THE JOURNAL
OF THE
Board of Arts and Manufactures
FOR UPPER CANADA.

DECEMBER, 1864.

BOOKS AND READING.

The season for excursions and pic-nics, together with their invigorating influences, has glided away once more into the irrecoverable past: and now, the cold nor'-wester or chilling drizzling rain—warning of the near approach of winter—render the roof of home more pleasurable than the arched canopy of nature. The ramble through the woods, the moonlight sail on the silvered lake, the hasty exciting railway trip—aye, and even the voyage to and fro upon the mighty Atlantic—are all forgotten in the zest with which the enthusiastic reader pursues in the track of the daring Livingstone through the dark jungle of interior Africa. In short, all classes have observed and learned by personal contact with men and things during the summer months; but now, they increase their knowledge by viewing objects of interest through the medium of the printed sheet.

Unfortunately, however, the most current literature of the day, so far from increasing the powers of intellect and exciting a healthy curiosity, stimulates the passions to inordinate manifestation, and robs the mind of its proper balance. Hence, a potent cause of vice in various forms, and of the frightful increase of lunacy amongst civilized communities. Youth, the time of life which should be devoted to systematic, physical, and mental training, is, alas! too often idly wiled away in aimless pursuits. Reason, the rightful sovereign of Cranium, is slighted, and not unfrequently ultimately dethroned. Now, to prevent this unhappy result, as well as to ensure continuous development of healthy mentality, should be the cause of anxiety, and the subject of cool deliberation.

In hope of affording some assistance to the reader in the formation of his character upon a sound basis, a few suggestions are offered in this paper, with regard to the appropriate subject-matter of reading; throwing out, as well, some hints respecting the most advantageous methods of thus obtaining information.

Man, a being of superior creation, has a physical system whose object is not to grow and in course of time become the provender for some other creation; but it is the abode of a spiritual principle, called the "soul" or "mind." In this unity we view much that is incomprehensible: yet there are certain facts quite clear to the most superficial thinker—facts having an immediate bearing upon our subject.

The material becomes inanimate when separated from the immaterial. Neither can the immaterial accomplish anything in this world of matter apart from the material. In fact, the one—is the instrument; the other—the agent. The both united form the complete being, a being to whose wants and desires all terrestrial things are made subservient—not only in supplying the necessary food to sustain and develope his physical organization, but also to administer to the requirements of his mental system, by affording him subjects of thought and objects of contemplation. And here the indebtedness of the intellect to the body is perceivable. Every particle of information is received through the medium of flesh and blood. By the organ of sense, facts are discovered, premises are then recognized, and eventually either logical or illogical conclusions are inferred.

Much, therefore, may be learned by observation. But to become conversant with the customs, manners, and ideas of the people belonging to past ages, or of those contemporary with ourselves, yet inhabiting different portions of the globe, we cannot by personal observation. Verbal tradition would, in a measure, have obviated this difficulty with regard to preceding ages—yet with great uncertainty; for, oral narration is subject to much perversion—a second-hand story invariably differing more or less from the occurrence of which it pretends to furnish a correct statement. That the progression of civilization has, amongst other blessings, at a very early stage of the world's existence, produced the art of writing, and at a comparatively late period that of printing, are causes of hearty congratulation. The philosophers of old committed their ideas of nature and human nature to books of parchment; the rulers of the separate realms in antiquity had recorded the important events transpiring in connection with their individual states; the biographer of the brave Grecian or equally renowned Roman, has left in manuscript form the eulogism of his favourite hero. These have all been collated by the modern antiquarian, committed to press, and thenceforth is presented to the public the history of the human race from almost the first hour of its existence, containing, as such a history does, mines of mental gold and treasures of wholesome experience.

But leaving the historian to trace the rise, progress, decline, and fall of mighty empires, and the biographer to record the deeds of proud conquerors, let us observe the traveller. He is a man of education, possessed with wealth, and is of an enquiring mind, combined with physical energy. Thus with all the requisite advantages for a successful scrutiny of men and things, the company of such a man, whether at his own fireside or at yours, would not only be pleasant but instructive. The scarcity of such men, however, would debar the mass from their profitable society, were it not for book-making and book-reading. By this means, it is quite possible to become conversant with the habits and ideas of all existing peoples. And, indeed, this mode of being acquainted with what others have seen in foreign climes is far the most satisfactory. The author, because of the publicity given to his account,—partly from dread of criticism, partly from benevolent impulses, and partly from an ambition to accomplish something great in scientific research as well as in literary production,—prepares each sentence of his volume with fastidious precision, both with regard to the facts stated and the diction by which they are expressed.

Besides works of history, biography, and travel, there are any number of scientific volumes with which to employ the spare moments. Especially is this kind of literature suited to the mechanic; and the mechanic, who in preference devours the unnutritious novel to the slower mastication of the more strengthening food, will not only allow his mind to lose its wonted vigour, but also neglects the use of an essential means to success in his craft—the learning of new facts in chemistry, geology, mineralogy, and mechanics—wherewith he frequently is enabled to construct his machinery on improved plans, manufacture his wares with greater advantage to himself and increased pleasure to the public, and not unfrequently to invent articles and machinery of great economic value or usefulness.

Owing to the countless variety of reading-matter, discrimination must be exercised. Within the narrow limits of human life, especially as bounded by civilization, it is imprudent to investigate many subjects. Those who are benefitted the most, are they who adopt a system in the perusal of their books. If, reader, you are preparing yourself to enter a position which involves the assuming of weighty responsibilities—it may be the pulpit, the bar, the surgery, or the manufactory—to fulfil the duties pertaining to the office, you will require a well-stored memory, coolness of judgment, keenness of perception, promptitude of action, determined executiveness, and undaunted boldness of spirit. To obtain the first pre-requisite, study those works which furnish the knowledge peculiarly adapted to the proposed profession. Presuming that we are now writing to young ambitious mechanics, we would urge forward the claims of the Journal through whose columns we are now speaking. The articles it contains are carefully selected to suit Canadian circumstances, from the standard British and American scientific publications: and wherein they fail, the deficiency is made up by home contributions. Its pages will also excite a patriotism on behalf of native manufactures, by its accounts of the various exhibitions held here and elsewhere; also by the descriptions occasionally given of our large manufactories—those monuments to patient industry, which here and there are being raised throughout our land.

To strengthen the reasoning powers, we would strongly advise mathematics. Of course much time thus engaged would be incompatible with encouraging progress. But the working out of one problem, either arithmetical, algebraical, or geometrical, previous to each evening's reading, would engross only a few minutes, and would be found beneficial, in that, the mind working more systematically, the book is more thoroughly understood.

Few individuals make what may be designated complete use of the organs of perception—they have eyes untouched by disease, and ears unclosed by impediment; yet, so often do some of them employ these improperly, and others keep the doors of observation closed by listlessness, that when brought by accident in contact with the product of inventive genius, no impression is received as to the end for which the machinery was designed, or of its adaptation to that end. And also, in the company of scientific men, these classes—the one from the impurity of their motives, the other from sluggish perception—do not glean one practical truth to make them wiser and more useful members of society. Let the first be admonished to the cultivation of high and ennobling aspirations. Your wits may be the sharpest; but, unless their action is directed in a lawful channel, those bright talents will prove a curse rather than a blessing. The reading should be fact and not fiction. While this, as well as other kinds, may afford subjects of thought, it is stimulating to the passions and detrimental to self-control, the absence of the latter and presence of the former being your besetment.

To sharpen the blunted observation of the second class, perhaps, is a more difficult task than is generally recognized. It cannot be accomplished in a day. It is a gradual process of improvement, not always speedy in expansion, and which has neither beginning, proceeding, nor ending without the concurrence of the individual mind, for whose benefit it is proposed. Books of voyages and travels are eminently qualified to give a start. Enumerating scenes alike wonderful and curious, describing phenomena both of land and sea, and revealing the manners and customs of men belonging to other regions, they cannot fail to awaken powerfully the sleeping curiosity. The portfolio of the tourist thus becomes a flowery path, leading the passenger therein to an enchanted palace, in which he is both enraptured and instructed. To conclude this paragraph, it may be said that whether a man be endued with great observing powers or with diminutive, reading will increase their ability. Indeed, there are many things which we should pass by unnoticed, were it not for the wondrous revelations of the chemist and geologist. As it is, chemistry and geology continually ferret from apparent masses of worthlessness, what prove to be of invaluable worth in almost every branch of manufacture. By reading we find these things out, and are induced to analyse more minutely surrounding matter.

The other elements of character mentioned as necessary to success, viz., promptitude of action, determined executiveness, and undaunted boldness of spirit—must be acquired in youth. A crooked tree cannot be made straight; a twig is bent as you would have it grow. Now, as reading is the most popular, and, indeed, one of the most efficient agents of education, the culpable conduct of many parents and tutors in permitting their charges to follow the course of their own inclinations in the choice of literature, is inexcusable. Certainly, fairy tales, ghost stories, and love, blood and murder romances are none of them the best calculated to inspire with high and lofty purposes, courage of action, and successful execution of plans. Remember children have their schemes as have grown up folk, and as these schemes are carried out in childhood, so will the enterprizes of manhood commence and finish. Endeavour to cultivate in the family a love for history and biography. In particular, would we recommend to the workshop apprentice "industrial biographies," comprising the memoirs of men who have risen from obscurity to the height of eminence, through diligent painstaking in improving their minds, and determined manly zeal in the prosecution of all their projects. James Watt, the inventor of the steam-engine, Arkwright, the constructor of the spinning-jenny, and George Stephenson, the originator of steam locomotion by rail, are men of this stamp. In their careers, we perceive the fortitude of the arctic navigator, although not in the endurance of the frigid temperature of the northern zone, yet the equally piercing frost of poverty. The impulsive ardour of the private soldier was also displayed, as well as the far-seeing penetration of the commander; not in the arts of war, but in the more honourable avocations of peace. And they, with multitudes besides whose names create sensations of respect when mentioned, have won for themselves richer laurels than a Napoleon, and gained for themselves seats in the chambers of fame, elevated as those occupied by the most skilful statesmen.

In conclusion, we ask of our youthful readers a thoughtful meditation on the scattered thoughts presented, earnestly urging them to economise their time, without robbing themselves of healthy and essential recreation—by having a well-arranged plan of reading, such a plan as will most surely promise the attainment of the proper objects for which books ought to be printed and read.

Board of Arts and Manufactures
FOR UPPER CANADA.

THE FOURTH VOLUME OF THE JOURNAL.

This number completes the fourth volume of the journal. Many of our subscribers are in arrear, not only for the present, but for the past year. The smallness of the subscription charged, renders it of importance that prompt payment should be made, in order to enable the Board to to meet its engagements. It is particularly requested that all arrears due, and also subscriptions for the new volume, be at once remitted to the Secretary, either in postage stamps or otherwise.

As to the Journal itself, with the valuable selections from British and Foreign publications of articles and memoranda on *practical* subjects, which each number contains, we frequently receive from its readers and from the PRESS, the warmest commendations.

All persons engaged or interested in industrial pursuits, and who can recognise the advantages which a Journal of this character is capable of conferring, are invited to contribute any information or suggestions calculated to be of benefit to others similarly engaged, or of general advantage to the public.

Descriptions of new inventions or improvements, and wood-cut illustrations of the same, whenever furnished, and suitable for its pages, will be cheerfully inserted without charge; as also any descriptions of new or extensive manufactories, or processes of manufacture carried on in the province.

