtained in great abundance in the summer time from ditches or other stagnant water, by inverting a vessel filled with water, and stirring up the bottom of the ditch with a stick, when large bubbles will rise, which may be caught in the vessel.

Hydrogen is abundantly distributed in nature, form-

* A jet of oxygen gas, made to pass through the flame of a spirit lamp, will produce nearly the same effect; alcohol being almost pure hydrogen.

ing one of the ingredients of all oils, fat, bitumen, &c., while carbon forms the other. Hydrogen gas unites with several other substances, forming compounds, as carburetted hydrogen,* sulphuretted hydrogen,† phosphuretted hydrogen,‡ and others, being severally carbon, sulphur, and phosphorus, in union with hydrogen gas.

There are one or two other gases, which it is intended to notice, on account of their peculiar nature and striking qualities.

The first of these is *Chlorine*, which takes its name from its colour—a *greenish yellow*. It possesses the peculiar property of supporting combustion, while it will not support life. If attempted to be respired, it produces a sense of strangulation, with a violent coughing and spitting of blood, yet in contagious diseases, as the typhus fever, cholera, &c., fumigations of this gas§ will destroy the contagion, and very generally preserve health. Water readily combines with chlorine, and acquires the property of discharging the colours of printed linens and muslins. If any of the metals in powder or leaves, as antimony, Dutch metal, gold-leaf, &c., be thrown into a vessel filled with this gas, they will instantly ignite.

Chlorine is made for experiment as follows:—Mix

* Common coal gas is carburetted hydrogen gas, and its brilliancy is produced by the carbon. It may be made in a pure way by mixing *one* part of alcohol or spirits of wine with *four* parts of sulphuric acid, and subjecting the mixture to the heat of a lamp in a glass retort. This is also called the Olefiant gas.

† It is sulphuretted hydrogen gas which escapes from drains, and is of a very poisonous nature, even when much diluted with atmospheric air. A dog would die speedily in an atmosphere containing *one* part in 800 of this gas, and a horse in an atmosphere containing *one* part in 250.

‡ Phosphuretted hydrogen gas is the most combustible body known; it ignites spontaneously in atmospheric air. It may be made by putting some small bits of phosphorus into a small glass retort, and pouring over it some *liquor potassæ*. The heat of a lamp should be applied, and the beak of the retort be immersed in a vessel of very warm water. It will soon generate, and each bubble will ignite with a sudden flash at the instant of its extrication.

§ Chloride of lime is now generally used for this purpose; a tablespoonful is dissolved in a glass of water, and sprinkled about the room.

three parts of common salt with *one* part of black oxide of manganese, and having introduced the mixture into a glass retort, pour upon it *two* parts of sulphuric acid, and apply the heat of a lamp, the gas will come off abundantly, and must be collected by means of the pneumatic trough. Great care should be taken that it does not escape in a room, as a comparatively small quantity will produce a violent irritation of the lungs. It combines with certain salts and metals, and its combinations are termed chlorates and chlorides.

Nitrous oxide gas is the last intended to be noticed, and is a compound of oxygen and nitrogen. It supports combustion better than common air, and may be respired. But the effects produced by inhaling it, constitutes its chief peculiarity. The most pleasurable sensations are the general results, producing immoderate fits of laughter, whence it has obtained the name of *laughing gas*. The excitement in some persons is so great as to produce violent muscular motion, and an inclination to leap and run. Unlike excitements in general, it does not appear to leave any unpleasant feeling after the excitement has subsided. This gas is obtained from crystals of nitrate of ammonia, by submitting them to the heat of a lamp in a glass retort.

GEOLOGY.

Introduction—*Primary* Series of Rocks—Divided into Crystalline and Sedimentary—Crystalline Considered—Volcanic Action—Sedimentary Rocks—*Transitive* Series—Divided into Cambrian and Silurian—Organic Remains in Transitive Series—*Secondary* Series—Names and Subdivisions of Secondary Series—Each Group in Secondary Series considered—Organic Remains in Secondary Series—*Tertiary* Series—Names and Subdivisions—Eocene—Meiocene—Pleiocene—Organic Remains in Tertiary Series—Diluvial and Alluvial Deposits—The London and Hampshire Basins—Conclusion.

GEOLOGY is that science which treats of the structure of the earth, and of the substances of which it is composed.

The earth is a spherical body whose diameter is nearly 8000 miles, and consequently its radius, or the

distance from its surface to its centre, almost 4000 miles; but of this no greater depth than somewhat more than half a mile has been actually investigated, nor more than ten miles can be at all speculated upon; consequently it is the very external part, or mere *crust* of the earth, with which we are at all acquainted.

The Scripture informs us, that "in the beginning God created the heavens and the earth," but when that beginning was we know not.

The creation of the earth has been referred as to time, to the creation of man, which may have been nearly 6000 years since; but the geologist, from various observations, is led to conclude that the earth must have existed for ages antecedent to that period.

In order to explain the various changes that the earth has undergone, various theories have been adduced; but as they, for the most part, appear chimerical and absurd, they will be here passed over. An opinion of Whiston, however, deserves notice, as it has been somewhat strengthened by recent experiments. He supposed that the earth was originally a comet, and that its *nucleus*, or internal part, was still in a state of incandescence, from its having retained a great portion of the heat which it was supposed to have acquired through its proximity to the sun.

That the earth had originally a *cometic* form has been argued and supported by philosophers of the present day; and it is known, by experience, that the lower we descend into the earth the warmer it is, the heat increasing, below a certain depth, according to Professor Phillips, *one* degree in about every 60 feet, so that in some deep mines the heat is so oppressive, that the miner, although very thinly clad, can with difficulty pursue his labours.*

Assuming that the materials which compose the lower rocks were once in a fluid state—and there is

* The Bath and Bristol, and other mineral waters, as also the waters from the Artesian Wells in France, afford a presumptive proof of the internal heat of the earth.

much evidence to render this more than probable—this fluidity was apparently caused by intense heat. The consolidation of this fluid might have been produced by the radiation of heat from its surface, the result of which might be a crystallization, and formation of a shell of granitic rocks round a nucleus of melted matter of a heavier nature than granite.

In viewing a vertical section of the earth's crust, it will be perceived that the materials of which it is composed are not thrown together confusedly, but are arranged in a most beautiful order, generally forming *layers* or *strata*, surrounding the globe like the coats of an onion, yet not perfectly horizontal, the lower ones particularly having such an inclination that they all occasionally appear on the surface.

The ingredients which compose the various strata are found to differ both in their nature and manner of formation; for while some are of a *crystalline*, or *unstratified* character, others are *sedimentary* or *stratified*. In the newer rocks the remains of animals and plants are found in a fossil state, while in the older rocks there are no such remains. Geologists, therefore, have availed themselves of these circumstances to form a division of the earth's strata; that series of rocks which did not contain organic remains they called *Primary*, and those which did contain organic remains they called *Secondary*; each of these being again variously subdivided. They, however, differ in this respect, some making *three* divisions, and some more, even *six* and *seven*. In this treatise there are assumed to be *four* divisions, the *Primary*, the *Transitive*, the *Secondary*, and the *Tertiary*.

PRIMARY ROCKS.

The lower, or *primary* rocks, are divided into the *unstratified* and the *stratified*. The former, from their crystalline character, and appearance of having been acted upon by intense heat, are termed *Igneous* or *Plutonic* rocks; the latter, from their being a deposition from water, are termed *Aqueous*, or *Sedimentary*.

PRIMARY SERIES.

Crystalline, or Unstratified.	*Sedimentary, or Stratified.*
Granite.	Gneiss.
Greenstone.	Mica Slate, or Schist.
Basalt.	Clay-Slate.
Porphyry.	Chlorite Slate.
Amygdaloid.	Quartz Rock.
Lava.	Primary Marble, or
Pumice.	Limestone

Of the Crystalline or Unstratified Rocks.

GRANITE. This rock not only forms, as it were, the floor or foundation for the various superincumbent strata, but, by its disintegration, it has furnished materials for various other rocks. Granite is universally diffused, many of the highest mountains in the different quarters of the globe being composed wholly, or in part, of this mineral. There is a granitic mountain near the Cape of Good Hope, 400 feet high, and half a mile in circumference, consisting of a single block of granite. Veins of granite are sometimes found to pass upward, through other strata, to a very considerable extent. As granite was apparently formed by the action of heat, it is supposed that, in many cases, it was in a state of fusion subsequent to the deposition of several posterior formations, so that it has been injected into fissures and openings by some expansive force.

Granite is evidently not a *simple* substance, but is composed of various substances, intimately mixed and cohering firmly together: these substances are generally quartz, felspar, and mica; and sometimes hornblende. It occasionally consists of only two substances; of quartz and felspar, or of felspar and hornblende. The quartz may be distinguished by its glassy appearance; the felspar is smooth, and of somewhat a different colour from quartz; the mica is brilliant and sparkling; and the hornblende dark.

Granite has been much used for architectural purposes both by the ancients and the moderns; and, from

its hardness, forms an excellent material for street paving and mending roads.

Various precious minerals have been found in granite, as the topaz, the beryl, the emerald, the garnet, &c.; it is also rich in veins of different metals.

GREENSTONE. Greenstone is the chief of a family called *Trap rocks*, from *Trappa*, the Swedish for a *flight of steps*, they presenting some such appearance.

All the Trap rocks, as Greenstone, Basalt, &c., as also Porphyry, Amygdaloid, Lava, and Pumice, are supposed to be of volcanic origin, and to have been once in a state of fusion, so that, similar to *lava*, when it becomes solidified it ends in a steep slope. Greenstone is composed of felspar and hornblende, and, as may be imagined from its name, is of a dark green or greyish colour. It is found in England and Scotland, and in most parts of the Continent, as well as in America. It is often used for mending roads, and the late Mr. M'Adam preferred it for that purpose to any other material.

BASALT. This rock is of a dark green or blackish colour, and is composed of hornblende with crystals of augite. It is very generally of a columnar form, although sometimes found in tabular masses. Edinburgh is built on rocks of columnar basalt. The Giant's Causeway, in the North of Ireland, and Fingal's Cave, in Staffa, are composed of a magnificent range of basaltic columns. The columnar structure is attributed to its having been cooled under immense pressure, and contracting in a manner similar to starch when first manufactured. CLINKSTONE or PHONOLITE, CLAYSTONE, and TRACHYTE, are nearly allied to basalt, as they pass one into the other. *Clinkstone* is so called from a peculiar ringing noise it makes when struck; it is of a greenish or greyish colour, having a tendency to divide into slabs and columns. *Claystone* is an earthy stone resembling indurated clay, and *Trachyte** receives its name from its roughness. The composition of trachyte is different from that of basalt; trachyte being a *felspathic* rock, while basalt is an *augitic* rock.

PORPHYRY, AMYGDALOID, LAVA, and PUMICE, are of igneous or volcanic origin.

* τραχυς rough.

PORPHYRY is a rock in which crystals of one or more minerals are diffused through a compact or earthy base. The crystals are generally of *felspar*, *augite*, or *olivine*; and the nature of the base gives the name to the porphyry. If the base be greenstone, claystone, or pitchstone, it is called *greenstone* porphyry, *claystone* porphyry, and so forth.

AMYGDALOID. This rock is so called from the word *amygdala*, an almond, and comprises any rock which contains round or almond-shape nodules of some mineral. The porous cavities in this rock were most probably formed through the expansion of vapour or gas when in a state of fusion, which cavities, being filled up with a solution of mineral substances afterwards became consolidated.

LAVA is a substance of a porous nature, which flows from volcanoes in action, and is a composition of various substances, as basalt, trachyte, &c.; and PUMICE is of a similar character, but much lighter, being fibrous and spongy, through the expansion of gases by means of heat.

As the rocks just named are produced through Volcanic action, it may not be irrelevant to consider briefly the cause and results of this most potent agency. The presumed cause of VOLCANIC ACTION has been variously conjectured by philosophers; but a very probable cause is often the oxidization of the basis of alkaline matter through the access of water; the water becoming decomposed and liberating its hydrogen, which, by its inflammable and elastic nature, might be sufficiently powerful to rend asunder the solid earth, were it not for these natural vents—Volcanoes.

Previous to a volcanic eruption, smoke appears from the mountain, a rumbling of the earth is heard, earthquakes are felt (earthquakes being produced from the same cause as Volcanic action), and presently an explosion takes place, with an ejection of ashes and sand, followed by a stream of melted lava. This action is not entirely confined to mountains, but will sometimes take place in the sea, which, by upheaving the superincumbent mass, sometimes forms islands. Nearly half of the islands are of volcanic origin, as the Azores, the Canary Islands, and others.

There are said to be 220 active volcanoes, of which 89 are in islands. In Europe there are but *four* great volcanoes. Asia has very few. The Continent of Africa has none, although there are several in its islands. In South America they are very numerous: in the range of the Andes there are not fewer than 86.

The cones and craters of extinct volcanoes still remain visible in various parts of the world, which, from their appearance, may have been inactive for thousands of years.

Etna, the largest volcano in Europe, is about 6000 feet high, its cone ninety miles in circumference, its crater is a quarter of a mile high, the mouth of the crater is *one* mile in diameter, and it has about eighty minor cones. *Thirty-one* great eruptions of this mountain have occurred within the period of history, and stones of an immense size have been hurled to an incredible height and distance: small stones have fallen at the distance of one hundred miles. The first eruption of this mountain on record is mentioned by a Greek historian as having taken place 480 years before Christ.

Vesuvius is next in magnitude to Etna, and is of great antiquity. It was in an inactive state for nearly 500 years until 1631, and its crater is said to have been 1000 paces in descent, and a mile and a half in diameter, and was rich in wood and herbage: but since that time it has had, every ten years, most destructive eruptions. In the year 79, a tremendous eruption took place, which destroyed and completely overwhelmed the cities of Herculaneum and Pompeii.

When the gases generated cannot escape, uplifting of the earth, or earthquakes, must be the natural result.

Of the Sedimentary or Stratified Rocks.

Gneiss is of the same character, and composed of the same materials, as granite; the only difference is, that one is stratified and the other is not. Gneiss is rich in metallic veins, almost all the metals being found in it; particularly tin, copper, silver, and lead. It forms extensive ranges in Norway, Sweden, Saxony, the Alps, the Pyrenees, and in North and South America.

Mica Slate, or Schist, is composed of quartz and

mica, with a small portion of felspar; and, like gneiss, is very extensively diffused: it is of a laminar structure, and splits into parallel layers. This rock is also rich in metals, but they are found rather in beds and masses than in veins.

CLAY SLATE is composed of indurated clay, with particles of quartz and mica. Beds of this slate are sometimes many hundred feet in thickness. Clay slate forms extensive mountain ranges in many parts of the globe, and the soil which is formed from its decomposition is of a fertile nature. Wales furnishes a very large quantity of clay slate for roofing and for writing slates. Hones are clay slates with an an admixture of quartz.

CHLORITE SLATE is composed of quartz and chlorite, a mineral of a greenish colour. It contains mica, garnet, &c.

QUARTZ ROCK is either pure quartz, or quartz mixed with felspar. It forms extensive strata in the Western islands, and is most probably universally diffused.

PRIMARY MARBLE, or LIMESTONE. This rock is pure carbonate of lime; and often contains crystals of mica, quartz, felspar, &c. Its colour varies from pure white to a yellowish grey. This limestone comprises some of the finest marble used in sculpture.

The Rocks that have been already noticed are called *Primary*, because they are supposed to have been the first formed, and from which the other superincumbent strata were produced. As no organic remains have been discovered in the primary rocks, it has been inferred that neither vegetable nor animal life had been then called into being; that the world was then but in an incipient state, and that thousands and tens of thousands of years must have rolled on before it became a suitable habitation for man.

TRANSITIVE SERIES.

The Transitive Series is divided into two groups, the CAMBRIAN, and the SILURIAN.

The *Cambrian* group is so called from Cambria, the ancient name of Wales, because this formation is

strikingly exhibited there. It consists of greywacké, greywacké slates, shales, and limestones. Anthracite is formed in this system. Minerals are very numerous in Transitive rocks. Fuci, corals, and shells, are the principal organic remains found in this group.

The *Silurian* group, so named from a tribe of ancient Britons who inhabited that part of Wales where these formations are found, consists of flags, sandstones, and limestones, some of which are many hundreds of feet in thickness.

The Transitive rocks are sometimes called the *Lower Secondary*—they are a marine formation.

Numerous organic remains have been found in the Silurian system, particularly of *radiated* animals, but they are found to differ from any known species now in existence. The *Radiata** are the lowest of the animal world, and apparently the first that were formed; and as we proceed we find that almost every successive formation produces animals of a more perfect nature.

A peculiar kind of radiated animal, called the Encrinite, † is found in this system. It is composed of a column with many joints, supporting a body of the shape of a cup, which contains its stomach. From this cup proceed arms or branches furnished with fingers for the purpose of seizing its prey, and conveying it to its stomach. Petrified portions of this body are often found in marble, which is thence called *encrinitic* marble.

SECONDARY SERIES.

Names.	*Subdivisions.*
Old Red Sandstone, or Devonian group	Conglomerates and Limestones.
Carboniferous or Mountain Limestone	Alternating Sandstones and Limestones.

* The Radiata are so called from their organs radiating as it were from a common centre. The star-fish, the echinus, coral, sponge, and all those which are called Zoophytes, belong to this branch.

† From κρινον, a lily, as it resembles that flower.

Coal	Strata, locally ascertained.
Magnesian Limestone, or Zechstein	Clays and Sandstone, Gypseous Marl, and Marl Slate.
New Red Sandstone, or Poikilitic group	Variegated Clays and Sandstones.
Lias	Shale and Lias Limestone.
Oolite	Portland Oolite, Kimmeridge Clay, Coralline Oolite, Calcareous Grit, Sand, and Oxford Clay.
Wealden	Weald Clay, Hastings Sands, & Purbeck Beds.
Green Sand	Green Sand and Gault.
Chalk	Upper and Lower Chalk, Chalk Marl.

The Old Red Sandstone is the lowermost of the secondary series, which, although it principally consists of sandstone, yet it comprises in various localities marls and limestones. *Conglomerates*, or *pudding stones*, belong to this stratum: they consist of pebbles conglutinated together with some mineral substance. The red colour is given to this sandstone by the oxide of iron which it contains. The Old Red Sandstone is occasionally seen from Wales to the North of Scotland; in Herefordshire, Worcestershire, and neighbourhood; and it is of immense thickness, being sometimes not less than 10,000 feet. There are very few fossils in marls and sandstones, where the oxide of iron prevails.

Mountain Limestone is of a grey crystalline character, and contains marine shells and corals. This stratum is in some places nearly 3,000 feet thick. Mountain limestone forms common lime, perfectly white; the animal and vegetable matter which rendered it dark being destroyed by the process of burning.

Coal.—The coal measures are the most useful productions of the globe, and abound in the northern and western parts of England. The depth of the strata is said to be, in some instances, from 4,000 to 5,000 feet, containing numerous beds or seams of coal from half an

inch to 30 feet thick. Coals are evidently of vegetable origin: leaves and stems of plants, and sometimes trunks and branches of trees, are found in coal fields, partially converted to coal. Whole forests may have been, in certain instances, overturned by some extraordinary action; and the mass, by being pressed by a vast superincumbent weight, and exposed to a high temperature, may have produced this most useful fuel. In many instances, coal fields may have been formed from vast masses of vegetable matter carried down into estuaries and seas, with soil, and sand, and clay, and have become arranged as we find them. The Mississippi, the Orooonoka, and other large rivers, carry annually into the ocean immense masses of vegetable matter, which are forming deposits to a vast extent.

As we know that a very great part of England, as well as the continent, was at one time under water, those very parts where the coal fields are might have been so, and have been subsequently upheaved from the sea, or they might have become dry land, by the seas retiring. Under any circumstances, an immensity of time must have been required to form this group.

Providence has made a most wise arrangement in regard to the coal strata, by causing rich beds of iron ore to be contiguous to the *coal beds* and *mountain limestone*, which latter is used as a flux for smelting the iron.* After the deposition of these strata, and before the superjacent rocks were formed, great derangement took place by some violent internal action, producing what the miners call *faults*, so that the seam of coal will suddenly terminate by the other part being either sunk down, or raised up, which, in some instances, amounts to as much as 3,000 or even 4,000 feet.

Magnesian Limestone.—This rock is so called, from the quantity of Magnesia that enters into its com-

* Dr. Buckland, in reference to this, observes: "The important uses of coal and iron in administering to the supply of our daily wants, give to every individual amongst us, in almost every moment of our lives, a personal concern, of which but few are conscious, in the geological events of those very distant eras. We are all brought into immediate connection with the vegetation that clothed the ancient earth, before one half of its actual surface had yet been formed. The trees

position. It is of a yellowish white colour, contains but few organic remains, and is in some places 300 feet thick.

The New Red Sandstone consists of red and white sandstones, clays, marls, &c., containing grains of quartz, mica, &c., all conglutinated together. Messrs. Conybeare and Buckland gave to this series the term *Poikilitic,* or *variegated,* from its exhibiting spots of different colours in a red base. The New Red Sandstone generally occupies a low country, and is found largely in the central counties of England. These strata are, in some instances, 1,000 feet thick. The organic remains in this group are fishes of a race quite extinct, and saurians, or animals of the lizard kind.

In Cheshire, and other parts of England, salt mines and salt springs are found to occur in this group. The salt mines in Cheshire consist of two beds, and are of very considerable extent. Salt mines are worked in Wieliczca in Poland, at the depth of 750 feet. These mines have been so excavated, and are of such an extent, as to contain a whole village, with horses, &c. &c.; and what is very remarkable, there are in these salt mines

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of the principal forests have not, like modern trees, undergone decay, yielding back their elements to the soil and atmosphere by which they had been nourished; but treasured up in subterraneous storehouses, have been transformed into enduring beds of coal, which, in these later ages, have become to man the sources of heat, and light, and wealth. My fire now burns with fuel, and my lamp is shining with the light of gas, derived from coal, which has been buried for countless ages in the deep and dark recesses of the earth. We prepare our food, and maintain our forges and furnaces, and the power of our steam-engines, with the remains of plants of ancient forms and extinct species, which were swept from the earth ere the formation of the transition strata was completed. Our instruments of cutlery, the tools of our mechanics, and the countless machines which we construct by the infinitely varied applications of iron, are derived from ore for the most part coeval with, or more ancient than, the fuel by the aid of which we reduce it to its metallic state, and apply it to innumerable uses in the economy of human life. Thus, from the wreck of forests that waved upon the surface of the primeval lands, and from ferruginous mud that was lodged at the bottom of the primeval waters, we derive our chief supplies of coal and iron, those two fundamental elements of art and industry, which contribute more than any other mineral production of the earth, to increase the riches, and multiply the comforts, and ameliorate the condition of mankind."

springs of fresh water. In Spain there are salt hills some hundreds of feet high. In Peru, salt is found 9,000 feet above the level of the sea.

Lias. This is a provincial name, and is given to this group from its lying in *layers*. It is a marine formation, and consists of argillaceous limestone, marl, and clay. It extends from Whitby to Lyme Regis, in Somersetshire. These strata are said to be, in some places, 1000 feet thick. Various organic remains are found in these strata, of which the Ammonite, the Gryphite, and the Belemnite, are the most remarkable.

In these strata are found the remains of that formidable animal, the *Ichthyosaurus*, which has nothing resembling it in the present day. It had the head of a lizard, with the teeth of a crocodile; and was, in some respects, like the porpoise. The expansion of its jaws was tremendous: its eye was larger than a man's head, and some Ichthyosauri exceeded 30 feet in length. It was a marine animal. The *Plesiosaurus* was another animal of a similar kind, found in these strata. Its neck was of an enormous length, like the body of a serpent, while its trunk and tail had the proportions of an ordinary quadruped. It had no feet, but paddles, like a whale, and its long neck would have allowed it to breathe in the air, while its body was concealed in the water; or have permitted it to seize on winged animals as it swam along on the surface of a lake or sea. The remains of animals of the crocodile kind are found in this formation, but, terrible as they are at the present day, they sink into insignificance when compared with those of the ancient world.

Oolite, or Jura Limestone. The term *Oolite* is derived from the Greek word *ωον*, an egg, and is so applied because many of the formations resemble, when examined minutely, the *roe of a fish*. The Oolite is a marine formation, and consists of limestone, with beds of clay and sandstone. Oolitic rocks are quarried near Bath, and the stone is used for building. *Coral rag*, an oolitic formation, is found near Oxford; and *Portland stone*, also an oolitic formation, is found in the Isle of Portland. These strata are about 1200 feet thick.

There are various fossil plants and radiated animals

found in this group. The *Echinus*, or *Sea hedge-hog*, is very abundant; as are also *Ammonites*.

Sauroid fishes are also numerous in this formation, and among the reptiles, the MEGALOSAURUS, or GIANT LIZARD, is the most remarkable. This was an enormous carnivorous animal, 40 or 50 feet long and 12 feet high, and formed for inhabiting the land. The PTERODACTYLE is also found in this group. This animal had the head of a bird, the wings of a bat, and its body and tail like those of the Mammalia. Its eyes were of an enormous size, so as to enable it to fly by night. Its size varied from that of a snipe to that of a cormorant. It appears to have been able to live either on the earth, in the air, or in the water. Dr. Buckland observes, "With flocks of such like creatures flying in the air, and shoals of no less monstrous *Ichthyosauri* and *Plesiosauri* swarming in the ocean, and gigantic crocodiles and tortoises crawling on the shores of the primeval lakes and rivers, the air, sea, and land must have been strangely tenanted in those early periods of our infant world."

WEALDEN BEDS. The Wealden is a freshwater formation or deposit, and, very singularly, lies between two marine formations. This formation takes its name from the *Wealds* of Kent, where it particularly occurs, and extends over a vast tract of the southern part of England, and is from 800 to 900 feet thick. Its subdivisions are *Weald clay*, including beds of sand and shelly limestone; *Hastings sand*, in which occur clay and calcareous grits; and *Purbeck beds*, consisting of limestone and marl. Between the inferior division of the Wealden and the Portland stone, or upper member of the Oolite, in Portland, there intervenes a layer of dark matter from 12 to 18 inches thick, evidently an ancient vegetable soil. Trunks of trees silicified, and remains of plants, are buried in this *Dirt-bed*, as it is called.

The Iguanodon, a reptile of a most gigantic size, has been found in a fossil state in these beds. This animal is said to have been from 50 to 80 or 90 feet in length. The Iguanodon was a herbivorous animal, and resembled the modern Iguana in having a horn on its nose.

GREENSAND. The Greensand, according to some geologists, forms a part of the Cretaceous group, and consists

of sand and sandy marl, with concretions of limestone, &c. The green sand is of a ferruginous nature, and consists chiefly of silicate of iron. The depths of these strata amounts to nearly 500 feet.

CHALK. This is the uppermost of the Secondary series, and is 600 feet or more in depth. The chalk is evidently a marine deposit, and was formed when Europe was covered with water; and although it extends over a considerable portion of the Continent, and is of such exceeding thickness, it is, to a very considerable amount, made up of animal matter; such as *testacea, echini, corals,* &c. The time which must have been taken for this deposit must have been immense, composed, as it principally is, of countless millions of shells of once living beings. The white coating of flints, found in the chalk, is composed of the shells of *infusoria.* Life was in these early times so universal, that it is difficult to say what had been and what had not been organic matter. Tripoli, a well known polishing material, has been found to be composed entirely of myriads of skeletons of microscopic animalia. It is difficult to convey an idea of the minuteness of these animalcula, but in the Tripoli of Bilin, in Bohemia, it has been calculated that there were 187,000,000 in a single grain.

Various species of fossil fish, and gigantic reptiles, are found in this formation; but there is one species peculiar to this group, the *Mosasaurus.* This animal was between 30 and 40 feet long, its head was four feet in length, and it had four large paddles like those of the whale.

TERTIARY SERIES.

Names.	*Subdivisions:*
Eocene	Plastic Clay, London Clay, Hampshire Freshwater formation, Bagshot Sands.
Meiocene	English Clay when not referred to the Pleiocene.
Pleiocene	Newer Pleiocene, Older Pleiocene.

This series exhibits the remains of animal and vegetable life approaching progressively to those of the present day. It would seem, from the alternate deposition of marine and freshwater strata in the Secondary Series, that the earth was then, at least in various places, alternately covered by the sea and by freshwater. But this is particularly evident in those immense basins of rocks discovered by later geologists, the principal of which are the *Paris basin*, the *London basin*, and the *Isle of Wight basin*. First there is a marine deposit, then there is a freshwater stratum; again there is another marine deposit, and fourthly, another freshwater stratum: and over these an alluvial soil.

The EOCENE* FORMATION is so called from its appearing to be the commencement of a new order of things. Fossils of *testacea*, which were then called into existence, have continued to inhabit the ocean until the present time. It is supposed that great alteration must have taken place in the temperature of the earth's surface since that period and the present time, as many of the testacea which were then found on the British shores, are now only found within the Tropics.

The *Plastic Clay* and *London Clay* are marine formations. The London Clay is so called because London stands as it were upon it. These clays pass into marl, and are covered with gravel, and are 500 or 600 feet or more in thickness. The *Hampshire freshwater formation*, consists chiefly of marls. The *Bagshot Sands* are a marine deposit.

The MEIOCENE FORMATION† does not exist in England, unless the English Crag is referred to it. Lignite,‡ a kind of imperfect coal, is found in Germany in this formation.

* Eocene, from ἠως, the break of day, and καινος, new.

† Meiocene, from μειων less, and καινος, new; in opposition to the ext formation.

‡ Wood has been found in Languedoc partly converted to jet. Trees have also been found converted to jet, and so entire as to mark their species. A petrified forest has been discovered under the banks of the Tiber. Forests of standing trees have been found in Yorkshire and in Ireland imbedded in stone. Trees have been found in Lapland and Siberia, converted into iron ore and carbonate of copper.

The PLEIOCENE FORMATION* is subdivided into the *older* and *newer Pleiocene.* The older Pleiocene comprises the Crag formation when not referred to the Meiocene. This crag is of two kinds, the Red and the Coralline, and is a marine formation. These crags are composed of sand and marl and comminuted shells, and sometimes are used as a building stone. The Newer Pleiocene consists of strata of sand, clay, and marl. Deposits of this nature are found in Cornwall.

In this series are found the remains of numerous animals; of some whose species are extinct, and of others which are still in existence. Of the extinct kind, the *Dinotherium* is the largest. This monster was from 15 to 18 feet in length, and 12 feet high, and its lower jaw was *four* feet long. It had two tusks of immense size. The use of these tusks was probably to dig up roots and herbage. It chiefly inhabited freshwater lakes and rivers. The *Megatherium* was another remarkable animal, somewhat allied to the sloth or ant-eater. Its body was 12 feet long, and 8 feet high, its feet were a yard long, with gigantic claws. It had a tremendous tail, so that with a single blow it would possibly have killed a lion or a tiger of the present day. It fed on vegetable productions.

The *Mammoth*, a species of elephant, has been found, 14 feet long, and 9 feet and a half high, with tusks 9 feet long. Remains of this animal have been discovered in various parts of Europe, also in America, but they are no where so abundant as in the northern part of Asia. In an island in the north of Russia, the tusks of this animal have been found in such abundance, and so perfect, that, for more than a century, they have proved a valuable article of traffic. They are used for making ivory goods.

Of the Diluvial and Alluvial Deposits.

Over the uppermost of the Tertiary strata, there are deposits consisting of gravel, sand and clay formed from the

* Pleiocene, from πλειων greater or more, and καινος new.

materials of decomposed rocks. These are termed *Diluvial* and *Alluvial,* and are sometimes indifferently used, but the Diluvial are more properly those which indicate a remote origin, and the Alluvial a more recent formation. These deposits are sometimes as much as 20 or 30 feet in depth. Over these lies the soil which is composed of sand mixed with decayed animal and vegetable matter.

In order to form the various depositions an immensity of time must have been required; thousands and tens of thousands of years must have passed by while these stupendous changes were being effected. Whether these repeated submersions were caused by the sinking and upheaving of the land, or whether they were the result of astronomical causes,* the length of time employed must have been immense. Changes are still going on on the Earth's surface, slow, it is true, but continuous. When the Earth had become in a proper state for the reception of a more noble inhabitant, *Man* was created.

Having thus traced the Earth from the most remote periods to the present time, it may be observed, in conclusion, that of all the sciences there is none more interesting than Geology, and, as an eminent writer observes, in vastness of extent, and sublimity of character, it yields only to Astronomy.

* Sir R. Phillips ascribes the different formations to deposits caused by the overflowing of the sea through the change of *the line* of *Apsides*, and argues that to whatever hemisphere the sun may be in *perihelion*, the centrifugal force will be greater there, and cause a greater elevation of the waters of the ocean. As the perihelion is now very nearly south, the waters of the southern hemisphere are more elevated than those of the northern, and consequently there is proportionately less land; and this will continue to be the case until the perihelion comes round to the northern hemisphere, when the land in that hemisphere will become to a considerable extent submerged. As the line of Apsides takes about 21,000 years to perform a revolution through the ecliptic, Sir Richard calculates that 600,000 years would be required for the formation of the Transitive, Secondary, and Tertiary formations: an immensity of time; but it must be remembered that with the Almighty a thousand years are as one day.

PHYSICAL GEOGRAPHY.

Earth's Rotatory and Orbicular Motions and Zones—Latitude, Longitude, and Ellipticity—Division into Land and Water—Elevation of Surface—Highlands and Lowlands—Islands—Springs and Rivers—The Ocean, Tides, Currents, &c. —Changes on the Earth's Surface—Climate or Temperature.

OF THE EARTH'S ROTATORY AND ORBICULAR MOTIONS AND ZONES.

THE earth is, as has been already observed, a planetary body, of a spherical shape; and forms one of a system of bodies called the Solar System.

The Solar System comprises *seven* Primary, and *eighteen* Secondary Planets, together with the four Asteroids. The primary planets revolve round the Sun, as their centre of motion, in the following order; Mercury, Venus, the Earth, Mars, Jupiter, Saturn, and Georgium Sidus. The Asteroids also revolve round the Sun; they are situated between the orbits of Mars and Jupiter, and are named Vesta, Juno, Ceres, and Pallas. Of the Secondary Planets or *Moons*, the Earth has *one*, Jupiter *four*, Saturn *seven*, and Georgium Sidus *six*, all of which revolve round their Primaries, and accompany them in their orbits round the Sun.

The Earth is situated at the distance of about 93 millions of miles from the Sun, and its motion, as well as that of the other planets, is two-fold, orbicular and rotatory. By its rotatory motion, or its revolution on its axis, is produced the succession of day and night, while its orbicular motion, combined with a deviation of its axis from a perpendicular to its orbit (which deviation is always uniform) produces the various seasons of the year, at once so necessary and delightful.

From the nature of the orbicular motion of the earth, it follows that some parts of its surface will receive a greater degree of heat than other parts, which circumstance has induced Geographers to divide it into Zones, so that there are considered to be *five* zones—*one* Torrid, *two* Frigid and *two* Temperate: they receiving their names from their localities as it regards the Sun, and the degree of heat experienced. The zone which includes that part of the earth in which the Sun in the

course of the year is vertical, is called the *Torrid* zone; those parts below whose horizon the sun remains for a certain space of time without setting or going below it, are called the *Frigid* zones; while the remaining parts, or those contained between each of the frigid zones, and the torrid zone, are called the *Temperate* zones.

