THE JOURNAL

OF THE

Board of Arts and Manufactures

FOR ONTARIO.

JULY, 1867.

CANADA — HER EDUCATIONAL AND INDUSTRIAL FUTURE.

On the day of our present issue, three of the hitherto separate Provinces of British North America enter upon a new era of their existence—the proclamation of *Her Most Gracious Majesty Queen Victoria* declaring, in the following words, " that on and after the first day of July, one thousand eight hundred and sixty-seven, the Provinces of *Canada, Nova Scotia, and New Brunswick* shall form and be one Dominion, under the name of Canada," in accordance with the terms of an Act of the Imperial Parliament, passed and assented to on the 29th March, 1867, in answer to the expressed wishes of the several Legislatures of the Colonies United.

What the future of this Dominion will be, no one can with any degree of certainty foretell; we cannot, however, but augur for it a career of prosperity hitherto unknown. The abolition of intercolonial custom-houses and adverse tariffs, and a closer and more constant political, commercial, manufacturing and social intercourse, and interests hereinafter in common, cannot but—with judicious management—result in much good to the peoples united. What will be the policies of the Confederate and Local Governments and Legislatures in respect to the technical education of the industrial classes, is what now more immediately concerns us. Hitherto, the encouragement and support afforded in this respect has been on the infinitesimal principle, and the results have, undoubtedly, been correspondingly unsatisfactory. For the mechanical and engineering classes next to nothing has been done in Canada. For a few years each of the Mechanics' Institutes received an annual legislative grant of $200, which was paid them irrespective of numbers, organization, or work being done; and without any conditions as to how that small amount should be expended, so as to produce the most good to those for whose benefit it was avowedly intended. Eight years ago this trifling assistance was withheld, and many of these Institutions in *consequence* ceased to exist, and since that time the only legislative grant having a special reference to the arts and manufactures of the Province, has been the sum of $4,000 per annum, equally divided between the Boards of Arts and Manufactures for Upper and Lower Canada. This grant of $2,000 to each Board, has been the whole amount available wherewith to establish free technical libraries of reference; to publish lectures and useful information, and establish schools or colleges for mechanics, and schools of design for females; to import and test new and useful machines and models of machines, &c., &c., as contemplated by the statute; and out of which also to pay rent, salaries and office expenses.

In contrast with this *mistaken* economy, let us notice what has been done for agriculture and the professions—the former of which we unhesitatingly admit to be the main stay and dependence of the country; the latter *necessary*, but not of so much importance to our material prosperity as the manufacturing or industrial arts.

We quote from the public accounts, for the year ending June 30th, 1864, not having the later returns before us, by which it appears that aid had been afforded the two interests referred to, to the following extent:—

Agricultural Associations	$108,419 33
Colleges	29,800 00
Medical Schools and Scientific Institut's	5,850 00
U. C. Grammar Schools, over and above fees and local income.....................	54,937 00
Superior Education, L. C..................	67,260 00

Here we have a total legislative aid for the year of $108,419 33 for agriculture, and $157,847 for professional or college education—together $266,266 33. The Colleges of U. C. have also other sources of income amounting to some $120,000, and the Colleges of L. C. we know not how much, and have no means within reach of ascertaining; but putting it at the same as for Upper Canada, the whole income available for instruction in agriculture and the professions has been upwards of half a million dollars per annum, as against $4,000 for Arts and Manufactures.