W. EDWARDS,

December, 1864. *Secretary.*

BOARD OF ARTS AND MANUFACTURES, UPPER CANADA.

Meeting of Committee.

The Executive Committee held a regular meeting on Thursday, 27th October, the members present being Dr. Beatty (president), Professor Hincks (vice-president), E. A. McNaughton, W. H. Sheppard, H. E. Clarke, R. J. Griffith, and H. Langley.

Minutes of former meeting being read and approved of, communications were read from the department of the Hon. the Postmaster General on the subject of postage rates on periodicals published in Canada and mailed to the United Kingdom; and also a department order (hereto appended) for future rates thereon; also communication from the Bureau of Agriculture, enclosing tables of imports of resin and turpentine into the United Kingdom, and copy of the index of registers of designs in the department of the Hon. the Minister of Agriculture, in accordance with Stat. 24th Victoria, cap. 21.

Answers to the above communications having been approved of, and accounts passed and other routine business transacted, the committee on EXAMINATIONS submitted a programme of examinations for 1865 (hereto appended).

The committee reported that as the programme of last year and the year previous had met with the general approval of the gentlemen who acted as examiners for the Board, they do not consider that any material changes therein are either necessary or desirable.

The report was adopted and ordered to be published in the December No. of the *Journal*, and also in *sheet form*, for more convenient circulation amongst Mechanics' Institutes and their classes.

The committee appointed at a previous meeting to consider the practicability of establishing a school of design in connection with the Board, presented the following Report:—

That they do not think the present income of the Board sufficient to sustain more than rudimentary classes for the study of drawing, and as the Mechanics' Institute here has already opened such classes at a low charge for the present season, it is not advisable now to engage in the work.

Your committee, however, in considering the subject, have felt that it is the duty of the Board to make some endeavour to promote the higher practical education of such of our artizans and mechanics as may desire it. It is well known that much labour and ingenuity is misapplied, and lost, by many enterprising artificers, for want of more correct and profound knowledge of the scientific principles which apply to their various pursuits.

There are at present no facilities for such persons to acquire an experimental knowledge of those principles of natural philosophy and chemistry which would be so useful to them. The great cost of teachers, apparatus and materials necessary to illustrate those subjects places the establishment of classes for their study out of the power of ordinary mechanics' institutes, and makes the private study of them very difficult. We therefore recommend that the Board should aim to establish a school, not of design only, but a general SCHOOL OF ARTS, wherein the principles of design, and the practical principles of the physical sciences shall be taught to the working classes.

We would, therefore, urge that an effort be made to induce the government to enlarge the endowment of the Board for that purpose, being sure that the comparative great work it is now carrying on with its small allowance, will be a guarantee that any further means which may be placed at its disposal will be economically and beneficially used.

In order that the enterprise may be presented in a tangible form, and in hope that it may be inaugurated the next season, we recommend that a committee be appointed at once to report a plan for such a school, and an estimate of its probable cost.

All which is respectfully submitted.

W. H. SHEPPARD.
HENRY LANGLEY.
HENRY E. CLARKE.

Board of Arts and Manufactures for U. C.,
October 27, 1864.

Moved by Mr. McNaughton, seconded by Prof. Hincks, and

Resolved,—That the report just read be adopted, and that the same committee, Messrs. Sheppard, Langley and Clarke, be appointed to prepare and report a plan and estimate for the proposed school, as recommended in the report.

The decreasing interest apparently manifested by the leading manufacturers, in several classes of the Arts and Manufactures department of the Provincial Exhibition, was the next subject of discussion. It was finally moved by Mr. Sheppard, seconded by Mr. Griffith, and

Resolved,—That Prof. Hincks, Mr. McNaughton, and the mover, be appointed a committee to consider and report as to any improvement that may be desirable in the system of awarding prizes in the Arts and Manufactures department of the exhibition; and also as to the reception and classification of goods, and admission of the public during the time the judges are engaged in the important duty of making their awards.

The meeting then adjourned.

W. EDWARDS, *Secretary.*

Department Order, No. 59.

POST OFFICE DEPARTMENT,
QUEBEC, Sept. 5, 1864.

Periodicals passing by Mail in Canada.

1. The rate on all Periodicals, other than Newspapers, passing by mail in Canada, save such as may be addressed to or received from the United Kingdom, and such as are exempted from postage by Statute, will henceforth be one cent per 4 oz. weight of package containing periodical matter, whether the package contain one or more numbers.

2. Any fraction of 4 oz. to be charged as a full rate.

3. On periodicals posted from the office of publication, or by News Agents or Booksellers, to regular subscribers *within the Province*, this rate may remain to be collected on delivery, and must in such cases be marked upon the packages and charged in the Letter Bills, but when mailed to go out of the Province such Periodical matter must be prepaid by Postage Stamp. British and United States Periodicals may be posted in Canada by News Agents and Booksellers to regular Subscribers in the Province under this regulation.

4. Transient Periodical Matter posted in Canada must in all cases be prepaid by Postage Stamp.

5. The above rate will be payable *on delivery* on all Periodical matter received from the United States, except that Canadian Editors may receive Exchange Periodicals from the United States free of Canadian Postage.

Canadian Periodicals posted for United Kingdom by Canadian Packets.

6. Periodicals, printed and published in Canada, may be posted addressed to any place in the United Kingdom *by Canadian Packet*, on prepayment by Postage Stamp of two cents each number.

7. This rate will be applicable to all classes of Canadian Periodicals posted as above for the United Kingdom, the exemption to which certain classes of Canadian Periodicals are entitled, extending to such numbers only, as are addressed from the Office of publication to places within the Province.

(Signed) O. MOWAT,
Postmaster General.

ANNUAL EXAMINATION OF CANDIDATES.

This Board will hold its 3rd annual examination of members of the various Mechanics' Institutes in Upper Canada, under the rules and restrictions hereafter laid down; the object of such examination being to encourage, test, attest and reward efforts made by the industrial classes for self-improvement.

This examination will be open to all members of incorporated Mechanics' Institutes or Library Associations in Upper Canada, who are not students of any college, graduates or under-graduates of any University, or certified school teachers; or who are not following any of the learned professions.

Copper-plate certificates of three grades, printed on parchment for pocket use, or reference, will be awarded to successful candidates; indicating, respectively, "Excellence," "Proficiency," and "Commendableness." A beautiful lithographed Diploma, for framing, will also be awarded to holders of first and second class certificates.

The Board invites the attention of the managers of the respective Institutions to the annexed programme, and solicits their earnest co-operation in carrying it out.

PROGRAMME.

Local Committees.

1. The Managers of Mechanics' Institutes and Library Associations desirous of co-operating with this Board, in promoting the education of such of their members as have not been able to avail themselves of the benefits of academical instruction and distinction, but who are now willing to engage in classes or evening schools, or other means of self-improvement, are invited to form local committees for the purpose of organizing and superintending classes; for conducting the necessary preliminary examinations; and to assist and co-operate with the examiners appointed by the Board. Each local committee must consist of at least three members, and should be composed of such persons as would give their time and earnest attention to the subject.

Preliminary Examinations by Local Committees.

2. The local committees will conduct the preliminary examinations of their own candidates, and also supervise the working of papers which the examiners appointed by the Board will set for the final examination.

3. No candidate will be admitted to the final examination without a certificate from his local committee, that he has satisfactorily passed its preliminary examination in the subjects in which he wishes to be examined by the Board.

4. The preliminary examinations by the local committees may be either wholly written, or partly oral and partly written, as each local committee may think best; and must be held sufficiently early in the year to allow the results to be communicated to the Secretary of this Board on or before the first day of May, 1865.

5. The "pass" to the final examination should not be given to any candidate, however meritorious, whom the local committees consider not to have a reasonable chance of obtaining certificates from the Board.

Final Examination by the Examiners appointed by the Board.

6. Forms containing the names of the candidates "passed" by the local committees, and the subjects in which they wish to be examined, must be returned to the Secretary of the Board not later than the first day of May, 1865.

7. The examiners appointed by the Board will set the requisite papers for the final examination,

and these will be forwarded to the local committees. The local committees will see, and certify to the Board, in the form which the Board will furnish, that the papers are fairly worked by each candidate without copying from any other, and without books or other assistance; and will return the worked papers to the Board.

8. The final examination will be conducted by the means of printed papers.

9. The Examiners will award certificates of three grades, but certificates of the first grade will be awarded only to a high degree of excellence.

10. The final examinations will be held simultaneously on the days, and at the hours specified in a time-table, to be hereafter furnished, but not later than the first week in June, 1865, and at those institutions where local committees are established.

11. Judgment will then be passed by the examiners appointed by the Board, and the awards of certificates will be communicated to the respective local committees.

12. In appointing the following subjects for the final Examination in 1865, it is suggested to pupils that they confine their attention to the subjects as tabulated; but it is not the intention nor the wish of the Board to limit their studies to any of the branches embraced in particular groups.

1.	I.	Arithmetic.
	II.	Book-keeping.
	III.	English Grammar and Analysis.
	IV.	Geography.
	V.	Penmanship.
2.	VI.	Algebra.
	VII.	Geometry.
	VIII.	Principles of Mechanics.
	IX.	Geometrical and Decorative Drawing and Modelling.
	X.	History.
3.	XI.	Trigonometry.
	XII.	Mensuration.
	XIII.	Practical Mechanics.
	XIV.	Conic Sections.
	XV.	Chemistry and Experim'l Philosophy
	XVI.	Geology and Mineralogy.
4.	XVII.	Animal Physiology and Zoology.
	XVIII.	Botany.
	XIX.	Agriculture and Horticulture.
	XX.	Political and Social Economy.
5.	XXI.	English Literature.
	XXII.	French.
	XXIII.	German.
	XXIV.	Music.
	XXV.	Ornamental and Landscape Drawing

To indicate the portions of the subjects that will be taken in the examination, certain text-books are suggested for several of the departments. In other departments, where no text-books are named, the treatises in general use in the schools and colleges in Upper Canada are recommended; but it is distinctly to be understood, that in so doing no opinion is pronounced as to their comparative merits. Real knowledge, however or wherever acquired, will be accepted, and the exposition of a subject in the candidate's own words will be preferred by the examiners.

I. Arithmetic.

Fundamental rules of Arithmetic; Proportion, Simple and Compound; Practice; Interest; Fractions, Vulgar and Decimal; Extraction of Square and Cube Roots.

The Examiners will take into account not only the correctness of the answers, but the excellence of the method by which they are worked out, and the clearness and neatness of the working (which must always be shown.)

II. Book-keeping.

Book-keeping by Single and Double Entry; Drafts of the various forms of Bills of Exchange, Promissory Notes, Invoices, &c.; and an accurate knowledge of the various books used in the counting-house.

III. English Grammar and Analysis.

Grammatical Analysis of Sentences in Prose and Poetry; Composition on a given subject.

IV. Geography.

Political Geography. General Questions in Ancient and Modern Geography; Maps drawn from memory; Explanation of Geographical Definitions; Mathematical Geography; Physical Geography; Outlines of Physical Geography.

V. Penmanship.

Business Hand. An even round hand, without flourishes, will be preferred.

Specimens to be selected by the local committees, and forwarded to the Board, on the same conditions as specimens in department IX.

VI. Algebra.

Algebraic Fractions, Square and Cube Root, Simple and Quadratic Equations, Single and Simultaneous, Ratio and Variation. Candidates should be prepared to give explanations of Elementary Principles and proofs of Fundamental Propositions.

Text Books.—Colenso's Algebra or Bridges' Algebra.