OF THE LATITUDE, LONGITUDE AND ELLIPTICITY.

In order to mark any particular part or spot of the Earth's surface, geographers have imagined it to be divided by or surrounded with various circles. From the extremities of the Earth's axis, called the Poles, an indefinite number of semicircles are supposed to extend, which are termed *Meridians*, and form the nearest distance between the two Poles. Equidistant from the Poles, and at right angles with the Meridians, there is an imaginary circle surrounding the Earth, called the *Equator* from its apparently dividing the Earth into two equal parts or hemispheres. Parallel with the Equator there is supposed to be an indefinite number of circles extending to the Poles by means of which, together with the Meridians, any particular spot may be designated.

All circles are supposed to be divided into 360 parts called degrees, and each degree into sixty minutes; every Meridian therefore from the Equator to the Poles, which is a quarter of a circle, will be divided into ninety degrees commencing from the Equator; so that whatever distance any place may be in degrees either Northward or Southward from the Equator, it is said to have that number of degrees of *North* or *South Latitude*.

The Equator is also divided into 360 degrees; but these are reckoned from a certain Meridian called the *first* Meridian, 180 degrees each way; which first Meridian, as it is an arbitrary assumption, is generally considered by mathematicians as passing through the capital, or rather the Observatory of their own country: thus the first Meridian of Great Britain is supposed to pass through the Royal Observatory of Greenwich; the first meridian of France, to pass through the Observatory of Paris, &c. The number of degrees that the

Meridian of any place is distant from the first Meridian, is said to be the *Longitude* of that place; and is either *East* or *West*, according to its direction, and may amount to 180 degrees, the greatest Longitude that any place can have.

The being able to note the exact situation of any place, is of the greatest use, in a general point of view; but to the mariner who is excluded from the sight of every thing but sea and sky, and can have no local mark by which he may be directed to avoid rocks and whirlpools, &c., its utility is incalculable.

The Latitude of any place may be ascertained in various ways, but the most simple is from the sun's meridian altitude, or height above the horizon at noon. At the Equator, from which circle the Latitude is reckoned, the Poles are in the horizon, while the Celestial Equator passes through the Zenith; but in proceeding either northward or southward, the Pole will become proportionately elevated, which elevation will be equal to the Latitude of the place, or to the complement of the altitude of the Celestial Equator, or Equinoctial. To find the degree of Latitude, it is only necessary to ascertain the height of the Celestial Equator, and to subtract it from ninety degrees, the remainder will be the Latitude.*

To ascertain the Longitude mathematically, is attended with considerable difficulty, and requires much astronomical observation and laborious calculation. The most easy and mechanical mode is by the chronometer, a time-piece of a particularly correct nature, and so constructed as not be affected by a change of temperature. As the Earth performs a rotation on its axis in twenty-four hours; and as the Equator, or any circle of Latitude, is supposed to be divided into 360

* By *adding* the Sun's declination to the degree of altitude when of a *like* name, and *subtracting* it when of an *unlike* name, the *complement* of the Latitude will be obtained; which must be *subtracted* from 90 degrees, to give the Latitude; and this will be always of a different name or kind to the altitude. Should the sum of the Sun's declination and altitude exceed 90 degrees, 90 must be subtracted from it, the remainder will be the Latitude, and will be of the same name as the declination and altitude.

degrees; it follows that fifteen degrees on the Equator will pass by any Celestial Meridian in one hour; consequently any place that is fifteen degrees eastward or westward of a given place, will vary one hour in time, and so in proportion. If the chronometer be regulated for any particular meridian, it will always give the time at that meridian; then, by ascertaining the exact time under any other meridian, which may be easily done, the difference between the two, reduced to degrees, &c. will give the difference of Longitude between the places. Thus, if the sun be observed to be on the meridian of any place when it is *eleven* o'clock by the chronometer, the difference of Longitude will be fifteen degrees, and to the *eastward;* if on the meridian when it is *one* o'clock, it will be fifteen degrees to the *westward.*

Although it was long known that the earth was of a spherical shape, yet its precise degree of ellipticity remained undetermined, as also its magnitude. The ablest mathematicians of which Europe could boast, particularly during the last hundred years, have been directing their attention to this subject, and as yet have been unable to solve this problem as accurately as desired.

The figure of the Earth is, however, known to be an oblate spheroid compressed towards the Poles; its equatorial diameter, as determined by M. Laplace, being 7924 miles, and its polar axis 7898 miles, while its circumference is rather more than 24,000 miles.

DIVISION INTO LAND AND WATER — ELEVATION OF SURFACE—HIGHLANDS AND LOWLANDS.

On considering the nature of the surface of the Earth, its division into *land* and *water* will be the first circumstance that will attract the attention.

The land consists of two continents, together with innumerable islands; the continents being separated by those vast bodies of water, the Atlantic and Pacific Oceans. It might be imagined that there was a time when the whole land formed one immense mass, and that some internal and most potent agency produced a tremendous disruption, which separated it into continents, while the smaller pieces formed islands.

If the Earth be supposed to be divided by the Equator so as to form two hemispheres, the quantity of land in the northern hemisphere will be more than three times that in the southern hemisphere; which circumstance induced the early mathematicians to imagine that there must be a counterbalancing continent towards the South Pole, but this is far from probable to be the fact. The whole surface of the land, as compared with the surface of the water, is said to be in the ratio of three to ten, or somewhat more than two-thirds of the Earth's surface is covered with water.

The elevation of the Earth's surface evidently varies in degree; it is therefore divided into *high* lands and *low*-lands. In Europe there are *two* high-lands and *one* low-land. One of the high-lands rises in Norway, and extends with a little interruption, to the Ural Mountains; the other traverses Spain and Portugal, and includes a great part of France, Germany and Italy, and a part of Turkey, terminating at the Black Sea. America comprises the largest extent of elevated land on the globe. An immense range of mountains runs almost uninterruptedly from Berring's Straits to the most southerly part of South America. Another ridge, called the Alleghany and Apalachian mountains, runs nearly parallel with the Stony Mountains to the west of the United States, to which those of Brazil seem to correspond. Thus America may be said to have *two* high-lands and *three* low-lands. Asia is also traversed by mountains in a similar manner, so as to form a like division. In Africa thisdivision cannot be so defined, from its central regionsbeing so little known.

The high-lands consist either of mountains, as the Alps, the Andes, &c.; or of extensive tracts of level country called *plateaux*, as the plains of Mexico and Peru. The interior of Asia also forms an extensive *plateau*. The low-lands are divided into vales and plains. These plains are sometimes called *Steppes* in Europe and Asia; *Savannahs* in North America; and *Pampas* in South America.

ISLANDS.

Islands may have been formed in various ways.

Many, as has been elsewhere observed, have been evidently the result of volcanic action. It is said that nearly half of the islands are indebted for their origin to this most potent agency. In the time of Seneca, an island called Therasea suddenly emerged from the Ægean Sea. Pliny mentions *thirteen* as having appeared at the same time. But to confine ourselves to later times: in 1757 *eighteen* small islands suddenly appeared near the Azores, but they at length disappeared. In 1811, a volcanic mountain rose out of the sea near St. Michael's, one of the Azores. In 1814, an island of this nature arose among the Aleutian Islands. In 1831, an island suddenly made its appearance near the Lipari Islands, in the Mediterranean, when an English vessel was accidentally in sight: the commander of the vessel, Lieut. Graham, landed and took possesion of it in the name of his Britannic Majesty, but after a few months it entirely disappeared.

Numerous islands are the work of the Coral insect; while some are formed by the action of water, separating a portion of land from the main land. Great Britain may have been thus formed. Islands are also often formed by sand banks in the mouths of rivers. Some of those formed at the mouth of the Ganges, of which there are many, are more than thirty miles in circumference.

SPRINGS AND RIVERS.

Springs and rivers constitute a peculiar feature of the Earth's surface. Springs derive their origin from the condensation of aqueous vapour, which, entering the ground in the form of rain or mist, continues to sink until it has arrived at some rock impermeable to water, when it finds means to gush out sometimes in a very considerable stream. The cavernous parts of mountains will occasionally become reservoirs for the collection of water, which, flowing out of their sides, will form the source of rivers. The largest rivers of Europe, Asia, and America, take their rise in the higher mountains. Thus the Danube, the Rhine, and the Rhone take their rise from the Alps; the Ganges, the Indus, and the Brahmapootra, from the Himalayan mountains; and the

Mississippi and Missouri, from the Rocky or Stony mountains.

A peculiar phenomenon attending tropical rivers, is that they are subject to a periodical overflowing of their banks. It used to be supposed that the Nile was the only river that was affected in this way; but it is now well known that all the great rivers within the Tropics experience this overflow, although not with the same regularity and to the same extent as the Nile.

These inundations are caused by the rains which fall at stated periods, and which are of a particularly violent nature. The overflowing of the Nile is caused by the rains that flow from the mountains of Abyssinia.

It sometimes happens that a river is impeded in its progress; the result is the formation of a lake, the extent of which will depend on the nature of the surface of the land. Sometimes the water surmounts the impediment, and flows on towards the sea; and sometimes there is no visible outlet, as in the Caspian Sea, and the Sea of Aral, which, although they receive the waters of several large rivers, have no apparent communication with any open sea. In the latter case, the excess of water is most probably evaporated.

OF THE OCEAN, TIDES, CURRENTS, &c.

The Ocean forms the largest mass of waters on our globe. Although the *extent* of *surface* of the Ocean may be pretty correctly ascertained, its *depth* can be only a matter of conjecture. Some have supposed that a great part of the body of the globe consists of water; but from the Earth's average density being well known to be $5\frac{1}{2}$ times that of water, such cannot be the fact.

The most striking quality of sea water is its saltness; and that taken from the surface has, in addition to its saltness, a bitter taste.* A considerable variation appears to take place in regard to the saltness of the Ocean from the action of currents, tides, &c., as well as from

* This is attributed to the decomposition of animal and vegetable matter; for water taken from a certain distance below the surface, has the taste of a solution of salt in water.

its immediate locality. The waters of the Tropical regions are generally salter than those towards the Poles; but, during the monsoons on the coast of Malabar, the water becomes so fresh as to be almost drinkable. In some places the water is salter at the ebb of the tide than at the flow; in others, the contrary takes place. These phenomena are, however, but rare. The saltness increases the density, and consequently the buoyancy of salt water compared with river water, and this renders it advantageous for the purpose of navigation.*

The temperature of the water on the surface is much the same as that of the atmosphere, but it has been found to decrease as the depth increases. At the depth of 380 fathoms near the Equator the temperature was found to be only about 45° of Fahrenheit, when at the surface it was 80°.

The chief phenomenon attending the sea is its *Tides.* The advantage of the tides is too apparent to require noting. The water, by its constant movement, is prevented from becoming putrid; and vessels, by means of the rise of the tide, are enabled to enter rivers and harbours, and land their freight much more conveniently than otherwise they would be able to do.

The ancients had no correct idea of the cause of the tides, but the moderns know that they are caused by the combined action of the sun and moon.

Independent of the solar and lunar action, there is another cause which produces a motion of the water in various parts. This motion is called a *current.* The principal current is that within the Tropics, and its direction is contrary to that of the rotation of the Earth, viz., from East to West. A general current also flows from the Poles towards the Equator, which is caused by the increased evaporation in the Torrid Zone.

It is the business of navigators to ascertain the nature and drifts of the various currents, and to take advantage of them.

Whirlpools are occasionally met with in the ocean. These are sometimes caused by the congruence of oppo-

* Some years since a vessel heavily laden, after having crossed the Atlantic in safety, sank when it entered the Thames.

site currents; sometimes their cause is inexplicable. The Maelstroom of Norway is a very celebrated whirlpool.*

OF THE CHANGES ON THE EARTH'S SURFACE.

That a change has taken place on the earth, and is continuing to do so, is most strikingly evident. The inroad made by the sea on the land cannot but be noticed even by a casual walker on the sea side. But a more powerful agent has been engaged in this work than the mere action of the waves, and this may probably to a certain extent be *fire*. By the industry of geologists it has been ascertained that the greater part of Europe was at one time underneath the surface of the water. Indeed the whole of the Northern hemisphere is said to have resembled a great ocean interspersed with islands. The whole of Italy and Sicily was at one time underneath the water, as also a large portion of Spain, France, Germany, Russia, England, and other countries. The Apennines have been raised from 1,000 to 2,000 feet; the Alps from 2,000 to 4,000; and the Pyrenees have acquired the whole of their altitudes since the origin of some of the secondary strata.† Some geologists imagine that this rising of the land is still progressing in certain places. The depth of the Baltic‡ and Black Sea has been found to decrease gradually, as also that of the North Sea or German Ocean, which is supposed by some to be produced by the upheaving of the bottom.

Volcanic action has been very effective in altering the face of the Earth. It has been already observed, that nearly half of the islands are of volcanic origin; and since the middle of the last century, *six* mountains, of

* At certain times, particularly in stormy weather, it is dangerous to venture within five or six miles of the Maelstroom, as vessels have often been absorbed by it. Whales have frequently come within the range of its vortex, and have been carried down into it. Trees have been purposely sent down the vortex, and after a considerable time they have risen again, shattered and crushed as if they had been dashed against the rocks.

† See Lyell's Geology.

‡ The Baltic sea is said to decrease in depth at the rate of one foot in 25 years.

which one was 1600 feet high, have been thrown up by volcanoes in Mexico.

The action of the sea has evidently effected much in the work of change; it is slow in its operations, but still it is constant. If we consider the alteration made on the coast of England by this action, we shall find it far from inconsiderable. In Yorkshire the sea has for centuries been encroaching on the land, and causing towns and islands to disappear.* Ravenspur was, in the beginning of the fourteenth century, so considerable a port, that the English Barons sailed from it to invade Scotland; it has long since been devoured by the waters of the ocean. In Norfolk, towns have disappeared: as much as seventeen yards were swept away on its coast between the year 1824 and 1829. The site of the ancient Cromer is now in the German Ocean, the inhabitants having been gradually driven inland. In Suffolk the sea also continues to encroach. The Reculvers, on the Kentish coast, were, about 300 years ago, one mile inland from the sea; they are now close to the edge of the cliff, and are preserved from being undermined and washed away by artificial means. From the Reculvers to the North Foreland, the annual waste of land is very considerable. All Sussex has been encroached on by the sea. In the time of Elizabeth, Brighton was under the cliffs. In 1665 there still remained more than 100 tenements, although many had been destroyed; at the commencement of the eighteenth century these were all swept away, and not a vestige of them remained. Generally throughout the whole of the South of England, there has been a gradual loss of land. There was, no doubt, a time when England was a Peninsula; but, by the constant action of the sea, it ultimately became severed from the Continent at the Straits of Dover. It is conjectured that the Mediterranean Sea was once a great lake, but through some cause the sea rushed in, caused Deucalion's flood, separated Sicily from Italy, and formed various islands. In Holland the

* The rate of encroachment in some parts of this county, it is said, amounts to four yards annually.

sea has made great inroads, sweeping away villages and covering immense tracts of land. The city of Calicut in the East Indies has been quite overflowed by the sea, and ships sail over the place where it once stood.

Large rivers produce a considerable alteration in the surface of the land, sometimes sweeping away islands at their mouths, and sometimes forming new ones. The soil that is carried into the Gulf of Mexico by the various rivers that flow into it, is so immense, that it is far from impossible but that at some future time it may become innavigable, and ultimately be filled up. It is calculated that 250 millions of tons of matter are annually carried down the river Ganges. The Yellow Sea is said to be rapidly filling up with mud and soil. The land on which Alexandria is built, was not formed 3000 years ago; and the cities of Damietta and Rosetta, which less than 1000 years ago were close to the shore, are now *two* leagues inland. The arms of the Rhone have, in the course of 1800 years, increased three leagues in length, and great additions of land have been made to the west of that river; and numerous places, which less than 1000 years ago were situated close to the sea, are now some leagues inland.

The *Lagunes** of Venice are apparently filling up, so that that city will ere long be connected with the mainland. Ravenna was, eighteen centuries ago, situated amongst the lagunes, but it is now a league inland.†

Downs or hillocks of sand, thrown up by the sea, produce a certain alteration in the Earth's surface. In some places they overwhelm even forests and villages. On the Western coast of France these *downs* are proceeding at a fearful rate, at some places from sixty to seventy feet yearly. On the coast of Scotland, on the Hebrides, and various other places, their effect is very evident. By the sands of the Desert, a great part of Egypt has been inundated, and cities and villages destroyed.

* The Lagunes are lakes or marshes in which that city is situated. They communicate with the sea, and there are about fifty islands in them.

† See Cuvier's and Lyell's Treatises.

In addition to these, there are other causes of a minor import, which it will be unnecessary to enter into, as the action of the rain on mountains, the melting of snows, &c. which have a tendency to alter the Earth's surface, and produce a level. Landslips will occasionally take place, by which means a tract of land will suddenly sink into the earth, as if one of its pillars had given way; but these occurrences are, providentially, rare.

OF THE CLIMATE OR TEMPERATURE.

The general *climate* or *temperature* principally depends on two causes, viz., the distance of the place from the Equator, and its elevation above the surface of the sea. There are other causes which may tend to alter the temperature, but these are the principal.

Those parts of the globe which lie within the Tropics, from their having the sun vertical twice a-year, and its receding at no time to a very great distance from their zenith, must necessarily be most favourably situated for the reception of his rays; while in proportion as any place is distant from the Equator, the Sun's rays will fall obliquely, and such place will receive proportionately a smaller portion of them. Another cause for increased heat within the Tropics is the Sun's being below the horizon for so short a time, never much more than 12 hours; while in the Temperate Zones during the winter half year, the Sun is absent for a time varying from between 12 and 13 hours to 24 hours; and in the Frigid Zones he keeps below the horizon from 24 hours to *six* months, in proportion to the distance of the place from the Arctic Circle. Geographers have, therefore, arbitrarily divided each hemisphere into 30 different degrees of temperature, called *climates*, each climate comprising a zone parallel with the Equator, and of an extent depending on the length of the longest day. Thus at the Equator, where the day is uniformly 12 hours long, the *first* climate is said to commence, and to extend to that parallel where the length of the longest day is 12 hours and a half, when the second climate begins, and continues to where the longest day is 13 hours: half an hour in the length of the longest day thus forming a new climate. This

mode of reckoning is continued to the Polar Circles where the longest day is 24 hours, and is consequently considered to be in the 24th climate. Between the Polar Circles and the Poles the reckoning is carried on by months; so that those places which are contained between the Polar Circles, and that parallel where the sun keeps above the horizon for *one* month, will be in the 25th climate, for *two* months in the 26th climate; and so on to the Poles, which will be in the 30th climate.

The other principal cause for alteration in the temperature is the height of the place above the level of the sea; even in the Torrid Zone elevated lands have their temperature lowered in proportion to such elevation. An elevation of from 6,000 to 8,000 feet will render the temperature as mild as that of the Temperate Zones: Mexico has nearly such elevation, and Quito somewhat greater, both of which are remarkable for the mildness of their temperature. In Asia also the elevated tropical lands have a temperature particularly mild and salubrious.

Independent of the causes already named, mountains have a surprising effect on the temperature of a country, occasionally acting as barriers to the hot winds of one country and the cold winds of another. Siberia, for instance, being exposed to the piercing winds from the Frozen Ocean, and shut out by the Altaian mountains from the warm winds of the southern regions, has a much lower temperature than under other circumstances it might have. At Naples the *Tramontanes*, as they are called, coming from the frozen regions of the Alps and Apennines, are intensely cold; while the *Siroccos*, or southern winds, are as excessively hot. Even in our own country, the mildness of the temperature at many parts of the southern coast is well known, being shielded by hills from the northerly and easterly winds.

The cultivation of a country, and the nature of its soil, have also an effect on the temperature. Forests and profuse vegetation of all kinds imbibe the sun's rays without reflecting them, and consequently lower the temperature, which is one reason why those parts of North America that lie within the same parallel as Eng-

land are so much colder; but these, as the land becomes cleared, will have their temperature raised. The immense deserts of Africa and Asia can, from their nature, imbibe but little of the sun's rays, which causes the air to become intensely hot. The sea likewise has an effect on the temperature; the water cools the atmosphere by absorbing the caloric, and this it is that renders islands less hot than the main land.

The effects of the climate both on the animal and vegetable world are particularly striking. Within the Polar Circles scarcely any other vegetables are seen than mosses and lichens, while in the Torrid Zone vegetation is most profuse. In the higher latitudes domestic animals become stunted in their growth, until they ultimately disappear. The Torrid Zone, on the contrary, produces animals of the most gigantic and of the most powerful and savage nature; the air, the earth, and the water here all teem with life; and the number of animals of every kind, of birds, fishes, reptiles, insects, and vegetable productions, is excessive, beyond our imagination. The Temperate Zone preserves a happy medium between the scarcity of the Frigid Zone and the superabundance of the Torrid, and produces everything necessary for the wants and comforts of man.

While different kinds of animals and vegetables are confined to certain climates, and are with difficulty made to exist by art, except by a peculiar temperature, man alone is unconfined, and can exist in the frozen regions of the North, or in the scorching deserts of the South.

The inhabitants of the Frigid Zones differ from those of the Torrid Zone, and both from Europeans, in their physical and mental qualities; but this cannot be supposed to be through any original difference in their nature, as undoubtedly all mankind sprang from one head, but from difference of climate and incultivation of mind. Thus as mankind of every clime become more and more enlightened, and their mental faculties expanded, and particularly as they become sensible to the truths of Christianity, so will their characters become elevated, and their habits and modes of living improved. We ourselves were originally a savage people, and are now pre-eminent in science, literature, and religion.

QUESTIONS

ON

THE SCIENTIFIC READINGS.

ATTRACTION.

1. What is meant by Attraction?
2. Into how many kinds may attraction be divided, and explain them?
3. How many kinds of attraction of gravitation are there, and what are they?
4. At what part of the earth is the power of Gravity the greatest?
5. What prevents bodies of a loose structure from falling with the same velocity as bodies of a denser nature?
6. In what ratio does the power of gravity increase and decrease?
7. What is that kind of gravitation by which the heavenly bodies are retained in their orbits?
8. In what proportionate degree do the Primary planets act upon their Secondaries?
9. What is the rate of descent of a falling body, near the earth's surface?
10. Through what principle is it that a glass ruler, or a stick of sealingwax, when rubbed, will attract light bodies?
11. By what power is it that the atoms of bodies cohere?

12. Were the ancients acquainted with magnetic attraction?

13. Why or through what principle does water ascend to the branches of trees by means of their roots?

14. To what cause is the cohesion of bodies attributed?

15. What is the opinion of Sir Richard Phillips in regard to capillary attraction?

16. What is the chief antagonist to cohesion.

17. What kind of attraction is that when the force acts on atoms of the *same* species?

18. When the force of attraction acts on atoms of *different* substances, what is it then termed?

19. To what is the spherical shape of drops of quicksilver attributed?

20. How many kinds of chemical attractions are there?

21. How do bodies generally combine?

22. When a chemical combination has been effected, can the bodies combined be separated by mechanical means?

23. What is simple and what compound affinity, and give an example of each?

24. What is the chief principle of action in chemical combinations?

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25. How far will a body fall near the earth's surface during the space of *five* seconds, of *seven* seconds, and of *ten* seconds?

26. What will be the quantity of descent of a body during the *third* second, the *sixth* second, and the *ninth* second of its fall?

27. How long would a body take to fall through a space of 500 feet, of 1000 feet, and of 1500 feet?

CALORIC, HEAT, FIRE.

28. What would have been the state of man without fire?

29. Is fire a real substance?

30. What is Fire?

31. What is Heat?

32. What is meant by the term Caloric?

33. What effect do we produce on a heated body by touching it, and what on a cold body?

34. By what term are those bodies distinguished which transmit caloric readily?

35. Which are the best and which the worst conductors of caloric?

36. Why does the quicksilver or alcohol rise in the Thermometer in hot weather?

37. What do the thermometers contain which are used in the higher latitudes?

38. What is the natural state of bodies?

39. What is meant by atomic motion?

40. Does water, when converted into ice, take up more or less space than when in its fluid state?

41. At what angle do the crystals of frozen water form?

42. When water is converted into steam, what striking power does it acquire?

43. What is the chief source or cause of caloric?

44. Into how many kinds is caloric divided, which are they, and explain them?

45. Which colour radiates heat most?

46. Which colour absorbs the rays of light, and which reflects them most?

47. What would be the effect produced on a vessel scratched, as it regards the radiation of heat?

48. What is it said that the cause which produces the sensation of heat resembles?

49. What is the shape of those mirrors used to concentrate the sun's heat?

50. What effect has a convex lens on the sun's heat?

51. What is the difference between a lens and a mirror?

52. By what means did Archimedes set fire to the Roman fleet?

53. In what ratio were the sun's rays condensed by Mr. Parker's burning-glass?

54. What person, in the reign of Elizabeth, ignited bodies by a combination of plane mirrors?

55. Describe Buffon's combination of plane mirrors, and the effect produced?

56. What was the effect produced by Mr. Parker's burning-glass?

57. What are the various means by which caloric is produced?

58. How is caloric produced by combustion?

59. By what means is the strongest heat produced by combustion?

60. How is heat produced by Percussion; how by Friction?

61. Explain how fire is produced by the collison of the flint and steel?

62. To what does oxygen owe its gaseous state?

63. How do savages procure fire?

64. What is the general rule for the production of heat by chemical mixture?

65. If *two* ounces of sulphuric acid be mixed with *eight* ounces of cold water, what will be the quantity of the mixture?

66. Why is heat evolved in slaking lime?

67. By what means has the strongest heat known been produced; and what has been the effect resulting therefrom?

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68. With what force will steam, at 590°, press on a space of *two* inches square, of *three* inches, and *of four* inches square?

69. If a mirror of *four* feet in diameter produce a focus of *half an inch* in diameter, in what ratio will the heat be increased?

70. If a convex lens of *one* foot in diameter produce a focus of a *quarter* of *an inch* in diameter, in what ratio will the sun's rays be condensed?

COMBUSTION.

71. Define Combustion.

72. Which are *simple*, and which *compound* combustibles?

73. Which is the only simple combustible that nature offers pure and in abundance?

74. What substance is that which so much abounds in the different kingdoms of nature?

75. What quantity of sulphur has been imported annually, for the purpose of making gunpowder and sulphuric acid?

76. With what metals is sulphur found in combination?

77. Why are milk and bread so necessary for the first food of an infant?

78. With what metals is phosphorus found in combination?

79. In what part of the animal kingdom does phosphorus chiefly abound?

80. What is the chief use of the sub-borate of soda?

81. What is the nature of Iodine, when was it first discovered, and how is it procured?

82. Is wood a simple or compound combustible?

83. Which are the supporters of combustion?

84. Are supporters of combustion *always* supporters of life?

85. On what does the rapidity of combustion depend?

86. What is the philosophical effect produced on a fire by blowing?

87. Do the products of any combustion increase or decrease in weight?

88. What would be the weight of a fother of lead when converted into red lead?

89. Whence does the light come during combustion?

90. Is the product of combustion always an oxide?

91. If potassium or sodium be burnt, what will be its product?

92. What metal is that which has such affinity for oxygen, as to decompose water so rapidly as to ignite the hydrogen?

93. How is Potassium formed, and what are its peculiar qualities?

94. Has Sodium any peculiar affinity for oxygen?

95. How is soda obtained, and what are its uses?

96. Give the theory of burning a common candle.

97. Why is the top of the wick in common candles black when burning?

98. What angle of inclination must a candle have so as not to require snuffing?

99. What is Sir Richard Phillips's theory of Combustion?

100. Define Inflammation, Ignition, and Detonation or Explosion.

LIGHT.

101. What is Light?

102. What is the effect of the action of light on vegetables?

103. Why are the hearts of lettuces and other vegetables white, as also the bellies of fishes, and the inner feathers of birds, &c.?

104. What was the opinion of Sir Isaac Newton in regard to the nature of light?

105. What effect has the sun's rays when condensed and thrown on a delicate balance?

106. In what direction do the rays of light proceed?

107. Which rays of light from the sun that fall on our atmosphere undergo refraction, those that fall perpendicularly, or those that fall obliquely?

108. Required the velocity of light.

109. Through what cause is it that the heavenly bodies appear higher in the heavens than they actually are?

110. What is meant by a diaphanous body?

111. On what does the science of dioptrics depend?

112. When a ray of light passes from a dense into a rarer medium, how, or in what direction is it refracted?

113. In what direction is a ray of light refracted, when it passes from a *rare* into a *denser* medium?

114. When a ray of light falls upon a body and it does not become absorbed, what is the result?

115. What kind of bodies reflect light most?

116. On what does the quantity of reflected light depend?

117. To what is the angle of reflection always equal?

118. Which colour absorbs, and which reflects light the most?

119. What is that science termed which explains the doctrine of reflected light?

120. How are bodies seen?

121. What is meant by Vision?

122. Of what shape must the eye necessarily be?

123. What is that membrane of the eye termed on which objects seen become painted?

124. Which are the humours of the eye, and explain them?

125. By what contrivance is the idea of the images of bodies seen conveyed to the brain?

126. If the object seen be delineated in an inverted position on the retina of the eye, how is it that it appears to us in its natural position?

127. As the object seen is painted on the retina of each eye, how is it that it does not appear double?

128. Of what *particular* shape are the eyes of such persons as are near-sighted, and what kind of glass must they use to rectify their vision?

129. How does age generally affect the shape of the eye?

130. Which are the seven primary colours?

131. How is the idea of colour produced in our minds?

132. What is meant by the Spectrum?

133. How does Sir Richard Phillips explain colour?

134. If the spectrum be divided into 360 parts, what are the proportional parts of each colour?

135. The seven primary colours are reduceable to three; which are those three?

136. Which colour is most refrangible, and which least refrangible?

137. What is understood by *homogeneous*, and what by *heterogeneous* light?

138. Why does the sun appear of a red colour on a hazy morning?

138. From what does the whiteness and from what does the blackness of bodies arise?

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139. What space of time would a ray of light take to travel from the sun to each planet individually; Mer-

cury being 37 millions of miles distant, Venus 69 millions, the Earth 95 millions, Mars 144 millions, Jupiter 494 millions, Saturn 906 millions, and Georgium Sidus 1820 millions?

COLD.

140. What is Cold?

141. What effect has cold on bodies in general?

142. What is the highest degree of cold that has been produced artificially?

143. What simple mixture will cause the thermometer to sink suddenly from the freezing point to *Zero*?

144. In extreme cold, what is the consequence when the external air is suddenly admitted into a sitting-room?

145. What is the usual effect of extreme cold on the system?

146. Under what circumstances, and when was it, that 7000 Swedes perished through extreme cold?

147. Relate the occurrence which took place at Terra del Fuego, during a botanical excursion of Sir Joseph Banks and others.

PNEUMATICS.

148. On what does the science of Pneumatics treat?

149. What are the component parts of the atmosphere?

150. What figure does the atmosphere assume, through the motion of the earth and the action of the sun?

151. Is there any gas in the atmosphere, independent of its constituents, oxygen and azote?

152. What is the height of the atmosphere?

153. What is the *whole* weight of the atmosphere?

154. What is the greatest height that an aeronaut has ascended?

155. How does air press?

156. What is, generally speaking, the greatest height of the clouds?

157. At what rate does the density of the atmosphere decrease?

158. What effect is produced on the system at the tops of mountains, through the extreme rarity of the air?

159. At what rate, on every square inch of surface, does the air press?

160. Why will not the quicksilver rise higher than about 31 inches in the barometer?

161. Within what height from the earth do the sun's rays, in passing through the atmosphere, begin to suffer refraction?

162. Describe an easy experiment, showing the upward pressure of the air?

163. What quantity of oxygen, or the pure part of air, does a man consume in an hour?

164. Why is it unwholesome to remain shut up in a newly plastered or whitewashed room?

165. Where is it that the air is so affected by exhalations of a coppery nature, as to tarnish the silver in the pocket?

166. What is the effect of heat on air?

167. What is the cause of Wind?

168. Describe an experiment, calculated to show the effect of heat in rarefying the air.

169. On what principle are fire-balloons made?

170. What would be the result if the air had no *reflective* power?

171. What is the cause of twilight?

172. Describe Montgolfier's balloon.

173. What are the principal instruments used to show the various phenomena of the atmosphere?

174. Why will water boil sooner on the top of a high mountain than in a valley?

175. Where will water boil soonest, or with a less degree of heat, and why—at the bottom of a deep mine, or on the earth's surface?

176. What is the use of the Air-pump; and by whom was it invented, and when?

177. When a vessel has been partially exhausted by means of the Air-pump, through what principle is it that the remaining air fills the whole of the vessel?

178. On what does the weight of bodies depend?

179. Will vegetation proceed in an exhausted receiver?
180. What effect is produced by the condensation of air?
181. Describe the Condensing Syringe.
182. On what principle does the Air-gun depend?
183. Why does the quicksilver fall in a Barometer when it is about to rain?
184. Describe the Barometer, and explain the principle.
185. For what other purpose is a Barometer used besides that of ascertaining the probable change of the weather?

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*185. Required the density of the air at twenty-eight miles above the earth's surface.
186. Required the pressure of the atmosphere on six square inches of surface.
187. Required the weight of the atmosphere in *tons*.
188. If the atmosphere of Mars be twice as dense as that of the earth and reckoned as high, what will be its weight, supposing the diameter of Mars to be 4000 miles?
189. What difference would there be in the height of the quicksilver in a barometer at the top of the highest mountain in the world, to what it would be at the bottom of the mountain?

WATER.

190. In what different states does water exist?
191. What is Steam or Vapour?
192. What is the simplest state of water?
193. Is ice heavier or lighter than water?
194. What are the component parts of water?
195. What was the opinion of the ancients respecting water?
196. Give proofs of the universality of water.
197. Which is the purest kind of water?
198. What are the opinions of philosophers relative to the sea's acquiring its saltness?

199. What part of the earth's surface does the ocean cover?

200. Is there any air in water?

201. What part of the ocean is the saltest, and why?

202. What causes the impurity of rain water?

203. Why is the Thames water preferred for long voyages?

204. Which putrefies soonest, spring water or river water?

205. What causes the hardness of spring water?

206. Where have springs of fresh water been discovered in the sea?

207. Which is most capable of being confined, water or air?

208. What is the boiling point of water when the barometer is at 29 inches, and when at 31 inches, and what is the cause of the difference?

209. Where are the chief hot springs?

210. What is the mean specific gravity of water?

211. What causes the specific gravity of water to vary?

212. To what cause may Earthquakes and Volcanic eruptions be often assigned?

213. Which may be made to displace the greater weight, a pound of gunpowder, or a pound of water?

214. What causes that motion of water called boiling?

215. Give an example of the surprising power of steam-engines.

216. How much rarer than water is steam at 212°?

217. Explain the theory of boiling.

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218. How many balls in a day of 16 hours would Perkins's steam-gun discharge, if it could continue with the same rapidity that it does in the first four seconds of its action?

219. Required the weight of a tun of water.

220. Required the weight of a cube of three feet of water.

221. What quantity of water might be thrown up by St. Winifred's Well in a day of 24 hours?

HYDROSTATICS AND HYDRAULICS.

222. Define Hydrostatics and Hydraulics.

223. How are fluids divided?

224. How do fluids press?

225. How much greater will be the pressure of a body of water of a cylindrical shape than of a body of a conical shape, provided their bases are equal?