These items of expenditure do not include cost of Normal and Common Schools, of either Upper or Lower Canada, which afford general instruction to all classes, but *little* that is adapted especially to prepare the pupils for industrial pursuits. We ask, is this either politic or just towards so important an interest in the country? Is it right that so large a share of the public revenues of the Province, towards which all classes alike contribute, should be appropriated in so one-sided a manner, for the special benefit of the agricultural and professional classes; and that the large and important class of artisans and manufacturers should receive an amount of encouragement so utterly disproportionate to their numbers? Is an acquaintance with the classics more conducive to the prosperity of the country than a knowledge of mechanics; or proficiency in the dead languages, belles-lettres, and the abstrüse sciences, of as much importance as a thorough knowledge of our own language, the practical mathematics, geometry, designing and chemistry? And yet these more practical studies are almost lost sight of during the first year or two of academic courses, and but little thought of during the subsequent years; while studies in a host of Latin and Greek Authors, Grammars, Lexicons and Readers, with a fair sprinkling of French, Spanish and Italian, and Exercises in Ancient History and Geography, logic and rhetoric, Metaphysics, and the higher departments of science, absorb almost all the time and attendance of the student, leaving him but little leisure and less inclination to pursue the more important subjects of a useful education. We would not complain of this system of instruction for those to whom it is adapted, did it not monopolise nearly all the legislative aid, and thus induce so many of our most talented young men from the industrial classes to enter the professions; and how many sons of mechanics are there, who, having thus graduated, are now *barely* existing as masters of Grammar Schools, at salaries of from $500 to $800 a year, or are connected with the press at no better or even worse remuneration, that might have become eminent men, and have taken honorable positions as mechanics or mechanical engineers, or in various other active employments, had they been enabled to obtain in the country a suitable technical education.

We have no hesitation in saying, that our colleges and universities do not at present afford suitable means of education for any but professional occupations; and the sooner the curriculum of studies of each is re-modelled, so as to give increased attention to, or embrace a greater number of the more useful and practical departments of knowledge, the better will it be for their graduates and for the industrial interests of the country. We have *too* much education of the *higher* kind, and *too* little of that which leads to practical results. How many of our university graduates can be found in any callings but those of the pulpit, the bar and medicine, or as grammar school teachers, or editors of party political newspapers? They have become unfitted, by the very course of studies they have had to pursue, for any more practical vocations—no matter what their former positions in society may have been, it would be *losing caste* for even an A. B. to descend to the position of a mechanic or manufacturer, or even to that of a mechanical engineer.

The *Scientific American* recently stated that "it is now not uncommon for graduates of our collegiate institutions either to settle down as mechanics or attempt the *role* of journalists"—the latter position some amongst us in Canada may take, but we doubt if one can be found who has committed himself to the former. Since commencing this article, we have met with some excellent remarks in the London *Mechanics' Magazine*, on "Technical Education in England," in which the writer says:—

"There is a marked contrast between the avowed intention of the instruction of youth on the Continent and in this country. The general consent of authority here is, that the object of the school is chiefly and primarily mental discipline, and, in a secondary degree, the acquirement of rudimentary knowledge of those subjects which either form the key to other studies, or which must necessarily be studied early, if they are ever to be mastered. It is only casually that useful knowledge is admitted in our conventional notion of education. The chief work of our public schools is the classics, and these are taught more as illustrations of general grammar and of the structure of language than with a view to the mere facility of reading Latin and Greek authors. Mathematics are but little studied; and the modern tendency is to regard them more as a peculiar example and exercise of logic than to teach them with direct reference to their immediate practical use. Mensuration, linear drawing, and practical geometry have been dropped, and descriptive geometry never adopted in the ordinary curriculum. The presumption is that the school and the university have trained a man to learn, and that his practical education begins when he leaves the latter. We are not prepared to discuss the propriety of this system, in so far as it applies to the higher and wealthier classes. We may be quite sure that they will always see their own true interests, or if they do not, that they will soon be replaced by people who are more alert. It is sufficient to observe that it defers practical education to an age when the children of the middle and professional classes ought to have begun to maintain themselves.

Now in France, Prussia, Switzerland, and the states lying between them, the instruction of the people is conducted on a totally different principle. While the classics are far less exclusively studied, a knowledge of them is much more common. They are taught as languages to be understood and written, while the chief application of grammar is to the language of the country, whether French, German, or Dutch. Geometry is taught, not from Euclid, but in a thoroughly practical form, and the whole of the mathematical instruction has direct reference to possible application. The result is, that an English boy leaves school at fifteen or sixteen years of age with an imperfect smattering of Latin and Greek, and an acquaintance with algebra and Euclid which it would be ridiculous to dignify by the name of mathematical knowledge; while the French or German has acquired a useful general training, of which he finds the immediate application in his technical school, if he is in a situation to prolong his education, or in his business, if he passes at once to a skilled handicraft.