VII. Geometry.

A facility in solving geometrical theorems and problems, deducible from the first four books of Euclid, will be expected on the part of those who desire to obtain certificates of the first or second class.

Text Books—Euclid, Books I, II, III & IV.

VIII. Principles of Mechanics.

The Properties of Matter, solid, fluid and gaseous.

Statics: The composition, resolution and equilibrium of pressures acting on a material particle; constrained particles; machines; attractions.

Dynamics: gravitation; collision; constrained motions; projectiles; oscillations.

Rigid Dynamics: Motion of a rigid body about a point; of a free rigid body; of a system of rigid bodies.

Hydrostatics: Pressures of fluids; equilibrium of floating bodies; specific gravity; elastic fluids; machines; temperature and heat; steam; evaporation.

Hydrodynamics: Motion and resistance of fluids in tubes, &c.; waves and tides.

Pneumatics: Mechanical properties of the air; the barometer.

Text Book—Silliman's Natural Philosophy.

IX. Geometrical and Decorative Drawing and Modelling.

Orthographical Projection, or Geometrical Drawing, of Architectural or Engineering subjects, Machinery, &c.

Linear Perspective.

Original Designs.

Models of figures, groups, foliage, &c., connected with the Fine or Decorative Arts.

The local committees will select, and forward to the Board, such specimens of Drawing and Modelling as they may deem worthy, and which they shall certify to be the work, solely, of the candidate named, who may not be an artist by profession.

X. History.

Outlines of Greek and Roman History; English History from the Norman Conquest; Canadian History.

XI. Trigonometry.

In Plane Trigonometry, the solution of plane triangles, and the use of logarithmic tables, &c.

Spherical Trigonometry, Napier's Rules, Solution of Spherical Triangles.

XII. Mensuration.

The calculation of the areas and circumferences of plane figures bounded by right lines or arcs of circles. The superficial and solid contents of cones, cylinders, spheres, &c. Measuring and estimating artificer's work.

XIII. Practical Mechanics.

The Application of the Principles of Mechanism to Simple Machines. The Steam Engine.

Text Books—Lardner on the Steam Engine; Nasmyth's Elements of Mechansim, with Remarks on Tools and Machinery (*Weale*); Bourne's Catechism of the Steam Engine.

XIV. Conic Sections.

Analytical Conics, including the equations of the straight line, the circle, the three conic sections, and the general equation of the second degree. The Principles of Projection, Orthogonal and Central.

XV. Chemistry and Experimental Philosophy.

Physical. Elementary laws of heat, light and electricity, in connection with chemical action.

Inorganic. Chemistry of the Metalloids and Metals, laws of combining proportions, volumes of gases, vapours, &c.

Organic. Composition, properties and decompositions of alcohols, acids, &c.

Candidates are expected to be able to explain decompositions by the use of symbols. Questions illustrative of general principles will be selected from the following amongst other trades and manufactures; Metallurgy of Lead, Iron and Copper; Bleaching, Dyeing, Soap-boiling, Tanning; the manufacture of Coal Gas, Sulphuric Acid, &c.

Text Books—Fowne's Manual of Elementary Chemistry; Croft's Chemistry (*Maclear & Co.*); Elements of Chemistry (*Chambers' Educational Course*); Tyndall's Lectures on Heat.

XVI. Geology and Mineralogy.

The properties and distinctive characters of the commonly occurring Minerals and Metallic Ores; the structural characters, conditions of occurrence, and classification of Rocks generally.

Text Books—Dana's Manual of Mineralogy, and Dana's Geology.

XVII. Animal Physiology and Zoology.

The general principles of Animal Physiology. Practical application of them to health and the wants of daily life.

Text Books—Agassiz & Gould's Introduction to Comparative Physiology; Paterson's Zoology; Carpenter's Animal Physiology, 1859 (*Bohn*); Lardner's Animal Physics (*Walton & Maberly*).

XVIII. Botany.

Vegetable Physiology. Classification of Plants: Leading principles of Morphology; Scientific and applied Botany.

Text Books—Gray's First Lessons in Botany; or George Bentham's Outlines of Botany.

XIX. Agriculture and Horticulture.

Theory and Practice of Agriculture and Horticulture.

Text Books—Johnston's Elements of Agricultural Chemistry and Geology; Youatt's Treatises on the Horse, Cattle, Sheep and the Pig; Sipson's Agricultural Chemistry; Buist's (Robt.) American Flower Garden Directory; and Family Kitchen Gardener; P. Barry's Fruit Garden; and Smith's (C. H. J.) Landscape Gardening, &c.

XX. Political and Social Economy.

A general knowledge of the Commercial, Financial and Statistical History of the United Kingdom and of Canada, will be required.

XXI. English Literature.

Shakspeare's "Tempest;" Milton's "Paradise Lost," Books I & II; Spencer's "Faerie Queen," Book I; Cowper's "Task;" Pope's "Essay on Man;" Wardsworth's "Excursion," Books I & II; Macauley's "Essays;" Bacon's "Advancement of Learning," Book I; Addison's "Spectator;" Johnson's "Rambler;" Craik's "History of the English Language;" Trench on the "Study of Words."

N. B.—Candidates may select any two of the authors in the above list.

Candidates are recommended to make a very careful study of the text of the authors they may select. The questions on each author will be divided into two sections, the first intended to test the candidate's acquaintance with the text, the second his knowledge of the subject matter, and his critical and literary information. Full marks will not be given for answers to the second section, if those to the first section do not prove satisfactory.

XXII. French.

Questions on any portion of the French Grammar (To be answered in French, if possible), and an extract from a contemporary French writer to be translated into English.

An English extract to be translated into French, and a list of idiomatic expressions to be rendered from French into English, or *vice versa*.

XXIII. German.

Schiller's "Wilhelm Tell." Grammatical and Critical Analysis of.

Goethe's "Iphigenie Auf Tauris."

Goethe's "Egmont."

Composition on a given subject.

Pieces from each of the above works will be given for translation. Every candidate must translate one piece. First class certificates will be given to those only who translate well from English, and write in German a good Essay relating to German History since the Reformation.

XXIV. Music.

Theory of music. Notation, the modern modes, intervals, time, signatures, the stave, transposition, modulation, terms and characters in common use.

Elements of Harmony.

Arrangements must be made in the previous examinations, by the local committees, to test candidates by oral examination, in their knowledge or appreciation of the sound of musical successions and combinations. A form of the test to be used for this purpose by the local committees, at the previous examinations, will be sent by this Board to such local committees as may apply for it, in due time before the examination.

XXV. Ornamental and Landscape Drawing.

Ornamental Drawing of Natural or Conventional objects.

Landscape Drawing in pencil, crayon, water colours, or in oil.

Specimens to be selected by the local committees, and forwarded to the Board, on the same conditions as specimens in department IX.

Terms of Admission to the Final Examinations.

13. Every candidate for examination must be "passed" by a local committee, and must be a member of, or student of a class in, an Incorporated Mechanics' Institute or Library Association in Upper Canada.

14. The examinations will be held at the rooms of the respective institutions reporting candidates. Instructions as to the particular evenings upon which the respective subjects will be taken up, and all the necessary forms for returns to the Board, will be furnished by the secretary of the Board, so soon as candidates are reported by any local committee.

TORONTO MECHANICS' INSTITUTE.

The Toronto Mechanics' Institute has now in operation classes for the study of Arithmetic, Book-keeping, English Grammar and Analysis, Penmanship, Geometrical Drawing, Ornamental Drawing, and the French Language, comprising in all 108 pupils. The term for instruction is five months, each class meeting twice a week.

Selected Articles.

MACHINE TOOL-MAKERS.

If we trace back the history of what may be termed machine tools, we shall find that they owe their birth to the patent lock. When Bramah, at the latter end of the last century, turned his attention to the improvement of the tumbler lock, he found that the most skilled hand-labour of the day was incapable of turning out the precise and beautifully executed work needed, and even if it had, the expense would have been so great as to preclude its becoming an article of general sale. In order to accomplish his task, it was necessary to invent special tools, many of which were of a self acting character, and all possessing a delicacy of application, and an accuracy and speed of working which left far behind the efforts of the most cunning hand. From the workshop of this ingenious engineer it may be said that the mechanical greatness of England took its rise. He it was who fostered the latent skill of the young smith, Harry Maudslay, and strengthened the passion of Joseph Clements for accuracy of work. Giving, as we must do, Bramah the credit of being the first great tool-maker, yet we feel that it was to Henry Maudslay we owe the vast merit of raising a race of machinists—for the term tool-maker is, we think, too insignificant—who have made England famous among nations. We shall be better able to appreciate the merit of the master, Bramah, and his man, Maudslay, when we remember what William Fairbairn has said, that when he began life, at the commencement of the present century, *the human hand performed all the work that was done.* And how it was performed, we have the testimony of Watt, who experienced the greatest difficulty in getting work executed, where an almost mathematical accuracy was demanded. It was a mercy for mankind that he was able to finish the first working model of his steam-engine, so utterly impossible was it to get the steam-cylinder turned with any approach to truth.

Henry Maudslay, when a smith in the Arsenal at Woolwich, was invited by Bramah, who had heard of his ability, to enter his service. The youth, for he was only eighteen at the time, adopted a very characteristic method of giving his new master a taste of his skill. Pointing to a worn-out old vice in the workshop, he asked if the fact of his being able to renew it in the course of the afternoon would be considered his diploma of proficiency; this being agreed upon, he immediately set to work; before the appointed time the vice was as good as new, and he gained at once a first-rate position in the shop.

Whilst a journeyman with Bramah, he invented the famous slide-rest, the prolific parent of a whole race of labor-saving machines of the present day—the slotting machine, the planing-machine, and many others, all tracing their parentage in this simple contrivance. Before its invention, the turning-lathe depended for the accuracy of its work entirely upon the muscles of the workman. If, in turning a cylinder, for instance, the tool at one moment cut deeper than at another, by reason of the workman bearing more heavily upon it, the whole work had to be gone over again. The slide-rest, by substituting a fixed tool for one guided by the human hand, at once abolished the possibility of these inaccuracies, and inaugurated the reign of that mathematical truth in workmanship without which great machinery cannot work.

After Maudslay left Bramah, he set up a little shop of his own, first in Wells street, then in Margaret street, Cavendish square, where he was found out by the elder Brunel, and employed to construct the famous block machinery at present in use in Portsmouth Dockyard. His power of generalizing from a few hints was strongly exemplified in the intercourse between the young inventor and this rising young machinist. Brunel, with that fear all inventors have of disclosing their designs prematurely to others, was in the habit of taking drawings of fragments of the proposed machinery to Maudslay for his inspection, without mentioning the real nature of the work he wished accomplished. At the third visit, however, Brunel was surprised to hear the young workman say: "Ah, now I see what you are thinking of, you want machinery for making ships' blocks." These machines, which were the first labor-saving works set up in our public establishments, at once evidenced the enormous amount of productive power the country had acquired.

There is scarcely a contrivance in use among modern machinists which cannot find its origin in this series of engines, for they number forty-four, at work nearly sixty years ago, and at present in excellent condition and in full employ. These machines, with the aid of ten men, do the work that formerly occupied one hundred, and, moreover, they do it infinitely better. The only wonder to us is, that, the vast superiority of these machine-tools having been thus tested at so early a date, their use did not more rapidly increase; but there are pauses, for some unaccountable reason, in all revolutions, and it was full thirty years from the date of this invention before the full tide of labor-saving appliances began to be felt.