*224. Give an example of the astonishing effect that might be produced by the perpendicular pressure of a small body of water.

*225. What causes the sides of canals to be sometimes blown up?

226. What is meant by Specific Gravity?

227. In reference to what other body is the specific gravity of bodies given?

228. If a body sink in a fluid, what quantity of the fluid will it displace?

229. If a body swim in a fluid, what quantity of the fluid will it displace?

230. What is the name of that instrument by which the specific gravity of bodies is ascertained?

231. How is the specific gravity of a body that *swims* in water ascertained?

232. How is the specific gravity of a body that *sinks* in water ascertained?

233. Had the ancients a knowledge of Hydraulics?

234. How did the ancients convey water from the top of a hill, or other elevated place, to the top of another hill?

235. To what science does the construction of mills belong?

236. Why cannot water be raised in a sucking pump beyond a certain limited height?

237. Describe the Sucking Pump.

238. Describe the Forcing Pump.

239. Is the height limited to which water may be thrown by a forcing pump?

240. Describe the Siphon.

241. Why must the siphon be exhausted of air before it will act?

242. Why will not the siphon act, when the longer leg is immersed in the liquor that is to be drawn off?

243. On what principle are Fire Engines?

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244. If a body weigh 74 grains in air, and 68 in water, what will be its specific gravity?

245. If a body weigh 136 grains in air, and 120 in water, what will be its specific gravity?

*245. If a tube of one inch bore, and 30 feet high, be inserted into a cask of water, whose base is *one* foot in diameter, what will be the pressure if the tube be filled with water?

246. If it were possible that the quicksilver could rise in a barometer to 40 inches, of what height would be the column of water that might be counterbalanced by it in a pump?

ACOUSTICS.

247. Of what does Acoustics treat?

248. Is air the sole transmitter of sound?

249. Define Sound.

250. On what does the intensity of sound depend?

251. What difference is there in the intensity of sound, conveyed by hydrogen gas, and by carbonic acid gas?

252. What is the name of that nerve which conveys sound to the brain?

253. Is the ear the only means by which sound may be conveyed to the brain?

254. What effect has the state of the atmosphere in regard to sound?

255. Required the number of vibrations in a second, to produce the most acute and the most grave sound?

256. Which travels quickest, the human voice, or the report of a cannon?

257. At what rate per second does sound travel?

258. How may the distance of a thunder-storm be calculated?

259. Give an example of the conducting power of water?

260. At what rate does sound travel in water?

261. In what do sound and light resemble each other?

262. Which is the best conductor of sound, brick or stone?

263. What is an Echo?

264. Why can a person in the whispering-gallery of St. Paul's, hear another distinctly, if he speak in a whisper on the opposite side?

265. Why are the repetitions of an echo more numerous in the night-time than in the day?

266. Describe the Speaking Trumpet.

267. Describe the Invisible Girl.

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268. Required the distance of a thunder-cloud, if a space of *thirty* seconds intervene between the lightning and the thunder.

269. Heard the report of a gun from a ship at sea, when just twelve seconds before, the flash was seen; required the distance of the ship.

270. What space of time will intervene between the flash and report of a piece of ordnance fifteen miles distant?

271. If I hear the echo of my voice from a building just eight seconds after I speak, at what distance will the building be from me?

METEOROLOGY.

272. What is Meteorology?

273. How high does the atmosphere extend?

274. What is the average quantity of aqueous vapour contained in the atmosphere?

275. How much lighter than water is the atmosphere?

276. Through what means is it that water is suspended in the atmosphere?

277. What quantity of water is supposed to be taken up annually by the atmosphere?

278. What quantity is carried off by evaporation from the Thames in a summer's day, and what quantity from the Mediterranean in the same time?

279. What is the cause of Rain?

280. What was Sir Richard Phillips's plan for fertilizing barren lands?

281. To what does Sir Richard Phillips attribute the sterility of certain countries that have been once fruitful?

282. Does most rain fall in mountainous countries or in plains?

283. To what are those fertile spots called Oases, in deserts, ascribed?

284. What are Fogs, and how are they produced?

285. What is Dew, and how is it produced?

286. In what part of England does the greatest quantity of rain fall?

287. Required the annual depth of rain at London.

288. In what part of the year does least rain fall?

289. At what part of the world, or within what latitudes, does the greatest quantity of rain fall?

290. Are dews more copious in cloudy weather or in clear weather?

291. What is Snow?

292. What is Hail?

293. What are Coronæ, or Halos?

294. What are Parhelia?

295. What instrument has been invented and used for the purpose of diverting hail stones?

296. What quantity of rain falls on an average annually in England?

297. At what rate of descent do hailstones fall?

298. Relate some instances of extraordinary hail-storms.

299. To what cause is a Halo or Corona attributed?

300. How are Parhelia or Mock-suns produced?

301. What are Paraselenæ?

302. Relate some instances of the appearance of mock-suns in England.

303. What are Aeroliths?

304. Are fiery Meteors ever seen in England?

305. Relate an instance of the fatal effects of a luminous cloud at Java.

306. Have aeroliths ever fallen in England?

307. Has there ever been an instance of the manufacture of meteoric iron?

308. Are aeroliths of common or uncommon occurrence?

309. Describe the Aurora Borealis.

310. Describe the Ignis Fatuus, or Jack-with-a-lantern.

311. What is the cause of Wind?

312. Is there any general regularity with regard to the direction of the wind at any part of the earth?

313. Is there any regularity in England with regard to the direction of the wind?

314. To what is the Ignis Fatuus attributed?

315. At what rate does a hurricane travel?

316. What is the name of that instrument by which the force or velocity of the wind is estimated?

317. How does evaporation produce wind?

318. Required the name of that instrument by which the quantity of dew is measured.

319. Required the name of the instrument which measures the purity of the air.

320. What is the use of the Hygrometer?

321. Are whirlwinds common in temperate climates?

322. What is the Cyanometer?

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323. Required the quantity of water in *tuns*, annually taken up by the process of evaporation.

324. Required the *weight* of the water evaporated in a summer's day from the Mediterranean.

325. What would be the height of a cylindrical vessel of 40 feet in diameter, capable of containing all the water that may be evaporated from the Thames in a summer's day?

326. How many tuns of water fall annually, on an average, on a farm of 350 acres; and what would be the diameter of a globular vessel capable of containing it?

ELECTRICITY.

327. To whom may the origin of Electricity be traced?

328. Why is this science termed *Electricity?*

329. What substances are Electrics, and why are they so termed?

330. At what time might Electricity have been first properly deemed a science?

331. Why are certain substances termed Conductors, and which are they?

332. Is it possible that any electric may be made to become a conductor?

333. What is the usual mode of exciting electricity?

334. Are the following substances Electrics or Conductors—glass, brass, silk, air, baked wood, water, and sealing-wax?

335. What is Electricity?

336. What is the opinion of Sir Richard Phillips in regard to Electricity?

337. What is meant by *positive*, and what by *negative* electricity?

338. Explain the difference between *vitreous* and *resinous* electricity.

339. Explain the theory of Du Fay, and show in what it differs from the Franklinian theory.

340. Is it possible that different kinds of electricity may be produced from the same body?

341. What kind of electricity is produced from the excitement of sealing-wax by fur; and what if the sealing-wax be excited by tinfoil?

342. What is the principle article in an electrical apparatus, and describe it?

343. Describe the Leyden Jar.

344. According to the Franklinian theory, what difference is there in the quantity of electricity that a jar may contain, when charged, and when not charged?

345. By what means is an electric jar discharged, and what is the result?

346. What causes that peculiar sensation called an electric shock?

347. Why would a person not receive a shock, if he were to discharge a jar by means of points?

348. What is meant by an electrical battery, and what may be the result produced from one strongly charged?

349. If a jar be charged *negatively*, why will it give a shock in a manner similar to what it would if charged positively?

350. What is an Electrophorus, and explain the mode of exciting it?

351. Why are points so generally to be avoided in electrical apparatus?

352. What is an Electrometer?

353. Who was it that first identified electricity with lightning?

354. What are Paratonneres, and what is expected from their use?

355. On what principle does the action of the Electrophorus depend?

356. What are Conductors, and explain the principle of their action?

357. There are certain fishes that are capable of giving electrical shocks; required their names, and designate that which is the most powerful.

358. When may electricity be employed as a medical agent?

359. Required the accepted difference between Galvanism and Voltaism.

360. By what means did Galvani first discover that action which received the name Galvanism?

361. Who was Galvani, and who Volta?

362. Which are the best metals for producing Voltaic action?

363. Describe a Voltaic pile, and the manner in which it should be erected.

364. Who first invented the Galvanic trough?

365. What is the best mixture to produce Voltaic action?

366. Describe a galvanic battery and the effects capable of being produced by it.

367. If a piece of zinc be placed under the tongue, and a piece of silver between the lips and gums near the eye-tooth, and the two metals be brought into contact, a flash will be perceived; required the cause of the flash?

368. There are certain facts of common occurrence referred to Galvanism, relate them.

369. May the nature of Electricity and Galvanism be said to be thoroughly understood?

MECHANICAL POWERS.

370. How many mechanical powers are there, and name them?

371. What was the cause that originated the invention of mechanical powers?

372. Which was the first mechanical power invented?

373. How many kinds of Levers are there?

374. What is meant by the *fulcrum* in leverage?

375. Explain the different kinds of levers, and their action?

376. What is the proportional gain in levers of the first and second kinds?

377. In which kind of lever is it that there is a loss of power, and why is it used?

378. If there be a gain in power, what loss is it that there is then necessarily incurred?

379. To what kind of lever are the following articles referred; the hammer in drawing a nail, a pair of scissors, the rudder of a vessel, pincers, a steel-yard, a door, and the oars of a boat?

380. Describe the Wheel and Axle, and to what other power may this be referred?

381. Required the advantages gained in the wheel and axle.

382. To what uses are the wheel and axle applied?

383. Describe the Pulley.

384. What advantage is gained in a *single* fixed pulley?

385. Required the advantage gained in a single moveable pulley.

386. Required the advantage gained in a series of moveable pulleys.

387. To which of the mechanical powers is the adze referred?

388. Which mechanical power is that which offers the greatest advantages, and why?

389. Describe the Inclined Plane.

390. If two inclined planes are placed flat together, what other mechanical power will it make?

391. What advantage is obtained from the inclined plane?

392. Describe the wedge, and the advantage obtained from it.

393. Which of the other mechanical powers does the screw resemble?

394. What is on an average allowed for friction?

395. What bodies produce the least friction?

396. Required the advantage obtained from the screw.

397. The ancients used to form their armies into the shape of one of the mechanical powers, required which, and why?

398. To which of the mechanical powers are needles, knives, and spades referred?

399. What degree of velocity will a body acquire in descending an inclined plane?

400. Of what use is friction in machines?

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401. If the length of a wedge be two feet, and the breadth or thickness be six inches, what will be the advantage obtained?

402. If the distance from the fulcrum to the moving power in the human arm (a lever of the third kind) be one inch and a half, what will be the actual weight sustained by holding a body of *five* pounds weight in the hand with the arm extended, the length of the arm, from the elbow to the hand, being 18 inches?

403. If a man can exert the force of one hundred weight on an inclined plane, what weight will he be able to raise, if the length of the plane be to its height as twelve to three?

404. If the distance between the threads of a screw be one eighth of an inch, and the radius formed by the lever be three feet, what power of compression may a person effect, who can use the force of one hundred weight, deducting one-third for friction?

405. In a lever twelve feet long, if the distance between the fulcrum and the weight to be raised be *one* foot, what power will be sufficient to raise three quarters of a ton?

406. If a man has to raise a weight of 10 tons one foot, with what length of inclined plane will he be able to effect it by using a force of 160 lbs.?

407. If the diameter of the moon be 2180 miles, and her density four-fifths of that of the earth, while the density of the earth is five-and-a-half times that of water, what would be the length of a lever capable of raising her, if inserted quite through her axis, and the fulcrum be 1100 miles distant from her centre, provided a person could advantageously use a force of 2 cwt.: also how long, under the above circumstances, would it take to raise the moon *one inch,* if the moving power were to travel at the rate of 50 miles an hour?

408. If the breadth of the back of a wedge be 6 inches, what must be its length to counterpoise a weight of 10 tons, provided that a force of 10 cwt. be given to it?

409. If the arm of a windlass be 18 inches, and the diameter of the axis be four inches, what force will be sufficient to raise a weight of 12 cwt. provided that there be but one coil of rope?*

410. If the diameter of the axis of a crane be eight inches, and the circumference made by the moving power be 10 feet, what weight will a man be able to raise that can exert advantageously the force of 150 lbs.?

411. If the distance between the threads of a screw be a quarter of an inch, and a man can use the force of 1 cwt., what must be the length of the lever which forms the radius of the circle of the moving power to raise a weight of 20 tons?

GASEOUS BODIES.

412. Define a gaseous body, and explain the difference between it and vapour.

413. By what means is it that certain bodies assume a gaseous form?

414. Have any of the gases been at any time condensed into a liquid state?

415. Required the name of that gas which is the chief supporter of life and light.

* In raising a body by a wheel and axis, or windlass or other similar power, if the rope after having coiled once over the axis be reverted again over itself, as under certain circumstances it sometimes is two or three times, it is necessary that nearly twice the thickness of the rope should be added to the axis at every fresh coil.

416. What may be the result of the combination of oxygen with a combustible body ?

417. What is the product of the combination of oxygen with a metal ?

418. What would be the consequence if the oxygen were abstracted from the atmosphere ?

419. Is there any exception to the general poisonous nature of the oxides of metals ?

420. How may oxygen be obtained for experiment ?

421. What is the meaning of the word oxygen ?

422. Does oxygen ever exist in a solid state ?

423. Why does not the atmosphere become so deteriorated through a constant loss of oxygen, as to be incapable of supporting respiration ?

424. What is the other principal constituent of the atmosphere ?

425. Does Nitrogen ever exist in a solid state, and to what is it indebted for its fluidity ?

426. What are the properties of Azote or Nitrogen ?

427. How may nitrogen be obtained ?

428. Does nitrogen combine with any other body ?

429. What does the combination of nitrogen and hydrogen produce ?

430. What other gas besides oxygen and nitrogen enters into the composition of atmospheric air ?

431. Required the properties of Carbonic acid gas.

432. What is the name that miners give to carbonic acid gas ?

433. Describe the Grotto del Cano.

434. What domestic operations produce carbonic acid gas ?

435. To what do Champagne and bottled Cider owe their sparkling qualities ?

436. Of what use is Carbonic acid gas in vegetation ?

437. Which gas has the greatest specific gravity ?

438. How may carbonic acid gas be procured ?

439. Required the process of making lime.

440. What substance is peculiarly noted for its antiseptive properties ?

441. What gas do animal and vegetable substances give out when in a state of putrefaction ?

442. What combination forms Sal Ammoniac?
443. What are the constituent parts of water and their relative proportions?
444. What is the meaning of the word Hydrogen?
445. What is the specific gravity of hydrogen gas?
446. Will hydrogen gas support life?
447. Is hydrogen gas inflammable, and will it support flame?
448. How is Drummond's Signal Light produced?
449. Required the principle and use of the safety lamp.
450. Required the effect produced by a stream of hydrogen gas made to fall on a piece of spongy platinum.
451. What kind of gas is that used for the purpose of lighting the streets, shops, &c.?
452. What are the constituent parts of oils and fat?
453. How may Hydrogen gas be obtained for experiment?
454. What gas is that which escapes from drains?
455. What is the chemical name for that which is commonly called Laughing gas, and how may it be obtained?
456. What is Olefiant gas, and how may it be obtained?
456. What are the peculiar properties of Phosphuretted hydrogen gas, and how may it be made?
457. Whence does Chlorine obtain its name?
458. Will chlorine support life and flame?
459. What will be the result if metal in powder or leaves, as gold leaf, be thrown into chlorine gas?
460. What is the use of chlorine gas in the arts, and how may it be obtained?

GEOLOGY.

461. Define Geology.
462. What depth of the earth's surface has been investigated?
463. Is it generally understood by Geologists that the earth was formed at the creation of man, or that it had a prior existence?

465. What was Whiston's opinion relative to the formation of the earth?

466. What difference as to temperature is experienced at the bottom of a deep mine?

467. If the earth was originally in a fluid state, how may its consolidation have been effected?

468. How are the various strata of the earth arranged and divided?

469. Give a description of the Primary rocks, and repeat the series.

470. Describe the nature, supposed origin, and other qualities of each individual rock of the primary series.

471. Which are the *Trap* rocks, and whence do they receive the name?

472. Which rock takes its name from its roughness; which from its sounding noise when struck; and which from its containing almond-shape nodules of some mineral?

473. Which rock is celebrated for its beautiful columnar structure?

474. Required the cause and result of Volcanic action.

475. How many active volcanoes are there, and how are they situated?

476. Describe Ætna and Vesuvius, with their action, and the results thereof.

477. Which rocks are particularly rich in metallic veins?

478. Why are the *Primary Rocks* so called?

479. Is animal and vegetable life supposed to have had an existence when the Primary rocks formed the floor of the world?

480. How is the Transitive series divided, and describe each group, and whence it takes its name?

481. What remains of animal and vegetable life are found in the Transitive series?

482. Describe the *Radiata*, and that particular one the Encrinite.

483. Give the names of the Secondary series, and describe each individual formation.

484. Required the depths of the Coal strata, and how they are supposed to have been formed.

485. What are faults in coal mines?

486. Describe the salt mines of Poland.

487. Describe the Plesiosaurus, the Ichthyosaurus, the Megalosaurus, and the Iguanodon.

488. What fossil remains are formed in the Chalk formation?

489. Give the names of the Tertiary series, and their derivations.

490. Describe the Megatherium, the Dinotherium, and the Mammoth.

491. What are those deposits above the Tertiary strata?

492. Name the different *basins*, and the arrangement of the strata.

PHYSICAL GEOGRAPHY.

493. Of what is the solar system composed?

494. What is the distance of the earth from the sun?

495. Required the number of Zones, their extent, and how they are formed.

496. What are the Meridians, and what is the first meridian?

497. What is the Equator, and how is it divided?

498. What is the Latitude, and what the Longitude of a place, and their use, and how formed?

499. Explain how the longitude may be ascertained by the chronometer.

500. What is the proportion of land and water on the Earth's surface, and how much more land is there in the Northern hemisphere than in the Southern?

501. Describe the division of the Earth into High lands and Low lands.

502. Describe the origin of Islands.

503. Give examples of the sudden rise of islands from the sea.

504. Explain the origin of Springs and Rivers.

505. What causes the overflowing of Tropical rivers?

506. At what part of the globe is sea water so fresh as to be almost drinkable?

507. What rivers take their rise from the Alps, what from the Himalayan, and what from the Stony mountains?

508. How are Lakes sometimes formed?

509. Where is the temperature of the ocean the lowest, on its surface, or some fathoms below it?

510. What are the causes of Currents?

511. What are the causes of the change which has taken place on the Earth's surface?

512. What change has taken place on the coast of England?

513. What is the present situation of Calicut?

514. Cite examples of the land having gained on the the sea.

515. What quantity of matter is on an average annually carried down the Ganges?

516. What has been the effect of Downs of sand thrown up by the sea?

517. How many Climates are there, and how are they formed?

518. What effect has the elevation of a place on the temperature?

519. What is the height of Quito and of Mexico above the level of the sea, and the consequence of such elevation?

520. What effect have mountains on the temperature, and give examples?

521. What are the *Tramontanes*, and what the *Siroccos*?

522. What effect has the cultivation of a country on its temperature?

523. What effect has the sea on the temperature, and why are islands less hot than the main lands?

524. What effect has climate on the animal and vegetable world?

VOCABULARY

OF

SCIENTIFIC TERMS.

Absorption, a sucking up; a term in Chemistry, used when a gas loses its properties by combination; thus, if muriatic acid gas be introduced into water, it is absorbed, and muriatic acid is formed.

Accelerated Motion, or *Acceleration*, is that which receives fresh accessions of velocity: this particularly refers to the falling of heavy bodies towards the centre of the earth through Gravitation.

Achromatic, a term applied to Telescopes contrived to remedy aberrations and colours. These were first invented by Mr. John Dolland.

Acidimetry, the measuring of the power or strength of acids.

Acids, are those substances which produce a sour taste, probably caused by the shape of their particles. Acids are known by their changing vegetable blue colours, as syrup of violets, into red. They unite with earths, alkalies, &c., and form numerous salts.

Acoustics, the doctrine of hearing and sound. See page 49.

Adhesion, a species of union that takes place between the surfaces of bodies: this must not be confounded with Cohesion. Adhesion implies an union to a certain point between two substances either of similar or dissimilar kinds; Cohesion that which retains the component particles of the same mass.

Æolipile, a hollow tube of metal with a long pipe, formerly used to show the elasticity and force of water converted into steam. If this instrument be filled with water, and exposed to a pretty strong heat, the water will issue from the pipe, in the form of vapour, with prodigious violence. The well-known Jack of Hilton is an Æolipile; as also Pluster, a celebrated German idol: the latter being filled with water, and set over a fire, would apparently become covered with perspiration, which was considered as a miracle by the ignorant.

Aeroliths, certain stones which occasionally fall from the atmosphere. See page 56.

Aerology, the science of the air as to its properties.

Aerostation, the art of ballooning or navigating in the air.

Affinity, an inclination which certain bodies have to combine chemically. See page 14.

Agate, a species of transparent quartz.

Air-gun, an instrument to propel bullets by means of the air. See page 39.

Air-pump, a pneumatic machine for exhausting the air. See page 38.

Ajutage, a sort of tube used in water-works for jets d'eau.

Albumen, one of the radical parts of animal substances. It exists in its most perfect state in the white of eggs, and in the serum of the blood; it also abounds in milk, and to this it is chiefly indebted for its nutritious qualities.

Alcohol, highly rectified spirits of wine. It constitutes the basis of all spirituous liquors, and in this country it is procured from wheat, barley, molasses, &c.; in the wine countries it is obtained from wine, whence the term *spirits of wine*. Alcohol is used as a solvent of resinous substances and essential oils; it is also used in thermometers for measuring extreme degrees of cold, as it will not freeze. Tinctures of various substances are extracted by means of diluted alcohol.

Alembic, a vessel used in Chemistry for distillation.

Alkalies, peculiar substances which have a caustic taste, and a strong tendency to combine with acids, and thus form various salts. They change the blue juices of vegetables to a green, and the yellow to a brown.

Alloy, a combination of two or more metals; thus brass is an alloy of copper and zinc.

Alluvial, "Deposition," soil formed by the destruction of mountains through the agency of water.

Aluminum, the metallic base of Alumina or common clay.

Alum, a well-known mineral salt, of an acid taste, generally prepared artificially from Alum-slate, though sometimes it is produced naturally. Alum is of very great use in the arts. By its means the colours are fixed in dying; in tanning it is used to restore the cohesion of the skins which had been impaired by the action of the lime; bakers use it to whiten their bread; vintners to fine down their wines; in the dairy it assists in the separation of the butter, and fishermen often use it to dry their fish. In medicine as a styptic and tonic it is particularly valuable. There is scarcely any substance so generally useful and so plentiful as Alum.

Amalgam, a combination of mercury with another metal.

Amethyst, a transparent gem of a purple colour.

Ammonia, the volatile alkali. See page 74.

Ammonite, a fossil shell of a spiral shape. It takes its name from Jupiter Ammon, whose statues were represented with rams' horns. It is from the smallest size to *three* feet in diameter.

Amygdaloid, a compound mineral composed of spar, green earth, &c., imbedded in green stone, or in wacké.

Analysis, the resolution of a substance into its component parts.

Anemometer, an instrument for measuring the force of the wind. For Meteorological instruments, see page 58.

Antimony, a brittle metal of a white colour. It is used in combination with other metals for printers' types, and for specula for telescopes.

Apparatus, a term applied to the different parts of machinery used in philosophical experiments, chemical utensils, &c.

Aquafortis, another term for "Nitric Acid."

Aqua-regia, or "Nitro-muriatic acid," a mixture of nitric and muriatic acid, in the proportion of *two* parts of the former to *one* of the latter: this alone will dissolve gold.

Arbor Dianæ, or Silver-tree, Diana being the symbolical name given by ancient alchymists to silver. Form a solution of silver by dissolving a piece of silver, as a sixpence, in nitric acid. Dilute this very considerably, and pour it into a small decanter or phial with a flat bottom. Into this pour an ounce or two or more of mercury; the silver will in the course of a few days, if kept quiet, become precipitated on the mercury, and form a beautiful arborescence.

Arbor Plumbi, or *Lead-tree*. This is an arborescence of lead somewhat similar to the above, and is thus made. Fasten a piece of zinc to one end of a spiral-shaped wire, and let the other end of the wire be thrust through a cork. Form a solution of sugar of lead in spring water and filter it; fill a phial or decanter with the solution, and immerse into it the zinc; in a few days the lead will be precipitated on the zinc, and arboresce in a very beautiful manner.

Areometry, the science of measuring the density and gravity of fluids.

Arsenic, a metal usually found in combination with sulphur; when reduced to a metallic state it is of a brilliant colour, and at the same time the most brittle and the softest of metals. It is extremely poisonous.

Asbestus, a mineral celebrated for its resisting fire. It is of a fibrous nature, and has been spun into cloth. This cloth when soiled may be restored to its primitive whiteness by being thrown into a clear fire.

Asphaltum, a kind of bitumen or pitchy substance, found in various parts of the earth.

Atmometer, an instrument contrived for measuring the quantity of exhalation in a given time.

Atmosphere, that invisible fluid that surrounds our earth. It received its name from the Greeks, in consequence of the vapours which are continually mixing with it. See page 35.

Atomic Motion, a supposed rapid motion of the atoms of bodies which produces heat.

Attraction, a term used to imply that power by which all bodies have a mutual tendency towards each other. See page 11.

Aurora Borealis, a meteor sometimes seen in the northern part of the heavens. See page 57.

Aurum Fulminans, a dangerous fulminating powder made of gold.

Azote, the atmospheric air deprived of its oxygen. It was first discovered in 1772, by Dr. Rutherford, of Edinburgh, and its properties ascertained by Priestly and Cavendish. See page 73.

Balloon, a term applied to a chemical receiver of a spherical shape, also to a well known body used for aerostation.

Barium, a recently discovered metal, the base of Barytes.

Barometer, an instrument for ascertaining the weight of the atmosphere. See page 40.

Barytes, an earth usually found in combination with an acid, as the Sulphate and Carbonate of Barytes. It received its name from its weight, being the heaviest of all the earths. It is a violent poison.

Basaltes, a kind of stone of a very ponderous nature found in large masses. The Giant's Causeway in Ireland is a range of basaltic columns.

Base, a chemical term applied to denote the earth, the alkali or the metal which is combined with an acid to form a salt.

Battery, "Electrical and Galvanic." See pages 62 and 65.

Belemnite, a kind of fossil, vulgarly called a thunderbolt.

Beryl, a gem of a pale yellow, green, or blue colour, sometimes called Aquamarine.

Bismuth, a metal of a white reddish colour, rather hard, but neither malleable nor ductile. A preparation of it is occasionally used in cosmetics.

Blende, an ore of zinc.

Boiling,—Theory explained, page 44.

Bolognian Stone, a stone of a phosphoric nature, first discovered near Bologna in Italy.

Boracic-acid, a recently discovered substance formed from borax. When burnt with alcohol, it communicates a green colour to the flame.

Brass, a well known artificial metal made of zinc and copper.

Bronze, a compound of copper, tin, and sometimes zinc. This compound is specifically heavier than either of the metals separately. From its not being so liable to become oxidized as pure copper, it is used for statues, cannon, and other works exposed to the air.

Calamine, an ore of zinc used in making brass.

Calcareous, a term applied to earths or combinations of lime with carbonic acid gas, as chalk, which is a carbonate of lime, marble, &c.

Calcium, the metallic base of lime.

Caloric, the supposed matter of heat or atomic motion. See page 15.

Calorimeter, an instrument for ascertaining the quantity of heat disengaged from any body during combustion.

Calx, a metal combined with oxygen through combustion.

Camera Lucida, a contrivance to make the image of any thing to appear in a darkened room.

Camera Obscura, an optical machine by which the images of external objects are received through a double convex glass, and exhibited on a white ground placed within the machine.

Caoutchouc, Indian-rubber, a gum exuding from various trees and plants in South America.

Capillary, a term applied to a species of "Attraction." See page 14.

Carbon, the base of wood, coal, &c. See page 15.

Carbonates, Salts formed by the combination of carbonic acid gas with any base.

Carbonic Acid Gas, the heaviest of the gases. See page 73.

Carbuncle, a stone of the ruby kind, of a blood-red colour.

Carburets, a combination of Carbon with a base.
Catacoustics, the science of reflected sounds or echoes. See page 51.
Catoptrics, the science of reflected vision. See page 28.
Centre of Gravity, that point of a body about which all its various parts exactly balance each other.
Cerium, a recently discovered metal of which little is known.
Chalcedony, a kind of quartz.
Chromium, a newly discovered metal, white, brittle, and of low specific gravity; it is noted for the beautiful colour it gives to other bodies when in combination with them.
Chlorine, a peculiar kind of suffocating gas. See page 77.
Chromatics, that part of Optics that explains the properties of the colour of bodies.
Chrysolite, a precious stone having the property of becoming electric when rubbed.
Cinnabar, an ore of quicksilver.
Cobalt, a metal of a grey colour, and exceedingly brittle. It is used in pottery, and gives the beautiful blue colour to porcelain.
Cohesion, that kind of attraction that unites the particles of bodies. See page 13.
Cold, the absence of heat, or atomic motion. See page 32.
Colour, a property inherent in light, depending on the different vibrations excited in the optic nerves. See page 30.
Columbium, a metal discovered at the beginning of the present century, and so called from the mineral from which it was first procured, having been brought from America. It is of a dark colour, and particularly infusible; it is of no real use.
Combustion, the decomposition of certain substances, attended with heat and fire.
Conchology, the science which treats of shells.
Condensation, the reducing of a body into less bulk or space. Condensation always produces heat.
Copper, a well-known metal, very hard, sonorous, and elastic, and nearly as malleable as gold. It has been found in various parts of the world, but is most abundant in Cornwall, where as much as 10,000 tons per annum has been produced. Wales has also produced 2,000 tons per annum. It has a slight affinity for oxygen, and will form chemical combinations with various substances. It also forms a part of various alloys, of which *brass*, *bell-metal*, *pinchbeck*, and *the metal of which cannon is made*, are the principal.
Crystal, a very hard and clear body, of which there are various kinds, presenting a resemblance to different precious stones.
Crystallization, an operation in which various earths, salts, &c., pass from a fluid to a solid state.
Cyanogen, Prussic acid, a most virulent poison.
Decomposition, the reducing a body into its simple elements.
Decrepitation, the crackling noise that salts make when heated.
Deliquescence, a term applied to saline bodies becoming liquid through their affinity for the moisture of the atmosphere.
Dew, a kind of mist which falls when the sun is below the horizon. See page 54.

Diamond, the most valuable, the most pellucid, and the hardest of all the minerals. The Diamond is simply crystallized carbon. It is very nearly the same as common charcoal, only it is in a state of crystallization.

Diaphanous Body, a body through which the rays of light can pass.

Dioptrics, the science of refracted vision. See page 27.

Discharger, an instrument used in electricity for the purpose of discharging an excited body.

Distillation, that process whereby the most subtle parts of a compound body are separated by the means of caloric from the mass, in a state of vapour.

Divergent, a term in optics to express rays of lights receding from each other; concave glasses make the rays *diverge*, while convex glasses make them *converge*.

Ductility, a property possessed by various metals of undergoing extension. Gold is the most ductile, and lead is the least ductile of such metals as possess this property.

Dynamics, the science of the motion of bodies.

Earths, certain bodies which are incombustible and generally unalterable by fire.

Echo, reflected sound. See page 51.

Effervescence, that motion which takes place in certain liquids through the escape of a gaseous substance.

Efflorescence, a kind of mealy substance on the surface of certain bodies, produced generally by decomposition.

Elastic fluids, a name given to vapours and gases. Vapour is an elastic fluid, but it may be condensed. Gas is a permanently elastic fluid, because it cannot be readily condensed.

Electric, a body which may be easily excited by electricity, as resin, silk, wood, &c.

Electricity. See page 58.

Electrometer, an instrument to measure electricity. See page 63.

Electrophorus, an electrical instrument for showing perpetual electricity. See page 62.

Emerald, a precious stone of great beauty and value. The colour of the emerald is generally green, sometimes it is sky blue.

Eudiometer, an instrument for measuring the purity of the air.

Evaporation, that act by which fluids are converted into vapour by heat. See page 53.

Fata Morgana, or *Mirage*, an aerial phenomenon exhibiting in the atmosphere a part of a coast or country. When the weather is calm there arises a vapour which acquires considerable density; this is sometimes so disposed as to receive, and reflect as from a mirror, various objects. In this way the coast of France, some few years since, became clearly visible from Hastings, although actually below the horizon.

Fermentation, an intestine motion arising spontaneously among the particles of a mixed body, producing a different combination of those parts: there are three kinds, *acetous*, *vinous*, and *putrefactive*.

Flame, volatile inflammable matter in the act of combustion.

Fluoric Acid, a peculiar acid obtained from fluor spar; it is the only acid that will corrode glass.

Flux, a substance mixed with any mineral to promote its fusion; thus an alkali is mixed with silica or sand, to form glass.

Focal-distance, the distance from the centre of the glass to the focus.

Focus, in optics, a central point where rays of light converge.

Fossil-remains, those animal and vegetable remains of the earliest times which have preserved their original forms.

Freezing, the fixing of a fluid body into a solid mass, through the abstraction of its caloric. See page 16.

Friction, in Mechanics, implies the resistance arising from the roughness of the surfaces of the moving bodies. See page 70.

Fulcrum, in Mechanics, is the point about which a lever moves.

Fusion, the state of a solid body rendered fluid by heat.

Galvanism, the science of animal electricity. See page 64.

Garnet, a precious stone of a red colour.

Gas, the state of any permanently elastic fluid. See page 71.

Gasometer, a vessel for measuring, collecting, or containing gas.

Gelatin, an animal substance; jelly.

Geology, that part of Natural History which treats of the structure of the earth. See page 78.

Glucine, a peculiar earth, so named from its sweetness.

Gold, a well-known metal found in almost every country of the world. South America furnishes the greatest quantity of gold now used, although various parts of Hindostan are very rich in it. Gold is obtained in a more pure state than any other metal, and, with the exception of platinum, is the heaviest of all metals. It is so exceedingly ductile, that a cube of one inch and a quarter would gild a wire of sufficient length to extend round the earth. Gold has no affinity for the oxygen of the atmosphere, and therefore will not rust; it is also considered a perfect metal, for if kept in a state of fusion for a very considerable time, it will sustain but a very trifling loss of weight.

Granulation, the operation by which metallic substances are reduced into small pieces. This is performed by pouring the melted metal slowly into water, while kept in a state of agitation.

Gravimeter, another term for the Aerometer or Hydrometer.

Gravitation, the tendency of bodies towards the centre of the earth. See page 11.