As regards the higher results of the two systems, we do not find that the best scholars of France and Germany are inferior to the great men whom our own universities have produced. At the other end of the system we find that the superior education of the artisans, and especially of the foremen and designers, have enabled them to compete with and outsell us in our best staples, notwithstanding the advantage which we had in holding prior possession of the market, and in cheap access to raw material. We have no longer the lead, either as workers in iron, as engineers, or as engineering contractors. It is not many years since that these things were among our chief sources of national pride."

The London *Times* of the 29th ult. contains a letter from Earl Granville, enclosing one addressed to the Right Hon. Lord Taunton, by Dr. Lyon Playfair, on the importance of "Technical Education," and its neglect in England as compared with continental countries. Referring to the opinions elicited by him from the eminent men upon the different juries of Mechanical Departments in the French Exposition, he remarks:

"I am sorry to say that, with very few exceptions, a singular accordance of opinion prevailed that our country had shown little inventiveness and made but little progress in the peaceful arts of industry since 1862. Deficient representation in some of the industries might have accounted for this judgment against us, but when we find that out of 90 classes there are scarcely a dozen in which pre-eminence is unhesitatingly awarded us, this plea must be abandoned. My own opinion is worthy only of the confidence which might be supposed to attach to my knowledge of the chymical arts; but when I found some of our chief engineers lamenting the want of progress in their industries, and pointing to the wonderful advances which other nations are making; when I found our chymical and even textile manufacturers uttering similar complaints, I naturally devoted attention to elicit their views as to the causes. So far as I could gather them by conversation, the one cause upon which there was most unanimity of conviction is that France, Prussia, Austria, Belgium, and Switzerland, possess good systems of industrial education for the masters and managers of factories and workshops, and that England possesses none. A second cause was also generally though not so universally admitted, that we had suffered from the want of cordiality between the employers of labour and the workmen, engendered by the numerous strikes, and more particularly by that rule of many Trades' Unions, that men shall work upon an average ability, without giving free scope to the skill and ability which they may individually possess.

"Dumas, well known as a '*savant*,' and who, from his position as a senator of France and President of the Municipal Council, has many opportunities of forming a correct judgment, assured me that technical education has given a great impulse to the industry of France. In going through the exhibition, whenever anything excellent in French manufacture strikes his attention, his invariable question is 'Was the manager of this establishment a pupil of the Ecole Centrale des Arts et Manufactures?' and in the great majority of cases he received a reply in the affirmative. General Morin, so well known as the Director of the Conservatoire des Arts et Metiers, has lately sat on a commission to examine into the state of technical education in other countries, and to extend it to France, and he informed me that their recommendations were likely to be promptly and largely acted upon. I mention for your Lordship's information, that General Morin was of opinion that the best system for the technical education of workmen is to be found in Austria, though the higher instruction of masters and managers is better illustrated in France, Prussia and Switzerland..

"In 1853, I published a little work on 'Industrial Education on the Continent,' in which I pointed out that as an inevitable result of the attention given to it abroad, and its neglect in England, other nations must advance in industry at a much greater rate than in our own country. I fear that this result is already attained for many of our staple industries. * * * * It would be important that the government, either through your commission, or through the committee of council on education, should hold an official enquiry on this subject, and should tell the people of England authoritatively what are the means by which the great States are attaining an intellectual pre-eminence among the industrial classes, and how they are making this to bear on the rapid progress of their national industries."