The punch by which thick plates of iron are pierced for riveting was another of his inventions, by which greater accuracy is gained and an immense amount of labor is saved.

When Maudslay left Margaret street, in 1810, he removed to the site of an old riding-school in Lambeth Marsh, and there founded together with his partner, Mr. Field, the world-famous establishment of Maudslay and Field. Mr. Smiles has remarked, with great truth, that the shop of Maudslay and Field gave a stamp to the workmen who labored in it, just as the Universities of Oxford and Cambridge give their peculiar impress to their respective students—an impress which never leaves them. Like Mr. Penn, the great marine engine-maker, Maudslay "could not afford to turn cut anything but first-rate work;" and this accuracy and perfection of finish has been passed on to other shops by means of the Nasmyths and the Whitworths, who learned their art under him. In short, Maudslay was to his "hands" under him what Dr. Arnold was to his boys, a presiding spirit, whose teaching made a lasting impression upon all those with whom he came in contact. It was his habit to enter his workshops when the men were absent, and carefully to note every man's work whilst in progress at the bench; he used to make his remarks with a piece of chalk, sometimes in terms of approbation, but sometimes sharply and tersely, if reproof were needed. When the men returned to the shop, the reading of the master's eye was thus set plainly before them, and caused no small excitement.

To the last this admirable artist, for we can call him by no meaner name, was fond of working at his craft. He had a beautifully fitted up little workshop, in which he used to employ himself, and Mr. Nasmyth, his pupil, used to observe, that he never enjoyed anything so much as to get an opportunity of having a "go in" with hammer and anvil at the pieces of soft lead he kept to work out any design he had in his mind. Henry Maudslay was, in fact, as great an artist in practical machine-work as Quentin Matsys was in ornamental iron-work, and the "presence" of the one was as marked as that of the other in every bit of work he did.

The example he set of exquisite work made a lasting impression, and in the history of manufacture there is nothing an Englishman should be prouder of than the character of the machinery it produces. Those who carefully inspected the machinery department of the late International Exhibition could not help being struck by the beauty, accuracy, and solidity of the English workmanship, when compared with the flimsiness and want of finish of the French and Belgian productions. We may be thought fanciful, but to us there is something awe-inspiring in the inevitable regularity of a vast machine of English work, and there is an expression of calmness in its irresistible action which reminds us of the presence of some fate; look down the hold of the *Great Eastern*, good reader, at her engines when she is in motion, and you will doubtless feel the full force of what we say.

Another great mechanic, bred in the school of Bramah, and afterward in the employ of Maudslay and Field, was Joseph Clements. He lays claim to have made the first machine for planing iron. There have been more disputes respecting the parentage of this machine than perhaps any other; but Clements's machine, which was finished in 1825, was certainly the earliest in action, and in the metropolis it did the whole work of the trade for many years. The value of a machine which can produce a true plane is incalculable. Indeed, Whitworth has written a treatise upon it, as a standard of reference in mechanical productions. Before the planing-machine came into use, true planes were approximated, for they could not be wholly obtained, by means of chipping and filing. Clements's machine, however, at once superseded that method, and for some years, Mr. Smiles informs us, his income mainly depended upon the earnings of this iron planer, which never ceased working night or day, and earning for its master as much as £10 for every twelve hours' work. In every machinist's shop is now to be seen this beautiful tool, cutting a long narrow ribbon of metal with its keen tooth, producing the most perfect work, and tended in many cases only by a lad. Clements, in consequence of the great fame he had acquired for accuracy of work, was sought by Professor Babbage, to construct the famous calculating machine. This extraordinary work, after progressing for some years, was however, discontinued by Government, and it remains a magnificent fragment of mechanical skill. The working drawings, we are told, of the calculating machine alone, irrespective of the printing machine, which was equally elaborate, covered no less than four hundred square feet of surface. The apparatus was intended to calculate with unerring accuracy, and this it is fully equal to accomplish, for when through any cause an error has been made, it actually reverses its action, and, to use Mr. Smiles's expression, "rubs itself out." Although this machine was never finished in England, Messrs. Scheutz, of Stockholm, after twenty years' labor, completed this extraordinary combination of what may be almost termed "thinking iron," and it was first displayed in the Paris Exhibition of 1855. Although the work was completed by foreigners, it was done from the English drawings; therefore the merit is wholly due to Babbage and Clements. Our own Government have procured a copy of this machine, and it is now in actual use at Somerset House, working out annuity and other tables for the Registrar-General, possibly calculating our mortality tables—a dead piece of machinery counting up our dead men—a most appropriate occupation. Clements followed the lead of Maudslay in reforming a very important detail in mechanism. Before the time of these thoughtful workmen there existed no regularity with respect to those all-important parts of mechanism, screws and nuts. Every maker suited his own fancy with regard to their construction, and there was no such thing as uniformity with respect to the pitch of the screw. The consequence was, that on taking a machine to pieces for repair, the screw-hole had to be drilled out and re-cut, so as to suit the thread used in the shop. The great expense and loss of time caused by this arrangement led Clements to the conclusion that the number of threads should be settled according to the length of the screw. He did this, and constructed a screw-engine lathe to do the work before accomplished by hand. This plan the trade ultimately accepted, and now there is no more trouble about this very important implement which holds machinery together. Clements did his work thoroughly, but he would have his own price for it; like Mr. Penn who could not afford to turn out imperfect work. His screws were constructed with mathematical accuracy, but they were unfortunately costly. A story is told of his having received an order from America to make a large screw "in the best possible manner." The work was accomplished with great care, and the American was astonished to find a bill for several hundred pounds for the work done; the matter was referred to arbitration, and of course the case went in favor of the machinist. It may be interesting to the public to know that Clements is the inventor of the too effectual steam-whistle of our locomotive. Brunel the younger, being dissatisfied with the performance of the earlier whistle employed, asked Clements to construct one for him. It was made, and answered but too well; but Clements made the engineer pay for his whistle to the tune of £40 each, and unfortunately, before the terms were known, a hundred had been ordered.

James Nasmyth, the Thor of the present age, was brought up under the immediate eye of Maudslay, and perhaps was more intimately associated with him than any other person, for he was the assistant appointed to take charge of the great machinist's own particular workshop, and the pupil has done credit to the master. Nasmyth, unlike the other great machinists, was by no means a self-made man, at least as regards his education, as he was the son of the Alexander Nasmyth, of Edinburgh, whose landscapes have charmed us all; moreover, he was a scientific man, and his son therefore started in life with hereditary ability. Nevertheless, he fought his way up as a great smith unaided. His first employment was as an assistant in Maudslay's beautiful little workshop at ten shillings a week; and in the establishment of this famous firm he learned his art. Nasmyth's fame rests mainly upon his steam-hammer, a tool without which modern forgings could not be accomplished. Indeed, it was in consequence of the demand for such a Cyclopean instrument that it was produced, and it is a singularly apposite example of the manner in which great works sometimes produce great tools, as surely as great tools lead to the production of mammoth works. When the *Great Britain* steamship was being constructed, it was at first intended that she should have paddle engines: such were accordingly designed for her by the late Mr. Humphreys. the paddle-shaft, however, was to be of such enormous proportions, that no forge in the kingdom was capable of turning it out. In this difficulty Mr. Brunel was forced to apply to Mr. Nasmyth to aid him with his advice. Mr. Nasmyth's reply was a sketch made on the spur of the moment of his famous hammer, and returned by post that night. Unluckily, it was determined to change the paddle for the screw, and the paddle-shaft therefore was never required.

The great hammer accordingly remained a dream upon the paper, as far as its inventor was concerned, for strangely enough none of the great iron-founders would have anything to do with it. Some time after, when on a visit to a celebrated foundry in France, Mr. Nasmyth was shown an enormous piece of forged work; curious to know how such an unusual size had been accomplished, he asked the question of the director of the works. "Why, with your steam-hammer, to be sure," was the instant reply. The Frenchman had been shown the drawing by Nasmyth's partner at the time it was made, and with a keener appreciation of its value than was evinced by the English machinists, he determined to have one made. This was certainly an instance but little in accord with the English manufacturer's boast, "that if not the first to invent, he is the first to see the value of the inventions of others," for, with a demand for gigantic forgings far beyond what exists in France, we yet allowed our friends on the other side of the water to steal a march upon us. However, the steam hammer is now in common use, and year by year it is assuming larger proportions. The effect of its introduction is the vast increase of the size of the forgings, now so easily accomplished, and the consequent enormous development of the proportions of our machinery; in fact, there is no limit now to the size of the engines that can be produced, or to the power that the use of this simple instrument has placed in the hands of man. Without it, we should have had no armor-plated ships of war, no great engines for their propulsion, no enormous works in iron of any kind such as have marked the last dozen years, and have at once elevated men, mechanically, from mere pigmies to a race of giants.

One of the most useful applications of the principle of the steam-hammer is to pile-driving. We well remember, years ago, watching a party of twenty men at this work on the quay at Rotterdam

—and the Dutchmen should know something about the operation. This was performed by the ordinary monkey, which rises and falls every three minutes. Now by the use of Nasmyth's steam pile-driving machine, a pile can be driven in *four* minutes as deeply as by the old method it could be in twelve hours! The steam-hammer sits on the shoulders of the pile like the Old Man of the Sea, adding its dead weight to its lively taps at the rate of eighty blows a minute! In consequence of this rapidity of action, works of reclamation from the sea, before undreamed of, will be effected; and an immense impetus will be given to all building works constructed on unstable ground.

But the hand of Nasmyth can not only thunder like that of Thor, but can work with the grace and delicacy required in the finest art. He is an admirable painter—a gift which seems to be inherent in his family—as shown by the pictures by his pencil, exhibited at Pall Mall, with other amateur works, for the relief of the Lancashire distress; and since his retirement from his profession, he has turned his attention to astronomy, and with a telescope of his own manufacture, made the discovery of bodies on the face of the sun of the shape of a willow leaf, which are now believed to be the source of light and heat.

Perhaps the most scientific of the race of machinists formed in the establishment of Maudslay, Field and Co., is Joseph Whitworth, whose fame as a tool-maker is known throughout the world. He has considerably improved upon the planing machine, in his "Jim Crow" machine, so called because the cutter reverses itself and works both ways, and in fact adapts itself to any position to do its work. His name is, however, more identified with rifled ordnance and small-arms, in the production of which he has no rival. The passion for accuracy of work which was instilled into him by his old master, has led him to invent various machines for the attainment of that end; among others, he has devised a contrivance by which a variation of a millionth of an inch can be detected! In fact leviathan engines of all kinds are turned out by him which work with all the precision of a chronometer; and the value of this accuracy of practice is not confined to his workshop, as it extends its influence throughout the profession, and establishes a standard of excellence to which other machine manufacturers, if they would flourish, must also attain. What a contrast does the work of the mechanists of the present day present to those of a hundred years ago! At that time, as Mr. Smiles observes, an engine of any size, when once erected, required the constant attention of the engineer, who almost lived beside it, in order to keep it in working order, such was the friction of its parts and the clumsiness of its construction. At the present time, however, almost absolute perfection of working is obtained. When the five thousand different pieces of the marine engine designed for the *Warrior* were brought together from the different shops of the Messrs. Penn, although the workmen who built them up had never seen them before, yet such was the mathematical accuracy of their fit, that immediately steam was got up they began working with the utmost smoothness. As a new-born child, immediately it enters the world and expands its lungs, begins to stretch its limbs, so this gigantic engine, as soon as steam began to expand in the cylinder, at once exerted its huge members with the smoothness and ease of a thing of life.