Gravity, Specific, the relative weight of different bodies compared with some well-known body. Water is generally used for this purpose, and the specific gravity of any body denotes that such body is so many times heavier than water, bulk for bulk. Thus the specific gravity of platinum is 21, of gold 19, of mercury 13·6, of lead 11, of silver 10, of cobalt 8·7, of manganese 8, of iron 7·7, of tin 7, of zinc 7, of antimony 6·7. See page 46.

Grotto del Cano, a grotto in Italy, which takes its name from the number of dogs killed there through suffocation. See page 73.

Gryphite, an oblong fossil shell increasing in width from the head towards the extremity where it terminates in a curve or circle.

Gypsum, sulphate of lime, selenite or plaster of Paris.

Hail, water congealed during the act of falling. See page 55.

Halo, or *Corona*, a coloured circle sometimes appearing round the sun or moon. See page 55.

Heat, the sensation caused by the action of fire.

Helioscope, a peculiar kind of telescope.

Hydrates, those substances which have such an affinity for water as to solidify it. Slaked lime is a hydrate of lime.

Hydraulics, that science which teaches the velocity and force of fluids in motion. The construction of water engines of all kinds depends on Hydraulics. See page 47.

Hydrogen, one of the constituents of water. See page 75.

Hydrometer, an instrument to show the strength of spirits.

Hydrostatic-Balance, an instrument for ascertaining the specific gravity of bodies. See page 46.

Hydrostatics, that science which teaches the weight and pressure of fluids. See page 45.

Hygrometer, an instrument for measuring the moisture of the air.

Jargon, a precious stone found in Ceylon.

Ice, the state of water deprived of its caloric.

Ignis-fatuus, a meteor occasionally seen in marshy places. See page 57.

Iodide, a compound formed by the union of Iodine with any substance. For Iodine, see page 21.

Iridium, a newly discovered metal, so named from Iris, the rainbow, in consequence of the different colours its salts assume. It is not much used.

Iron, a well-known metal, exceedingly malleable, ductile, and elastic; it is easily oxidized, and will burn in oxygen gas. It combines with most of the acids, as well as forms other chemical combinations, which are used in painting, dyeing, and medicine. That substance known by the name of *black lead* is a *Carburet* of iron; *Red Ochre* is an ore of iron; *Umber* is a compound of the ores of iron and manganese; and *Emery* is an oxide of iron.

Kaleidoscope, an optical instrument formed by a combination of mirrors so as to produce a symmetrical reflection of different objects.

Kelp, a kind of soda obtained from sea-weed dried and burnt. It is used in making certain kinds of glass.

Lac, a well-known substance used for making sealing-wax. It is the production of an insect.

Lapis Lazuli, a stone of a beautiful blue colour, very prettily spotted with gold-coloured spangles. Painters form their ultramarine from Lapis Lazuli calcined.

Lead, a well-known metal, particularly abundant in Great Britain. The lead-mines of Derbyshire alone yield 15,000 tons per annum. Lead possesses but very little tenacity and ductility, and with the exception of platinum, gold, and mercury, it is the heaviest of the metals. It has a great affinity for oxygen, and will form various chemical combinations. Its oxides are used in dyeing, calico printing, making glass, earthenware, &c.

Lens, a piece of glass or other transparent body whose sides are either convex or concave, used for the purpose of converging or diverging the rays of light.

Lever, a bar of iron or wood, used as one of the mechanical powers. See page 67.

Leyden Jar, a glass jar, coated with tin foil, for electrical purposes. It received its name from the first contriver being a native of Leyden. See page 61.

Light, that power by which objects are made perceptible to our sense of seeing. See page 25.

Lightning, an electrical phenomenon preceding thunder.

Liquid, the state of any body, in which by means of heat, the particles slide over one another, and wet any substance that comes in contact with it. Water, Oil, &c., are both liquids and fluids. Quicksilver is fluid, but not a liquid.

Lithium, a recently discovered metal, brought from Sweden. It is of no practical use.

Machine, any body intended to produce motion, so as to save either time or strength.

Magnesium, the metallic base of magnesia.

Magnetism, the quality of a body rendered capable of attracting. See page 13.

Malleability, that property by which metals may be extended through hammering.

Manganese, a metal noted for its peculiar affinity for oxygen: it is very generally diffused through all kinds of rocks, and is procured in great abundance from different parts of England. In its pure metallic form it is of a bright white colour; but through its affinity for oxygen, if exposed to the air it will soon lose its metallic appearance, and fall to powder. The metallic form is obtained by art, as its natural state is an oxide. Manganese is used in glazing, and also in preparing bleaching liquor.

Matrix, the substance in which ores are imbedded in the earth.

Mechanical Powers, engines used for raising weights. See page 67.

Meniscus, a glass, convex on one side, and concave on the other.

Menstruum, any fluid that will disssolve hard bodies.

Mercury, another name for quicksilver, so called from its volatility. Although its natural state is that of a fluid, it will become frozen at about 40° below *Zero*, and is then both malleable and ductile. Mercury will combine with several of the metals, which combinations are called amalgams; it also combines with sulphur, phosphorus, &c. It has very little affinity for oxygen, except when heated.

Metals, are bodies known by their weight, ductility, &c. There are said to be nearly *forty* kinds of Metals; *Platinum* is the *heaviest*, and *Potassium* the *lightest*.

Metallic Oxides, metals combined with oxygen, when, from being combustible, they become incombustible.

Metallurgy, the art of extracting metals from the ore.

Meteorology, the doctrine of the various phenomena of the atmosphere. See page 53.

Microscope, an optical instrument, formed by the combination of lenses, to magnify small objects.

Mineral, any substance, either of a metallic, earthy, or saline nature.

Mineralogy, the science which treats of the properties of minerals.

Minium, a red oxide of lead.

Mirror, any smooth body which forms the images of objects by reflection. For the effects of Mirrors, see page 18.

Molybdenum, a metal obtained from a mineral found in Sweden; it is of a brittle nature, and has been procured only in small quantities.

Muriates, the combination of a base with muriatic acid.

Muriatic Acid, a powerful acid obtained from sea-salt. It is much used in the arts.

Natron, a salt found at different parts of the earth, either on or near its surface. It is the nitre of the ancients, but is very different from our nitre, the latter being a nitrate of potash, and the former a carbonate of soda.

Neutral Salt, a salt in which the acid is completely neutralized by the base, and the base by the acid.

Nickel, a white metal, both ductile and malleable, but of difficult fusion. The oxide of this metal is used in the arts, and the metal itself is sometimes used in combination with other metals.

Nitric Acid, a powerful acid, obtained from nitre or saltpetre, by distilling it with sulphuric acid. It is much used in the arts. Nitrous Acid is of a similar nature to the former. The salts are *Nitrates* and *Nitrites*.

Nitrogen or *Azote*, one of the constituent parts of the atmosphere. See page 73.

Nitro-Muriatic-Acid. See *Aqua-Regia*.

Nitrous Oxide Gas, commonly called Laughing-gas. See page 78.

Ochre, a combination of an earth with an oxide of iron.

Olefiant Gas, a kind of carburetted hydrogen. See page 77.

Onyx, a precious stone of the agate kind.

Opal, a precious stone of which there are various kinds and different colours.

Ophites, a stone resembling a serpent, from which it takes its name.

Optics, the science of vision.

Ores, metallic earths.

Oscillation, the vibration of a pendulum.

Osmium, a newly-discovered metal; it is insoluble in the acids, and has not been applied to any use.

Oxalic Acid, a peculiar acid found in sorrel; it may be also obtained from sugar. It is of a highly poisonous nature, and from its resemblance to sulphate of magnesia (Epsom salts) persons have occasionally been poisoned with it. It is used in the arts.

Oxide, a substance combined with oxygen.

Oxygen, a component part of the atmospheric air and of water. See page 72.

Oxygenate, to acidify a substance with oxygen.

Oxymuriatic Acid Gas, same as *Chlorine*.

Palladium, a recently discovered metal. It is hard, and of a white colour. It has been obtained only in small quantities, and has been scarcely applied to any use.

Paraselene, a mock moon. See page 56.

Parhelion, a mock sun. See page 56.

Pendulum, a heavy body, so suspended that it may swing backwards and forwards. A second's pendulum, or a pendulum that will make

one oscillation in a second, should be 39$\frac{1}{8}$ inches in length, reckoning from the point of suspension.

Petrifaction, an incrustation formed on any body by the deposition of earthy matter from water.

Petroleum, a liquid bitumen found on the waters of springs in various parts of the world.

Pewter, an artificial metal, being a mixture of tin, lead, and brass.

Phosphorus, a simple combustible. See page 21. A phosphuret is a combination of phosphorus with some other substance. Phosphates and phosphites are salts formed by the combination of a base with phosphoric and phosphorous acid.

Phosphuretted hydrogen gas. See page 77.

Photometer, an instrument for measuring the intensity of light.

Physics, the science of matter and bodies, with their motions, operations, &c.

Plano-convex, a term applied to a lens which has one side flat and the other convex.

Plano-concave, a term applied to a lens which has one side flat and the other concave.

Platinum, a metal noted for its weight, (being the heaviest of all metals,) ductility, and want of affinity for oxygen.

Plumbago, a carburet of iron ; black lead.

Pluviameter, an instrument for measuring the quantity of rain that falls.

Pneumatics, the science which treats of the properties of the air. See page 35.

Pneumatic trough, a vessel for collecting gases.

Potash, the vegetable alkali. See page 23.

Potassium, the metallic base of potash. See page 22.

Precipitation, a process in chemistry by which any body separated from others in a solution falls to the bottom of the vessel.

Prism, a glass wedge used to refract light and exhibit its different colours.

Prussic Acid, a peculiar acid of a most poisonous nature, it is prepared from blood and animal substances. Prussian blue is iron combined with this acid.

Pump, a well-known instrument for raising water. See page 48.

Pyrites, a combination of sulphur with a metal.

Pyrometer, an instrument for measuring the higher degrees of heat.

Pyrophorus, a substance which ignites when exposed to the air.

Rainbow, a well known beautiful appearance in the heavens, caused by the refraction and reflection of the rays of light.

Retina, that enlargement of the optic nerve on which any body we see is painted. See page 29.

Retort, a chemical vessel for distillation, &c.

Rhodium, a recently discovered metal of a white colour, remarkable for its hardness and brittleness.

Ruby, a precious stone of a fiery red colour. The largest ruby known adorns the imperial crown of Russia.

Rust, the oxide of a metal. Gold is of all metals the least inclined to rust. Platinum and silver have also but very little affinity for oxygen.

Safety Lamp. See page 76.

Salt, chloride of soda. Of this there are two kinds, sea salt and rock salt. Sea-salt is obtained by evaporating sea-water, which when done sufficiently the salt will form in crystals. Rock-salt is obtained from mines in various parts of the world. England supplies it very plentifully.

Salts, the combination of any base with an acid.

Sapphire, a precious stone of a blue colour. The finest sapphires come from the East Indies, although remarkably beautiful ones have been found in Scotland. This is the hardest of all the gems, with the exception of the diamond and the ruby.

Sardonyx, a precious stone of the agate kind.

Sebacic-acid, an acid procured from fat, whence it takes its name.

Selenite, a species of gypsum or plaster of Paris.

Silicum, the metallic base of silica or flint.

Silver, a well known metal possessing great tenacity, ductility, and malleability. It has very little affinity for oxygen, and is of so indestructible a nature, that it may be kept in a state of fluidity through intense heat for a long time with but a trifling loss of weight.

Siphon, a bent tube used for the purpose of drawing off liquors. See page 48.

Snow, particles of water frozen in falling. See page 55.

Soda, the mineral alkali. See page 23.

Sodium, the metallic base of soda. See page 23.

Spectrum, an oblong image of light made by a prism. See page 31.

Stalactites, spars in the form of icicles found hanging from the roofs of caverns, &c.

Statics, a branch of physico-mathematical science, which considers weight or gravity, and the motion of bodies resulting therefrom.

Steel, iron combined with carbon.

Steel-yard, the most ancient and universal instrument used for the purpose of ascertaining the weight of bodies. The Jews, Greeks, and Romans used it, and it is in general use throughout Asia at the present day. It is in fact a balance of unequal arms, and depends on the principle of the lever of the first kind for its action.

Strontium, the metallic base of the earth strontites.

Sublimation, a process whereby certain substances are volatilized by heat, and again condensed by cold into a solid form. Flowers of sulphur are made in this way.

Sulphur, a well known simple substance, found in combination with metals and otherwise. See page 21. Sulphurous and Sulphuric acids are formed through the affinity of sulphur for oxygen. Sulphur, in combination with another substance, forms a sulphuret; sulphurous and sulphuric acids form in combination Sulphites and Sulphates.

Synthesis, the composition of any body from its original parts.

Syringe-Condensing, an instrument used for the purpose of charging the ball of an air-gun. See page 40.

Telescope, an instrument for viewing distant bodies. By a combination of lenses the object is seen under a larger angle than with the naked eye, and its apparent magnitude proportionately increased.

Tellurium, a metal discovered in the year 1798. It forms combinations with various bodies, but it has not yet been used except for experiments.

Thermometer, an instrument for discovering the temperature of the air.

Tin, a well known white metal, and very little inferior in appearance to silver. It has but very little affinity for oxygen, for which reason our culinary vessels are coated with a solution of it.

Topaz, a gem of a gold colour, called by the ancients chrysolite. The finest topazes come from the East Indies, the Great Mogul is said to have had one worth £20,000.

Trumpet, Speaking and Hearing. See pages 51 and 52.

Tungsten, a very heavy metal, when pure it is extremely hard and brilliant. It is of very little use.

Uranium, a metal discovered in the year 1786. It is hard and brittle, but is found in very small quantities, and is of no particular use.

Vacuum, a space void of matter.

Valve, in hydraulics a kind of cover of a tube so contrived as to admit a fluid one way and by its pressure to prevent its return.

Vision. See page 28.

Voltaic Electricity, or "Galvanism." See page 64.

Water. For the various kinds of this fluid, see page 41.

Wind, air in motion. See page 57.

Yttria, a kind of earth discovered in Sweden at the latter end of the last century.

Zaffre, the oxide of cobalt, used for painting porcelain a blue colour.

Zero, a term applied to a certain point in the thermometer; in Fahrenheit's thermometer, it is placed at 32° below the freezing point. In Reaumur's, as also in the French centigrade thermometer, it is placed at the freezing point.

Zinc, a well known metal. It is never found in a pure state, but principally obtained from calamine and blende. Zinc is naturally brittle, yet when heated and annealed, it may be passed through rollers and formed into sheets. This is one of the most useful alloys, principally in combination with copper. It is also used in medicine.

Zirconia, a new kind of earth, first discovered in the Jargon or Zircon of Ceylon.

POETRY.

OF THE OBJECT AND EFFECT OF POETRY.

Poetry and Eloquence are universally acknowledged to hold the highest rank among the fine arts: they, of all others, possess the most attractive influence, and charm the soul with an inestimable sweetness and force.

The study of Poetry, while it produces the most elegant, instructive, and amusing entertainment, is calculated to elevate the mind and to rouse into action its most noble and amiable qualities. Persons of every rank in life feel its charms and acknowledge its sway. As it was the earliest kind of literature, so it is at once the most delightful and the most powerful. The opinions, the conduct, and the passions of mankind, are, to a considerable degree, influenced by the poet; which influence, as has been well observed, may be greater and more permanent than that of Sages and Legislators.

Poetry was, most probably, originally invented for the purpose of adoration and praise to God. On occasions of miraculous deliverance by the interposition of the Almighty, the Hebrews gave expression to their feelings of gratitude by those sublime effusions which we find in the Scriptures.

The Song of Moses, the earliest regular ode with which we are acquainted, is a masterpiece of composition; and the human mind can scarcely conceive any language more grand, and at the same time more sweet and expressive, than the songs of the Hebrew Bards. In the book of Job, the Psalms, and the Prophets, poetry shines

forth in the most resplendent manner. The beautiful imagery, the bold and dignified language, cannot but most forcibly affect the most indifferent reader. As Poetry was first employed by the Hebrews in praise and thanksgiving to the true God, so it was first employed by the Heathens in praise and adoration of their divinities; and, next to the Bible, the Greek Poets present the most beautiful and sublime language imaginable. The histories of most nations have been preserved in Poetry. Harmonious and sonorous language, with highly metaphorical terms in measured lines, ending in similar sounds or alternating with each other in sense, were easily committed to memory and retained; and as these were accompanied by a tune on some instrument, it became an agreeable amusement thus to celebrate any interesting event. In this manner was handed down to posterity, from father to son, any thing of consequence, the memory of which it might be deemed desirable to preserve. Many an ancient tale has thus descended among the Irish, even to the present day, the recital of which forms a source of amusement during their long and tedious winter evenings.

A very particular object of Poetry was to give a tone to the morals of society. The *Epic* Poem instructed under the allegory of some heroic action. The aim of Tragedy was to inspire a horror for guilt and a love of virtue; and of *Comedy*, to ridicule vice and folly. The *Ode* celebrated the exploits of eminent men, in order to inspire others to imitate them; while the *Elegy* was calculated to call up feelings of tenderness and regret at the loss of a friend or companion.

As each of the different kinds of Poetry is comprehensively explained in the "Rhetorical Speaker," it is not deemed necessary to give a more particular explanation here.

CLASSICAL MODERN POETRY.

HAPPINESS.

One morning in the month of May,
I wander'd o'er the hill;
Tho' nature all around was gay,
My heart was heavy still.

Can God, I thought, the just, the great,
These meaner creatures bless,
And yet deny to man's estate
The boon of happiness?

Tell me, ye woods, ye smiling plains,
Ye blessed birds around,
In which of nature's wide domains
Can bliss for man be found?

The birds wild caroll'd over head,
The breeze around me blew,
And nature's awful chorus said—
No bliss for man she knew.

I question'd Love, whose early ray
So rosy bright appears,
And heard the timid genius say,
His light was dimm'd by tears.

I question'd Friendship: Friendship sigh'd,
And thus her answer gave:—
The few whom fortune never turn'd
Were wither'd in the grave!

I ask'd if Vice could bliss bestow,
Vice boasted loud and well;
But fading, from her wither'd brow,
The borrow'd roses fell.

I sought of FEELING, if her skill
Could sooth the wounded breast;
And found her mourning, faint, and still
For others' woes distress'd!

I questioned VIRTUE: VIRTUE sigh'd,
No boon could she dispense;
Nor Virtue was her name, she cried,
But humble Penitence.

I question'd DEATH: the grisly shade
Relax'd his brow, severe;
And, "I AM HAPPINESS," he said,
"If Virtue guides thee here."

HEBER.

WHAT IS LIFE?

And what is Life? An hour-glass on the run,
A mist retreating from the morning sun,
A busy, bustling, still-repeated dream.—
Its length?—A minute's pause, a moment's thought.
And happiness?—A bubble on the stream,
That, in the act of seizing, shrinks to nought.

What is vain Hope?—The puffing gale of morn,
That robs each flow'ret of its gem, and dies;
A cobweb, hiding disappointment's thorn,
Which stings more keenly through the thin disguise.

And thou, O Trouble?—Nothing can suppose
(And sure the Power of Wisdom only knows)
What need requirest thee:
So free and liberal as thy bounty flows,
Some necessary cause must surely be.
But disappointments, pains, and every woe
Devoted wretches feel,
The universal plague of life below,
Are mysteries still, 'neath Fate's unbroken seal.

And what is Death? is still the cause unfound?
That dark, mysterious name, of horrid sound?—
A long and lingering sleep, the weary crave.
And peace? where can its happiness abound?
Nowhere at all, save heaven, and the grave.

Then what is Life?—When stripp'd of its disguise,
A thing to be desired it cannot be;
Since every thing that meets our foolish eyes
Gives proof sufficient of its vanity.
'Tis but a trial all must undergo;
To teach unthankful mortals how to prize
That happiness vain man's denied to know,
Until he's call'd to claim it in the skies.

CLARE.

THE SPIRIT'S PRAYER.

A Spirit, whom the voice of death
Had call'd from this cold sphere,
Paused for a moment on her path,
To look at scenes once dear.
The frozen tinge that shadow'd o'er
Her face had died away;
The shroud she wore an hour before,
She left beside her clay.

Her eye beheld, with strange delight,
The systems round her roll;
A thousand things, unknown and bright,
Broke on her wondering soul.
She saw the Earth hang dim and far
Beneath her airy tread,
Lit by each solitary star
That round her calmly spread.

She saw the city of her birth
Beneath the moonshine lie:
She saw the thousands of the earth
Unheeded, fall and die;
Smote by the giant arm of death,
They fell, and left no trace;
Their spirits pass'd her on their path,
Through the wild fields of space.

She gazed through the unclouded air,
Where once her mansion lay;
Her children still were weeping there,
Beside her tombless clay.

She saw them in their loneliness,
Unheeded, round her bow,
And, in their sorrow, kiss each tress
That hid her lifeless brow!

They were in want—none came to cheer;
Even hope in darkness slept!
The spirit saw each burning tear,
And as she saw she wept;
And bending then her deathless eye
Far through the slumbering air,
Where God sat in the starry sky,
She breathed a mother's prayer:

"Eternal Spirit! comfort now
Yon mourners in their dark abode;
They have no parent—oh! be thou
Their guardian and their God.
Cold is the breast where they have clung
And prattled in their infant glee;
Closed are the lips, and mute the tongue,
That would have turn'd their hearts to thee.

"Then, oh, bind up the broken heart,
Which few in yon cold world will heal;
Where is the shield to break the dart
That misery's victims feel?
Yes, thou shalt plume the spirit's wing
That bends on thee faith's trusting eye;
Though tempests gather, she shall spring
In sunshine to the sky.

"Then smile upon their opening bloom;
Let virtue lead their hearts above;
Till, past the darkness of the tomb,
They share once more a mother's love!"
She ceased—an arch of light appeared,
Love's brightening banner to her given:—
The spirit knew her prayer was heard,
And bore away for heaven.

D. MOORE.

SEA-SIDE THOUGHTS.

Beautiful, sublime, and glorious,
Mild, majestic, foaming, free;
Over time itself victorious;
Image of Eternity.

Sun, and moon, and stars, shine o'er thee,
See thy surface ebb and flow,
Yet attempt not to explore thee
In thy soundless depths below.

Whether morning's splendours steep thee
With the rainbow's glowing grace;
Tempests rouse, or navies sweep thee,
'Tis but for a moment's space.

Earth—her valleys, and her mountains,
Mortal man's behest obey:
Thy unfathomable fountains
Scoff his search and scorn his sway.

Such art thou, stupendous ocean!
But if overwhelm'd by thee,
Can we think, without emotion,
What must thy Creator be?

BARTON.

THE SHIP AT SEA.

A white sail gleaming on the flood,
And the bright orb'd sun on high,
Are all that break the solitude
Of the circling sea and sky;—
Nor cloud nor cape is imaged there,
Nor isle of ocean, nor of air.

Led by the magnet o'er the tides,
That bark her path explores;
Sure as unerring instinct guides
The birds to unseen shores.
With wings, that o'er the waves expand,
She wanders to a viewless land.

Yet not alone;—on ocean's breast,
Though no green islet glows,
No sweet refreshing spot of rest
Where fancy may repose,
Nor rock, nor hill, nor tower, nor tree
Breaks the blank solitude of sea.

No! not alone;—her beauteous shade
Attends her noiseless way,
As some sweet memory, undecay'd,
Clings to the heart for aye,
And haunts it, wheresoe'er we go,
Through every scene of joy and woe.

And not alone;—for day and night
Escort her o'er the deep,
And round her solitary flight
The stars their vigils keep;
Above, below, are circling skies,
And heaven around her pathway lies.

And not alone;—for hopes and fears
Go with her wandering sail;
And bright eyes watch, through gathering tears,
The distant cloud to hail;
And prayers for her, at midnight lone,
Ascend, unheard by all, save One.

And not alone;—with her bright dreams
Are on the pathless main;
And o'er its moan—earth's woods and streams
Put forth their choral strain;
When sweetly are her slumberers blest
With visions of the land of rest.

And not alone;—for round her glow
The vital light and air,
And something that, in whispers low,
Tells to man's spirit there,
Upon her waste and weary road,
A present, all-pervading God!

MALCOLM.

MY NATIVE LAND.

Where'er we wander, still we find
A thousand cares on either hand;
But none can feel true grief of mind,
Unless far from his native land.

When to invoke the future, high
The Captive lifts his chain-gall'd hand;
That chain—alas!—he heaves so high,
Reminds him of his native land.

If borne by fancy, while he sleeps,
To where his cottage used to stand,
With joy he wakes, but waking weeps,
To find no more his native land.

If, kindly, to relieve his pain,
Some friendly, generous hearts expand,
He would be happy, but in vain,
It minds him of his native land.

Should e'er it be *my* lot to stray,
To be by southern breezes fann'd,
I'll ne'er forget, though far away,
How much I love thee, native land!

Or, if to climes enrobed in snow,
And locked in winter's icy band,
By adamantine fate obliged to go,
I'll think of thee, my native land.

MY BIRTH-DAY.

Time shakes his glass, and swiftly run
Life's sands, still ebbing grain by grain,—
For weary, wan, autumnal sun,
Brings round my birth-day once again;
And lights me, like the fading bloom
Of Pale October, to the tomb.

My birth-day! Each revolving year—
It seems to me a darker day;
Whose dying flowers, and leaflets sere,
With solemn warning, seem to say,

That all on earth like shadows fly ;—
That nought abideth 'neath the sky.

My birth-day! Where, when life was young,
Is now each promise which it gave ?
Hope's early wreaths have long been hung,
Pale, faded garlands, o'er its grave,
Where memory waters with her tears,
Those relics of departed years.

My birth-day! Where the loved ones now,
On whom, in happier times, it dawn'd ?
Each beaming eye, and sunny brow,
Low in the dark and dreamless land
Now sleep,—where I shall slumber soon,
Like all beneath the sun and moon.

My birth-day! Once I loved to hear
These words, by friendship echoed round ;
But now, they fall upon mine ear,
With thoughts too mournful and profound,—
Fraught with a sad and solemn spell,
And startling as a wailing knell.

MALCOLM.

THE FATE OF TYRANNY.

AN ODE.

[This is a free Paraphrase on part of the 14th chapter of Isaiah, where the Prophet, after he has foretold the destruction of Babylon, subjoins a Song of Triumph, which he supposes the Israelites will sing when his prediction is fulfilled.]

Oppression dies ; the Tyrant falls :
The golden city bows her walls!
Jehovah breaks th' Avenger's rod.
The son of wrath, whose ruthless hand
Hurl'd Desolation o'er the land,
Has run his raging race, has closed the scene of blood ;
Chiefs, arm'd around, behold their vanquish'd Lord,
Nor spread the guardian shield, nor lift the royal sword.

He falls, and Earth again is free.
Hark! at the call of Liberty,
All Nature lifts the choral song.
The fir-trees on the mountain's head,
Rejoice through all their pomp of shade ;
The lordly cedars nod on sacred Lebanon:
Tyrant! they cry, since thy fell force is broke,
Our proud heads pierce the skies, nor fear the woodman's stroke.

Hell, from her gulf profound,
Rouses at thine approach ; and all around,
Her dreadful notes of preparation sound.
See, at the awful call,
Her shadowy heroes all,
E'en mighty kings, the heirs of empire wide,
Rising, with solemn state, and slow,
From their sable thrones below,
Meet, and insult thy pride :—
What, dost thou join our ghostly train,
A flitting shadow, light and vain ?
Where is thy pomp, thy festive throng,
Thy revel dance, and wanton song ?
Proud King! Corruption fastens on thy breast,
And calls her crawling brood, and bids them share the feast.

O Lucifer! thou radiant star ;
Son of the Morn, whose rosy car
Flamed foremost in the van of day ;
How art thou fall'n, thou King of Light!
How fall'n from thy meridian height!
Who said'st the distant poles shall hear me, and obey.
High, o'er the stars, my sapphire throne shall glow,
And, as Jehovah's self, my voice the heavens shall bow.

He spake, he died. Distain'd with gore,
Beside yon yawning cavern, hoar,
See, where his livid corse is laid.
The aged Pilgrim, passing by,
Surveys him long with dubious eye,
And muses on his fate, and shakes his reverend head.—
Just heavens! is thus thy pride imperial gone ?
Is this poor heap of dust the King of Babylon ?

Is this the man, whose nod
Made the Earth tremble? whose terrific rod
Levell'd her loftiest cities? Where he trod
Famine pursued, and frown'd,
Till Nature, groaning round,
Saw her rich realms transform'd to deserts dry;
While at his crowded prison's gate,
Grasping the keys of Fate,
Stood stern Captivity.
Vain Man! behold thy righteous doom;
Behold each neighb'ring monarch's tomb;
The trophied arch, the breathing bust,
The laurel shades their sacred dust;
While thou, vile outcast, on this hostile plain,
Moulder'st, a vulgar corse, among the vulgar slain.

No trophied arch, no breathing bust,
Shall dignify thy trampled dust;
No laurel flourish o'er thy grave.
For why? proud King, thy ruthless hand
Hurl'd Desolation o'er the land,
And crush'd the subject race, whom kings are born to save.
Eternal Infamy shall blast thy name;
And all thy sons shall share their impious father's shame.

Rise, purple Slaughter! furious rise,
Unfold the terrors of thine eyes;
Dart thy vindictive shafts around:
Let no strange land a shade afford,
No conquer'd Nations call them Lord;
Nor let their cities rise, to curse the goodly ground,
For thus Jehovah swears: No name, no son,
No remnant shall remain of haughty Babylon.

Thus saith the righteous Lord:
My vengeance shall unsheath the flaming sword;
O'er all thy realms my fury shall be pour'd.
Where yon proud city stood
I'll spread the stagnant flood;
And there the bittern in the sedge shall lurk,
Moaning with sullen strain:
While, sweeping o'er the plain,
Destruction ends her work.

Yes, on mine holy mountain's brow,
I'll crush this proud Assyrian foe.
Th' irrevocable word is spoke.
From Judah's neck the galling yoke
Spontaneous falls; she shines with wonted state.—
Thus, by MYSELF I swear, and what I swear is FATE.

MASON.

HEAVENLY MINSTREL.

Enthroned upon a hill of light,
A heav'nly minstrel sings;
And sounds, unutterably bright,
Spring from the golden strings.
Who would have thought so fair a form
Once bent beneath an earthly storm!

Yet was he sad and lonely here;
Of low and humble birth;
And mingled, while in this dark sphere,
With meanest sons of earth.
In spirit poor, in look forlorn,
The jest of mortals, and the scorn.

A crown of heav'nly radiance now,
A harp of golden strings,
Glitters upon his deathless brow,
And to his hymn-note rings.
The bower of interwoven light
Seems, at the sound, to grow more bright.

Then, while with visage blank and sear,
The poor in soul we see,
Let us not think what he is here,
But what he soon will be;
And look beyond this earthly night,
To crowns of gold, and bowers of light.

EDMESTON.

LOVE.

They sin who tell us love can die.
With life all other passions fly;
All others are but vanity.
  In heaven ambition cannot dwell,
  Nor avarice in the vaults of hell.
Earthly, these passions are of earth,
They perish where they have their birth;
  But love is indestructible.
Its holy flame for ever burneth,
From heaven it came, to heaven returneth;
  Too oft on earth, a troubled guest,
At times deceived, at times opprest,
    It here is tried and purified,
  And hath in heaven its perfect rest;
It soweth here with toil and care,
But the harvest-time of Love is there.
  O! when a mother meets on high
  The babe she lost in infancy,
Hath she not then, for pains and fears,
  The day of woe, the anxious night,
For all her sorrow, all her tears,
  An over payment of delight?

SOUTHEY.

LESSONS OF WISDOM.

Wisdom took up her harp, and stood in place
Of frequent concourse, stood in every gate,
By every way, and walked in every street;
And lifting up her voice proclaimed: "Be wise,
Ye fools! be of an understanding heart;
Forsake the wicked, come not near his house,—
Pass by, make haste, depart, and turn away.
Me follow, me, whose ways are pleasantness,
Whose paths are peace, whose end is perfect joy."

The seasons came and went, and went and came,
To teach men gratitude; and as they passed,
Gave warning of the lapse of time, that else
Had stolen unheeded by. The gentle flowers
Reared, and stooping o'er the wilderness,
Talked of humility and peace and love.
The dews came down unseen at evening-tide,
And silently their bounties shed, to teach
Mankind unostentatious charity.
With arm in arm, the forest rose on high
And lesson gave of brotherly regard.
And on the rugged mountain-brow exposed,
Bearing the blast alone, the ancient oak
Stood lifting his mighty arm, and still
To courage in distress exhorted loud.
The flocks, the herds, the birds, the streams, the breeze,
Attuned the heart to melody and love.
Mercy stood in the cloud with eye that wept
Essential love! and from her glorious bow
Bending to kiss the earth in token of peace,
With her own lips, her gracious lips, which God
Of sweetest accent made, she whispered still,
She whispered to Revenge, Forgive, forgive.
The sun rejoicing round the earth, announced
Daily the wisdom, power, and love of God.
The moon awoke, and from her maiden face,
Shedding her cloudy locks, looked meekly forth,
And with her virgin stars walked in the heavens,
Walked nightly there, conversing, as she walked,
Of purity and holiness and God.
In dreams and visions, sleep instructed much.
Day uttered speech to day, and night to night
Taught knowledge. Silence had a tongue; the grave,
The darkness, and the lonely waste, had each
A tongue, that ever said, Man! think of God!
Think of thyself! think of eternity!—
Fear God, the thunders said. Fear God, the waves.
Fear God, the lightning of the storm replied.
Fear God, deep loudly answered back to deep.

POLLOK.

THE SEASONS.

Oft have I seen the laughing Spring
Shed her rich blessings o'er the earth,
While born beneath her fragrant wing,
Spring Beauty forth, and Love, and Mirth.

But Spring soon fled, and Summer then
Her genial heats diffused around,
And Nature's wildest, roughest glen
Was by her hand with verdure crown'd.

Sweet Summer, too, alas! was doom'd
To quit the rich and smiling plain:
For while in fruitfulness she bloom'd,
Autumn began her glorious reign.

But Autumn's sun soon ceased to burn,
And clouds which roll'd across the sky,
Declared that winter and his urn,
In viewless icy car was nigh.

When Winter came, the gorgeous sun
Turn'd pale, and seem'd to wait his doom,
And all that late so radiant shone,
Now sunk in Winter's joyless tomb.

Thus blooming is life's early spring,
For Nature on each path hath shed
Her smiles, and Pleasure seeks to fling
Her garlands round each youthful head.

My spring has fled, and summer now
Rich o'er my youthful cheek doth breathe,
And soon to deck this gladsome brow,
Autumn her holiest sweets will wreathe.

Yet ere dim winter's gloomy birth,
Or age destroy this cheek of bloom,
Oh! I may press my mother earth,
And quit this vain world for the tomb.

Then let me, Lord, at whose command,
Summer, and spring, and winter roll,
Praise, while I've life, th' Almighty hand
That spans the world from pole to pole.

At morning's light, Lord of all space,
I'll praise thee; and at close of even;
Then lend me, Lord, some ray of grace
To light my trembling steps to Heaven.

RYAN.

HOPE AT DEATH.

Unfading Hope! when life's last embers burn,
When soul to soul, and dust to dust return!
Heaven to thy charge resigns the awful hour!
Oh! then, thy kingdom comes! Immortal Power!
What though each spark of earth-born rapture fly,
The quivering lip, pale cheek, and closing eye!
Bright to the soul thy seraph hands convey
The morning dream of life's eternal day—
Then, then, the triumph and the trance begin!
And all the Phœnix spirit burns within!