If this subject is considered of so much importance to England, so long pre-eminent in the industrial arts, especially in machinery, and iron manufactures, how much more important must it be to us, having so powerful and inventive a nation as the United States as neighbors. If the Dominion of Canada is to attain a higher and more fitting position than the Provinces have hitherto occupied, in the engineering and mechanical departments, greater attention must be given to the more practical studies in our common and grammar schools, and in our colleges and universities. Special importance must be given to algebra, geometry, principles of and practical mechanics, chemistry and experimental philosophy, geology and mineralogy; and to supplement and perfect the work of the schools and colleges in this direction, Mechanics' Institutes should be encouraged in every community, with well organized means and appliances for adult instruction, by evening classes and lectures, and with liberal prizes and scholarships attached.

The education of the operative classes must be continued after the pupils leave the schools, and enter upon the active labours of life; and to induce the regular attendance of youths at evening classes, after having been engaged in laborious employment for ten or twelve hours during the day, requires comfortable class rooms, good teachers, and judicious rewards for successful study. Need there be any difficulty in securing these? We think not, with legislative aid nearly proportioned to that given to other interests. The class accommodation in the Toronto Mechanics' Institute is not so good as it should be, nor are the prizes awarded to the successful students of any considerable money value; yet the average attendance of pupils at these classes for the past four years has been about 150 per session. This is indicative of the success that might be attained under a more liberal system of support. Our next enquiry is, how the necessary public support can best be given to these institutions, so as to secure the desired result?

In the year 1859, the Finance Minister of Canada, the Hon. Mr. Galt, assured a deputation from this Board that the grants to Mechanics' Institutes would shortly be resumed, under a more judicious mode of distribution than formerly. In April 1862 the Board again memorialized the government to renew the grants to institutes, and submitted a scheme nearly as follows:—

1st. A renewal of the grants to each properly organized Mechanics' Institute throughout the Province, embracing not less than fifty members, paying at least $1 per annum, and twenty of whom shall be working mechanics or manufacturers.

2nd. Fifty per cent. of the grant to be appropriated to the purchase of books of an instructive character for manufacturers and artizans; such works to be supplied through the Board of Arts and Manufactures at reduced rates; but the selection from an approved list, to be made by the Institutes themselves.

3rd. Forty per cent. to be devoted to the encouragement of classes established in the respective Institutes, for class instruction in mechanical or natural sciences, by lectures or otherwise.

4th. Ten per cent. to be retained by the Board of Arts and Manufactures, for prizes to successful competitors at the Annual Examination of members of Mechanics' Institutes, established by this Board.

5th. The distribution of the annual grants for Upper Canada to be made by this Board, upon approved returns from each Institute of the proper application of the funds applied for and expended in the formation and instruction of classes, or in the establishment of prizes, such returns to be forwarded by this Board to the Auditor General at the close of each year, with a report on the working of the respective Institutes.

6th. Any funds not legally claimed by the Institutes, to be set apart for the engagement of occasional lectures on subjects relating to arts and manufactures, selected by the respective Boards and for the publication of such lectures with appropriate illustrations in the journals of the respective Boards.

Some such plan as was then sketched out by the Board, would, under a wise management, produce results as satisfactory in the Arts and Manufactures of the Dominion, as has the Legislative aid to Agricultural Associations been beneficial to Agriculture; and that such aid to the latter has been productive of the most satisfactory and beneficial results, no one at all acquainted with the history of Agriculture in the Province, for the last twenty-five years, will attempt to deny.

As to whether the grants should be made as formerly of a fixed sum to each Institute, irrespective of the populations of the different localities, or of the number of enrolled members; or whether the aid given should be on the same principle as the grants to Agricultural Societies, *viz.*, in proportion to the *bona fide* subscriptions of their members, is a mere matter of detail not now necessary to discuss; but that aid should be given, in some form or other, is beyond doubt, in view of the liberal grants to other class interests, and of the importance of the interests in question.