It would be impossible to estimate the gain to the country brought about by the self-acting tools now coming constantly into use. If we had to depend upon the old hammer and file, and chisel and gauge, it is questionable whether our mechanical art could keep pace with the requirements of our rapidly increasing population; and commodities of all kinds that spring from the skilled hand would soon reach a fabulous price. Now it is the brain that works; the mechanician in his study increases a thousand-fold the fingers of the seamstress with his sewing-machine, builds fleets of boats (by the American patent) in as many days as the old boat-builder would have formerly taken years, and manufactures rifles—stock, lock, and barrel—without human fingers coming in contact with them after the wood and iron are carried into the workshop. Perhaps the Government manufactory of rifles at Enfield is one of the most perfect marvels of labor-saving machinery in existence; and the hundreds of machines which go to build up this most perfect military tool of the day, have an automatic action so perfect, and bite, cut, file, drill, and plane, with such marvellous intelligence, quickness, and care, that one cannot for a moment help thinking that the human hand is after all a very slow invention, and not at all up to the work demanded by the present age. Yet these unerring digits, which now do our daily work, were not in existence sixty years ago, and our ten fingers were the slaves that accomplished every stroke of work. As regards our mechanical appliances, at least, the present century has lifted us from a condition but little superior to that of barbarians to a pitch of excellence which seems almost divine. But for the marvels accomplished in this direction, we must refer the reader to Mr. Smiles's very interesting "Industrial Biography," to which we are indebted for many facts in this article.—*Once a Week.*

AMATEUR ENGINEERING.

A somewhat humorous lexicographer once defined man as an animal which carries a stick. The definition was witty, but incorrect, Ourang-outangs carry sticks, but they are not therefore men. Another definition was imperatively required, and this time man was defined as an animal who makes bargains. This leaves little to be desired, and yet we propose a third definition. Man is an animal which invents, and in this fact really lies perhaps the great superiority of the genus *homo* over all other created beings. The faculty, too, is possessed by every tribe or nation upon the face of the earth; it is absolutely independent of civilization, being an inborn and inherent attribute, planted in the human breast by the Deity. The operations of the mind bear little relation to the magnitude of the object on which they are exerted. The brain thinks, practically without regard to the results following on thought, and, as far as it is concerned, there is nothing either too great or too little for it to work upon. In other words, there was just as much labour involved in determining the means by which the eye could be formed in a needle, as can be expended in arranging part of the plan of a great campaign. Provided a man thinks his hardest, it is a matter of little importance to his powers of ratiocination on what that act of thinking is exerted. The steam generated in a boiler causes the revolution of a wheel, and this revolution again may perchance cause the propulsion of a locomotive engine, or it may enable a steam ship to cross the broad Atlantic, or it may give motion to the thousand spindles of a cotton mill. The power originally lies in the fuel, and it is produced by the act of combustion without any regard to the purpose to which it is subsequently applied. The revolving wheel knows naught of the work it does. The burning coal will burn equally whether the steam blows to waste through the safety valve, or finds its way to the cylinder; and thus it is with thought, and above all inventive thought. The magnitude of the results produced, bears no relation other than one of haphazard to the amount of mental labour expended upon them. Physiologists tell us that there is just as much mental energy, as measured by the waste of the tissues, expended in debating what we shall have for dinner to-day, as in working out any other problem, be it an item in the budget, or a point of detail in the design for a great marine engine, and we are not disposed to differ from these gentlemen. We do not of course wish to imply that in the operations of daily life, the gentleman who lives at home at ease on his own income, works his brain as hardly as the student reading for honours, or the statesman preparing his speech for the House. All we wish to convey is that, so long as thought is exerted to the fullest, the labour involved in no way depends on the object on which it is exerted for the time being; and thus it happens that the abilities of the engineer or the mechanician are not to be measured by the mere magnitude of the works he produces. The inventor of the chronometer escapement is not a whit behind James Watt, the inventor of separate condensation. The results which have followed on the labours of each differ in their importance because the principle of separate condensation is practically more generally useful, and has contributed more to the common good than the principle of the detached escapement; but it requires no very profound speculation to perceive that this result is wholly independent of the amount of mental labour expended by James Watt and by Harrison, in carrying out their respective ideas, and, therefore, we are correct in stating that equal praise is due to each man as an inventor.

In every civilized nation may be found a numerous body of men, whom we may for the nonce style amateur engineers. These men regard the act of inventing as the great object of their lives, and, in a modified sense, Sir William Armstrong's far from elegant simile is applicable to them: "They can no more help inventing than a hen can help laying eggs." Of course we might draw a great many distinctions, as, for instance, between the individual whose proximate motive is the love of science, and he who invents because he expects to make a fortune. We do not, however, mean to have anything to do just now with these. We shall speak merely of the community—for so we may term it—as a whole, as a corporate body, working very hard indeed for its own, and intentionally, at least, for the public good. It matters nothing that some of its members devote themselves to civil, others to mechanical engineering, others, again, to inventions in natural philosophy—we use the words in the widest sense—all alike work, and experience all the miseries of wrath and tribulation because they are not appreciated by an ungrateful world. Unfortunately for the inventor, however, there is a great deal to be said on both sides, and as many amateur engineers read our pages, we trust that a word in season may prove both useful and comforting.

The true amateur engineer is unsuccessful as a rule, simply because he regards every subject from but one point of view, and that his own; standing on a certain coign of vantage, he regards the world of mechanical science in but one aspect, and this, it is almost needless to say, is the theoretical. Occasionally the theory is perfectly sound; far more frequently it is utterly false and opposed to fact. In either case, the result is the same pretty nearly. Our inventor is always before or behind the day in which he lives. Thus the result of his labours is either a design for a machine to effect some object already effected much better by machinery actually in existence, or for an arrangment of mechanism which the resources of modern art are insufficient to carry out. Thus the story is told of a man, a shoemaker we believe by trade, who, after four years' thought, succeeded in producing an ordinary power loom. He had betrayed the secret of his soul to no mortal until the moment when it had reached what he thought perfection. He then carried his model to a gentleman residing in his neighbourhood. Fancy the effect produced on the unfortunate inventor when he was introduced to an establishment where some two hundred power looms were actually at work! Such a circumstance could hardly happen in these latter days of exhibitions, when every man has at least a fair chance held out to him of making himself acquainted with what is being done in iron and wood. Yet even now events of a very similar character occur with startling frequency. A little knowledge is truly but too often a dangerous thing. Practical difficulties of manufacture are seldom suffered to stand in the way of the amateur. Thus we find castings designed from which the cores cannot possibly be extracted; huge girders for bridges proposed which could never be got by any earthly means from the maker's yard to the locality where they are required; wheels and bearings accurately laid down on paper which would wear themselves out by their own friction in a week. One hour spent in looking over specifications at the patent office will afford stronger evidence, and a more powerful practical illustration of the existing state of amateur mechanical science in this country and on the continent than whole pages of assertion. We do not mean to state that the men who produce these things are not clever—it may be talented; far from it. We have not the least doubt—in point of fact, no doubt can reasonably have existence—that every scheme, be it bad or good, involves the expenditure of a great deal of mental labour; but mental labour alone cannot impart any value to an invention. The worth of a design can only be properly estimated in pounds, shillings, and pence; and thus it is that comparative trfles, such as a snuff-box or a candlestick, sometimes bring in a fortune, while things of a thousand times the apparent importance are absolutely worthless. The inventor of the child's perambulator sold his patent for £10,000, and it would be very easy to pick out a thousand similar cases. The amateur engineer is not able to compete with his professional brother as an inventor, because he is lacking, not in talent, but in that special knowledge by which means can be best adapted to the production of a given end, and this knowledge cannot be gained from books. It must be derived from personal observation. There can be no doubt that many men possess even more than the ordinary amount of the knowledge which books can teach concerning mechanism. Yet this knowledge is useless because the possessor does not know how far it is or is not applicable to particular purposes. The result is that, when such men invent, the labour of their brain is practically wasted, and then once more we hear a great deal about an ungrateful world.

The word "amateur," after all, is merely a relative term, and many men practising successfully are amateurs in everything out of their own peculiar line of business. We may give up the general inventor, the man who schemes everything, as a hopeless case. Such an individual must possess transcendent talent, coupled with enormous experience and a thorough knowledge of first principles, in order that he may have a chance of success. If he has these things, of course, all men ultimately bow down and worship him. In their absence he sinks but the more the more he invents, and the greater number of patents he secures. But the case is different with the particular inventor—the man who devotes all his attention to some specific purpose. There is no reason why he should remain an amateur one moment longer than he wishes. An accurate knowledge of the principles on which every mechanical combination, statical or dynamical, should be constructed; a perfect appreciation of the laws of virtual velocities, and of the conversation of force, are easily acquired. Once thoroughly mastered, the inventor is virtually safe from the quicksands in which so many of his class flounder helplessly all their lives. These things taken to heart and thoroughly well digested, some particular machine or combination of machinery may be selected on which the inventive faculty is to be exerted. Everything, to the minutest detail connected with this machine should, then, be learned as expeditiously as may be,—its history from the earliest moment, the principles which govern its action, and above all, the practical details of its manufacture, and price of the labour and materials expended upon its production by different makers. Thus trained, the inventor can go on his way rejoicing; and the chances are that he may then produce something which will prove really useful. As far as that particular machine is concerned, he ceases to be an amateur, and really becomes an engineer in the fullest sense of the word. The history of nearly every practically useful machine of modern days proves that it has been the result of just such a mental process of education as that to which we have just alluded. Watt could not have improved the steam engine until he made himself acquainted with at least the broad principles on which the action of steam depends. The wrought-iron tubular bridges over the Menai Straits are purely the result of inductive reasoning. The self-acting mule is the offspring of a mind trained in the art of mechanical combination to the highest possible finish. So long as men wholly or almost wholly ignorant, not only of scientific principles, but of the common-place questions of profit and loss, persist in inventing, they must expect disappointment—and they deserve it. Many, doubtless, who read these pages are not, and never will be, engineers; but most men are inventors of something; and they may rest assured that there is no golden road to success in any pursuit, least of all in engineering. If, then, men will invent at all, let them do so with their eyes open, knowing precisely and accurately *everything* connected with the object of their labours. Be it the steam engine or a candlestick, the principles of its action first, the details of the methods of its manufacture afterwards. If this task is too great, it is better that the inventor should cease to deserve that name as soon as possible. —*Mechanics' Magazine.*

[A short time since a young Canadian inventor called at this office with a neat model of a "Horse Hay-maker," which he was desirous of obtaining a patent for. We informed him that we had seen exactly such machines in regular use in England over thirty years ago; he then produced a well made model of a "Box Mangle," such as had been in use long before his grandmother was born; and was both surprised and disappointed when shown representations of both these machines in the *Encyclopedia Brittanica.* Similar instances are of frequent occurrence.—Ed. Journal.]

Machinery and Manufactures.

THE FIRST STEAM RAILWAY LOCOMOTIVE.