Oh! deep enchanting prelude to repose,
The dawn of bliss, the twilight of our woes!
Yet half I hear the parting spirits sigh,
It is a dread and awful thing to die!
Mysterious worlds, untravell'd by the sun!
Where Time's far wandering tide has never run;
From your unfathom'd shades, and viewless spheres,
A warning comes, unheard by other ears.
'Tis Heaven's commanding trumpet long and loud,
Like Sinai's thunder, pealing from the cloud!
While Nature hears, with terror-mingled trust,
The shock that hurls her fabric to the dust;
And like the trembling Hebrew, when he trod
The roaring waves, and called upon his God,
With mortal terrors clouds immortal bliss,
And shrieks and hovers o'er the dark abyss!

Daughter of Faith! awake, arise, illume,
The dread unknown, the chaos of the tomb!
Melt and dispel ye spectre doubts that roll
Cimmerian darkness on the parting soul!
Fly like the moon-eyed herald of dismay,
Chased on his night steed by the star of day!

The strife is o'er—the pangs of nature close,
And life's last rupture triumphs o'er her woes.
Hark! as the spirit eyes, with eagle gaze,
The noon of Heav'n, undazzled by the blaze,
On heavenly winds that waft her to the sky,
Float the sweet tones of star-born melody;
Wild as that hallowed anthem sent to hail
Bethlehem's shepherds in the lonely vale,
When Jordan hush'd his waves and midnight still
Watch'd on the holy towers of Zion hill!

Soul of the just! companion of the dead!
Where is thy home, and whither art thou fled?
Back to its heavenly source thy being goes,
Swift as the comet wheels to whence he rose;
Doom'd on his airy path awhile to burn,
And doom'd, like thee, to travel and return.
Hark! from the world's exploding centre driven,
With sounds that shook the firmament of heaven,
Careers the fiery giant, fast and far,
On bickering wheels and adamantine car,
From planet whirl'd to planet more remote,
He visits realms beyond the reach of thought;
But, wheeling homeward when the race is run,
Curbs the red yoke, and mingles with the sun;
So hath the traveller of earth unfurl'd
Her trembling wings, emerging from the world,
And o'er the path by mortal never trod,
Springs to her source, the bosom of her God!

Eternal Hope! when yonder spheres sublime
Peal'd their first notes to sound the march of time,
Thy joyous youth began—but not to fade—
When all the sister planets have decay'd;
When wrapt in fire the realms of ether glow,
And Heaven's last thunder shakes the world below;
Thou undismay'd, shalt o'er the ruins smile,
And light thy torch at Nature's funeral pile!

CAMPBELL.

MY LONG LAST HOME.

In that sweet hour when morning bright
  Pours o'er the world a flood of light,
And wood and mountain, tower and stream,
  Are glittering in the golden beam.
Or when the gentle moonbeams rest
Upon the broad lake's peaceful breast,
  When the light breeze is full of balm,
  And all around is still and calm,
I love in solitude to roam,
And muse on thee, my distant home.

My mother's gentle voice I hear,
  Her tender smile I see;
That voice, that smile, that seem more dear,
  Than ever now to me.
With her through shady walks I rove,
  Or tend her favourite flowers,
Or by the stream we used to love
  Spend the bright summer hours.
Why did I cross the blue sea's foam,
Why leave my dear, my pleasant home!

If care or sorrow rend my heart,
  Or agitate my breast,
Who now will seek, with tender art,
  To sooth my griefs to rest?
Who when on pain's hard couch I lie
  Will share my chamber's gloom.
And who will watch me when I die,
  And lay me in my tomb?
It is enough—no more I'll roam,
I haste to thee, my long last home!

E. S. L.

CHILDE HAROLD'S FAREWELL TO ENGLAND.

Adieu, adieu! My native shore
Fades o'er the waters blue;
The night winds sigh, the breakers roar,
And shrieks the wild sea-mew.
Yon sun that sets upon the sea
We follow in his flight;
Farewell, awhile, to him and thee
My native land!—Good night.

A few short hours and he will rise
To give the morrow birth,
And I shall hail the main and skies,
But not my mother earth.
Deserted is my own good hall,
Its hearth is desolate,
Wild weeds are gathering on the wall,
My dog howls at the gate.

And, now I'm in the world alone,
Upon the wide, wide sea:
But why should I for others groan,
When none will sigh for me?
Perchance my dog will whine in vain,
Till fed by stranger hands;
But long ere I come back again
He'd tear me where he stands.

With thee, my bark, I'll swiftly go
Athwart the foaming brine,
Nor care what land thou bear'st me to
So not again to mine.
Welcome, welcome, ye dark blue waves,
And when you fail my sight,
Welcome ye deserts and ye caves!
My native land—Good night!

BYRON.

THE POLISH MOTHER.

The Polish mother sat and wept
  Afar in wild Siberia's land,
Her lovely little infant slept,
  Cradled upon her knee and hand:
She gazed upon his placid face,
  His father's image, mild but brave,—
Anxious she gazed if she could trace
    One feature of a slave.

"Ah, no!" she cried, "thou art, my son,
  Thy father's son, who died so brave;
I'd rather that thy race was run,
  Than nurture thee to be a slave!
Yes, I would rather dig thy grave,
  And lay thee there without a tear,
Than suckle thee, that tyrant knave
    Should dare enslave thee here.

"But I will tell thee of thy sire—
  I'll tell thee of thy country's shame,
And I will mark thy young breast's fire,
  And fan and feed the flame:
I'll tell thee of our Russian foe,
  Who came into our land once free,
And sent us to this land of snow,
    To die in slavery!

"I'll tell thee how that Europe gazed
  And wonder'd Poles could face each horde,
But how they only look'd and praised,
  Nor sought to aid the patriot's sword!
I'll tell thee too, when Warsaw fell,
  What cruelties our nation bore,
And when thou growest, I will tell
    Thee—Be a slave no more.

"Away—away—my bosom glows,
I'll make a hero of my son;
He'll lead his countrymen from snows,
To death or victory—on—on!"
With this she raised him, and embraced
The young and yet unconscious child:
He oped his lovely eyes, and gazed
Upon her face and smiled.

THE DYING BOY.

It must be sweet, in childhood to give back
The spirit to its Maker, ere the heart
Has grown familiar with the paths of sin,
And sown—to garner up its bitter fruits.
I knew a boy, whose infant feet had trod
Upon the blossoms of some seven springs,
And when the eighth came round, and called him out
To gambol in the sun, he turn'd away,
And sought his chamber, to lie down and die!
'Twas night—he summon'd his accustom'd friends,
And in this wise, bestow'd his last bequest:—

"Mother! I'm dying now—
There is deep suffocation in my breast,
As if some heavy hand my bosom press'd,
And on my brow
I feel the cold sweat stand,
My lips grow dry and tremulous, and my breath
Comes feebly up. Oh! tell me, is this death?
Mother! your hand—
Here—lay it on my wrist,
And place the other soft beneath my head,
And say, sweet mother!—say, when I am dead,
Shall I be miss'd?
Never beside your knee
Shall I kneel down at night to pray,
Nor with the morning wake, and sing the lay
You taught to me!

Oh, at the time of prayer,
When you look round and see a vacant seat,
You will not wait there for my coming feet—
You'll miss me there!"

"Father! I'm going home—
To the good home you spoke of, that bless'd land
Where it is one bright summer always, and
Storms do not come.
I must be happy then:
From pain and death you say I shall be free—
That sickness never enters there, and we
Shall meet again!"

"Brother! the little spot
I used to call my garden, where long hours
We've stay'd to watch the budding things and flowers,
Forget it not.
Plant there some box or pine—
Something that lives in winter, and will be
A verdant offering to my memory,
And call it mine!"

"Sister! my young rose-tree
That all the spring has been my pleasant care,
Just putting forth its leaves so green and fair,
I give to thee.
And when its roses bloom,
I shall be gone away—my short life done!
But will you not bestow a single one
Upon my tomb?"

"Now, mother! sing the tune
You sang last night—I'm weary, and must sleep!
Who was it called my name?—Nay, do not weep,
You'll all come soon!"

Morning spread over earth her rosy wings,
And that meek sufferer, cold and ivory pale,
Lay on his conch asleep! The gentle air
Came through the open window, freighted with
The savoury labours of the early spring—
He breathed it not!—The laugh of passers by
Jarr'd like a discord in some mournful tune,
But marred not his slumbers.—He was dead!

THE UNIVERSAL PRAYER.

Primeval Power; Almighty and Supreme,
Omniscient, Omnipresent, and Eterne,
The Uncreated God! at whose command
Nature and time did hand in hand arise,
And round Thee wheel a universe of worlds,—
Descend! and magnify our thoughts for prayer;
Illume, expand, and purify the soul
With inward light, reflected from Thyself;
Unlock the springs of mind, and let them pour
The vital feelings forth in one full stream
Of adoration, duteous as divine.

Thou Infinite! since first creation roll'd,
Thy mercy hath reveal'd a ray of Thee
To every heart: in every age or clime,
Heard in the wind, or vision'd in the cloud,
Or in the parent sun presumed to shine,—
Still has th' immortal soul been stamp'd with Thee!

Oh! all that thought can span, or eye perceive,
Is but a part, a shadow of Thy power,
Creating, filling, and upholding all!
The airy ocean, far above us spread,
Where balanced worlds perform their silent march,
And seasons dwell and roll,—the chainless deep,
Belting the earth with majesty and might,—
The mountains pinnacled with storms, the floods
And streams, the meadows beautified with flowers,—
Are fill'd with Thee! and in the thunder-peals,
Rattling from cloud to cloud, terrific ire,
We hear the language of a God! and in
The winds, careering till they whirl and roar
Like rebel spirits plunging from the sky,—
We dread Thee, wing'd upon each awful blast!

Fountain of Light and Love! while Nature hymns
Thy praise, in wave or wind, from shore to shore,
Thy miniature, immortal Man, the grace
And glory of the Earth, with brow erect,

Was made to walk the world in joy, to share
Thy goodness, and adore the hand divine.
Then look! Thou Universal One, whose eye
Is fixed alike on all,—with mercy look
Upon the spacious World; from east to west,
From north to south, extend Thy guardian care:
In polar climes, in lands refined or rude,
In isles remote, and deserts darkly spread,—
Where beats a heart within a human breast,
There be Thou present, and Thy power adored!
And, oh! since all are doom'd one common race
To run, and one eternal goal to win,
May Thy prime attribute each bosom warm
With tender sympathy and truth; may man
Be link'd to man in fellowship of soul,
Till one vast chain of Love embrace the world.

R. MONTGOMERY.

THE DOVE.

The dove let loose in eastern skies,
  Returning fondly home,
Ne'er stoops to earth her wing, nor flies
  Where idle warblers roam;

But high she shoots through air and light,
  Above all low delay,
Where nothing earthly bounds her flight,
  Nor shadow dims her way.

So grant me, God, from earthly care,
  From pride and passion free,
Aloft, through faith and love's pure air,
  To hold my course to thee.

No lure to tempt, no art to stay
  My soul, as home she springs;
Thy sunshine on her joyful way,
  Thy freedom on her wings.

MOORE.

INFANCY.

On yonder mead, that, like a windless lake,
Shines in the glow of heaven, a cherub-boy
Is bounding, playful as a breeze new-born,
Light as the beam that dances by his side.
Phantom of beauty! with his trepid locks
Gleaming like water-wreaths—a flower of life,
To whom the fairy world is fresh, the sky
A glory, and the earth one huge delight!
Joy shaped his brow, and pleasure rolls his eye,
While Innocence, from out the budding lip,
Darts her young smiles along his rounded cheek;
Grief hath not dimm'd the brightness of his form;
Love and affection o'er him spread their wings,
And Nature, like a nurse, attends him with
Her sweetest looks. The humming-bee will bound
From out the flower, nor sting his baby hand;
The birds sing to him from the sunny tree;
And suppliantly the fierce-eyed mastiff fawns
Beneath his feet, to court the playful touch.
To rise all rosy from the arms of sleep,
And, like the sky-bird, hail the bright-cheek'd morn
With gleeful song, then o'er the bladed mead
To chase the blue-wing'd butterfly, or play
With curly streams, or led by watchful Love,
To hear the chorus of the trooping waves,
When the young breezes laugh them into life!
Or listen to the mimic ocean-roar,
Within the womb of spiral sea-shell wove;—
From sight and sound to catch intense delight,
And infant gladness from each happy face;
These are the guileless duties of the day:
And when at length reposeful evening comes,
Joy-worn, he nestles in the welcome couch,
With kisses warm upon his cheek to dream
Of heaven, till morning wakes him to the world.

The scene hath changed into a curtain'd room,
Where mournful glimmers of the mellow sun
Lie dreaming on the walls! Dim-eyed and sad,

And dumb with agony, two parents bend
O'er a pale image in the coffin laid,—
Their infant once, the laughing, leaping boy,
The paragon and nursling of their souls!
Death touch'd him, and the life-glow fled away,
Swift as a gay hour's fancy; fresh and cold
As winter's shadow, with his eyelids seal'd,
Like violet lips at eve, he lies, enrobed,
An offering to the grave! but, pure as when
It wing'd from heaven, his spirit hath return'd,
To lisp his hallelujahs with the choirs
Of sinless babes, imparadised above.

MONTGOMERY.

THE PARTING SPIRIT.

Farewell, thou vase of splendour!
I need thy light no more,
No brilliance dost thou render
The world to which I soar.

Nor sun, nor moonbeam brightens
Those regions with a ray,
But God himself enlightens
Their one eternal day.

Farewell, sweet nature! waving
With fruits and flow'rets fair,
Of these but little craving
Of what thou well canst spare.

Only an earthly pillow
To bear my death-cold head,
And the turf and drooping willow,
To deck my lowly bed.

The world to which I'm going
Has fairer fruit than thine;
Life's river ever flowing,
And skies that ever shine.

Farewell, each dearest union,
That blest my earthly hours;
We yet shall hold communion
In amaranthine bowers.

The love that seems forsaken
When friends in death depart,
In heaven again shall waken
And repossess the heart.

The harps of heaven steal o'er me;
I see the jasper wall;
Jesus who passed before me;
And God the judge of all.

So sang the parting Spirit,
While down flow'd many a tear,
Then spread her wings to inherit
A throne in yonder sphere.

WHAT IS PRAYER?

Pray'r is the soul's sincere desire,
Utter'd or unexpress'd;
The motion of a hidden fire
That trembles in the breast.

Pray'r is the burden of a sigh,
The falling of a tear:
The upward glancing of an eye,
When none but God is near.

Pray'r is the simplest form of speech
That infant lips can try;
Pray'r is the sublimest strains that reach
The Majesty on high.

Pray'r is the Christian's vital breath,
The Christian's native air,
His watchword at the gates of death,
He enters heaven by prayer.

Pray'r is the contrite sinner's voice,
Returning from his ways;
While angels in their songs rejoice
And say, "Behold he prays!"

The saints in pray'r appear as one,
In word, and deed, and mind,
When with the Father and the Son
Their fellowship they find.

No prayer is made on earth alone ·
The Holy Spirit pleads;
And Jesus on th' eternal throne
For sinners intercedes.

O Thou! by whom we come to God,
The Life, the Truth, the Way;
The path of pray'r thyself hast trod:
Lord, teach us how to pray.

MONTGOMERY.

RELIGIOUS HEROISM.

"Go, Lictor, lead the Bishop forth,
Let all the assembly stay,
For he must openly abjure,
His Christian faith to-day."

The Prætor spake: the Lictor went,
And Polycarp appeared;
And totter'd, leaning on his staff,
To where the pile was reared.

His silver hair, his look benign,
Which spake his heavenly lot,
Moved into tears both youth and age,
But moved the Prætor not.

The Heathen spake: "Renounce aloud,
Thy Christian heresy."
"Hope all things else," the old man cried,
"Yet hope not this from me!"

"But if thy stubborn heart refuse
Thy Saviour to deny,
Thy age shall not avert my wrath,
Thy doom shall be—to die!"

"Think not, O Judge! with menaces,
To shake my faith in God;
If in his righteous cause I die,
I gladly kiss the rod."

"Blind wretch! doth not the funeral pile
Thy vaunting faith appal?"
"No funeral pile my heart alarms,
If God and duty call!"

"Then expiate thy insolence,
There perish in the fire;
Go, Lictor, drag him instantly
Forth to the funeral pyre!"

The Lictor dragg'd him instantly
Forth to the pyre: with bands
He bound him to the martyr's stake,
He smote him with his hands.

"Abjure thy God," the Prætor said,
"And thou shalt yet be free."
"No," cried the hero, "rather let
Death be my destiny!"

The Prætor bow'd: the Lictor laid
With haste the torches nigh:
Forth from the faggots burst the flames,
And glanced athwart the sky!

The patient champion at the stake
With flames engirdled, stood;
Calm, patient, look'd he heavenwards
And seal'd his faith with blood.

THE EXILE.

Not yet, not yet, a few brief hours
Are mine to linger still,
To gaze upon the ivied towers
That crown my native hill;
To glance o'er each familiar tree
That shades that lovely spot;
And that must soon forgotten be,
But shall not be forgot!

What varied hours of joy or woe,
My childhood here hath pass'd;
Ah, happy! ere I learnt to know
Woe must prevail at last!
As summer clouds are quickly fled
Before the blaze of noon;
So transient were the tears I shed,
And joy returned as soon!

Here would I muse beside the stream,
Or seek the shelter'd vale,
To shade me from the broad noon-beam,
And woo the fragrant gale;
While ardent fancy loved to frame
Fond dreams of future bliss;
Nor deem'd I, when that future came,
Of such an hour as this!

In yon low copse my brothers played,
Their bosoms light as mine;
Through yon dark wood my sisters strayed,
At summer eve's decline;
And now—I cannot gaze on aught,
Around—above—below,
That is not with remembrance fraught,
And memory is but woe.

For now a wanderer must I roam,
The sport of every wave;
Far from my childhood's much-loved home,
And from my father's grave!
Nor can I hope in other clime
To find a home as dear;
Hearts cannot change with place or time,
And mine will still be here!

For here, with father, sister, friend,
With nature's holiest ties,
Another name was wont to blend,
And other dreams to rise.
But oh! I must not breathe it now—
In silence let me bear—
Man should his lighter griefs avow,
But bury his despair!

'Twere vain to mourn the hopes that fled
When fortune ceased to smile;
Yet o'er the scenes *she* loved to tread
I would have roam'd awhile—
'Twould sooth me, where in other days
With other thoughts I ranged,
On wood and hill and tower to gaze,
And find them still unchanged!

But now a tyrant's stern command
Constrains me hence to roam;
Then, O farewell, my father-land,
Farewell, my *only* home!
Whate'er of valley, or of hill,
In other lands I see,
That will I deem the loveliest place
That leads my thoughts to thee.

REV. T. DALE.

THE WOODMAN.

The Woodman with his keen bright axe,
Throughout the forest goes;
Its sound the leafy silence breaks,
Trees fall before its blows.
He careth not though summer green,
On leaves and blossoms there is seen;
He careth not for winter's cold,
But onward hews, the Woodman bold.

The forest king,—the mighty oak
He levels with the ground;
Its glories fall with every stroke
That through the glades resound,
Until at length so low 'tis laid,
That twigs long dwarf'd within its shade,
Do o'er it wave their leaflets free;
The Woodman bold what careth he.

The poplar, lady of the wood,
Is doom'd his prey to be,
He snaps the willow by the flood,
Nor spares the beechen tree.

The forest's pride he layeth low,
He nippeth all things that do grow:
The little shrub, the tree so old—
He smiteth all—the Woodman bold.

He leaveth not the brier-bush,
He spareth not the rose,
Whene'er he comes the winds shall rush
No longer through green boughs.
He taketh all, he spareth none,
He leaves the tree-land bare and lone,
Without an elm to rest beneath—
The stalwart Woodman's name is—DEATH!

FORGET ME NOT.

Forget me not when I am gone,
I grieve to cause one sigh to thee,
But ere thou seest to-morrow's dawn,
Thou wilt have said 'farewell' to me.
When much-loved friends shall bid adieu
To him they never more may see,
'Twill cheer the last, sad, lingering view,
To know that thou wilt think of me.

Tho' years of sorrow pass away
Ere we can hope to meet again;
Sure as yon pale moon sheds her ray,
Unalter'd shall my truth remain:
When friendship's voice so sweetly dear
Shall loudly chant in praise of thee,
Then will my spirit hover near,
And gently whisper, "Think of me."

May guardian angels never cease
O'er thee their constant watch to keep;
May painful thoughts ne'er wound thy peace,
Nor anguish make thy eyes to weep:
When heaven hangs out her orbs of light
And thou in secret bend the knee,
Let memory tell thee of this night,
And with affection think of me. E. F.

MY NATIVE SPOT.

My native spot, my native spot,
Where first I saw the day;
Oh, ne'er through life to be forgot,
Where'er my footsteps stray.

Where first I knew a mother's love,
And felt a mother's kiss;
And day-dreams of the future strove
With childhood's present bliss.

Alas! the present faded fast,
The future never came,
And life is but a wither'd waste,
And joy is but a name.

Yet midst the wreck of hopes o'ercast,
The weight of worldly ills,
With mournful pleasure still the past
My aching bosom fills.

There's nought maturer age can find
To equal those bright hours,
When the sunshine of the opening mind
Deck'd coming life with flowers.

Each happy scene returns to view,
The loved, the dead are there,
All gilded with the brilliant hue
Which childhood bade them wear.

My thoughts yet dwell on each loved haunt,
Beside each favourite tree;
The verdant path, the grassy mount,
An universe to me.

These speak of years of innocence,
Of many a sportive game,
Of schemes of youthful confidence
And airy plans of fame.

Now vanish'd all—the sports have fled,
Ambition and her train
No more excite this wearied head—
The loved are wept in vain.

Yet still my native spot is dear,
When memory bids it rise;
Still hallowed with a heartfelt tear,
Still chronicled with sighs.

LORD DOVER.

THE PEN.

FROM THE GREEK.

I was an useless thing, a lonely reed!
No blossom hung its beauty on the weed.
Alike in summer's sun and winter's gloom;
I sigh'd no fragrance, and I bore no bloom.
No cluster wreath'd me,—day and night I pined
On the wild moor, and wither'd in the wind.
At length a wanderer found me. From my side
He smooth'd the pale decaying leaves, and dyed
My lips in Helicon! From that high hour
I SPOKE! My words were flame and living power!
And there was sweetness round me,—never fell
Eve's sweeter dews upon the lily's bell.
I shone!—night died!—as if a trumpet call'd,
Man's spirit rose, pure, fiery, disenthrall'd!
Tyrant's of Earth; ye saw your light decline,
When I stood forth, a wonder and a sign.
To me, the iron sceptre was a wand,
The roar of nations peal'd at my command;
To me the dungeon, sword, and scourge, were vain,
I smote the smiter, and I broke the chain:
Or towering o'er them all, without a plume,
I pierced the purple air, the tempest's gloom;
Till burst th' Olympian splendours on my eye,
Stars, temples, thrones, and gods,—Infinity!

CROLY.

DISAPPOINTMENT.

Come, Disappointment, come!
Not in thy terrors clad:
Come in thy meekest, saddest guise,
Thy chastening rod but terrifies
The restless and the bad.
But I recline
Beneath thy shrine,
And round my brow resign'd thy peaceful cypress twine.

Though Fancy flies away
Before thy hollow tread,
Yet Meditation in her cell
Hears with faint eye her lingering knell
That tells her hopes are dead;
And though the tear
By chance appear,
Yet she can smile and say, My all was not laid here.

Come, Disappointment, come!
Though from Hope's summit hurl'd,
Still, rigid nurse, thou art forgiven,
For thou severe wert sent from Heaven
To wean me from the world,—
To turn my eye
From vanity,
And point to scenes of bliss, that never, never die.

What is this passing scene?
A peevish April day!
A little sun, a little rain,
And then night sweeps along the plain
And all things fade away.
Man (soon discuss'd)
Yields up his trust,
And all his hopes lie with him in the dust!

Oh, what is Beauty's power?
It flourishes and dies,
Will the cold earth its silence break,
To tell how soft, how smooth a cheek

Beneath its surface lies?
Mute—mute is all
O'er Beauty's fall;
Her praise resounds no more, when mantled in her pall.

The most beloved on earth
Not long survive to-day;
So music past is obsolete,
And yet 'twas sweet,—'twas passing sweet,
And now 'tis gone away!
Thus does the shade
In memory fade,
When, in forsaken tomb, the form beloved is laid.

Then, since this world is vain,
And volatile, and fleet,
Why should I lay up earthly joys,
Where rust corrupts and moth destroys,
And cares and sorrows eat?
Why fly from ill,
With anxious skill,
When soon this hand will freeze,—this throbbing heart be still?

Come, Disappointment, come!
Thou art not stern to me;
Sad monitress! I own thy sway;
A votary sad in early day,
I bend my knee to thee:
From sun to sun
Thy race will run,—
I only bow and say, My God, thy will be done!

KIRKE WHITE.

FAREWELL TO LIFE.

Composed by Körner, as he lay wounded and helpless in a wood, expecting to die.

My deep wound burns;—my pale lips quake in death;—
I feel my fainting heart resign its strife;
And reaching now the limit of my life,
Lord, to thy will I yield my parting breath!

Yet many a dream hath charm'd my youthful eye!
And must life's fairy visions all depart?
Oh, surely no! for all that fired my heart
To rapture here, shall live with me on high.

And that fair form that won my earliest vow,
That my young spirit prized all else above,
And now adored as freedom, now as love,
Stands in seraphic guise before me now:
And as my wav'ring senses fade away,
It beckons me on high, to realms of endless day!

A MOTHER'S WISH.

Sweet smiling cherub! if for thee
Indulgent Heaven would grant my prayer,
And might the threads of destiny
Be woven by maternal care—
No golden wishes there should twine,
If thy life's web was wrought by me;
Calm, peaceful pleasures should be thine,
From grandeur and ambition free!

I would not ask for courtly grace
Around thy polish'd limbs to play,
Nor Beauty's smile to deck thy face,
Given but to lead some heart astray.
I would not ask the wreath of Fame
Around thy youthful brow to twine;
Nor that the Statesman's envied name,
And tinsell'd honours, should be thine!

Ne'er may War's crimson'd laurels bloom,
To crown thee with a hero's wreath—
Like roses smiling o'er a tomb,
Horror and death lie hid beneath.
Nor yet be thine his feverish life,
On whom the fatal Muses smile;
The Poet, like the Indian wife,
Oft lights his own funereal pile!

No! I would ask that virtue bright
May fix thy footsteps, ne'er to stray;
That meek Religion's holy light
May guide thee through life's desert way.
That manly sense, and purest truth,
A breast, Contentment's chosen shrine,
May, through the slippery paths of youth,
Unstain'd, untarnish'd, still be thine!

That Love's chaste flame,—that Friendship's glow,
May kindle in thy generous breast;
That peace, which greatness ne'er can know,
Be thy calm pillow's nightly guest.
Sweet smiling infant! if for thee
Indulgent Heaven would hear my prayer,
Thus should the web of Destiny
Be woven by a mother's care.

MRS. C. B. WILSON.

PAUPER ORPHANS.

They never knew what 'twas to play,
Without control, the long, long day,
In wood and field at will:
They knew no bird, no tree, no bud;
They got no strawberries from the wood,
No wild thyme from the hill.

They play'd not on a mother's floor;
They toil'd amidst the hum and roar
Of bobbins and of wheels;
The air they drew was not the wild
Bounty of nature, but defiled,
And scanty were their meals.

Their lives can know no passing joy,
Dwindled and dwarf'd are girl and boy,
And even in childhood old;
With hollow eye and anxious air,
As if a heavy grasping care
Their spirits did enfold.

Their limbs are swoln, their bodies bent,
And worse, no noble sentiment
Their darken'd minds pervade:
Feeble, and blemish'd by disease,
Nothing their marble hearts can please,
But doings that degrade.

Oh, hapless heirs of want and woe!
What hope of comfort can they know?
Them man and law condemn:
They have no guides to lead them right,
Darkness they have not known from light,
Heaven be a friend to them!

MARY HOWETT.

MAN.

Like as the damask rose you see,
Or like the blossom on a tree,
Or like the dainty flower in May,
Or like the morning to the day,
Or like the sun, or like the shade,
Or like the gourd which Jonas had;
Even such is man, whose thread is spun,
Drawn out, and cut, and so is done.—
The rose withers, the blossom blasteth,
The flower fades, the morning hasteth,
The sun sets, the shadow flies,
The gourd consumes, and man—he dies.

Like to the grass that's newly sprung,
Or like a tale that's new begun,
Or like a bird that's here to-day,
Or like the pearled dew of May,
Or like an hour, or like a span,
Or like the singing of a swan;
Even such is man, who lives by breath,
Is here, now there, in life and death.
The grass withers, the tale is ended,
The bird is flown, the dews ascended,
The hour is short, the span not long,
The swan's near death, man's life is done.

Like to a bubble in a brook,
Or in a glass much like a look,
Or like the shuttle in weaver's hand,
Or like the writing on the sand,
Or like a thought, or like a dream,
Or like the gliding of a stream;
Even such is man, who lives by breath,
Is here, now there, in life and death!
The bubble's out, the look's forgot,
The shuttle's flung, the writing's blot,
The thought is past, the dream is gone,
The waters glide, man's life is done.

Like to an arrow from a bow,
Or like swift course of water-flow,
Or like that time 'twixt flood and ebb,
Or like the spider's tender web,
Or like a race, or like a goal,
Or like the dealing of a dole;
Even such is man, whose brittle state
Is always subject unto fate.
The arrow's shot, the flood soon spent,
The time no time, the web soon rent,
The race soon run, the goal soon won,
The dole soon dealt, man's life soon done.

Like to the lightning from the sky,
Or like a post that quick doth hie,
Or like a quaver in a song,
Or like a journey three days long,
Or like the snow when summer's come,
Or like the pear, or like the plum;
Even such is man, who heaps up sorrow,
Lives but this day, and dies to-morrow.
The lightning's past, the post must go,
The song is short, the journey so,
The pear doth rot, the plum doth fall,
The snow dissolves, and so must all.

WASTELL.

THE OMNIPRESENCE OF GOD.

Dweller in heaven, and ruler below!
Fain would I know thee, yet tremble to know!
How can a mortal deem how it may be,
That being can not be, but present with thee?
Is it true that thou saw'st me ere I saw the morn?
Is it true that thou knew'st me before I was born?
That nature must live in the light of thine eye?
This knowledge for me is too great and too high!

That fly I to noonday or fly I to night,
To shroud me in darkness, or bathe me in light,
The light and the darkness to thee are the same,
And still in thy presence of wonder I am!
Should I with the dove to the desert repair,
Or dwell with the eagle in clough of the air,
In the desert afar on the mountain's wild brink,
From the eye of Omnipotence still must I shrink.

Or mount I on wings of the morning away,
To caves of the ocean unseen by the day,
And hide in these uttermost parts of the sea,
Even there to be living and moving in thee?
Nay, scale I the cloud in the heavens to dwell,
Or make I my bed in the shadows of hell;
Can science expound, or humanity frame,
That still thou art present, and all are the same?

Yes, present for ever! Almighty—alone,
Great Spirit of nature, unbounded, unknown!
What mind can imbody thy presence divine?
I know not my own being! how can I thine?
Then humbly and low in the dust let me bend,
And adore what on earth I can ne'er comprehend,
The mountains may melt and the elements flee,
Yet an universe still be rejoicing in thee.

HOGG.

THE SUPERIOR BEAUTY OF THE EYE.

Lovely the milk-white orient pearl,
Deep hid beneath the waves that curl
In Ormus' sunny bay;
And bright the blush of the Ruby's red,
When we drag it forth from the secret bed,
In the dark earth where it lay.

But lovelier far the Diamond bright,
Darting its beams of living light
Through the darkness of the mine:
More beautiful its silvery rays,
Than the pearl's soft white, or the ruby's blaze,
Or the fairest gems that shine.

So the brow may be pure as the unsunned snow,
And the blushing tints on the cheek that glow
May be exquisitely bright;
But these fading charms can never vie
With the diamond-sparkle of the Eye,
With its pure and lustrous light.

'Tis here the immortal spirit lives,
The spark of heavenly fire, that gives
Expression to the whole;
Each feeling pictured here we find,
'Tis the index of the mighty mind,
The palace of the Soul.

A. W. L.

THE POLISH CHILDREN.

Forth went they from their father-land,
A fallen and fetter'd race,
To find upon a distant strand,
Their dark abiding place.
Forth went they—not as freemen go,
With firm and fearless eye,
But with the bow'd down mien of woe
As men go forth to die.

The aged in their silver hair,
The young in manhood's might,
The mother, with her infant care,
The child in wild affright—
Forth went they all—a pallid band,
With many an anguish'd start:
The chain lay heavy on their hand,
But heavier on their heart!

No sounds disturb'd the desert air,
But those of bitter woe,
Save when at times re-echoed there
The curses of the foe.
When hark! another cry peal'd out—
A cry of idiot glee,
Answer'd and heighten'd by the shout
Of the fierce soldiery.

'Twas childhood's voice—but ah! how wild,
How demon-like its swell!
The mother shriek'd to hear her child
Give forth that soulless yell!
And fathers wrung their fetter'd hands,
Beneath this maddening woe;
While shouted out those infant bands,
The chorus of the foe!

And curses deep and low were said,
Whose murmur reach'd to heaven;
And sighs were heaved and tears were shed,
And woman-hearts were riven;
While all forgetful of their woes,
The children onward trod,
And sang *—and their young voices rose
A vengeance-cry to God!

* It is said that the Russians intoxicated the children of the condemned Poles, in order that they might sing while on their way to the mines.

DRAMATIC SCENES.*

THE TRIAL OF THE MACEDONIAN PRINCES.

Perseus, the eldest son of Philip, the last King of Macedon, having for a considerable time seen with extreme indignation the regard which the Macedonians entertained for his brother Demetrius, took the most culpable means to gain over to his side as many chiefs of the nation as he possibly could, who formed the determination of taking the earliest opportunity of ruining him in the opinion of his father, or of even taking his life. As was the custom, after a certain annual festival the army was reviewed, and a sham fight took place. On this occasion the army was divided into two parts, one of which was commanded by Perseus, and the other by Demetrius; and, although the troops fought with foils, they entered so much into the spirit of the engagement as to cause bloodshed. Demetrius's party had the advantage, which increased the hatred of his brother, and made him more intent than ever on his destruction. After the battle the two princes gave a grand entertainment, and Perseus was invited by his brother to his banquet; he, however, refused to go, but sent a spy, whose object being known, was treated rather roughly by some of Demetrius's party, but entirely without the knowledge of Demetrius. Demetrius, wishing to conciliate his brother, proposed to his friends to visit him; they all agreed, but those who had ill-treated the spy, took with them, privately, arms to defend themselves if attacked, as they expected they might be. This being told to Perseus, he refused their admittance, under the pretence that he feared assassination, and the next day went to Philip, and accused his brother of endeavouring to take his life. Philip immediately ordered Demetrius to appear before him to answer the charge; the accusation and defence form the groundwork of the following dramatic scene.

CHARACTERS.