In January 1865, this Board submitted to the government a scheme for establishing a school of arts, or college for mechanics;* as contemplated by its act of organization. This school, if established, and in connection with the Annual Examinations by the Board, would bear the same relations to the Mechanics' Institute adult classes, that the universities now sustain to their several affiliated colleges; and, when once fairly in operation, would secure for the graduates as great proportionate advantages as are now enjoyed by the successful competitors at the London *Society of Arts* Examinations, or the *middle-class* examinations of the University of Cambridge—the certificates of either Institutions being now accepted by the great body of employers in Great Britain, and by the Imperial Government for employment in the civil service, without further examination.

Since the establishment of our Canadian universities, a few benevolent individuals have donated free scholarships therein; and one, at least—John McDonald, Esq., M. P. P.—has restricted the competition for his gift to the sons of mechanics. This, under the circumstances, was recognizing as far as possible the importance of the mechanical interests; but under the system here proposed, a scholarship in the school of arts would be a much more valuable gift, as a general rule, both to the mechanical interests and to the country.

We trust to see this subject taken up, by both General and Local Governments, and treated upon

* See Journal for Feb. 1865, p. 34.

the broad grounds of justice and expediency that the importance of the subject demands; and may we not also hope that the school teachers of this Province of Ontario, who we believe will meet in convention in this city during the month of August, will find time to thoroughly ventilate this subject, and thus bring it fully before the public, and specially under the notice of the educational authorities.

FILE MAKING.

A subscriber enquires as to the process of file-making. We quote from Ure's Dictionary, that the heaviest and coarsest kind of files are made from the inferior marks of blistered steel; the finest Lancashire files, for watch and clock makers, are of steel from the best Swedish iron. Small files are mostly made from cast steel, but it is too costly for the larger and common files.

"The file-maker's forge consists of large bellows, with coke as fuel. The anvil block, particularly at Sheffield, is one large mass of mill-stone grit. The anvil is of considerable size, set into and wedged fast into the stone, and has a projection at one end, with a hole to contain a sharp-edged tool for cutting the files from the rods. It also contains a deep groove for holding dies or bosses, for giving particular forms to the files. The flat and square files are formed entirely by the hammer. The half-round files are made in a boss fastened into the groove above mentioned. The steel being drawn out, is laid upon the rounded recess, and hammered till it fills the die. The three-sided files are formed similarly in a boss, the recess of which consists of two sides, with the angle downwards. The round files are formed by a swage similar to those used by common smiths, but a little conical.

"The file-cutter requires an anvil of a size greater or less, proportioned to the size of his files, with a face as even and flat as possible. The hammers weigh from one to five or six pounds. The chisels are a little broader than the files, sharpened to an angle of about twenty degrees. The length is just sufficient for them to be held fast between the finger and the thumb, and so strong as not to bend with the strokes of the hammer, the intensity of which may be best conceived by the depth of the impression. The anvil is placed in the face of a strong wooden post, to which a wooden seat is attached, at a small distance below the level of the anvil's face. The file is first laid upon the bare anvil, one end projecting over the front, and the other over the back edge of the same. A leather strap now goes over each end of the file, and passes down upon each side of the block to the workman's feet, which, being put into the strap on each side, like a stirrup, holds the file firmly upon the anvil as it is cut. While the point of the file is cutting, the strap passes over one part of the file only, the point resting upon the anvil, and the tang upon a prop on the other side of the strap. When one side of the file is single cut, a fine file is run lightly over the teeth, to take away the roughness; when they are to be double cut, another set of teeth is cut, crossing the former nearly at right angles. The file is now finished upon one side, and it is evident that the cut side cannot be laid upon the bare anvil to cut the other. A flat piece of an alloy b. t. lead and tin is interposed between the toothed surface and the anvil, while the other side is cut, which completely preserves the side already formed. Similar pieces of lead and tin, with angular and rounded grooves, are used for cutting triangular and half-round files. Rasps are cut precisely in the same way, by using a triangular punch instead of a flat chisel. The great art in cutting a rasp is to place every new tooth as much as possible opposite to a vacancy."