The *American Artizan* says—"The world may be said to have slept in the belief that locomotive engines could not drag trains along lines of rail until 1812. In that year the "viewer" of the Wylam Colliery, near Newcastle-upon-Tyne (England), was an ingenious man, named William Hedley. It was the year of Napoleon's retreat from Russia, when his gigantic army perished in the snows—a terrible year of cold and distress, when wheat in England reached the highest point it had attained for a hundred years, and famine stared the people in the face. The trouble, which, however, day and night haunted the mind of William Hedley was the high price of fodder for cattle. All the coals from the Wylam Colliery were carried by a long tramway in trucks dragged by horses to the place of shipping; and Hedley knew well that unless something could be invented to supersede horses in the conveyance of the coals, it would be impossible to continue to work the tramway. He saw nothing before him but the prospect of closing the colliery, and of himself and his wife and family being cast on the world. In a state of despondency he retired to bed one night in the autumn of the year 1812; but it was not to find repose. Suddenly the idea flashed across his mind that if all the wheels of a moving carriage were connected, a tendency in any particular set of wheels to surge or revolve on their axes without moving forward might possibly be overcome by the remaining wheels. He determined to ascertain if this was the fact. On the following morning he ordered a frame and wheels to be made, and with the help of a clockmaker in Newcastle, completed his model. It was successful, and he had the satisfaction of seeing his notions realized within twenty-four hours; and eventually he had the happiness of inventing and building the first locomotive engine moving by the friction of the wheels upon the road. It was extremely slow in its movements, but it served his purpose, and above all consumed neither hay nor oats—wanted nothing, in short, but that coal in which the neighborhood abounds.

The original Wylam locomotive is now in the Patent Museum at South Kensington, London. A rude, old, weather-beaten, rusty machine of gigantic size and ponderous appearance, it was nevertheless in constant use at the colliery from 1813, when it was constructed, until June, 1862, when it was removed to the honorable asylum in which it now finally rests from its labor. At Wylam it was called by the country people "Puffing Billy," from the great noise it made, and it never received any other name. The career of "Puffing Billy" had almost been brought to a premature close, while its owner narrowly escaped a lawsuit in his defence. His perpetual puffing and snorting along the road was voted a nuisance; landlords complained, and great lawyers were appealed to, on legal cases solemnly drawn up. But "Puffing Billy" was too good a friend to Newcastle folks to be allowed to be put down. The colliery went on, William Hedley retained his employment, remained at Wylam for many years, and died in 1842.

Good Suggestions about Cylinder Boilers.

The Manchester Boiler Association gives the following useful information to engineers and owners of steam boilers:—

"1st. Heat the feed water before its introduction to the boiler, and disperse it by means of a perforated pipe carried horizontally for several feet near to the surface of the water, and thus prevent its impingement on any particular spot, especially near the firing end.

"2nd. Where the water is at all sedimentary an efficient blow-out apparatus should be attached and regularly used. Surface blowing out, by means of a scum pipe, is particularly adapted to externally-fired boilers.

"3rd. Do not allow the flames to act too intensely on any one spot, but spread the action over as extended a surface as possible, and lower the fire-bars should any signs of distress appear at the seams of rivets.

"4th. Have a spare boiler, so that defects may be suitably repaired immediately on detection, and the boilers regularly cleaned out without the necessity of Sunday work—a practice which is unadvisable, though, regarded only from an engineering point of view, is demoralizing in its influence upon the workmen, and expensive to the steam user.

"5th. With regard to the construction of the boiler, secure good workmanship and material in the first instance. It is a mistake to suppose that externally-fired boilers are better for being made of thick plates. Those under inspection which have given the least trouble have not been more than three-eighths of an inch in thickness, and it is thought that in plain cylindrical boilers this thickness should not be exceeded. In effecting repairs, as well as in the first construction, the rivet holes should be brought fairly one over the other, without straining, while drifting should not be allowed. In putting in new plates to old boilers, it will, in many cases, be advisable to cut away the old line of rivet holes and drill new ones; while the new work should rather be thinner than the old, instead of being thicker, as it sometimes is."

Manifold Uses for Leather.

The old saying, that there is "nothing like leather," is amply verified in the thousand and one little articles of feminine decoration which Madam Fashion has recently decreed for her daughters' wear. In my up-town stroll the other day, I paused before the tastefully arranged window of a fancy store, wherein were displayed the usual miscellaneous collection of ornaments, trimmings, etc., which go to make the sum total of such an establishment, and I thought as I noted how freely the material, leather, had been used in their construction—O that mother Eve, as she perambulated Eden in her primitive garment of fig leaves, could have foreseen how skillfully her sons and daughters should convert the skins of such animals as those over which she held dominion, into the multitude of articles both useful and ornamental, which meet our eye on every side, and supply our needs at every step. Could she have seen the girdle, formed to encircle the slender waist of some fair damsel—the coquetish little bow which fastens the collar of your fashionable belle, the trimming of her dress, the rosettes upon her hat, the buttons scattered in delightful confusion over her garments, or arranged in mathematical precision, in rows containing twelve, eighteen, or twenty-four, as fashion and taste shall dictate, the gauntlet, to shade the delicate wrist, the bracelet, for its adornment, the anklet, to protect the ankle, the page to elevate the trailing skirts from contact with muddy crossings, the reticule, the fan for subduing summer's heat—these, and many other ornaments too numerous to mention, and all made of leather, so embossed, and stitched, and pinked and otherwise decorated as almost to lose its indentity, yet leather still, are additional evidence of the truth of the saying at the head of our paragraph.—*Shoe and Leather Reporter.*

To Keep Tires on Wheels.

Hear what a practical man says on this subject:

"I ironed a wagon some years ago, for my own use, and before putting on the tires I filled the fellies with linseed oil; and the tires have worn out and were never loose. I ironed a buggy for my own use seven years ago, and the tires are now as tight as when put on. My method of filling the fellies with oil is as follows: I use a long cast-iron oil heater, made for the purpose; the oil is brought to a boiling heat, the wheel is placed on a stick, so as to hang in the oil, each felly an hour, for a common sized felly. The timber should be dry, as green timber will not take oil. Care should be taken that the oil be not made hotter than a boiling heat, in order that the timber be not burnt. Timber filled with oil is not susceptible to water, and the timber is much more durable. I was amused some years ago, when I told a blacksmith how to keep the tires tight on wheels, by his telling me it was a profitable business to tighten tires, and the wagon maker will say it is profitable to him to make and repair wheels—but what will the farmer, who supports the wheelwright and smith say?"

An Excellent Lamp.

A petroleum lamp has been patented by Mr. David Wilson, of Ceylon, which combines greater advantages as regards perfect safety than any we have seen. It is also adapted for the heavier oils, though the same requirement does not exist in them for a cut reservoir. The reservoir which contains the oil is suspended in a bowl, the size of which allows the free passage of air round every portion of the reservoir. The lamp is particularly suited for suspending in halls or passages, and for this purpose it is enclosed in two glass bowls, a perforated metal ring between the two serving to secure them. The lamp within is attached by rods to the ring, to which also are attached the chains or cords for hanging the lamp. The air necessary to supply the flame passes through the perforations in the metal ring. Applied to either hall or table lamps, the supply of air obtained by this principle must be very ample, and the manner in which it is accomplished effectually prevents sudden drafts reaching the flame.

Rolled Armor Plate.

Messrs. John Brown and Co., of the Atlas Works, have succeeded in rolling an iron plate, six feet by seven feet, and thirteen and a half inches thick. The idea of manufacturing so enormous a plate orginated, we believe, with Captain Inglis, of the Royal Engineers, with a view of ascertaining if it would be desirable to protect casemates with such a powerful covering. The plate has been forwarded to Shoeburyness, where it will be exposed to a very trying test.

Photography.

VIGNETTING.

A correspondent of the *Philadelphia Photographer* writes, in answer to some queries by another writer:—

I send you a short description of the method of printing vignettes practised in the establishment with which I am connected. It may be used by many others, but I am not aware that it is. We exclude the common vignette glass entirely, and content ourselves with pieces of pine wood and tissue paper.

Take the common printing block, and cut a piece of pine wood, half inch thick, the size of the part of the negative exposed when printing. In this cut oval holes, the size and number required, and level the inside smoothly. Place the negative and paper in the block in the usual way, and fasten (with springs made for that purpose) the block of wood over the negative. Paste tissue paper at the upper end of the block (letting it cover the whole of it), and fasten the lower end with the spring at the bottom of the block, so the paper may be raised, when adjusting the block for printing. Expose to the sun, and in this way you can print clear and beautiful vignettes. Some little practice will be needful before great perfection may be attained. The oval holes in the pieces of wood and the bevel inside, must vary according to the size of vignette wanted. The smallest hole used for card vignettes is about seven-eighths of an inch long, and the largest 2-ins. The larger the hole, and the more it is bevelled inside, the larger and more indicated the prints will be, and *vice versa.* The thickness of the board will also make some difference. The thicker the board, the deeper the bevel must be, and of course making the prints more indicated. Sometimes a block of the size needed may not be convenient (though an assortment should be kept always); in that case a little raw cotton properly placed between the negative and the hole in the block of wood, will make the prints of the proper size. Cotton may be used also, when a direct line across the person is required. As negatives vary in intensity, as well as in size of figure, some care must be taken in the amount of tissue paper used also. For a weak negative a double quantity of it is required, and in extreme cases even a piece of photograph paper will not be too much. The more paper used, the more intense the prints will be. These blocks may also be used in printing photographs of the largest size made, with splendid success. If "Hartly" will have his blocks carefully made, he can make elegant vignettes with one-fourth the trouble of the old plan.

F. S. K.

THE HYGIENE OF PHOTOGRAPHY.

BY M. CAREY LEA.

I have long desired to make some observations on the subject of the influences of Photography on health, and the increasing attention which this subject seems to be attracting abroad, leads me to hope that remarks upon it will not be altogether disregarded even in this country, where we are thought to be so reckless of life and health.

On entering the working-room of a professional photographer, one is apt to be saluted by a penetrating and at first almost overpowering odour. In this combination a chemical nose can generally distinguish acetic and nitric acids, ether and alcohol. I propose to consider these substances in succession.

Acetic acid, only when very much diluted, as in the form of vinegar, can be considered to be innocuous. In a more concentrated form, it is highly irritating and unquestionably pernicious. Acetyl, the radical of acetic acid, appears to have an irritating nature, which passes into all its compounds, and shows itself especially in those which it forms with the halogens. Chloride of acetyl is so irritating as to cause immediately blood spitting when inhaled. But because acetic acid exists in vinegar, and vinegar may be swallowed without injury, people are too apt to attribute to acetic acid a harmlessness which it does not possess.

The vapour of *nitric acid* is not merely corrosive, but is directly poisonous. It is only very lately that this direct poisonous character has been recognized. The terrible accident which happened to Mr. Stuart and his assistant, in England, both of whom died in consequence of sopping up acid spilt from a broken bottle, has thrown a new light on the matter, and has recalled other cases which, if less marked, were still similar.

Now there is not the least need that the odour of either of these acids should ever contaminate the air of the working-room. They are frequently produced by the practice of setting old acid negative baths on the stove to evaporate down, or other equally improper acts. Much the best course with negative baths that have ceased to work well, is to place them aside in convenient vessels until they accumulate, then throw down the silver as chloride, wash it with a few waters, add sulphuric acid and a few lumps of zinc until the silver is completely revived, wash with hot water, and dissolve the silver in nitric acid for positive printing. It requires but little acquaintance with chemical manipulation to accomplish this. The nitrate of silver need not even be crystallized. Weigh the silver after drying it, dissolve it in nitric acid, using a quantity not quite sufficient to take up all the silver, even after standing several days with it in a warm place. If it is wanted in an ammonio-nitrate bath, the ammonia may be added at once. If a plain nitrate bath is to be made for fumed paper, add a little bicarbonate of soda until the solution is faintly alkaline, and then drop in seven drops of nitric acid for each ounce of metallic silver; to obtain the right dilution compute in round numbers 7-ozs. of metallic silver as equivalent to 10 of nitrate.