PHILIP, King of Macedon.
PERSEUS, his elder son.
DEMETRIUS, his younger son,
DYMAS, the King's favourite.
PERICLES, the friend of Perseus.
ANTIGONUS, a minister of state.

* In the Dramatic Scenes, the Orations, Impassioned and Comic Pieces intended for Recitation; those words which are Emphatic are printed in italics, while those which require decidedly a very *full* emphasis are printed in CAPITALS.

The King appears seated. Dymas stands by the side of the King. The King's manner is naturally most *dignified*, but his peculiar position, in being the judge between his sons, requires the tone of voice to be most *solemn*, and *expressive* of the feelings which must necessarily *harass* and *distress* his mind.

KING. Bring forth the prisoners.
Strange trial this! Here sit I to debate,
Which vital limb to lop, nor that to save,
But render wretched life more wretched still.
What see I, but *heaven's vengeance* in my SONS?
THEIR guilty scourge for MINE. 'Tis thus heav'n writes
Its awful meaning, plain in *human deeds*.
And *language* leaves to *man*.

Enter PERSEUS and DEMETRIUS *in chains, from opposite sides:* Perseus *followed by* Pericles, *and* Demetrius *by* Antigonus.

DYMAS. *Dread Sir, your sons.
KING. †I have no sons, and that I *ever* had
Is now my HEAVIEST CURSE. And yet, what *care*,
What *pains*, I took to curb their rising rage!
How often have I rang'd through history
To find examples for their private use?
The *Theban* brothers did I set before them—
What blood! what desolation! but—in vain!
For *thee*, Demetrius, did I go to ROME
And bring thee patterns thence of brothers' love;
The *Quintii* and the *Scipios*. But in vain!
If I'm a *monarch*, where is your *obedience?*
If I'm a *father*, where's your *duty* to me?
If *old*, your *veneration* due to years?
But I have wept, and you have sworn, in vain!
I had your *ear*, and enmity your *heart*.
How was this morning's counsel thrown away!
How happy is your mother in the grave!
She, when she bore you, suffered less. Her pangs,
Her pungent pangs throb thro' the father's heart.
DEM. ‡You can't condemn me, Sir, to *worse* than this.
KING. §Than what, thou young deceiver? While I live,

* In the most respectful manner.
† With *intense* feeling.
‡ Much affected.
§ In a *severe* tone.

You both with impious wishes grasp my sceptre:
Nothing is sacred, nothing dear, but EMPIRE;
Brother, nor *father*, can you bear: fierce lust
Of EMPIRE burns, extinguish'd all beside.
Why pant you for it? To give others awe?
Be therefore aw'd yourselves, and *tremble* at it,
While in a father's hand.

DYMAS. My lord, your warmth
Defers the business.

KING. *Am I then *too* warm?
They that should shelter me from ev'ry blast,
To be *themselves* the storm. O! how ROME triumphs!
Oh! how they bring this hoary head to shame!
Conquest and fame, the labour of my life,
Now turn against me, and call in the world
To gaze at what *was Philip*, but who now
Wants ev'n the *wretch's privilege*—a WISH.
What can I wish? *Demetrius* may be guiltless.
What then is *Perseus?* Judgment hangs as yet
Doubtful o'er them; but I'm condemn'd already,
For both are mine;
Should these two hands wage war (these hands less dear!)
What boots it which prevails? In both I bleed.
But I have done. *Speak*, Perseus, and at large,
You'll have no second hearing. *Thou* forbear.†

PERSEUS. ‡Speak!—'Twas with utmost struggle I forbore.
These chains were scarce designed to reach my tongue:
Their trespass is sufficient, stopping *here*.
These chains!§ for what? Are chains for innocence?
Not so; for, see, *Demetrius* wears them too.

* Relaxing into a *milder* tone, with *much feeling*.

† To *Demetrius*.

‡ Perseus is a great villain and a consummate hypocrite, and has been long aiming at the life of his brother. His manners are plausible, but his defence breathes an expression of defiance. His hypocrisy should be rendered evident by the speaker, although it be apparently concealed by the garb of honesty.

§ He here shows his arms.

Fool that I was, to tremble at vain laws,
Nor learn from *him* defiance of their frown;
Since *innocence* and *guilt* are us'd alike;
Blood-thirsty stabbers, and their destin'd prey;
PERSEUS, and HE*—I will not call him *brother*,
He wants not *that* enhancement of his guilt.

KING. But closer to the point; and lay before us
Your whole deportment this ill-fated day.

PERSEUS. Scarce was he cool from that embrace this morning,
Which *you* injoined, and *I* sincerely gave;
Nor thought he plann'd my death within my arms,
When holding vile, *oaths, honour, duty, love,*
He fir'd our friendly sports to martial rage.
If war, why not *fair* war? But THAT has danger.
From hostile conflict, as from brother's play,
He blushed not to invite me to his banquet.
I went not; and in that was I to blame?
Think you, there nothing had been found but peace,
From whence, soon after, salli'd armed men?
Think you, I nothing had to fear from swords,
When from their *foils* I scarce escaped with life?
Or poison might *his* valour suit as well.——
This pass'd, as suits his wisdom, Macedonians!
Who volts o'er *elder* brothers to a throne;
With an armed rout, he came to visit me,
Did I refuse to go, a *bidden guest?*
And should I welcome him, a *threat'ning foe?*
Resenting my refusal; *boiling* for REVENGE!

DEM. †'Tis FALSE.

ANT. ‡Forbear——The King.

PERSEUS. Had I receiv'd them,
You now had mourn'd my *death*, not heard my *cause*.
Dares he deny he brought an armed throng?
Call those I name; who dare this deed, dare all;
Yet will not dare deny that *this* is *true*.
My death alone can yield a stronger proof;
Will no less proof than *that* content a FATHER?

* Pointing at *Demetrius*.
† Most energetically.
‡ In a low tone.

PER. *Perseus*, you see, has art, as well as fire;
Nor have the wars worn *Athens* from his tongue.
PERSEUS. Let him, who seeks to bathe in *brother's* BLOOD,
Not find well pleas'd the fountain whence it flow'd:
Let him, who shudders at a *brother's* KNIFE,
Find refuge in the bosom of a FATHER.
For *where* else can I fly? *whom* else implore?
I have no ROMANS, with their eagles' wings,
To shelter ME; DEMETRIUS borrows those,
To mount full rebel-high: I have their *hatred*
And, thanks to heav'n! DESERVE it: Good *Demetrius*
Can see your towns and kingdoms torn away
By these PROTECTORS, and ne'er lose his temper.
My weakness! I confess, it makes me rave;
It makes me weep, and *my* tears rarely flow.
PER. Was ever stronger proof of filial love?
PERSEUS. Vain are ROME'S *hopes*, while YOU and I survive:
But should the sword take ME, and age my FATHER,
(Heav'n grant they *leave* him to the stroke of age!)
The *kingdom* and the *King* are both their own;
A *duteous, loyal* king, a *sceptred* SLAVE,
A willing *Macedonian* slave to ROME.
KING. First let an earthquake swallow Macedonia.
PERSEUS. How, at such news, would HANNIBAL rejoice?
How the great shade of Alexander smile?
The thought quite chokes me up: I can no more.
KING. Proceed!
PERSEUS. No, Sir——Why have I spoke at all?
'Twas needless: PHILIP justifies my charge,
Philip's the single witness which I call,
To prove *Demetrius* GUILTY.
KING. What dost mean?
PERSEUS. *What mean I, Sir! what mean I!——To run mad;
For who, unshaken both in heart and brain,
Can recollect it!
KING. What?

* In a *hurried* tone and manner.

PERSEUS. This morning's *insult.*
This morning they proclaimed HIM *Philip's* KING.
This morning they forgave YOU for HIS sake.
O pardon, pardon!——I could strike him dead.
KING. More temper.
PERSEUS. Not more truth, that cannot be!
And that it cannot, one proof can't escape you;
For what but truth could make me, Sir, so bold?
Rome puts forth all her strength to crown her *minion;*
Demetrius' vices, thriving of themselves,
Her fulsome flatt'ries dung to ranker growth.
Demetrius is the burden of her song;
Each river, hill, and dale, has learnt HIS name;
While elder *Perseus* in a whisper dies.
DEMETRIUS treats, DEMETRIUS gives us peace;
Demetrius is our GOD, and *would* be so——
My sight is short: Look on him you that can:
What* sage experience sits upon his brow,
What awful marks of wisdom, who vouchsafes
To patronize a *Father,* and a *King?*
Such patronage is TREASON.
KING. TREASON!† DEATH!
PERSEUS. Nor let the ties of blood bind up the hands
Of justice; Nature's ties are broke already:
For who contend before you?—Your two sons?—
No; read aright; 'tis MACEDON and ROME.
A *well-mask'd foreigner,* and your—ONLY SON,
Guard of your LIFE, and—*exile* of your LOVE.
Now, bear me to my dungeon: What so fit
As darkness, chains, and death, for such a traitor?
KING. Speak, Demetrius.
ANT. My lord, he cannot speak; accept his tears—
Instead of words.
PERSEUS. His tears as false as they.—
Now, with fine phrase, and *foppery* of tongue,
More *graceful* action, and a *smoother* tone,
That orator of fable, and fair face,

* This sentence should be given in a *sneering, sarcastic* manner.
† With much *vehemence.*

Will steal on your bribed hearts, and, as you listen,
Plain truth, and I, *plain Perseus*, are forgot.
DEM.* My FATHER! KING! and JUDGE! *thrice awful* power!
Your SON, your SUBJECT, and your PRISONER, hear.
Thrice humble state! If I have grace of speech,
(Which gives, it seems, offence) be that no crime,
Which oft has serv'd my country, and my king:
Nor in my brother let it pass for virtue,
That, as he is, ungracious he would seem:
For, oh! he wants not *art*, tho' *grace* may fail him.
The wonted aids of those that are accus'd,
Has my accuser seiz'd. He shed *false* tears,
That my *true* sorrows might suspected flow:
He seeks *my life*, and calls *me* MURDERER;
And vows no refuge can *he* find on earth,
That *I* may want it in a *father's* arms;
Those arms to which e'en *strangers* fly for safety.
KING.† Speak to your charge.
DEM He charges me with treason;
If I'm a TRAITOR, if I league with ROME,
Why did his zeal forbear me till this hour?
Was treason then no crime, till (as he feigns)
I sought his *life?* Dares *Perseus* hold, so much,
His *father's* welfare cheaper than *his own?*
Less cause have I, a brother, to complain.
He says, I wade for Empire thro' *his blood:*
He says, I place my confidence in ROME:
Why murder *him*, if ROME will crown my brow?
Will then a sceptre, dipt in brother's blood,
Conciliate love, and make my reign secure?
False are both charges, and he proves them false,
By placing them together.
ANT. That's well urg'd.
DEM. Mark, Sir, how *Perseus*, unawares, absolves me
From guilt in all, by loading all with guilt.

* Demetrius is a very amiable prince, and has been much persecuted by his brother. His tone of voice is *mild* and *plaintive*, although *earnest;* and as he proceeds in his defence, he has frequently much difficulty in suppressing his feelings.

† *Sternly.*

Did I design him poison at my *feast*,
Why then did I provoke him in the *field*,
That, as he did, he might refuse to come?
When angry he refus'd, I should have sooth'd
His rous'd resentment, and deferr'd the blow;
Not *destin'd* him that moment to my sword,
Which I before instructed him to *shun*.
Thro' fear of death, did he decline *my* banquet,
Could I expect admittance then at *his?*
These numerous pleas at variance, overthrow
Each other, and are advocates for ME.

PERSEUS. No, Sir, *Posthumius* is *his* advocate.

KING.* Art thou afraid that I should hear him out?

DEM. Quit, then, this picture, this well painted fear,
And come to that, which touches him indeed:
Why is *Demetrius* not despis'd of all,
His second in endowments, as in birth?
How dare *I* draw the thoughts of MACEDON?
How dare I gain esteem with FOREIGN POWERS?
Esteem, when gain'd, how *dare I* to PRESERVE?
These are his secret thoughts; *these* burn within;
These sting up accusations in his soul,
Turn friendly visits to foul fraud, and murder;
And pour in poison to the bowl of love.
MERIT is TREASON in a *younger* brother.

KING. But clear your conduct with regard to *Rome*.

DEM. Alas! dread Sir, I grieve to find set down
Among my *crimes*, what ought to be my PRAISE.
That I went hostage, or ambassador,
Was PHILIP'S high command, not MY request:
Indeed, when there, in both those characters,
I bore in mind to whom I owe my birth:
Rome's favour follow'd. If *it is* a crime
To be regarded, spare a crime *you* caus'd;
Caus'd by *your* orders, and example too.
True, I'm *Rome's* friend, while *Rome* is your *ally*:
When not, *this hostage, this ambassador*,
So dear, stands forth the FIERCEST *of her* FOES;
At your command, flies swift on wings of fire,
The native thunder of a father's arm.

* The King here becomes apparently biassed towards *Demetrius*.

ANT. There spoke, at once, the Hero, and the Son.
DEM. To close—To thee,* I grant, some thanks are due;
Not for thy *kindness*, but *malignity:*
Thy *character's* my friend, tho' THOU my foe:
For, say, whose temper promises most guilt?
Perseus, importunate, demands my death:
I do not ask for HIS: Ah! no; I feel
Too pow'rful nature pleading for him HERE:
But, were there no fraternal tie to bind me,
A son of *Philip* must be dear to me.
If *you*, my FATHER, had been angry with me,
An ELDER *brother*, a less AWFUL *parent*,
HE should assuage you, HE should intercede,
Soften my *failings*, and *indulge* my *youth:*
But my asylum drops its character;
I find not there my *rescue*, but my *ruin*.
PERSEUS.† His bold assurance——
KING. Do not interrupt him;
But let thy brother finish his defence.
DEM.‡ O *Perseus!* how I tremble as I speak!
Where is a *brother's* voice, a *brother's* eye?
Where is the melting of a *brother's* HEART?
Where is our *awful father's dread command?*
Where a DEAR, DYING MOTHER'S last request?
FORGOT, SCORN'D, HATED, TRODDEN under foot!
Thy heart, how *dead* to ev'ry call of nature!
UNSON'D! UNBROTHER'D! nay, UNHUMANIZ'D!
Far from affection, as thou'rt near in blood!
Oh! *Perseus! Perseus!*—But my heart's too full.§
KING. Support him.
PERSEUS.‖ Vengeance overtakes his crimes.
KING. No more!
ANT.** See, from his hoary brow he wipes the dew,
Which agony wrings from him.
KING.†† Oh! my friend,
These boys at strife, like Ætna's struggling flames,
Convulsions cause, and make a mountain shake;

* To *Perseus*.
‡ *Exceedingly* affected.
‖ In a *malicious* tone.
† With a *contemptuous sneer*.
§ He here falls on Antigonus.
** In reference to the King.
†† Turning to Dymas with much *internal emotion*.

Shake *Philip's* firmness, and convulse his *heart*,
And, with a fiery flood of civil war,
Threaten to deluge my divided land.
I've heard them both; by neither am convinc'd:
And yet *Demetrius'* words went thro' my HEART.—
A *double* crime, *Demetrius*, is *your* charge;
Fondness for *Rome*, and *hatred* to your *brother*.
If you can clear your innocence in one,
'Twill give us cause to think you wrong'd in both.

DEM.* How shall I clear it, Sir?

KING. This honest man
Detests the Romans. If you wed his daughter,
Rome's *foe* becomes the guardian of your faith.

DEM. I told you, Sir, when I return'd from *Rome*—

KING.† How!—Dost thou want an *absolute command?*
Your BROTHER, FATHER, COUNTRY, ALL exact it.

ANT.‡ See yonder guards at hand, if you refuse;
Nay, more, a father, *so* distress'd, demands
A son's compassion, to becalm his heart.
Oh! Sir, comply.

DEM.§ There! there! indeed you touch me;
Besides, if I'm *confin'd*, and *Perseus* FREE,
I never, never, shall behold *her* more,———
Pardon, ye gods! an artifice forc'd on me.
Dread Sir, your Son complies.‖

DYMAS. Astonishment!

KING. Strike off his chains. Nay, *Perseus*, too, is free:
They wear no bonds but those of duty, now.
Dymas, go, thank the prince: He weds your daughter,
And highest honours pay your high desert.

YOUNG'S BROTHERS.

* In the *most anxious* manner. † In a *haughty* manner.
‡ Aside to *Demetrius*. § Aside to *Antigonus*. ‖ To the *King*.

SCENE FROM THE IRON CHEST.

CHARACTERS.

SIR EDWARD MORTIMER.
WILFORD.

Sir Edward Mortimer is represented by the dramatist as a man universally respected and loved for his virtues, and particularly for his kindness to the poor and distressed. He had, however, received such extremely cruel and brutal treatment from a neighbouring gentleman, that he openly avowed his determination to send him a challenge. The gentleman was soon after found murdered in the high road. Sir Edward was charged with the murder; he was tried and acquitted, and generally considered innocent, although he had actually perpetrated the horrid deed. The bloody dagger with which the murder had been effected, together with other proofs, he kept in an *iron chest* in his library. Conscious of his guilt, he was always apprehensive lest it might be discovered, and consequently led a life of the most horrid anxiety. Wilford, an orphan youth, whom he had taken under his protection, and made his amanuensis, having heard something of the circumstance, takes an opportunity of looking into the chest, and there discovers the dagger. Sir Edward enters the room while he is looking at it, and, in a transport of fury, seizes a pistol with the intention of shooting him, but which, after a violent struggle of mind, he throws from him. Sir Edward was, through the arrival of his brother at that moment, diverted from the affair; he, however, shortly after desired Wilford to wait his presence in the library, when the following dialogue is supposed to have taken place.

The above explanation will afford the speaker an idea of the feelings with which both Sir Edward and Wilford may be supposed to be agitated. Sir Edward is racked with mistrust and apprehension, and the most horrid feelings that a mind, naturally noble and honourable, may be supposed to possess. Wilford's manner is modest and submissive, evincing an excellent disposition, with a grateful remembrance of Sir Edward's kindness.

SIR E. Wilford! Is no one in the picture-gallery?
WILF. No—not a soul, Sir;—not a human soul:—
None within hearing, if I were to bawl
Ever so loud.
SIR E. Lock* yonder door.
WILF. The door,† Sir!
SIR E. Do as I bid you.
WILF. What, Sir? lock‡——
[*Sir Edward waves with his hand.*]
I shall, Sir. [*Going to the door, and locking it.*]

* *Mysterious* manner. † *Surprise* mingled with *alarm.*
‡ *Hesitating.*

SIR E. Wilford, approach me.—What am I to say
For aiming at your *life?*—Do you not *scorn* me,
Despise me for it?
WILF. I! Oh, Sir!———
SIR E. You *must;*
For I am singled from the herd of men,
A *vile, heart-broken* wretch!
WILF. *Indeed,** *indeed,* Sir,
You deeply wrong yourself. Your equal's love,
The poor man's prayer, the orphan's tear of gratitude,
All follow you:—and *I!—I* owe you ALL!
I am *most* bound to bless you.
SIR E. Mark me, Wilford:——
I know the value of the *orphan's tear;*
The *poor man's prayer;* respect from the *respected;*
I *feel* to *merit* these, and to *obtain* them,
Is to taste, here below, that thrilling cordial
Which the remunerating angel draws
From the eternal fountain of delight,
To pour on blessed souls that enter Heaven.
I FEEL this:—I!—How must my nature, then,
Revolt at *him* who seeks to stain his hand
In *human blood?*—and yet, it seems, *this* day
I sought *your* life.—Oh! I have suffer'd madness!
None know my tortures,—pangs!—but I can end them;
End them as far as appertains to *thee.*———
I have resolv'd it.—Hell-born struggles tear me:
But I have ponder'd on't,—and I *must* trust thee.
WILF. Your confidence shall not be——
SIR E. You must SWEAR.
WILF. *Swear,* Sir!—will nothing but an *oath,* then——
SIR E. Listen.
May† all the ills that wait on frail humanity
Be *doubled* on your head, if you disclose
My fatal secret! May your body turn
Most *lazar*-like and *loathsome;* and your mind
More loathsome than your body! May those fiends,
Who strangle babes, for very wantonness,

* Most *emphatic* manner.

† This imprecation requires the most *earnest* delivery, with the greatest degree of *solemnity.*

Shrink back, and shudder at your monstrous crimes,
And, shrinking, *curse* you! *Palsies* strike your *youth!*
And the *sharp terrors* of a *guilty* mind
Poison your *aged days;* while all your *nights,*
As on the earth you lay your *houseless* head,
OUT-HORROR HORROR! May you quit the world
Abhorr'd, self-hated, hopeless for the next,
Your *life* a *burden,* and your *death* a *fear!*

WILF. *For mercy's sake, forbear! you terrify me!

SIR E. Hope THIS may fall upon thee:——SWEAR thou *hopest* it,
By every attribute which *heaven, earth, hell,*
Can lend, to bind, and strengthen conjuration,
If thou betray'st me.

WILF. Well, I—— [*Hesitating*]

SIR E. No retreating!

WILF. [*After a pause.*] I swear by all the ties that bind a man,
Divine or human,——*never to divulge!*

SIR E. Remember, you have sought this secret:—Yes, *Extorted* it. I have not *thrust* it on you.
'Tis big with danger to you; and to *me,*
While I prepare to speak, *torment unutterable.*
Know, Wilford, that——†Confusion!

WILF. Dearest sir!
Collect yourself. This shakes you horribly:
You had this trembling, it is scarce a week,
At Madame Helen's.

SIR E. There it is——Her uncle——

WILF. ‡Her *uncle!*

SIR E. HIM. *She* knows it not;—None know it,—*You* are the first ordained to hear me say,
I am——§HIS MURDERER.

WILF. O Heaven!

SIR E. His ASSASSIN.

WILF. What, you that—mur—the murder——I am choked!

* With the greatest degree of *alarm.*
† Sir Edward is here apparently convulsed by his feelings.
‡ *Surprize* and *alarm.* § The greatest degree of *horror.*

SIR E. Honour, thou blood-stain'd god! at whose red altar
Sit War and Homicide: O! to what *madness*
Will insult drive thy votaries! By Heaven!
In the world's range, there does not breathe a man
Whose brutal nature I more strove to soothe,
With long forbearance, kindness, courtesy,
Than *his* who fell by me. But he *disgraced* me,
Stain'd me,—oh, death, and shame! the world look'd on
And saw this *SINEWY SAVAGE *strike me down;*
Rain blows upon me, *drag me to and fro,*
On the base earth, like carrion. Desperation,
In every fibre of my frame, cried *vengeance!*
I left the room, which he had quitted: Chance,
(Curse on the chance!) while boiling with my wrongs,
Thrust me against him, darkling, in the street:——
I stabb'd him to the heart:——And my oppressor
Roll'd, lifeless, at my foot.

WILF. Oh! mercy on me!
How could this deed be cover'd?

SIR E. Would you think it?
E'en at the moment when I gave the blow,
Butcher'd a *fellow-creature* in the *dark,*
I had all good men's *love.* But my disgrace,
And my opponent's death, thus link'd with it,
Demanded notice of the magistracy.
They summon'd me, as friend would summon friend,
To acts of import, and communication.
We met: and 'twas resolv'd, to stifle rumor,
To put me on my trial. No accuser,
No evidence appear'd, to urge it on:——
'Twas meant to clear my fame.——How clear it then?
How cover it?—you say.—Why, by a LIE:—
Guilt's offspring, and its *guard.* I taught this breast,
Which truth once made her throne, to *forge* a LIE:
This tongue to *utter* it;—rounded a tale,
Smooth as a seraph's song from Satan's mouth;
So well compacted, that the o'erthrong'd court

* The recollection of the insults he received almost overpowers him.

Disturb'd cool Justice in her judgment-seat,
By shouting "*Innocence!*" ere I had finish'd,
The court enlarged me; and the giddy rabble
Bore me, in triumph, home. Ay!—look upon me.—
I know thy sight aches at me.

WILF. Heaven forgive me! It may be wrong, but *Indeed* I *pity* you.

SIR E. I disdain* all pity.—
I ask no consolation. Idle boy!
Think'st thou that this compulsive confidence
Was given to move thy *pity?*—Love of fame
(For still I cling to it) has urg'd me, thus,
To quash thy curious mischief in its birth.
Hurt honor, in an evil, *cursed* hour,
Drove me to MURDER;—LYING;—'twould again.
My honesty,—sweet peace of mind,—*all, all,*
Are barter'd for a NAME. I will maintain it.
Should slander whisper o'er my sepulchre,
And my soul's agency survive in death,
I could embody it with heaven's lightning,
And the hot shaft of my insulted spirit
Should strike the blaster of my memory
Dead, in the churchyard. Boy, I *would* not *kill* thee;
Thy rashness and discernment threaten'd danger!
To check them there was no way left but this——
Save one:—*your death:*—you shall not be my *victim.*

WILF. My *death!* What, take my *life?*—My *life!* to prop
This empty honour.

SIR E. Empty? †Grovelling fool!

WILF. I am your servant, Sir: child of your bounty,
And know my obligation. I have been
Too curious, haply: 'tis the fault of youth,
I ne'er *meant* injury: if it would serve you,
I would lay down my *life;* I'd *give* it *freely:*
Could you, then, have the heart to *rob* me of it:
You *could* not;—*should* not.

SIR E. How!

WILF. You *dare* not.

* Strong expression of *disdain.* † Most *contemptuous* manner.

SIR E. *Dare* not!
WILF. Some hours ago you durst not. Passion moved you,
Reflection interposed, and held your arm.
But, should reflection prompt you to attempt it,
My innocence would give me strength to struggle,
And wrest the murderous weapon from your hand.
How would you look to find a peasant boy
Return the knife you levell'd at his heart;
And ask you which in heaven would show the best,
A *rich* man's HONOUR, or a *poor* man's HONESTY?
SIR E. 'Tis plain I dare not take your life. To spare it,
I've endangered mine. But dread my power;
You know not its extent. Be warned in time;
Trifle not with my feelings. Listen, Sir!
Myriads of engines, which my secret working
Can rouse to action, now encircle you.
Your ruin hangs upon a *thread:* provoke me,
And it shall fall upon you. Dare to make
The *slightest* movement to awake my fears,
And the gaunt criminal, naked, and stake-tied,
Left on the heath, to blister in the sun,
Till lingering death shall end his agony,
Compared to thee, shall seem more enviable
Than cherubs to the damn'd.
WILF. O, misery!
Discard me, Sir! I must be hateful to you.
Banish me hence. I will be mute as death;
But let me quit your service.
SIR E. *Never.*——Fool!
To buy this secret, you have sold yourself.
Your *movements, eyes,* and, most of all, your *breath,*
From this time forth are fetter'd to *my will.*

COLMAN.

THE BANISHMENT OF CATILINE.

"About the 688th year of Rome, Catiline, a man of noble family, who had been prætor in Africa, canvassed for the consulship. His claim was set aside, on the ground that some charges relative to his late employment had not been cleared up. This he asserted to be a pretext, and occupied himself in forming a party. It was rumoured that his cabal entertained designs against the state. The pride of the senate gave way to their fears, and at the next election Cicero was chosen consul. Catiline canvassed a third time, and was again defeated, directly in consequence of Cicero's coming to the election in armour, and declaring that he wore it through fear of assassination. Hopeless of legitimate success, he now plunged into revolt, answered the menaces of the senate by open defiance, and set the republic on the chance of a single battle."*

CHARACTERS.

CICERO.	CATILINE.
CETHEGUS.	A CONSUL.
SENATORS.	LICTORS, OFFICERS, PRISONERS.

SCENE—THE SENATE-HOUSE.

The Senate are assembled. A Consul in the chair. CICERO *on the floor concluding his speech. The time supposed to be night.*

CIC. Our† long debate must close. Take one proof more
Of this rebellion.——Lucius Catiline
Has been commanded to attend the senate.
He *dares* not come. I now demand your votes,—
Is he condemned to exile?

[CATILINE *enters hastily, and takes a seat.*]

Here‡ I repeat the charge, to gods and men,
Of treasons manifold;—that but this day,
He has received despatches from the rebels—
That he has leagued with deputies from Gaul
To seize the province; nay, has levied troops,
And raised his rebel standard;—that but now

* Preface to Catiline.
† Cicero's manner and utterance are *earnest* and *firm*.
‡ Cicero here turns towards Catiline.

A meeting of conspirators was held
Under his roof, with mystic rites and oaths,
Pledged round the body of a murder'd slave.
To these he has *no* answer.

CAT. [*Rising calmly.*] Conscript Fathers!
I do not rise to waste the night in words:
Let* that *plebeian* talk, 'tis not *my* trade;
But *here* I stand for RIGHT. Let *him* show *proofs*;—
For ROMAN *right*; though none it seems dare stand
To take their share with me. Ay, cluster, there,
Cling to your master; *judges*†—*Romans*—SLAVES!
His charge is false;—I *dare* him to his *proofs*;
You have my answer now! I must be gone.

CIC. Bring back the helmet of this Gaulish‡ king;
[*Enter Lictors with a helmet and axe.*]
These, as I told you, were this evening seized
Within his house. You§ know them, Catiline?

CAT. The|| axe and helmet of the Allobroges! (*aside*)
Know¶ them! What crimination's there? what tongue
Lives in that helm to charge me? Cicero—
Go search my house, you may find twenty such,
All fairly struck from brows of barbarous kings,
When *you* and *yours* were plotting here in ROME.
I say, go search my house. And is this all?
I scorn to tell you by what chance they came.
Where have *I* levied troops—tamper'd with *slaves*—
Bribed *fool* or *villain*, to embark his neck
In this rebellion? Let my actions speak.

CIC. Deeds shall convince you! Has** the traitor done?

CAT. But this I will avow, that I have scorn'd,
And still *do* scorn, to hide my sense of wrong:
Who brands me on the forehead, breaks my sword,
Or lays the bloody scourge upon my back,

* Most *haughty* and *disdainful* manner.

† This requires a *protracted* utterance, with the strongest expression of *scorn*.

‡ This refers to Catiline; the helmet and axe were the kingly emblems he had received from the Allobroges in token of their submission to him.

§ With a significant tone and manner. || With apparent alarm.

¶ Resumes his *self-possession*.

** Most *dignified* manner, with a *severe* tone and look.

Can wrong me *half* as much as he who shuts
The gates of *honour* on me,—turning out
The *Roman* from his *birthright;* and for what?—
[*Looking round him.*]
To fling your offices to every slave:——
*Vipers** that *creep* where *man* disdains to *climb;*
And having wound their loathsome track to the top
Of this huge mouldering monument of Rome,
Hang hissing at the noble man below.

CIC. This is his answer! Must I bring more proofs?
Fathers, you know there lives not one of us
But lives in peril of his midnight sword.
Lists of proscription have been handed round,
In which your general properties are made
Your *murderer's hire.*
†Bring in the prisoners.
[*The Lictors return with Cethegus and others.*]

CAT. Cethegus!‡ (*aside.*)

CIC. Fathers! those stains to their high name and blood,
Came to my house to murder me; and came
Suborned by *him.*

CAT. [*Scornfully.*] Cethegus!
Did *you* say this?

CETH. §Not I. I went to kill
A prating, proud plebeian, whom those fools
Palm'd on the consulship.

CIC. And sent by whom?

CETH. By none.—By nothing but my zeal to purge
The senate of yourself, most ‖ *learned* Cicero!
[*An officer enters with letters for* CICERO; *other prisoners are also introduced chained.*

CIC. Fathers of Rome! If man can be convinced
By proof as clear as daylight, there it stands!
[*Pointing to the prisoners.*]
Those men have been arrested at the gates,
Bearing despatches to raise war in Gaul.

* Most *emphatic* and *disdainful* manner.
† In a tone of *command.* ‡ *Alarmed.*
§ *Careless* and *insolent* tone and manner.
‖ The tone of *irony* must here be observed, with the greatest degree of *mock respect.*

Look on these letters! Here's a deep laid plot
To wreck the province; a solemn league,
Made with all form and circumstance. *The time
Is desperate,——all the slaves are up;—Rome shakes!
The heavens alone can tell how near our graves
We stand ev'n *here!*—The name of *Catiline*
Is foremost in the league. He was their KING.
Tried† and convicted traitor, go from Rome!

CAT. ‡Come, consecrated lictors! from your thrones;
[*To the Senate.*]
Fling down your sceptres:—take the rod and axe,
And make the murder as you make the law.

CIC. Give up the record of his banishment.
[*To an officer.*]
[*The officer gives it to the Consul.*]

CAT. §Banish'd from Rome! What's banish'd but set
From daily contact of the things I loathe? [free
'*Tried* and *convicted traitor!*' ‖*Who* says this?
Who'll prove it at his peril, on my head?
Banish'd?—¶I thank you for't. It breaks my chains!
I held some slack allegiance till this hour—
But *now* my sword's my own. Smile on, my lords;
I *scorn* to count what *feelings, wither'd hopes,*
Strong provocations; bitter, burning wrongs,
I have within my **heart's hot cells shut up,
To leave you in your lazy dignities.
††But here I stand and *scoff* you: here I fling
Hatred and *full defiance* in your face.
‡‡Your Consul's merciful.—For this all thanks.
He *dares* not touch a *hair* of Catiline.

(*The* CONSUL *reads.*) "Lucius Sergius Catiline; by the decree of the Senate, you are declared an enemy and an alien to the State, and banished from the territory of the commonwealth."

* Increased *animation*.

† *Authoritative command* requiring a particularly *stern* air and *forceable* utterance.

‡ Catiline, having seated himself, here rises in the most *haughty* manner.

§ With the strongest *indignation*.

‖ Increased *violence*.

¶ *Sarcastic* tone.

** Suit the action to the word.

†† The language will here fully direct the speaker.

‡‡ Here is a transition to *sarcasm*.

CONSUL. Lictors, drive the traitor from the temple!
CAT. *'Traitor!' I go—but I *return*. This—trial!
Here I devote your Senate! I've had wrongs,
To stir a fever in the blood of age,
Or make the infant's sinew strong as steel.
This day's the birth of sorrows! This hour's work
Will breed proscriptions——Look to your hearths, my lords!
For there henceforth shall sit, for household gods,
Shapes hot from Tartarus!—all shames and crimes;—
Wan Treachery with his thirsty dagger drawn;
Suspicion poisoning the brother's cup;
Naked Rebellion with the torch and axe,
Making his wild sport of your blazing thrones;
Till anarchy comes down on you like night,
And massacre seals Rome's eternal grave!
[*The* SENATORS *rise and cry out,*
Go, enemy and parricide, from Rome!
CAT. †It shall be so!—(*Going. He suddenly returns.*)—When Catiline comes again,
Your grandeur shall be base, and clowns shall sit
In scorn upon those chairs;—Your palaces
Shall see the soldier's revels, and your wealth
Shall go to deck his harlot and his horse.
Then Cicero, and his tools, shall pay me *blood*——
Vengeance for every drop of my boy's veins;—
And such of you as cannot find the grace
To die with swords in your right hands, shall *feel*
The life, life worse than death, of *trampled slaves!*
[*The* SENATORS *cry out,*
Go, enemy and parricide, from Rome!
CIC. Expel him, lictors! Clear the senate house!
[*The Lictors approach him.*]
CAT. I go,—but not to leap the gulf alone:
I go;—but when I come—'twill be the burst
Of ocean in the earthquake—rolling back
In swift—and mountainous ruin. Fare you well!
You build my funeral pile; but your best blood
Shall quench its flame. Back, slaves! [*To the Lictors.*]
I will *return!* [*He rushes out.*] CROLY.