File cutting machines have from time to time been invented, some of which Ure describes. Those mentioned are by Duverger, in 1699; by Fardouet, in 1725; Thiout, 1740; Brachat and Gamain, 1756 and 1778; Raoul, 1800; Ericsson, 1836; and Robinson, in 1843. A full description, with illustrations, of the file cutting machine of Mr. W. Shilton, of Birmingham, shows its general principles and mode of working.

The cutting accomplished, the next thing is to harden the files. "Three things are strictly to be observed in hardening; first, to prepare the file on the surface, so as to prevent it from being oxidized by the atmosphere when the file is red hot, which effect would not only take off the sharpness of the tooth, but render the whole surface so rough that the file would, in a little time, become clogged with the substance it had to work. Secondly, the heat ought to be very uniformly red throughout, and the water in which it is quenched fresh and cold, for the purpose of giving it the proper degree of hardness. Lastly, the manner of immersion is of great importance, to prevent the files from warping, which in long thin files is very difficult. All files, except the half-round, should be immersed perpendicularly, as quickly as possible, so that the upper end shall not cool. The half-round file must be dipped in the same manner; but, at the same time that it is kept perpendicular to the surface of the water, it must be moved a little horizontally, in the direction of the round side, otherwise it will become crooked backwards.

"After the files are hardened, they are brushed over with water, and powdered cokes, when the surface becomes perfectly clean and metallic. They ought also to be washed well in two or three clean waters for the purpose of carrying off all the salt, which, if allowed to remain, will be liable to rust the file. They should, moreover, be dipped into lime-water, and rapidly dried before the fire, after being oiled with olive oil, containing a little oil of turpentine, while still warm. They are then finished.

Board of Arts and Manufactures
FOR ONTARIO.

TRADE MARKS.

Trade Marks registered in the office of the Board of Registration and Statistics, and open for inspection at the Library of this Board.

(*Continued from page* 151.)

Duncan McTavish, Action. Trade Mark:—"Ontario Pain Conquerer," written in red letters, shaded with black. Recorded in Vol. A. folio 173 (No. 394). May 27th, 1867.

London City Oil Refining Co., London, C. W. Trade Mark:—An Anchor, with the word "Gals" underneath, and the name of the Company surrounding the whole. Recorded in Vol. A., folio 175 (No. 340). May 29th, 1867.

A. L. Scovill & Co., Cincinnati, U. S. Trade Mark:—A Lithographed lable, with the vignettes, and the words "Dr. Wm. Hall's Balsam for the Lungs, &c." Recorded in Vol. A., folio 174 (No. 402). May 29th, 1867.

W. S. Finch, Toronto. Trade Mark:—A Tiger in a squatting posture, on a slab, with the words "The Royal Tiger," as a distinguishing sign, or words, in connection therewith. Recorded in Vol. A., folio 176 (No. 320). June, 1st, 1867.

Dr. J. A. Crevier, St. Cesaire. Trade Mark:—A maple leaf upon an escutcheon, which is covered with a beaver, with the three letters J. A. C. under the whole. Recorded in Vol. A., folio 177. (No. 419). June 3rd, 1867.

RECENT PUBLICATIONS.

British.

Bacon, J. Theory of Colouring; being an analysis of the Principles of Contrast and Harmony in the Arrangement of Colours, with their Application to the Study of Nature, and Hints on the Composition of Pictures, &c. With coloured Illustrations. Post 8vo, pp. viii—51. 2*s* 6*d*.

Blackie, Thos. M. Metric System, with the French Terms, and their approximate English equivalents; and a Table of the French Decimal Euqivalents to the English Standards of Weights and Measures; with Instructions for finding the French Equivalents for all the other Denominations. 16mo. sd, pp. 8. Simpkin. 6*d*

Brande and Cox. A Dictionary of Science, Literature, and Art; comprising the definitions and derivations of the Scientific Terms in General Use, together with the history and descriptions of the Scientific Principles of nearly every branch of human knowledge. New edition. Edit. by W. T. Brande and Rev. Geo. W. Cox. (In 3 vols.) Vol. 3. 8vo. pp. y—1068. Longmans; 21*s*.; Complete 3 vols. 63*s*.