I have made this brief digression to show how poor an economy it is to mess with spoilt baths, and how much time, as well as health, is saved by treating ten or twenty at once as above. Those who treat them by evaporation, simply transfer the impurities from the bath into the atmosphere, and thence into their own bodies.

The other prevailing odours are those of *alcohol* and *ether*. Alcohol is probably not very injurious in the quantity respired, but ether is very much so. Pour a little ether upon a handkerchief, and hold it over the mouth. The person so treated presently becomes perfectly insensible. Is it at all probable that so potent an image can be respired even in a dilute form, especially as a habit, with impunity? The anodyne influence of ether, is too well known in medicine to render such a supposition possible, and there can be no reasonable doubt that its influence is most injurious.

All these odours may be got rid of; if not wholly, at least nine-tenths. Acetic acid need never be used, except in very dilute form. In the developer, one-twentieth of acetic acid is abundance, instead of which it is often used as high as one-fourth, thereby keeping up a never-ceasing smell through the working room. Nitric acid, by avoiding its use as far as possible, in fact, except a few drops for acidulating baths, it need never enter the working-room; even for cleaning plates, there are other substances which can take its place. Ether is far more difficult to keep from the atmosphere. The best plan is to separate a portion of the dark-room by sashes, one of which is to be opened sufficiently to enable one to work conveniently. The plate is collodionized inside, while the photographer stands at the door. The upper portion of the glazed partition must communicate by an opening with the flue of the chimney, and it is better to make some provision for conducting fresh air into this glass chamber, independently of the sash. This is the plan which I have myself adopted, and I can say from experience, that the slight draft which is requisite for carrying off the vapours, does not injuriously affect the drying of the plate. The system answers admirably.

There remain other substances which may be briefly despatched. Of cyanide of potassium I have only to say that photographers should endeavour to dispense with it altogether. The reckless manner in which this substance is employed, is utterly wrong and unjustifiable. Some years ago M. Davanne was nearly killed by it, and was only saved by long-continued pouring of cold water down the head and spine. A little which he had rubbed on his fingers, had got into a cut. Lives are constantly lost by its use. Two cases have been lately mentioned in the English journals.

Iodine and bromine are less in the atmospheres of the work-rooms than in the days of the Daguerreotype. Both, especially the latter, are irritant poisons. They differ, however, from prussic acid in this, that the latter substance, when united with an alkali to form cyanide of potassium, retains its dangerous qualities, whilst iodine and bromine in their alkaline combinations are quite innocuous. In the free state they are highly irritating, and provoke inflammation of the lungs. Iodine is still a great deal used in certain processes for strengthening negatives, and when so used, it should be done either in open air, or in the glass chamber already described.

Finally, I may observe that there is a great deal of self-deception in the matter of health. Because a man has been exposed for a length of time to noxious influences, and has not materially suffered, he is too apt to underrate their importance, and yet a poison, if it enters the system for a sufficient time, no matter how small the quantity may be, ends by producing its characteristic effect. What is less volatile, than lead or its carbonate? And yet the painter, who is constantly exposed to an atmosphere in which this substance is contained, even to such an inappreciable extent, ends by having his health gravely compromised. In a vast number of cases, when a man's health is impaired, he does not himself know what to attribute it to. A consumption is considered to be the result of a cold, or of a constitutional tendency, when it is perhaps in reality traceable to the slow but long continued action of acetic or nitric acid. The long-continued use of cyanide may terminate in paralysis, ascribed to any other reason than the true one. Photography is so new an art that the specific diseases arising from a misuse of its materials, are not as yet understood. Is it not then worth while to take a little care which in a short time will cease to be an effort?—

TO REMOVE SILVER STAINS.

In the *Photographiscer Archiver*, M. Obernetter recommends a concentrated solution of perchloride of iron as a detergent for silver stains on the hands or clothes. If gallic or pyrogallic acid has been used it will be necessary to wash the spot afterwards with a few drops of a strong solution of oxalic acid. A weak solution of this salt is also useful for diminishing the intensity of negatives to be copied in the solar camera. Weak negatives may be transformed into strong ones by using first a solution of chloride of iron, and secondly with pyrogallic acid and nitrate of silver.

CARTE-DE-VISITES.

An English photographer has lately introduced a novelty in the mode of taking carte-de-visite photographs with the signatures of the sitters appended. This gives but little extra trouble. The sitter simply signs his name on a slip of paper, and finds its facsimile, diminished in size, transferred to the portraits when they come home.

DISSOLVING INDIA RUBBER.

It should be known to photographers that American petroleum will answer as a solvent for india-rubber as well as benzole, and that it costs less than half the amount.

Practical Memoranda.

TABLE *showing the Height of the Boiling Point, Fah., at different Heights of the Barometer.*

Barometer.	Boiling Point.	Barometer.	Boiling Point.
Inches.	Degrees.	Inches.	Degrees.
31	213·57	28½	209·55
30½	212·79	28	208 69
30	212·00	27½	207·84
29½	211·20	27	206 96
20	210·38		

In a vacuum water boils at 98° to 100°, according as the vacuum is more or less perfect.

DRAWING PENS.

Never on any account use common writing ink in a drawing pen, for the acid in such ink will quickly destroy the nibs. The only black ink that should be used in drawing pens is India-ink.

SPECIFIC GRAVITY.

"The comparative density of various substances expressed by the term *Specific Gravity*, affords the means of readily determining the bulk from the known weight, or the weight from the known bulk; and this will be found more especially useful, in cases where the substance is too large to admit of being weighed, or too irregular in shape to allow of correct measurement. The standard with which all solids and liquids are thus compared, is that of distilled water, one cubic foot of which weighs 1000 ounces avoirdupois; and the specific gravity of a *solid* body is determined by the difference between its weight in the air and in water. Thus,

If the body be *heavier* than water, it will displace a quantity of fluid equal to it in *bulk*, and will lose as much weight on immersion as that of an equal bulk of the fluid. Let it be weighed first, therefore, in the air, and then in water, and its weight in the air be divided by the difference between the two weights, and the quotient will be its specific gravity, that of water being unity.

Example. A piece of copper ore weighs 56¼ ounces in the air, and 43¾ ounces in water: required its specific gravity.

56·25—43·75 = 12·5 and 56·25 ÷ 12·5 = 4·5, the specific gravity.

If the body be *lighter* than water it will float, and displace a quantity of fluid equal to it in *weight*, the bulk of which will be equal to that only of the part immersed. A heavier substance must therefore be attached to it, so that the two may sink in the fluid. Then, the weight of the lighter substance in the air must be added to that of the heavier substance in water, and the weight of both united, in water, be subtracted from the sum; the weight of the lighter body in the air must then be divided by the difference, and the quotient will be the specific gravity of the lighter substance required.

Example. A piece of fir weighs 40 ounces in the air, and, being immersed in water attached to a piece of iron weighing 30 ounces, the *two* together are found to weigh 3·3 ounces in water, and the iron alone 25·8 ounces in the water: required the specific gravity of the wood.

40 + 25·8 = 65·8—3·3 = 62·5; and 40 ÷ 62·5 = 0·64, the specific gravity of the fir.

The specific gravity of a *fluid* may be determined by taking a solid body, heavy enough to sink in the fluid, and of known specific gravity, and weighing it both in the air and in the fluid. The difference between the two weights must be multiplied by the specific gravity of the solid body, and the product divided by the weight of the solid in the air; the quotient will be the specific gravity of the fluid, that of water being unity.

Example. Required the specific gravity of a given mixture of muriatic acid and water; a piece of glass, the specific gravity of which is 3·, weighing 3¾ ounces when immersed in it, and 6 ounces in the air.

6—3·75 = 2·25 + 3 = 6·75 ÷ 6 = 1·125, the specific gravity.

Since the weight of a cubic foot of distilled water, at the temperature of 60 degrees (Fahrenheit), has been ascertained to be 1000 avoirdupois ounces, it follows that the specific gravities of all bodies compared with it, may be made to express the weight, in ounces, of a cubic foot of each, by multiplying these specific gravities (compared with that of water as unity) by 1000. Thus, that of water being 1, and that of silver, as compared with it, being 10·474, the multiplication of each by 1000 will give 1000 ounces for the cubic foot of water, and 10,474 ounces for the cubic foot of silver.

TABLE OF SPECIFIC GRAVITIES—WATER = 1000.

Metals.	
Antimony	6·712
Zinc	7·100
Cast Iron	7·207
Tin	7·291
Steel	7·816
Cast copper	8·788
Bismuth	9·882
Silver	10·474
Lead	11·352
Gold	19·258
Platinum	20·337
Mercury	13·586
Organic Bodies.	
Oak wood	0·925
Cork	0·240
Ivory	1·826
White wax	0·960

Inorganic Non-Metallic Bodies.	
Agate	2·590
Amber	1·078
Sulphur	2·033
Crown glass	2·488
Flint glass	3·329
Rock crystal	2·653
Diamonds	3·501
Liquids.	
Ether	0·715
Alcohol	0·792
Oil of turpentine	0·870
Sea water	1·026
Milk	1·030
Nitric acid	1·503
Sulphuric acid	1·845

Weights of given bulks of water and air for calculating the absolute weights from the specific gravities of bodies.

		Logarithm
Cubic inch of distilled water (bar. 30, therm. 62) in grains	252·458	2·40219
......foot......in ounces avoir.	997·1369691	2·99875
......in pounds do.	62·3210606	1·79463
Weight of 100 cubic in. of air in grains do.	30·49	1·48416

THE CHEAPEST FILTER.

Le Moniteur Illustre des Inventions says:—"It is known that charcoal is the most efficacious substance that can be employed for the purification of liquids; foul and stagnant waters containing decaying animal carcasses have been purified to the extent of becoming inodorous, potable, and healthy. Here is a method of constructing one of these filters in the easiest manner. Take a flower-pot, or any other vase having a hole in the bottom, fill the bottom with large round pebbles, then cover with smaller pebbles, then with coarse sand or fine gravel, and finally with about four inches of pounded charcoal. The coal may be placed in a bag and broken with a mallet or hammer. It should be sifted, and the very finest dust thrown away."

Our contemporary adds that nothing is necessary above the charcoal, but we should suppose that it ought to be covered with a clean flannel, held down by stones on the corners. The charcoal should be freshly burned, and renewed occasionally. The other parts will of course last indefinitely.—*Scientific American.*

Statistical Information.

STATISTICS OF BRITISH AMERICA.

(*From Speeches of Delegates on Confederation of Provinces, Sept. & Oct.* 1864.)

The population of the Provinces, according to Census of 1861, was, Upper Canada, 1,396,091; Lower Canada, 1,111,566; Nova Scotia, 330,857; New Brunswick, 252,048; Newfoundland, 122,635; Prince Edward Island, 80,857; Total, 3,294,056. Average increase in four years calculated at 15 per cent, would make the present population of these Provinces 3,787,750. Males in the Provinces in 1861, between the ages of 20 and 60 years, 698,918, about 150,000 being between the ages of 45 and 60.