* Catiline here becomes perfectly *furious*, and continues so throughout; the tone of voice is *hurried*, while the eye sparkles with *rage*.
† With the greatest *indignation*.

CATO'S SENATE.

Cato having vainly tried to bring about an agreement between Pompey and Cæsar, sided with the former, and after Pompey's death fled with his party to Utica in Africa. Being pursued by Cæsar, he called his friends together, and advised them to leave him instantly and throw themselves on Cæsar's clemency. They left him accordingly, and Cato, being unwilling to fall into the power of Cæsar, put himself to death with his own hands. The poet here describes Cato deliberating with his senate as to the mode of conduct to be pursued, now they were so hotly pressed by Cæsar.

CHARACTERS.

CATO.	DECIUS.
SEMPRONIUS.	JUNIUS.
LUCIUS.	

Cato seats himself, and the senators take their places around him. Cato's tone and manner are most *grave*, *earnest*, and *dignified* throughout: Sempronius is particularly *animated* and *energetic*; Lucius is *mild* and *persuasive*; Decius is *solemn* and *forcible*; Junius's address is rather *hurried* and *monotonous*.

CATO. FATHERS, we once again are met in council:
CÆSAR'S approach has summon'd us together,
And *Rome* attends her fate from our resolves;
How shall we treat this bold aspiring man?
Success still follows him, and backs his crimes;
Pharsalia gave him ROME, EGYPT has since
Receiv'd his *yoke*, and the whole NILE is CÆSAR'S.
Why should I mention *Juba's* overthrow,
And *Scipio's* death? NUMIDIA'S burning sands
Still smoke with blood. 'Tis time we should decree
What course to take. Our foe *advances* on us,
And envies us even LYBIA'S sultry deserts.
Fathers, pronounce your thoughts: are they still fix'd
To hold it out, and fight it to the *last?*
Or are your hearts subdued at length, and wrought
By time, and *ill* success, to a submission?
SEMPRONIUS, speak.

SEM. My voice is still for WAR.
GODS! can a ROMAN senate long debate
Which of the two to choose, SLAV'RY OR DEATH!

No,* let us rise at once, gird on our swords,
And at the head of our remaining troops,
Attack the foe, break through the thick array
Of his throng'd legions, and charge *home* upon him;
Perhaps† some arm, more lucky than the rest,
May reach his HEART, and free the world from BONDAGE.
Rise,‡ fathers, rise! 'Tis ROME demands your help:
Rise, and revenge her slaughter'd citizens,
Or share their fate! The corpse of half her senate
Manure the fields of Thessaly, while we
Sit here *deliberating*§ in cold debates,
If we should sacrifice our *lives* to HONOUR,
Or wear them out in SERVITUDE and CHAINS.
Rouse up, for shame! our brothers of *Pharsalia*
Point at their wounds, and cry aloud—TO BATTLE!
Great Pompey's shade complains that we are *slow*,
And SCIPIO's ghost walks unreveng'd amongst us.

CATO. Let ‖ not a torrent of impetuous zeal
Transport thee thus beyond the bounds of REASON:
True FORTITUDE is seen in great exploits,
That *justice* warrants, and that *wisdom* guides:
All else is tow'ring frenzy and distraction.
Are not the lives of those who draw the sword
In ROME's defence intrusted to *our* care?
Should we *thus* lead them to a field of *slaughter*,
Might not th' impartial world with reason say,
We lavish'd at our deaths the blood of thousands,
To grace our fall, and make our ruin glorious?—
LUCIUS, we next would know what's your opinion?

LUC. My thoughts, I must confess, are turn'd on PEACE.
Already have our quarrels fill'd the world
With widows, and with orphans. SCYTHIA mourns
Our guilty wars; and earth's remotest regions
Lie half unpeopled by the feuds of ROME.
'Tis time to sheath the sword, and spare mankind.

* This and the three following lines require an increased *rapidity* of utterance.

† Here is a transition to a *deeper* tone, and more *lengthened* utterance.

‡ Much *animation*.

§ This requires a *protracted* utterance; thus *de-li-be-ra-ting*.

‖ Cato's gravity forms a striking contrast with the impetuosity of Sempronius.

It is not CÆSAR, but the GODS, my fathers,
The GODS declare against us, and repel
Our vain attempts. To urge the foe to battle,
(Prompted by blind revenge and wild despair)
Were to refuse th' awards of *providence*,
And not to rest in *Heaven's* determination.
Already have we shown our love to ROME;
Now let us show submission to the GODS.
We took up arms, not to revenge ourselves,
But free the commonwealth: when this end fails,
Arms have no further use. Our COUNTRY's cause,
That drew our swords, now wrests 'em from our hands,
And bids us not delight in ROMAN blood
Unprofitably shed. What men could do,
Is done already: *heav'n* and *earth* will witness,
If ROME must fall, that WE are innocent.

SEM. This smooth discourse, and mild behaviour, oft
Conceal a traitor—something whispers me
All is not right.—Cato, beware of Lucius.
[*Aside to Cato.*]

CATO. Let us appear nor *rash* nor *diffident;*
Immod'rate *valour* swells into a fault;
And *fear* admitted into public councils
Betrays like treason. Let us shun 'em both.—
Fathers, I cannot see that our affairs
Are grown thus desp'rate: we have bulwarks round us:
Within our walls are troops inur'd to toil
In AFRIC's heat, and season'd to the sun;
NUMIDIA's spacious kingdom lies behind us,
Ready to rise at its young prince's call.
While there is hope, do not distrust the GODS;
But wait at least till CÆSAR's near approach
Force us to yield. 'Twill never be too late
To sue for CHAINS, and own a CONQUEROR.
Why should ROME fall a *moment* ere her time?
No, let us draw her term of freedom out
In its full length, and spin it to the *last*,
So shall we gain still *one day's* LIBERTY:
And let me perish, but in CATO's judgment,
A DAY, an HOUR, of *virtuous* LIBERTY,
Is worth a whole ETERNITY in *bondage*.

[*Enter Junius.*]

JUN. Fathers, this moment, as I watch'd the gate,
Lodg'd on my post, a herald is arriv'd
From CÆSAR's camp, and with him comes old DECIUS,
The ROMAN knight; he carries in his looks
Impatience; and demands to speak with CATO.

CATO. By your permission, fathers——bid him enter.
[*Exit Junius.*
DECIUS was once my *friend*, but *other* prospects
Have loos'd those ties, and bound him fast to CÆSAR.
His message may determine our resolves.

[*Enter Decius and Junius.*]

DEC. CÆSAR sends health to CATO.

CATO. Could* he send it
To CATO's *slaughter'd* FRIENDS, it would be welcome.
Are not your orders to address the senate?

DEC. My business is with CATO. CÆSAR sees
The straits to which you're driven; and as he knows
CATO's *high worth*, is anxious for your LIFE.

CATO.† My life is grafted on the fate of ROME.
Would he save CATO? bid him spare his COUNTRY.
Tell your DICTATOR this; and tell him, CATO
Disdains‡ a life which *he* has power to offer.

DEC. ROME and her senators submit to CÆSAR;
Her gen'rals and her consuls are no more,
Who check'd his conquests, and deny'd his triumphs.
Why will not CATO be this CÆSAR's friend?

CATO. These very reasons thou hast urg'd *forbid* it.

DEC. CATO, I have orders to expostulate,
And reason with you, as from friend to friend:
Think§ on the STORM that gathers o'er your head,
And threatens ev'ry hour to *burst* upon it:
Still may you stand high in your *country's* honours;
Do but comply, and make your peace with CÆSAR,
ROME will rejoice, and cast its eyes on CATO,
As on the *second* of mankind.

* Cato here assumes much *sternness* of manner.
† *Enthusiastic* manner.
‡ *Haughtiness* of manner, with an expression of *disdain*.
§ Great *solemnity* of manner.

CATO. No* more!
I *must* not think of life on *such* conditions.
DEC. CÆSAR is well-acquainted with your *virtues*,
And therefore sets this value on your LIFE;
Let him but know the price of CATO's friendship,
And name your terms.
CATO. Bid† him disband his LEGIONS,
Restore the commonwealth to LIBERTY,
Submit his actions to the *public* CENSURE,
And stand the judgment of a ROMAN senate.
Bid him do *this*, and CATO is his FRIEND.
DEC. CATO, the world talks loudly of your *wisdom*.
CATO. Nay, more; tho' CATO's voice was ne'er employ'd
To clear the guilty, and to varnish crimes,
Myself will mount the ROSTRUM in his favour,
And strive to gain his pardon from the people.
DEC. A style like this becomes a CONQUEROR.
CATO. DECIUS, a style like this becomes a ROMAN.
DEC. What is a ROMAN, that is CÆSAR's *foe?*
CATO. *Greater* than CÆSAR: he's a friend to VIRTUE.
DEC. Consider, CATO, you're in UTICA,
And at the head of your own *little* senate:
You don't *now* thunder in the capitol,
With all the mouths of ROME to second you.
CATO. Let *him* consider that, who *drives* us hither.
'Tis CÆSAR's SWORD has made ROME's SENATE *little*,
And thinn'd its ranks. Alas! thy dazzled eye
Beholds this man in a *false glaring* light;
Which CONQUEST and SUCCESS have thrown upon him;
Did'st thou but view him *right*, thoud'st see him *black*
With MURDER, TREASON, SACRILEGE, and CRIMES,
That strike my soul with HORROR but to NAME 'em.
I know thou look'st on *me*, as on a *wretch*
Beset with ills, and cover'd with misfortunes;
But, by the GODS I SWEAR, MILLIONS OF WORLDS
Should *never* buy ME to‡ be like that CÆSAR.

* In an *angry* tone.
† Assumes great *dignity* and *earnestness*, with a tone of *command*.
‡ This requires a protracted utterance; thus, to—be—like—that—Cæsar.

DEC. Does CATO send this answer back to CÆSAR,
For all his gen'rous cares, and proffer'd friendship?
CATO. His cares for me are insolent and vain:
Presumptuous* man! the GODS take care of CATO.
Would CÆSAR show the greatness of his soul,
Bid him employ his care for *these my friends*,
And make good use of his *ill-gotten* pow'r,
By sheltering men much better than *himself*.
DEC. Your high unconquered heart makes you forget
You are a MAN. You rush on your destruction.
But I have *done*. When I relate hereafter
The tale of this unhappy embassy
All ROME will be in tears.

[*Exit* DECIUS *with* JUNIUS.]

SEM. CATO, we thank thee;
The mighty genius of immortal ROME
Speaks in thy voice; thy soul breathes LIBERTY.
CÆSAR will *shrink* to hear the words thou utter'st,
And *shudder* in the midst of all his conquests.
LUC. The senate owns its gratitude to CATO,
Who with so great a soul consults its safety,
And guards *our* lives, while he neglects *his own*.
SEM. Sempronius gives no thanks on this account.
Lucius† seems fond of life; but what is life?
'Tis not to stalk about, and draw fresh air
From time to time, or gaze upon the sun;
'Tis to be FREE. When LIBERTY is gone,
Life grows insipid, and has lost its *relish*.
Oh, could my dying hand but lodge a sword
In CÆSAR's bosom, and *revenge* my COUNTRY!
By heav'ns! I could *enjoy* the pangs of death,
And *smile* in agony.
LUC. Others, perhaps,
May serve their country with as warm a zeal,
Though 'tis not kindled into so much rage.
SEM. This sober conduct is a mighty virtue
In lukewarm patriots.
CATO. Come, no more, Sempronius;
All here are friends to ROME, and to *each other*.

* Most *disdainful* manner. † With a contemptuous *sneer*.

Let us not weaken still the weaker side
By our divisons.
SEM. CATO, my resentments
Are sacrific'd to ROME—I stand reprov'd.
CATO. FATHERS, 'tis time you come to a resolve.
LUC. CATO, we all go into your opinion,
CÆSAR's behaviour has convinc'd the senate
We ought to hold it out till *terms* arrive.
SEM. We ought to hold it out TILL DEATH: but, CATO,
My *private* voice is drown'd amidst the senate's.
CATO. Then let us rise, my friends, and strive to fill
This *little* interval, this *pause* of life
(While yet our *liberty* and *fates* are doubtful)
With *resolution, friendship,* ROMAN *bravery,*
And all the *virtues* we can crowd into it:
That *Heav'n* may say it ought to be prolong'd.
FATHERS, FAREWELL.

ADDISON.

ORATIONS AND IMPASSIONED PIECES.

SPEECH OF LORD CHATHAM AGAINST EMPLOYING THE INDIANS IN THE AMERICAN WAR.*

I *cannot*, my Lords, I *will* not, join in congratulation on *misfortune* and *disgrace*. *This*, my Lords, is a *perilous* and *tremendous* moment. It is not a time for *adulation*: the smoothness of *flattery* cannot save us in *this rugged* and *awful* crisis. It is now necessary to instruct the throne in the language of TRUTH. We must, if possible, dispel the *delusion* and *darkness* which envelope it; and display, in its full *danger* and *genuine colours*, the RUIN which is brought to our *doors*. Can ministers *still presume* to expect *support* in their infatuation? Can parliament be so *dead* to its *dignity* and *duty*, as to give their *support* to measures thus *obtruded* and *forced* upon them? Measures, my Lords, which have reduced this late *flourishing* empire to SCORN and CONTEMPT! "But *yesterday*, and *Britain* might have stood against the *world*: now, *none* so poor as to do her reverence." The people whom we at *first despised* as REBELS, but whom we *now acknowledge* as ENEMIES, are *abetted* against us, supplied with every *military store*; have their *interest* consulted, and their *ambassadors* entertained by *our* INVETERATE ENEMY—and ministers *do* not, and *dare* not, interpose with DIGNITY or EFFECT. The *desperate* state of our army *abroad* is in part known. No man

* This most eloquent and powerful speech particularly demands a *vehemence* of expression, with a *dignity* and *solemnity* of *manner*.

more highly *esteems* and *honours* the British troops than *I* do: I know their *virtues* and their *valour;* I know they can achieve any thing but *impossibilities;* and I know that the *conquest* of British America is an IMPOSSIBILITY. You *cannot,* my Lords, you *cannot* CONQUER America. What is your *present* situation there? We do not know the *worst:* but we know that in three campaigns we have done NOTHING, and suffered MUCH. You may *swell* every *expense, accumulate* every *assistance,* and *extend* your traffic to the shambles of every *German despot:* your attempts will be for ever *vain* and *impotent—doubly* so, indeed, from this *mercenary* aid on which you rely; for it irritates, to an incurable resentment, the minds of your adversaries, to over-run them with the *mercenary* sons of *rapine* and *plunder,* devoting them and their possessions to the *rapacity* of *hireling* cruelty. If I were an *American*—as I am an *Englishman,* while a foreign troop was landed in my country, I *never* would lay down my arms;——NEVER!—NEVER!—NEVER!——

But, my Lords, who is the man, that, in addition to the *disgraces* and *mischiefs* of the war, has dared to authorize and associate to our arms the *tomahawk* and *scalping-knife of the savage?* to call into *civilized* alliance, the *wild* and *inhuman* inhabitant of the woods? to delegate to the *merciless Indian,* the defence of disputed rights, and to wage the horrors of his barbarous war against our BRETHREN? My Lords, these enormities cry aloud for *redress* and *punishment.* But, my Lords, this barbarous measure has been *defended,* not only on the principles of *policy* and *necessity,* but also on those of *morality;* "for it is perfectly allowable," says Lord Suffolk, "to use all the means which *God* and *nature* have put into our hands." I am *astonished,* I am *shocked,* to hear such principles *confessed;* to hear them *avowed* in *this House,* or in *this country.* My Lords, I did not intend to encroach so much on your attention; but I cannot *repress* my indignation——I feel myself *impelled* to speak. My Lords, we are called upon as *members of this house,* as MEN, as CHRISTIANS, to *protest* against such horrible barbarity!—"That *God* and *nature*

have put into our hands!" What ideas of *God* and *nature* that noble Lord may entertain, I know not; but I know, that such *detestable* principles are equally abhorrent to *religion* and *humanity*. What! to attribute the sacred sanction of *God* and *nature*, to the *massacres* of the *Indian scalping-knife!* to the *cannibal savage, torturing, murdering, devouring, drinking the blood* of his *mangled victims!* Such notions *shock* every *precept* of *morality*, every *feeling* of *humanity*, every *sentiment* of *honor*. These *abominable* principles, and this *more abominable avowal* of them, demand the *most decisive indignation*.

I call upon that Right Reverend, and this most Learned Bench, to *vindicate* the *religion* of their GOD, to *support* the *justice* of their COUNTRY. I call upon the Bishops, to interpose the *unsullied sanctity* of their *lawn;*—upon the Judges to interpose the *purity* of their *ermine*, to *save* us from *this pollution*. I call upon the honor of your Lordships to reverence the *dignity* of your ancestors, and to maintain *your own*. I call upon the *spirit* and *humanity* of my country, to *vindicate* the *national character*. I invoke the *genius of the constitution*.———To send forth the *merciless* cannibal, *thirsting* for blood! against *whom?*—our BRETHREN!—to *lay waste* their *country*, to *desolate* their *dwellings*, and *extirpate* their *race* and *name*, by the aid and instrumentality of these HORRIBLE HOUNDS OF WAR!——— Spain can no longer boast *pre-eminence* in *barbarity*. She armed herself with *blood-hounds*, to extirpate the wretched natives of Mexico! We, *more ruthless*, loose these dogs of war against our *countrymen* in America, *endeared* to us by *every tie* that can *sanctify humanity*. I solemnly call upon your Lordships, and upon every order of men in the state, to stamp upon this *infamous* procedure, the *indelible stigma* of *public abhorrence*. More particularly, I call upon the holy prelates of our religion to do away this iniquity; let them perform a lustration, to purify the country from this *deep* and *deadly* sin. My Lords, I am old and weak, and at present unable to say more; but my feelings and indignation were *too strong*, to have said less. I could not have slept this night in my

bed, nor even reposed my head upon my pillow, without giving vent to my *eternal abhorrence* of such ENORMOUS and PREPOSTEROUS principles.

TELL IN PRISON.

*Think ye, vile chains! to curb the soul of TELL?
Dungeons can *never daunt* the PATRIOT'S spirit!
I'd sooner be within these four damp walls,
With *three-fold* fetters on me, with the worm,
That leaves its slimy trace of wretchedness,
For my companion, than the *pampered* wretch
Who, in his gorgeous tyranny above,
Tramples upon a *people's* RIGHTS, and earns
A *people's* CURSES for his *nightly blessing!*
†My BODY is thy prisoner, Gesler! Chains
May *gall* my FLESH—may *manacle* my LIMBS,
And for a time may make me blush to mark
The stains they've left upon them; but my MIND
Can ne'er be soil'd by things like THESE!
The coward *crouches* if the treacherous pard
Doth *look* on him. My spirit will not *crouch*
Nor *quail* before the spotted beast. I feel
There's that within me which doth hold me up,
And prompt me with a *mighty unseen* power
To deeds of *unseen glory*.—I am FREE—
Free in this *prison-house!* I range at will
The mighty bulwarks of our mountain worlds.—
Over beloved Switzerland I go
With my mind's energy!
Think‡ ye the spirit requires corporeal form
To converse with the spirit? Are there not hours,
Hours of pale solitude, when the outer world

* Strong expression of *disdain* with the most *undaunted, courageous* manner.

† The manner continues most *undaunted*, with the highest degree of *enthusiasm*.

‡ Relaxing into a *solemn, contemplating, reflecting* manner, requiring a *slow* utterance.

Is to the inner world a thing as vague
As the obscure and twilight line that bounds
The dim horizon? for the mind can make,
By its own magic powers, worlds fairer far
Than *this* one! [*He pauses.*]
Yea* it *must*, it *must* be so!
A beauteous land is passing now before me,
And there are glorious Alps, whereon the sun,
Oft, in his journey, pauses to look back
Upon the paradise he leaves behind him!
And there are valleys, basking in his beams,
Starred with white cottages, and orange-bowers,
And vine-groves, where the light guitar is swept,
To charm the golden fruitage.—I behold
Lakes blue as morning, where, at eve, the star
Delights to lave its far descending rays,
And ancient forests, giant-like, advancing
With towering strides, up to the high hill tops.
And ever and anon I hear the sounds,
The mighty sounds of avalanches rolling,
The crash of forests and the roar of waters;
But in the vales the maiden's free voice rings,
And on the hills the bold-eyed mountaineer
Looks proudly up to heaven, and children sport
Like swallows on the lea, and ancient sires
Within the trellised porch serenely sit,
And grandams read their missals in the sun,
Which AUSTRIAN† banners *dare* not *now* obscure.
I cannot be mistaken: 'tis my COUNTRY!
O Switzerland! and shall it be a *dream*—
A *wild, imaginative dream? No,‡ no!*
Thou shalt be FREE, thy fetters rive in twain;
The voice of *Prophecy* is on me now!
Back roll the volumy clouds, the mighty mists
That veil the future, roll, at my bidding, back!
Come forth! It comes! the sun of *Freedom* comes
With its refulgent canopy of clouds,

* Animation somewhat increases; the speaker should look forward during the delivery of this *Vision*, with a fixed countenance, as if he *actually* saw what he is describing.

† *Disdain.* ‡ Increased energy.

And in its radiance Switzerland's banners sparkle;
Helvetic swords its beams are multiplying;
Ten thousand stars upon their spear-points tremble:
Ten thousand voices roll their living thunders,
And all cry "LIBERTY!" It is no *dream!*
They shout again, and my own name they shout;
A *Tell,* a *Tell!* they cry. I *come,* I *come!*
Thou shalt be FREE; thy *fetters* rend asunder,
Thus, as I *rend my own.*

WALLACE.

*Cursed** be the fatal day when Edward came,
In crested pride, to urge a lawless claim;
Cursed be the day. Let† weeping History tell
How *fought* the *brave,* and how the *noble fell;*
When, slowly swelling, roll'd the battle-tide
On Falkirk's field of death, and Carron's side.—
The beam of morn, that rose on eastern height,
Danced on the plume of many a gallant knight;
The‡ ray that lingered on the ocean-wave,
Kiss'd the red turf of many a soldier's grave:
Dark as the torrent's desolating flow,
And drear as winter was that time of woe,
Yet droop'd not Hope; *she*§ turn'd her azure eyes
Where, heaven-ward, Caledonia's mountains rise,
And deep embosom'd in the glow of night,
A star was seen to shed a lonely light;
It burn'd afar, with lustre pale and sweet,
To mark the spot of *Freedom's* last retreat.
There,‖ on a rock, *unmov'd* and *undismay'd,*
The sable plumage waving o'er his head,
Stern Wallace stood. With high uplifted hand

* *Firm* and *strong* tone of voice, with a feeling of *anger.*

† Relaxes into a calmer manner, with much *solemnity* and *earnestness.*

‡ *Plaintive* utterance, with a *low* tone.

§ The tone and manner become more *animated* and *cheerful,* with a *calm* and *serene* expression of countenance.

‖ *Firm* and *impressive* manner, in order to reflect the *courageous* deportment of Wallace.

He shook the gleamy terrors of his brand,
Glanc'd proudly on th' embattled host below,
And mock'd the menace of a conquering foe—
And long had mock'd,*—but Heaven untimely frown'd,
And pluck'd the fairest flow'r on Scottish ground.
It was no falchion rais'd in mortal strife,
That snatch'd *thee*, Wallace, from the light of life;
No arrow glided on the wings of death
To drink *thy* blood, and steal away *thy breath;*
There were no honors of a glorious grave,
The patriot's *boast*, the birth-right of the *brave;*
Far other fate *thy* generous zeal repaid,
Torn from thy country, by thy *friend* betray'd.—
Methinks† I see thee led in sullen state,
High in thy fall, and e'en in *fetters great;*
And view thee, dragg'd in all the pomp of woe,
A sport of *impotence*, a *public show.*
Still‡ conscious virtue cheers *thy* latest hour,
Nor sinks thy spirit in the grasp of power.
Still, in the pangs of death, thy closing eyes
Speak the proud thoughts that in thy bosom rise!
And the last sigh, that gave the soul release,
Breath'd to thy Scotland LIBERTY and PEACE.

O§ Wallace! if *my* voice can pierce the gloom,
And rouse the silent slumbers of the tomb,
O'er thy cold dust the Muse shall pour her strain,
To tell thee, that thou didst not fall in vain—
Yes, *honour'd* Shade! though brief was *thy* career,
And not a stone records *thy* lowly bier;
E'en yet, thy native woods and wilds among,
Thy wreaths are verdant, and thy deeds are sung:
There, haply, as some minstrel tells thy tale
To many a mountain chief, and listening Gael,
Their kindling bosoms catch the patriot flame,
And learn the path to FREEDOM—and to FAME.

SMIRKE.—*Cambridge Prize Poem.*

* Here is a transition to *solemnity* of manner, requiring much *pathos.*
† Increased *solemnity.*
‡ The tone of voice becomes somewhat less *plaintive*, and the manner rather more elated.
§ Most *solemn* and *impressive* manner, with a slow rate of utterance.

GENERAL WOLFE TO HIS ARMY, BEFORE QUEBEC.*

I *congratulate* you, my brave countrymen and fellow soldiers, on the *spirit* and *success* with which you have executed this important part of our enterprise. The formidable heights of Abraham are now surmounted, and the city of Quebec, the object of all our toils, now stands in full view before you. A† perfidious enemy, who have dared to *exasperate* you by their cruelties, but not to *oppose* you on equal ground, are now constrained to face you on the open plain, without ramparts or entrenchments to shelter them.

You know too well the forces that compose their army to *dread* their superior numbers. A‡ few regular troops from old France, weakened by hunger and sickness, who, when *fresh*, were unable to withstand BRITISH soldiers, are their general's *chief dependence*. Those numerous companies of Canadians, INSOLENT, MUTINOUS, UNSTEADY, and ILL-DISCIPLINED, have exercised his utmost skill to keep together to *this* time; and as soon as their irregular ardour is damped by *one firm fire*, they will instantly turn their backs, and give you no farther trouble but in the PURSUIT.

As for those savage tribes of Indians, whose horrid yells in the forests have struck many a bold heart with affright; terrible as they are, with the tomahawk and scalping knife, to a flying and prostrate foe; you have experienced how little their ferocity is to be dreaded by *resolute* men, upon *fair* and *open* ground: you can now only consider them as the *just* objects of a *severe revenge*, for the unhappy fate of many slaughtered countrymen.

This day puts it into YOUR power to terminate the fatigues of a siege, which has so long employed your *courage* and *patience*. Possessed with a full confidence

* *Firmness* of manner, with a considerable degree of *ardour*, forms the principal characteristic of this address.

† This requires a tone of *indignation*.

‡ *Contemptuous*, *disdainful* manner.

of the certain success which BRITISH valour must gain over *such* enemies, I have led you up these steep and dangerous rocks, only solicitous to shew you the foe within your reach. The impossibility of a retreat makes no difference in the situation of men resolved to CONQUER or DIE: and believe me, my friends, if the conquest could be bought with the blood of your *general,* he would *most cheerfully* resign a life which he has long *devoted* to his country. AIKIN.

THE BRITISH WARRIOR QUEEN'S ADDRESS TO THE ROMANS.

Yes,* Roman! *proudly* shake thy crested brow,
'Tis *thine* to *conquer,* thine to *triumph* NOW;
For *thee,* lo! *Victory* lifts her gory hand,
And calls the fiends of terror on the land,
And flaps, as tiptoe on thy helm she springs,
Dripping with *British* blood her eagle wings.
Yet,† think not, think not *long* to thee 'tis given
To *laugh* at *Justice* and to *mock* at *Heav'n;*
Soon shall THY hand with blood-stained laurels crown'd
Stoop at the feet of VENGEANCE to the ground.
I‡ see amid the gloom of *future* days
Thy turrets *totter* and thy temples *blaze;*
I see upon thy *shrinking* Latium hurl'd,
The countless millions of the northern world;
I see, like vultures gathering to their prey,
The shades of states that fell beneath *thy* sway:
They leave their fallen palaces and fanes,
Their grass-grown streets, and ruin-scatter'd plains,
Where lonely long they viewless lov'd to dwell,
And *mourn* the scenes that *once* they loved so well;

* *Solemn* and *dignified* manner, with a strong expression of *indignation.*

† Increased degree of *solemnity,* with a *low full* tone of voice.

‡ During this vision the tone rises gradually, the eye of the speaker being fixed intently on space, the hand at the same time following the eye.

Triumphant,* lo! on all the winds they come,
And clap th' exulting hand o'er FALLEN ROME;
And hovering o'er thy domes that blazing glow,
Their waving pinions fan the flames below;
They view, rejoiced, the conflagration's gleams
Shoot their long glare o'er Tiber's redden'd streams;
And snuff the carnage-tainted smokes that rise,
An incense sweet, a grateful sacrifice.

Sad† Tiber's banks with broken columns spread!
Fall'n every fane that rear'd to heav'n its head!
Poor heap of ashes! Grandeur's mouldering tomb!
Art‡ THOU the place was once ETERNAL ROME?

Yes,§ Roman; snatch thy triumph whilst thou may,
Weak is thy rage, and *brief* thy little day;
Vanish'd and past the momentary storm,
Albion,‖ my Albion, brighter shows her form.
Far o'er the rolling years of gloom I spy
Her oak-crown'd forehead lifted to the sky,
Above the low-hung mists unclouded seen,
Amid the wreck of nations still serene;
She *bursts* the chain when hands like *thine* would *bind*
The groaning world, and *lord* it o'er mankind.
Amid yon glitt'ring flood of liquid light,
Flow regal forms before my dazzled sight;
Like stars along the milky zone that blaze,
Their sceptr'd-hands and gold-bound fronts they raise:
My *sons!*—my *daughters!*—faint,¶ alas! and dim,
Before these failing eyes *your* glories swim,
Mix'd with the mists of death. 'Tis *yours* to throw
Your radiance round, while happier ages flow;

* The manner becomes *animated* with the highest degree of *enthusiasm* and a tone of *exultation*. "Clap th' exulting hand," requires a suitable action.

† The tone here changes to that of *apparent sympathy* but *real disdain*, gradually increasing in violence.

‡ This line requires a particularly *slow* utterance with the strongest expression of *contempt*.

§ Here is a transition from *disdain* to a *haughty daring*, rising into ‖ *enthusiasm*.

¶ *Plaintive* tone.

I* *smile* at storms of earthly woe, and rise
Shades of my sires! to *your serener skies.*
WHEWELL'S BOADICEA.—*Cambridge Prize Poem.*

ALEXANDER'S ADDRESS TO HIS SOLDIERS.†

SOLDIERS! I am not ignorant that many things have been published by the Indians, purposely to affright us. But such artifices are by no means unusual to *you.* The Persians described the straits of Cilicia, the vast plains of Mesopotamia, the rivers Tigris and Euphrates, as the most insurmountable difficulties. Yet *your* bravery conquered THEM. Do you repent that you have followed me thus far? *Your* glorious deeds have subdued for you a *multitude* of provinces. You have extended your conquests beyond the Iaxarthes and Mount Caucasus; you see the rivers of India flow through the midst of your empire. Why are you afraid of crossing the Hyphasus, and of erecting your trophies on its banks as on those of the Hydaspes? What! can the elephants, whose number is so falsely augmented, *terrify* you to *such* a degree? Has not experience taught you that they were more destructive to *their own masters* than to the *enemy?* Endeavours are used to intimidate you by the dreadful idea of innumerable armies; are they more numerous than those of Darius? It is sure *very* late for you to count the legions of the enemy, after your victories have made *Asia* a *desert.* It was when you crossed the Hellespont that you ought to have reflected on the *smallness* of your number. Now the SCYTHIANS form part of our army; the BACTRIANS, the SOGDIANS, and the DAHÆ are with us, and *fight* for OUR *glory.* I do not depend on *those* barbarians: it is on YOUR courage that *I* rely. Your victorious arms are present to my imagination, and your courage *assures* me SUCCESS. So long as I shall be surrounded with YOU in fight, so long as YOU exhibit the

* *Exultation* increasing to *transport*; the last line to be uttered with *elevated* eyes and *extended* hands.

† This speech should be delivered in a *firm, manly* tone of voice.

same confidence and bravery you have hitherto displayed, there will be no occasion for *me* to compare the number of *my* troops with that of the *enemy*.

Consider, soldiers, not only your *glory* but even your SAFETY is at stake. Should we now retreat, it will be supposed that we fly before our enemies, and from that moment we shall appear as *mean* as the enemy will be judged *formidable*. It is in my power to make use of authority, and yet I employ entreaties only. Do* not abandon, I conjure you, I do not say your *King* and *Master*, but your *Pupil* and *Companion* in battles. Do not break in my hand that glorious palm which will soon, unless envy rob me of so great a glory, equal me to Hercules and Bacchus. What!† do I then speak to the DEAF? Will *no one* listen to me, nor deign to *answer?* Alas!‡ I am *abandoned*, I am *betrayed*, I am delivered up to the enemy. But§ I *will* advance *still farther*, though I go *alone*. The Scythians and Bactrians, more faithful than YOU, will follow wherever I lead them. Return,‖ then, to your country, and boast, ye DESERTERS of your *king*, that you have *abandoned* him. As¶ for *myself*, I will either meet DEATH OR VICTORY.

HAMILCAR'S SOLILOQUY.**

I†† *hate* their feastings; 'twould have been my *death*
To stay in that close room! This air is cool.
I felt my spirit *choked*. Gods; was I born
To bear those drunkards' tauntings on my *hue*,
My *garb*—Numidia's GARB! My *native tongue*

* Here is a transition to a tone and manner of *entreaty*.
† Here is another transition to a strong feeling of *indignation*.
‡ Apparent *apprehension*. § Most *courageous* manner.
‖ Most *contemptuous disdainful* manner.
¶ The highest degree of *enthusiasm*.
** Hamilcar, a Moorish prince, is supposed to have just quitted, through disgust, a Roman banquet. *Revenge* is the prominent feeling throughout this piece.
†† The utterance is *slow* and *emphatic*, and the deportment *most haughty*, the eyes flashing with indignation.

Not tuneable to their *Patrician* ears?
Will* the blow NEVER fall?
There's not a slave,†
Not the most *beggar'd, broken, creeping* wretch
That lives on alms and pillows on the ground,‡
But had done SOMETHING before now; and I—
A *soldier* and a *king*. The *blood* of kings,
Afric's last *hope*,—let months and years pass by,
And still live on a butt for ribald jests—
And more, to let Numidia's injuries sleep,
Like a chid infant's!
This§ is a mortal hour; the rising wind
Sounds angry, and those swift and dizzy clouds,
Made ghostly by the glances of the moon,
Seem horse and chariots for the evil shapes
That scatter ruin here.‖
Come from your tombs,
Warriors of Afric!—from the desert's sands—
From the red field—the ever surging sea,
Though ye were buried deeper than the plumb
Of seamen ever sounded.
Hamilcar,¶ *Hannibal, Jugurtha—Come,*
My *royal father!* from the midnight den
Where their *curst* Roman axes *murdered* thee!
Ye shall have VENGEANCE! *Stoop* upon my breast,
Clear it of man, and put therein a heart,
Like a destroying spirit's: make me *fire*,
The winged passion that can know *no sleep*,
Till VENGEANCE has been done; wrap up my soul
In darkness stronger than an iron mail,
Till it is *subtle, deadly, deep* as *night*,

* The fist is here clenched with the *most vindictive* expression of countenance.

† The tone of voice should be here *low*, with a *slow* and *emphatic* utterance.

‡ A most powerful feeling of self-condemnation.

§ Here is a transition to a somewhat more *sedate* and *composed* manner, whilst the same *revengeful* feelings are still preserved.

‖ This requires an *elevated* and *loud* tone of voice.

¶ Most *violent* and *emphatic* manner, with the most unsubdued feeling at "vengeance;" the fist should be clenched and the teeth set.

Close as *coil'd aspics, still* as *tigers* crouch'd,
But *furious* as them *roused*. Let me fill ROME
With *civil tumult, hate, conspiracy,*
All dissolution of *all holy ties,*
Till she has *outraged Heaven,* while *I* unseen,
Move like a spectre round a murderer's bed,
To *start* upon her DYING AGONY.

CROLY.

THE DOWNFALL OF POLAND.

Oh!* sacred Truth! thy triumphs ceas'd awhile,
And Hope, thy sister, ceas'd with thee to smile,
When leagued Oppression pour'd to northern wars
Her whisker'd pandoors and her fierce hussars,
Wav'd her dread standard to the breeze of morn,
Peal'd her loud drum, and twang'd her trumpet horn;
Tumultuous horror brooded o'er the van,
Presaging wrath to POLAND and to MAN!

Warsaw's last champion from her height surveyed,
Wide o'er the fields a waste of ruin laid:
"Oh † heaven!" he cried, "my bleeding country *save,*
Is there no hand on high to shield the *brave?*
Yet though destruction sweep those lovely plains,
Rise,‡ fellow men! our *country* yet remains!
By that dread name we wave the sword on high,
And swear *for her* to LIVE! *with her* to DIE!"

He § said, and on the rampart heights array'd
His trusty warriors, *few* but *undismay'd;*
Firm paced and *slow,* a *horrid* front they form,
Still as the *breeze,* but *dreadful* as the *storm;*
Low murmuring sounds along their banners fly,
REVENGE|| or DEATH! the *watchword* and *reply;*
Then peal'd the notes omnipotent to charm,
And the loud tocsin tolled their last alarm!
In ¶ *vain,* alas! in *vain,* ye gallant few!
From rank to rank, your volley'd thunders flew.

* *Solemn* manner. † *Ardent, enthusiastic* manner, rising into ‡ *Vehemence.* § *Narrative,* with much *solemnity.*
|| Strong emphasis, with a *low* tone. ¶ *Plaintive* tone and manner.

Oh! *bloodiest* picture in the book of time!
Sarmatia fell *unwept*, without a *crime;*
Found not a *generous* friend, a *pitying* foe,
Strength in her *arms*, nor *mercy* in her *woe!*
Dropp'd from her *nerveless* grasp the shatter'd spear,
Closed her *bright* eye, and curb'd her *high career;*
Hope for a season bade the world farewell!
And FREEDOM *shriek'd*, as KOSCIUSKO FELL!

The* sun went down, nor ceas'd the carnage there,
Tumultuous murder shook the midnight air—
On Prague's proud arch the fires of ruin glow,
His blood-dyed waters murmuring far below,
The storm prevails, the rampart yields a way,
Bursts the wild cry of horror and dismay!
Hark! as the mouldering piles with thunder fall,
A thousand shrieks for hopeless mercy call!
Earth shook—red meteors *flashed* along the *sky*,
And *conscious nature shuddered* at the cry!
Departed† spirits of the mighty dead!
Ye that at Marathon and Leuctra bled!
Friends of the world! restore your swords to man,
Fight in *his* sacred cause, and lead the van!
Yet for Sarmatia's tears of blood atone,
And make *her* arm puissant as *your own!*
Oh, once again to *freedom's* cause return
The patriot TELL—the BRUCE of BANNOCKBURN.

CAMPBELL.

BRUTUS, OVER THE DEAD BODY OF LUCRETIA.

Thus, thus, my friends! fast as our breaking hearts
Permitted utterance, we have told our story:
And now, to say one word of the imposture—
The‡ mask *necessity* has made me wear.
When the ferocious malice of your king—
King, do I call him:—when the MONSTER,§ Tarquin,
Slew, as most of you may well remember,
My father Marcus, and my elder brother,

* *Most solemn* manner, gradually approaching to a feeling of *horror*.

† Here is a transition to a *calmer* feeling, requiring much *solemnity*, with a *plaintive* utterance.

‡ Strong feeling of *indignation*. § *Hatred*.

Envying at once their virtues and their wealth,
How could *I* hope a shelter from *his* power,
But in the false face I have worn so long?
Would you know *why* I summon'd you together?
Ask ye what brings me *here?* Behold* this dagger,
Clotted with gore! Behold that frozen corse!
See where the lost Lucretia sleeps in death!
She was the *mark* and *model* of the time,
The mould in which each female face was form'd,
The very *shrine* and *sacristy* of virtue!
The *worthiest* of the *worthy:* Not the nymph
Who met old Numa in his hallow'd walks,
And whisper'd in his ear her strains divine,
Can I conceive *beyond* her!—the young choir
Of vestal virgins *bent* to her!—*Such* a mind
Might have abash'd the *boldest libertine,*
And turn'd desire to reverential love
And holiest affection! Oh, my countrymen!
You all can witness, when that *she* went forth
It was a *holiday* in Rome; old age
Forgot its crutch; labour, its task; all ran;
And mothers, turning to their daughters, cried,
"There,† there's Lucretia!" Now,‡ look where she lies,
That *beauteous* flower, that *innocent, sweet* rose,
Torn up by ruthless violence—*gone! gone!*
Say,§ would you seek instructions? would you seek
What ye should *do?*—Ask‖ ye yon conscious walls
Which saw his poison'd brother, saw the incest
Committed there, and they will cry, REVENGE!
Ask yon deserted street, where Tullia drove
O'er her dead father's corse, 'twill cry REVENGE!
Ask yonder Senate-house, whose stones are purple
With human blood, and it will cry, REVENGE!
Go to the tomb where lies his murder'd wife,
And the poor queen, who lov'd him as her son,

* Most *solemn* manner, requiring a *low* tone, with a feeling of *grief* mixed with *revenge.*

† This requires an elevated tone of voice.

‡ *Plaintive* utterance, with an expression of *horror.*

§ *Solemn* interrogatory, requiring a *low* tone.

‖ Rises into *vehemence,* with a strong feeling of *revenge.*

Their unappeased ghosts will shriek, REVENGE!
The temples of the gods, the all-viewing heaven,—
The *gods themselves*—shall justify the cry,
And swell the general sound—REVENGE! REVENGE!

PAYNE.

DUNCAN'S WARNING.

As* o'er the heath, amid his steel-clad thanes,
The royal Duncan rode in martial pride,
Where, full to view, high-topp'd with glittering vanes,
Macbeth's strong towers o'erhung the mountain's side;

In† dusky mantle wrapp'd, a grisly form
Rush'd with a giant's stride across his way;
And thus, while howl'd around the rising storm,
In hollow thundering accents pour'd dismay.

"*Stop*,‡ O King! thy destined course,
Furl thy *standard*, turn thy *horse;*
Death besets this onward track,
Come no further,—*quickly* back.

"Hear'st thou not the raven's croak?
Seest thou not the blasted oak?
Feel'st thou not the loaded sky?
Read thy danger, King, and FLY.

"Lo! yon castle's banners glare
Bloody through the troubled air:
Lo! what spectres on the roof,
Frowning, bid thee stand aloof.

"Murder, like an eagle, waits,
Perch'd above the gloomy gates,
Just in act to pounce his prey;
Come not near——AWAY! AWAY!

"Let not plighted faith beguile;
Honor's semblance, Beauty's smile;
Fierce ambition's venom'd dart
Rankles in the fest'ring heart.

* *Descriptive*, requiring little more than level speaking.
† The manner becomes more *serious*, with a feeling of *alarm*.
‡ This warning requires a peculiarly *solemn* and *earnest* tone and manner.

"'Treason arm'd against thy life,
Points his dagger, whets his knife,
Drugs his stupifying bowl,
Steels his unrelenting soul.

"Now 'tis time: ere guilty night
Closes round thee, *speed thy flight;*
If the threshold *once* be crost,
Duncan! thou'rt for *ever lost.*

"On* he goes!—resistless Fate
Hastes to fill his mortal date:
Cease, ye warnings, vain, though true,
Murder'd king, ADIEU!—ADIEU!"

DR. AIKIN.

THE SHIPWRECK.

As the eldest son of Henry I. was returning from Normandy, accompanied by the sons of the principal English nobility, together with Maude, his natural sister, the vessel, through the negligence of the captain, was wrecked, and the whole company, with one single exception, were lost.

'Twas† night; and its lovely empress shone
From her azure canopy,
And many a bright and holy star,
Glittering in its silvery car,
Spangled the cloudless sky.
And o'er the bosom of the deep
A vessel rode alone,
And proudly sail'd the pennon'd ship,
For she bore a *monarch's* son:
She bore great Albion's *hope* and *pride,*
The *kingly Henry's heir,*
(And ne'er could England wish a prince
More *virtuous* or more *fair*);
And with him were a *gallant* train—
The *lovely, young,* and *brave;*
And the sound of music and revelry
Came lightly o'er the wave.

* *Solemn* description, with a feeling approaching to *horror.*
† *Solemn* manner, with an *easy, graceful* delivery.

Alas!* alas! who could foresee,
In this *gay* and *joyous* hour,
That the angel of death was hurrying past
On the fearful wings of the tempest's blast,
With an all-destroying power!
Yet thus it was: for the doom-winds rose,
And the boiling surges dash'd;
The thunder walk'd in majesty
Along the dark and scowling sky,
And the livid lightnings flash'd!
The jocund laugh, and sprightly song,
Were quickly changed to wailing,
For wilder grew the deaf'ning roar
Of "waters loud prevailing."
A lesser boat was lowered now
Across the troubled wave,
And, "Haste,† my prince!" the captain cries,
"Heed not the raging of the skies,
Oh! haste thy *life* to save!"
The royal youth obeyed the call,
And fain the boat would gain,
But his lov'd sister's piercing shriek
Compell'd him to remain.
"My‡ brother! oh, my brother, *stay:*
Leave me not here to *die!*"
Ah!§ could he turn a senseless ear
To the despairing cry?
No! though the angry billows rush'd
With a stern resistless power,
He could not one *so dear* forsake,
In that o'erwhelming hour.
Till‖ now the boat had bravely sped
Through the tempest's mingled roar,
And the joyous mariners descried
The white spray of the foaming tide,
Lashing the friendly shore;

* Increased *solemnity*, with much *pathos*.
† This address to the prince requires an *eager* and *rapid* utterance.
‡ *Earnest* entreaty, with a *plaintive* tone and *rapid* utterance.
§ *Mournful* and *solemn* tone.
‖ Here is a transition to the *narrative*.

But* ah! no earthly ship could last,
In a storm so fierce as *this;*
And now she is toss'd a mountain's height,
Now sunk in the dark abyss.
At length was heard the dreadful sound
Of life's departing cry:
Another† shriek—a *horrid* one—
A *loud, appalling, lengthen'd* groan
Proclaim'd DEATH'S VICTORY!

Oh‡ Heavens! it was a fearful sight
That broke on the view with the morning light,
For all around the shore was spread
With the clay-cold bodies of the dead:
And where was the prince?—Alas! he lay
In the depths of the ocean cave;
No dirge was sung—no death-knell rung,
Above his lowly grave;
Yet the blue sea's daughters around him wept,
And murmur'd a requiem as he slept;
While many a nymph, from her coral bed,
A pearly mantle o'er him spread,
And placed on his brow a diadem
Of jewel rare and costly gem,
Such as a prince (however great)
Might *proudly* wear in *regal* state.

One, only *one,* escaped the storm,
And he was left to bring
The maddening tale—the tale of death,
Unto the childless king.
Alas! it was a mournful thing,
Such sad intelligence to tell!
To say his child was *lost, dead, drown'd,*
Nor lay his bones in hallow'd ground!
To tell him that his age's prop,
His kingdom's heir had pass'd away,

* Increased *solemnity,* approaching to †*horror.*

‡ *Most solemn* description, requiring a *mournful* tone, occasionally varying in intensity.

E'en as the rose droops, when the voice
Of autumn dooms it to decay.
Say what on earth could parallel
A woe so withering?
The royal mourner heard the tale
In silent agony;
He could not speak, he could not weep,—
His grief was far too wild and deep,
Too great his misery;
One only sigh escaped his breast—
Oh, SUCH a sigh! as it would fain
The vital fibres rend in twain,
And free him from life's galling chain,
And give his spirit rest!

The monarch sat, with his crown and robes,
In a splendid chair of state;
And laurel'd knight, and jewel'd dame,
His kingly notice wait:
But ah! with a cold and careless eye
He gazed on the gorgeous pageantry:
For what could homage or splendour bring
The heart which grief was withering!
His spirit had sunk in that ruthless wave
Where his bosom's joy had found a grave.
In vain the minstrel swept his harp,
To wake its thrilling strain;
For nothing now could delight inspire
In the aching breast of the mourning sire,
"*He never smiled again!*"

COMIC PIECES.

THE MISER'S WILL.*

OLD SCRAPE-ALL who had long been ailing,
Was at a trembling debtor railing;
Threat'ning, if he a *mite* should fail,
To whelm him in a neighbouring jail;
When *Truth*, his neighbour, pass'd that way,
The Debtor saw and slipp'd away.
Scrape-all then, thus, with sigh profound,
And wheezing cough, a church-yard sound!
Address'd, with lifted hand, his friend:—
"I think my grief will *never* end!
The hog that wallows in his sty,
Has thrice more happiness than I!
My care is now, whilst others sleep,
Not how to *gain*, but how to KEEP."

Said *Truth*—"As usual, still I see,
Brimful of grief and misery!—
Riches—the things which *others* bless,
To *you* bring nought but wretchedness!
But tho' your purse is deep and strong,
Good sir, you cannot hold it *long*;
Your years on years have so increas'd,
You must be *fourscore* now at *least*."

"Speak *louder*, friend, my ears do fail,
I'm grown as deaf as a door nail."
"I say your years have so increas'd,
Your must be FOURSCORE years at LEAST."

* The narrative part of this piece should be delivered in the natural voice of the speaker, but with an *earnestness* of manner. The tone and manner of Truth should be particularly grave and impressive, and form a contrast with the *tremulous*, *piping* voice of Scrape-all.

"*Hold, hold!*" he cried, "you're FAR away!
I am but *seventy-nine* this day,
And think, whatever others fear,
I still may reach my *hundredth* year!"

Said *Truth*, "Now make me your confessor!
Pray who do you keep your riches for?"—
"*Who for!*" cried Scrape-all, "for MYSELF!
And when at length I die—FIVE SCORE,
Or thereabouts,—say ten years more,
My wealth, I do design, shall be
Placed in my COFFIN close by me."

"Nay," answer'd Truth, "when you are dead,
Authority you'll find is fled;
Some-one, no doubt, will still contrive
To keep your slumbering gold alive.—
Make, make your will; howe'er it grieve,
You must your ALL to some one leave!"

"What! make my will! my all bestow
On some one else? No! neighour, no!
I'll be, whilst these my hands can hold,
The only keeper of my gold;
From night to morn, from morn to night,
I'll keep it *close*, and *hold it tight!*"

"You rightly speak, you are no more
Than *keeper* to your golden store,
But when you die, as die you must,
To whom will you bequeath your trust?"—

"To NO ONE!" Scrape-all stern replied;
"The WHOLE, I'll in my coffin hide!
I who have scraped for *fifty years*,
With ceaseless toil and hourly fears,
Shall I give ALL away, at LAST?
No! neighbour, NO! *I'll hold it fast!*"

"Strive how you will, your wealth to save,
You cannot hold it in the *grave!*
Although, old man, it rend your heart,
Your God and you at length *must* part!"

Said Scrape-all, sorrowful and slow,
'Well, then! come thirty years or so,

And I will think on this affair,
And if needs be appoint my heir."

Cried Truth, "*No moment* lose! you *now*
Your head with age and palsy bow!
I guess when Jack your wealth has got,
He soon will spend it all! a Sot!
And ere you've closed your eyes a year,
Behind a prison grate appear!"

"My spendthrift nephew, here, I swear!
Shall never be rich Scrape-all's *heir!*"
"Then make your *Will!* or 'twill be so!
He'll have it all, when you are low!"
"What! make my will just in my prime,
'Twould be to die before my time."

"Nay," Truth replied, "be well content!
You will not die, nor Jack lament,
The sooner for this instrument.
And I would more in candour say—
Do *good*, friend Scrape-all, while you *may!*
Erect, and you will gain renown,
A school within your native town;
Then build a hospital, that fame,
When you are dead, may bless your name,—
For you 'twill be a small bequest,
Your nephew then may spend the rest."

Cried Scrape-all, "NEVER, whilst I live,
Will I a *mite* to any give!
No, no! good neighbour, to the *last*,
With bolt and bar I'll hold it fast!—
And as I *cannot* give, when dead,
The law shall give it in my stead!
But as for Jack, again I swear,
The rogue shall NEVER be *my heir!*"——

One year is past!—let thirst of gold
Its *object* and its *end* behold!
Whilst none their different lots bewail—
SCRAPE-ALL is DEAD! and JACK's in JAIL!!

THE WALLET.*

From the French of La Fontaine.

Jove once assembling all his creatures,
  Proclaim'd, whoe'er disliked his lot,
As far as *outward* form and features,
  Might have them mended on the spot.

Among the rest he saw the *Ape*—
  Thought HIM fit subject for beginning:
But Jacko *faultless* found his shape,
  And saw the *graces* in his *grinning*.

Said Jack, "You might have pitch'd a *worse* on,
  Sire, in the crowd that here's attending!
There's brother *Bruin's* half-licked person
  May need, I think, *some little* mending."

The Bear *not* wishing to complain,
  Said, "That pert jackanapes must doat,
How many beasts desire in *vain*
  The comforts of this shaggy coat.

"Yon *Elephant*, our height o'ertopping,
  In clumsy bulk, perhaps I'm stronger—
But sure his EARS require some cropping—
  Should not his TAIL be somewhat *longer?*"

The Elephant these changes scouted,—
  The same vain notions e'en prevail
In *his* wise head; he rather doubted
  If not *too* large, was FAT DAME WHALE.

Contented was my *lady Whale*,
  While Mistress *Ant* believed Miss *Mite*
Was made on *much too small* a scale,
  She thought her *own* dimensions right.

* In this piece there is but little change of tone required. *Liveliness* of manner, *distinctness* of utterance, a *strict attention* to the *emphasis*, and a *suspension* of the *voice* before the supposed speech of the animals, claim the chief attention of the speaker.

Not one there was in all the crowd
Wish'd to be *larger, smaller, straighter:*
The ugliest monster there was proud
Of the fair gifts bestow'd by nature.

Above the rest conspicuous MAN
Appear'd, than other creatures vainer.
Great Jove contriv'd a simple plan,
To make this obvious truth the plainer.

At his command, men wallets bore:
For holding faults was made the sack;
One end, as usual, hung *before,*
The other close *behind* his back.

Each to his own dear failings blind,
To find another's error labours;
Packs up his *own* faults snug *behind,*
And trains the *front* pouch with his *neighbour's.*

THE HORSE AND THE WOLF.*

From the French of La Fontaine.

When nature, releas'd from the cold icy trammels
Which winter had form'd, all her lustre renews,
When the gold of the cowslip each meadow enamels,
And the amethyst blends with soft emerald hues.

At this sprightly season of love and of joy,
A *horse* from his stable was sent by his master,
In freedom these holiday hours to employ,
And graze at his ease in a *rich verdant pasture.*

A *wolf* who was prowling in search of adventures,
The glossy, plump animal joyfully spies,
With caution the paddock's enclosure he enters,
In hopes of possessing *so tempting* a prize

* The narrative part of this piece should be spoken in an *easy* and *lively* manner. The wolf is at first *exulting*, his tone then changes to that of *caution*, and finally he becomes *insinuating* and *artful*, while the horse is grave.

"Ah! wert thou, stout beast," cries the thief, "but a MUTTON—
In a *moment* that carcass I'd seize as my own;
As it is, some disguise I must artfully put on,
Before I can tear thy fat flesh from the bone."

So gravely saluting, he questioned the steed—
"Are you here, my fair sir, for your *health* or your *pleasure?*
From the symptoms, I fear you're a *great invalid,*
For, in health, men allow their poor nags but *small* leisure.

"As a pupil of Galen, accept my assistance,
By feeling your pulse I shall feel what your state is;
I have travell'd thus far from a *very great* distance,
To give the afflicted my best advice *gratis.*

"Very choice are the wise in selecting their food,
For plants that are noxious the functions disturb all;
As Solomon knew well the bad from the good,
I can point out each root in old Culpepper's herbal."

The horse Isgrim's character knew by repute,
And plainly perceiv'd what the traitor design'd:
So he says, "*Learned* doctor, my pains are *acute,*
An abscess is form'd in my off-foot behind."

"A delicate part!" quoth the leech, "and indeed
In the choice of a surgeon, 'tis well to be *wary;*
Allow me to touch it, and then I'll proceed,
Like a perfect adept in the art veter'nary.

"But first of your pain let's examine the cause—,"
The horse launch'd his heels, and *no* kick could be *kinder,*
It crush'd to a mummy the hypocrite's jaws,
And dash'd from their sockets, each holder and grinder.

"All this I deserve," said the wolf, full of sadness:
"In the trade of a butcher, I'd been quite at home, ah!
To change my profession was absolute madness—
Who dares kill a patient without a *diploma!*"

BLIND-MAN'S BUFF.*

Three Wags (whom some fastidious carpers
Might rather designate *three sharpers*)
Enter'd at York the Cat and Fiddle,
And finding that the host was out
On business for two hours or more,
While *Sam* the rustic waiter wore
The visage of a simple lout,
Whom they might *safely* try to *diddle;*
They ordered dinner in a canter
Cold or hot, it matter'd not,
Provided it was served *instanter;*
And as the heat had made them *very*
Dry and dusty in the throttles,
They bade the waiter bring *three* bottles
Of PRIME OLD PORT, and *one* of SHERRY.

Sam† ran with ardour to the larder,
Then to the kitchen;
And as he briskly went to work, he
Drew from the spit a *smoking turkey,*
With *sausages* embellish'd, which in
A trice upon the board was spread,
Together with a *nice*‡ *cold brisket,*
Nor did he even obliviscate
Half a pig's head:
To these succeeded *puddings, pies,*
Custards and *jellies,*
All doom'd to fall a sacrifice
To their insatiable bellies;

* In this speech there are *six* different tones of voice required; that of the narrator—of the three wags—of Sam and his master. The tone and manner of the narrator should be particularly *lively* and *comic*. The three wags are *affected* and somewhat *formal*. Sam, being an uneducated countryman, will naturally be supposed to use a *broad, rustic* dialect: while the innkeeper is *loud* and *angry*.

† This line should commence in an elevated tone, and gradually fall.

‡ The rate of utterance should be here slow.

As if, like camels, they intended
To stuff into their monstrous craws
Enough to satisfy their maws,
Until their pilgrimage was ended.

Talking,* laughing, eating, and quaffing,
The bottles stood no moment still;
They rallied Sam with joke and banter,
And as they drain'd the last decanter,
Call'd for the *bill.*

'Twas brought; when one of them, who eyed
And added up the items, cried,
"*Extremely*† moderate, indeed!
I'll make a point to recommend
This inn to every travelling friend;
And you, Sam, shall be *doubly* feed."
This said, a weighty purse he drew,
When his companion interposed;
"Nay,‡ Harry, that will never do,
Pray let your purse again be closed;
You paid all charges *yesterday,*
'Tis clearly now *my* turn to pay."

Harry, however, wouldn't listen
To any such insulting offer;
His generous eye appeared to glisten
Indignant at the very *proffer;*
And though his friend talk'd loud, his clangour
Served but to aggravate Hal's anger.
"My§ worthy fellows," cried the third,
"Now, really this is *too* absurd;
What! do both of you forget
I have not paid a *farthing* yet?

* This requires a tone of *jollity* and *mirth.* The tone also may be elevated at the commencement of the line, gradually sink towards the middle, and again rise at the end.

† This may be given in a *pompous* manner.

‡ This requires a tone of *expostulation.*

§ The tone and manner of this speaker must vary from each of the others. The first part of this address requires a tone of *expostulation;* the latter of *positiveness.*

Am I *eternally* to cram
At *your* expense?—'tis childish, quite;
I claim *this* payment as my RIGHT—
Here,* how much is the money, Sam?"

To this most rational proposal
The others gave such fierce negation,
One might have fancied they were foes all,
So hot became the altercation;
Each in his purse the money rattling,
Insisting, *arguing*, and *battling*,
One of them cried at last—"A truce!—
This point we will no longer moot;
Wrangling for trifles is no use,
And thus we'll finish the dispute.—
That we may settle what *we three owe*,
We'll blindfold Sam, and whichsoe'er
He catches of us *first* shall bear
The whole expenses of the trio;
With half a crown (if that's enough)
To *Sam*, for playing *Blindman's buff*."

Sam liked it *hugely*,—thought the ransom
For a good game of fun was handsome;
Gave his own handkerchief, beside,
To have his eyes securely tied;
And soon began to grope† and search,
When the three knaves, I need not say,
Adroitly left him in the lurch,
Slipp'd down the stairs, and stole away.

Poor Sam continued hard at work;
Now o'er a chair he gets a fall;
Now flound'ring forward with a jerk,
He bobs his nose against the wall;
And now encouraged by a subtle
Fancy, that they're near the door,
He jumps behind it to explore,
And breaks his shins against the scuttle;

* *Pompous*, *authoritative* manner.

† Suit the action to the word throughout Sam's supposed performance, but carefully and cautiously.

Crying at each disaster—"*Drat* it!
Dang it!—*'od rabbit it!*—and *rat* it!"

Just in this crisis of his doom,
The host returning, sought the room;
And Sam no sooner heard his tread,
Than *pouncing* on him like a bruin,
He almost shook him into ruin;
And with a shout of laughter, said—
By gom, I've cotch'd* thee *now!* so *down*
With cash for all, and *my half crown!*"
Off went the bandage, and his eyes
Seem'd to be goggling o'er his forehead,
While his mouth widen'd with a horrid
Look of agoniz'd surprise.

"GULL!" roared his master—"GUDGEON! DUNCE!
Fool as you are, you're right for *once;*
'Tis clear that *I* must pay the sum;—
But *this* one thought my wrath assuages,
That every *halfpenny* shall come
Out of *your wages.*"

THE FARMER'S WIFE AND THE GASCON.†

At Neufchatel, in France, where they prepare
Cheeses that set us longing to be mites,
There dwelt a farmer's wife, famed for her rare
Skill in these small quadrangular delights.
Where they were made, they sold for the immense
Price of *three sous* a piece;
But as salt water made their charms increase,
In *England* the fixed rate was *eighteen pence.*

This damsel had to help her in the farm,
To milk her cows and feed her hogs,
A *Gascon peasant,* with a sturdy arm
For digging or for carrying logs;

* Sam's rustic dialect must not be forgotten.

† Throughout this piece there is a great deal of *broad comic humour,* which will require a corresponding attention in the recital.

But in his *noddle* weak as any baby,
In *fact*, a GABY.*
And *such* a glutton when you came to feed him,
That Wantley's dragon, which "ate *barns* and *churches*
As if they were *geese* and *turkies*,"
So says the ballad, scarcely could exceed him.

One morn she had prepared a *monstrous* bowl
Of cream like nectar,
And would'nt go to church (good careful soul!)
Till she had left it safe with a protector;
So she gave *strict* injunctions to the Gascon,
To watch it while his mistress was to mass gone.

†Watch it he did, he never took his eyes off,
But licked his *upper* then his *under* lip,
And doubled up his fist to drive the flies off,
Begrudging them the *smallest* sip,
Which if they got,
Like my Lord Salisbury, he heaved a sigh,
And cried, "O *happy, happy* fly,
How I do *envy* you your lot!"

Each moment did his appetite grow stronger;
His stomach yearn'd,
At length he could not bear it any longer,
But on all sides his looks he turn'd,
And finding that the coast was clear, he quaffed
The whole up at a draught.
Scudding from church, the farmer's wife
Flew to the *dairy*
But stood aghast, and could not, for her life,
One sentence mutter,
Until she summon'd breath enough to utter,
‡"Oh! St. Mary!"

And shortly with a face of scarlet,
The vixen (for she *was* a vixen) flew
Upon the varlet,

* A suspension of the voice is requisite after "fact," to render "GABY" more emphatic.

† This line requires a *slow* but *emphatic* utterance.

‡ This ejaculation should be uttered with raised hands and eyes, and a look of *astonishment*.

*Asking the *when*, and *where*, and *how*, and *who*,
Had gulped her cream, nor left an atom,
To which he gave not *separate* replies,
But, with a look of excellent digestion,
One answer made to every question—
†"The *flies!*"

‡"The *flies*, you rogue!—the *flies*, you *guzzling hound!*
Behold your whiskers still are cover'd thickly;
You *gormandizing* rascal, I'll be bound
I'll make you tell another story quickly."
So out she bounced, and brought, with loud alarms,
Two stout Gens d'Armes,
Who bore him to the Judge—a little prig,
With angry bottle nose,
Like a red cabbage rose,
While lots of white ones flourish'd on his wig.

Looking at once both stern and wise,
He turn'd to the delinquent,
And 'gan to question him, and catechise
As to which way the drink went.
Still the *same* dogged answers rise,
"The *flies* my lord,—the *flies*, the *flies!*"

§"*Psha!*" quoth the Judge, half peevish and half pompous,
"Why, you're *non compos*,
You should have *watch'd* the bowl as she desired,
And *kill'd* the flies, you stupid clown."
‖"What! is it *lawful*, then," the dolt inquir'd,
"To *kill* the flies in *this here town?*"
"The man's on *ass*—a pretty question this!
Lawful, you booby!—to be sure it is:
You've MY authority, where'er you meet 'em,
To *kill* the rogues, and if you like, to EAT 'EM."

* The rate of utterance is at the beginning of this line *slow*, and gradually becomes more *rapid*, the voice also becoming at the same time gradually more elevated; with a strong expression of *anger* on the countenance.

† With a look of *stupidity*.

‡ This requires an *elevated* tone of voice.

§ The Judge's part requires a *thick* voice, with a gravity of manner bordering on the *ludicrous*.

‖ The clown speaks in a *rustic* dialect, and with a vacant look.

"*Zooks!*" cried the rustic, "I'm right glad to hear it.
Constable, catch that thief! may I go hang
If yonder bluebottle (I know his face,)
Isn't the very leader of the gang
That stole the cream; let me come near it!"
This said, he started from his place,
And aiming one of his *sledge-hammer* blows
At a large fly upon the Judge's nose,
The luckless bluebottle he smash'd,
And gratified a *double* grudge;
For the same catapult completely smash'd
The *bottle nose* belonging to the *Judge*.

THE CUR AND THE MASTIFF.

There lived in a village not far from a *river*,
A PUPPY, who thought himself *knowing* and *clever*;
A *pert little* cur, who, unable to BITE,
Kept *snarling* and *barking* from morning to night.

Whoever approach'd him he *noisily* greeted,
And with his shrill music each traveller treated;
If he bark'd himself hoarse he would speedily rally,
And alike on his friends and his foes would he sally.

With his weakness and folly since ALL were acquainted,
His violent conduct they *seldom* resented:
To pass him in scorn is the course they *prefer*,
Since nobody cared for an *insolent** *cur*.

The forbearance towards him thus daily extended,
To make him the *prouder* and *saucier* tended;
He thought the *whole village* beheld him with fear,
And he deem'd *himself* MASTER of all who came near.

It happen'd, however, *one*† *cold winter's day*,
A *noble*‡ *large mastiff* was passing that way;
When, to show his importance, our *silly* young whelp
As usual began at his betters to yelp.

* This requires an expression of *disdain*.
† *Slow* rate of utterance, for the sake of emphasis.
‡ *Protracted* utterance.

The mastiff turn'd round and look'd grave at the puppy,
And I thought this reproof from his face I could copy:
"You *saucy** *young cur*, had you ONE grain of *true* sense,
You'd *scorn* to be thus to your neighbours a *nuisance*.

"Your pranks, let me tell you, are *foolish* and *vicious*,
And bring a disgrace on the whole of the species;
But come, sir! I'm going to teach you the danger
To which you're expos'd in insulting a *stranger*."

Thus wisely resolv'd such *ill* manners to *check*,
He laid hold of the cur by the crag of the neck;
While the latter, half dead with confusion and terror,
Sincerely repented his *puppyish* error.

Then trotting away to the river in haste,
The mastiff plung'd in it, but held the cur fast;
There* *duck'd* him, and *sous'd* him, and *shook* him about,
Till at last he thought proper to carry him out.

By *this* mode of proceeding the puppy he taught
The duty of holding his tongue when he *ought*;
For he carried him back to the place of his dwelling
Quite cured of his passion for *barking* and *yelling*.

THE PASHA AND THE DERVISE.†

When a sage leaves his shop, and on *politics* doting,
Exchanges CLOTH PATTERNS for *plans* of REFORM;
When *preachers* hold forth on the pleasures of voting,
And roar, how *delightfully* calm is a storm!
Are they MAD? *mad* enough—see their frothy condition,
E'en the *simple* go mad when they're bit by AMBITION.

A Turkish Pasha in a whimsical mood,
Took a casket of gold full of jewelry fair,
And addressing a Dervise *thrice* solemnly good,
And wishing to make the grim animal *stare*,

* This line also requires a *slow* utterance, with considerable emphasis.

† This piece requires but little more than an *easy, lively* mode of delivery. Care must, however, be taken that the tones of the several speakers differ from each other, as also from that of the narrator.

"*This casket,*" he cried, with extravagant mirth,
"You must give to the *greatest of fools* upon earth."

Sedately the Dervise observed the command,
And carefully went the gems' owner to find;
Great fools in *abundance* he found in the land,
But to each of them gravely he said in his mind,
"Thou *art* a great goose, my good friend, I *allow*,
But perhaps I may yet find a greater than *thou*."

O'er the regions adjoining he rambled in vain;
All the land of the Tartars he wandered around,
And then to the Bosphorus cross'd he the main,
Where a people half frantic with terror he found;
With surprise he regarded the mob *so* delighted,
And with more when an Iman the *reason* recited.

With a bowstring the sultan has *graciously* sent
His *vizier* to take a short message to heaven;
These affairs give the faithful *amazing* content,
And oft *this* content by the sultan is given.
"What—often?" the sage with astonishment cried,
"Of late VERY often," the Iman replied.

The Dervise went on, "Is a *successor* named?"
"O yes, with a form and magnificence meet,
This man," said the Iman, "I heard him proclaim'd,
There, there, you may see him, he's now in the street."
The Dervise beheld him, with *wonder* he saw,
In the newly made vizier, his *friend* the *Pasha*.

"You still have the casket?" the Vizier began,
For well the grim face of the Dervise he kenn'd;"
Said the Dervise, "In vain *long* I sought for the man,
For whom you design'd it—my search has its end;
The jewels belong to no mortal but *you*,
They are YOURS, mighty Vizier, *accept* them—ADIEU."

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