In 1861 there were 333,604 farmers, and 160,702 laborers; and of lands held by private parties, 45,638,854 acres, of which 13,128,229 were under cultivation, as follows:—

	Held.	Cultivated
Upper Canada	17,708,232	6,051,619
Lower Canada	13,680,000	4,804,235
Nova Scotia	5,748,893	1,028,032
New Brunswick	6,636,329	835,108
Newfoundland	100,000	41,108
Prince Edward Island	1,365,400	368,127

The same Census returns gives the produce of these Lands for

Wheat	28,212,760	Bush.
Barley	5,692,991	"
Rye	1,934,583	"
Pease	12,302,183	"
Oats	45,634,472	"
BucEwheat	3,648,450	"
Indian Corn	2,624,163	"
Beans	75,755	"
Potatoes	39,485,246	"
Other Roots	23,730,706	"
Grass Seed	115,345	"
Hay	2,242,596	Tons.
Hops	300,439	lbs.
Maple Sugar	16,782,872	"
Wool	7,010,914	"
Flax and Hemp	2,183,759	"
Butter	52,570,886	"
Cheese	4,602,065	"
Beef, bbls. of 200 lbs.	134,562	
Pork... " "	581,802	

These, at a fair valuation, sum up nearly $120,000,000. The assessed value of Farm Lands was $550,000,000—the true value being more than the assessed value.

The number of Sailors and Fishermen of the six Colonies, in 1861, were: Upper Canada, 808, Lower Canada, 5,150; Nova Scotia, 19,637; New Brunswick, 2,765; Newfoundland, 38,578; Prince Edward Island, 2,318; Total, 69,256. Exports of Fish, nearly $10,000,000; Vessels built last year, 628, with an aggregate tonnage of 230,312 tons, thus:—

Canada	158	Vessels,	67,209	Tons.
Nova Scotia	207	"	46,862	"
New Brunswick	137	"	85,250	"
Newfoundland	26	"	6,000	"
Prince Ed'd Island	100	"	24,991	"

The exports of timber last year were valued at $15,000,000. The Provinces if united would have an annual export trade of $65,000,000; and an equal import traffic. They would have 2,500 miles of railway; telegraph lines extending to every city and town throughout the country, and an Annual General Revenue of nearly $13,000,000.—*Hon. George Brown, Canada.*

Income of four Maritime Provinces for 1864, will be $3,000,000; Imports and Exports last year were $42,000,000: Population is now nearly 900,000; Registered tonnage of Shipping, 645,530 tons valued at $27,821,000.—*Col. Grey, New Brunswick.*

The Maritime Provinces have an area of from 50,000 to 60,000 square miles. Nova Scotia has doubled her Revenue within 5 or 6 years, and her Imports and Exports are now something like $3,500,000—*Dr. Tupper, Nova Scotia.*

The population of the Maritime Provinces of something over 800,000 persons, owns nearly 800,000 tons of shipping; and will this year have surplus Revenues of nearly $500,000.—*Hon. Mr. Tilley, New Brunswick.*

Newfoundland has a coast line of 1,200 miles, with some of the finest harbours in the world; employs in her Fisheries 13,000 men; Imports and Exports, $12,000 per annum; Population, 130,000; Revenue, between $500,000 and $600,000; Debt, $900,000; and some 12,000 Vessels, independently of coasting vessels, enter and clear her ports annually.—*Hon. Mr. Shea, Newfoundland.*

Prince Edward Island is the garden of America, and abounds with fish. It is capable of sustaining a population of 1,000,000. — *Hon. Mr. Whelan, Prince Edward Island.*

Prince Edward Island has a population of some 80,000 inhabitants, almost purely agricultural; and has a Revenue of $200,000 a year.—*Hon. Mr. Haviland, P. E. I.*

IRISH AGRICULTURE AND EMIGRATION.

Total Area of Land under cultivation, 5,672,980 Acres; Acres under Wheat, 279,863; Oats, 1,869,918; Potatoes, 1,039,282; Turnips, 337,283; other root and green crops, 98,970; Flax, 301,942 acres. Total number of Cattle, 3,257,309; Sheep, 3,363,068; Horses, 564,361; Pigs, 1,056,245. Total value of Live Stock this year, estimated at $150,425,410.

The total extent of emigration from Ireland, since the first of May, 1851, when the enumeration of the several ports commenced, were 1,499,642 persons.

Lord Stanley, in a speech at the dinner of the Tipperary Union Farming Society, stated that there were about 100,000 Irish living in and around Liverpool, and that there were over 300,000 Irish in the manufacturing districts of England and Scotland.

MERCANTILE STEAM MARINE OF ENGLAND.

The mercantile steam marine of England consists of 2,277 vessels, of a gross tonnage of 883,034 tons, or (after deducting engine rooms and space) a registered tonnage of 591,434 tons. Of these vessels 1,391 are built of iron, and 886 of wood. The number propelled by the screw at the beginning of the present year, according to recent parliamentary returns, was 792, or a little over one-third of the whole number. The size of these steamers varies from 50 tons to the *Great Eastern* of 18,915 tons. Nearly 1,800 of these vessels are employed in the coasting trade of Great Britain and Ireland, and 477 in what may be called the ocean traffic. When steamships were first employed in the trade with America, vessels of 1,200 tons were employed—there are now 50 vessels of upwards of 2,000 tons employed on the routes between Great Britain and America. The return gives of vessels from 2,000 to 3,000 tons, 48; and above 3,000 tons, 7. The numbers have undoubtedly increased considerably since the commencement of the year.

GOLD MINING.

Russia gets $20,000,000 of gold a year from the Ural Mountains. The quantity of gold produced from mines in Great Britain is valued at about $100,000 per annum. Total gold exported from three New Zealand ports, from April, 1857, to September, 1863, was valued at $21,888,540; from New South Wales and Victoria for the same period, valued at $33,248,120.

VAST ARMIES OF HISTORY.

There have been vast armies and mighty movements of soldiers in ancient times. Here is a record of some of them:—

Sennacherib (the Bible tells us) lost in a single night 185,000 men by the destroying angel,

The city of Thebes had a hundred gates, and could send out at each gate 10,000 fighting men and 200 chariots; in all, 1,000,000 men and 2,000 chariots.

The army of Terah, king of Ethiopia, consisted of 1,000,000 of men and 300 chariots of war.

Sesostris, king of Egypt, led against his enemies 600,000 men, 24,000 cavalry, and 27 scythe-armed chariots—1491 years before Christ.

Hamilcar went from Carthage, and landed near Palermo. He had a fleet of 2,000 ships and 3,000 small vessels, and a land force of 300,000 men. At the battle in which he was defeated, 150,000 men were slain.

Ninus, the Assyrian king, about 2,200 years before Christ, led against the Bactrians an army of 1,700,000 foot, 340,000 horses, and 16,000 chariots armed with scythes.

Semiramis employed 2,000,000 men in building Babylon. She took 100,000 prisoners at the Indus, and sank 1,000 boats.

A short time after the taking of Babylon, the forces of Cyrus consisted of 600,000 foot, 120,000 horses, and 2,000 chariots armed with scythes.

An army of Cambyses, 50,000 strong, was buried up in the desert sands of Africa by a south wind.

When Xerxes arrived at Thermopylæ, his land and sea forces amounted to 2,614,610, exclusive of servants, eunuchs, women, sutlers, etc., in all numbering 5,283,220. (So say Herodotus, Plutarch, and Isocrates.)

The army of Artaxerxes, before the battle of Cunaxa, amounted to about 1,200,000 men.

Ten thousand horse and 100,000 foot soldiers fell on the fatal field of Issus.

Miscellaneous.

Benzine and Benzole.

A New York correspondent, O. H. K., requests us to point out the difference between benzine and benzole.

There are 68 elementary substances at present known, and these combine with each other in various ways to form all of the thousands of substances which exist on this earth. The compound substances are generally entirely different in their properties from the elements which unite to form them. For instance, nitrogen and oxygen are mechanically mingled together to constitute the air we breathe, but if these same elements are chemically combined in certain proportions they become nitric acid, a liquid of such corrosive power that if a single spoonful was introduced into the lungs of any person it would burn them to cinder.

Most of these elements combine together in only a very few proportions. For instance, carbon and oxygen in only two, one atom of carbon combining with one of oxygen to form carbonic oxide, and one atom of carbon combining with two atoms of oxygen to form carbonic acid. It is beyond the power of the chemist's art to induce these two elements to combine chemically without the presence of a third element, in any other proportions but these two. Hydrogen and oxygen also combine in only two proportions. One atom of hydrogen combines with one atom of oxygen to form water; and one atom of hydrogen combines with two atoms of oxygen to form the deutoxide of hydrogen, a sweet liquid wholly unlike water.

But carbon and hydrogen in their combinations with each other stand out as a remarkable exception to the general law. They combine in hundreds of different proportions, forming as many substances, each with its distinct and peculiar properties. There are several series of hydro-carbons, and the series which has been most studied is the coal tar series.

When bituminous coal is subjected to a high heat under shelter from contact with the air, it undergoes destructive distillation; it is decomposed and the elements of which it is constituted enter into new combinations, to form new substances. The kinds of substances formed vary with the temperature at which the destructive distillation takes place. At a bright cherry red are formed the hydro-carbons which mechanically mixed constitute illuminating gas and coal tar. Some of these are so volatile as to retain the gaseous form at ordinary temperatures, and all of the others are condensed in the form of tar by passing the vapors from the retort through cold water. Among the most volatile of the coal-tar hydro-carbons is benzole. This substance has the property of crystalizing at a temperature of 32°, and can therefore be easily separated from the mixture. It is a very volatile liquid, and is a powerful solvent of gums, oils and resins. This property adapts it for use in making varnishes. It is from benzole that the coal tar dyes are made. By treatment with nitric acid and nascent hydrogen, it is converted into aniline, which by oxidation is changed to magenta, solferino, and the others of these brilliant and beautiful colors.

Petroleum consists of hydro-carbons, only two or three of which have yet been separated from the mixture. It has recently been stated in England that a trace of benzole had been found in some specimens of petroleum, but other chemists have been unable to obtain it.

The benzine of our markets at the present time is merely the most volatile portion of petroleum. If it contains any benzole it is only a trace, and not enough to modify its properties. It is doubtless a mixture of various hydry-carbons, and varies in chemical composition and in its properties with the different wells from which it is produced. Its power of dissolving gums and resins is much inferior to that of benzole, and hence its unsuitableness for making varnishes. In the absence of benzole, of course no aniline, and therefore no aniline dyes can be made from it.—*Scientific American.*

Hard on the Hogs.

One of the most common causes of blood impurities is the use of pork. It has been said that all things were created for some wise purpose; but *hogs* were never made to eat. Christ only used them to drown the devils; they can never be of any other beneficent use. As an article of diet, pork exerts a most pernicious influence on the blood, overloading it with carbonic gas, and filling it with scrofula. The hog is not a healthy animal. From its birth it is an inveterate gormandizer—and to satisfy its eternal cravings for food, everything in field or gutter, however filthy, finds a lodgment in its capacious stomach. It eats filth, wallows in filth, and is itself but a living mass of filth. Our bodies are made up of the things that have been picked up from our plates. The humoral properties and inflammatory effect which pork imparts to the blood, tend to germinate vermin in the system. Grub in the liver, kidneys, lungs, and other organs frequently have their origin in the use of this filthy article of food. The *Gazette Medicale* asserts that "the tape-worm troubles only those who eat pork." It further remarks, that the Hebrews are never troubled with it, but the pork butchers are peculiarly liable to it, and that dogs fed upon it are universally so afflicted. In fact, it turns out that a small parasite worm, called "Crysticerons," which much effects pork, no sooner reaches the human stomach, than, from the change of diet and position, it is changed into the well-known tape-worm: and the experiments of M. Küchenmeister of Zottoria, made with great professional care upon an executed criminal, have established the fact beyond doubt. —*Medical Common-sense.*