Engineering Facts and Figures for 1866. An Annual Register of Progress in Mechanical Engineering and Construction. Cr. 8vo. pp. 8—404.—Fullarton. 6*s*.

English Catalogue of Books (The), for 1866, containing a complete List of all the Books published in Great Britian and Ireland, in 1866; also of the Principal Books published in the United States of America, with the addition of an Index of Subjects. Roy. 8vo. sd., pp. 74. Low. 5*s*.

Gilks, Thos. Art of Wood Engraving. A Practical Handbook. With Illustrations by the Author. 12mo. sd., pp. 57. 1*s*.

Gwilt. Joseph. Encyclopœdia of Architecture. Historical, Theoretical, and Practical. Illust. with more than 1,100 engraving on wood. A New Ed., revised, with Alterations and considerable Additions, by Watt Papworth. Additionally illustrated with nearly 400 engravings on wood, and more than 100 other woodcuts. 8vo. xx—1364. Longmans. 52*s*. 6*d*.

Haskoll, W. Davis, Engineer's, Mining Surveyor's, and Contractor's Field-Book. 2nd Ed., much enlarged. 12mo. pp. xxiv—189. Lockwood. 12*s*.

Rankine, William John Macquorn, C.E., L.L.D. Useful Rules and Tables relating to Mensuration, Engineering, Structures, and Machines. Post 8vo. pp. vii—312. 9*s*.

Tomlinson, Charles, Rudimentary Mechanics; being a concise Exposition of the General Principles of Mechanical Science, and their Applications, 9th Ed., corrected. (Weale's Rud. Ser., 6.) 12mo. cl. sd., pp. viii—176. Virtue. 1*s*. 6*d*.

Treatise (A) on Punctuation, and on other matters re lating to correct Writing and Printing. By an old Printer. F cap. 8vo. cl. sd., pp. 157. Pitman 2*s*. 6*d*.

Treatise on Architecture; including the Arts of Construction, Building, Stone-Masonry, Arch, Carpentry, Roof, Joinery, and Strength of Materials. Edit. by Arthur Ashpetil. With Plates., 4to. Black. 30*s*.

Richardson, Thomas, and Watts, Henry. Complete Practical Treatise on Acids, Alkalies, and Salts; their Manufacture and Application. 2nd Edit. Illust. 3 vols. 8vo. pp. lxxiii—2276. Bailliérd. 90*s*.

American.

Annual of Scientific Discovery: or, Year-Book of Facts in Science and Art for 1866 and 1867. Edited by S. Kneeland, A.M., M.D. Portr. 12mo. pp. 370. Boston: Gould and Lincoln. Cl.—$2.

American (The) Annual Cyclopœdia and Register of Important Events. 1866. Vol. 6. Large 8vo. pp. iv., 795. N. Y.: D. Appleton & Co. Cl.—$4.

Craig. Weights and Measures according to the Decimal System, with Tables of Conversion for Commercial and Scientific Uses. By B. F. Craig, M.D. 24mo. pp. 48. N. Y.: D. Van Nostrand. Flex. Cl.—50 cts.

De Voe. Abattoirs. A Paper read before the Polytechnic Branch of the American Institute; June 8, 1865. By Thomas F. De Voe. 8vo. pp. 82. Albany: C. Van Benthuysen & Sons, Prs. Paper.

Disturnell. Census of the United States and Territories, and of British America: giving the Population by Counties and Districts, with the Cities and Principal Towns. Compiled by J. Disturnell. 8vo. pp. 64. N. Y.: Amer. News. Co. Paper.—35cts.

Donlevy. Practical Hints on the Art of Illumination. By Alice Donlevy. Oblong, 8vo. pp. 78. Illustr. N. Y.: A. D. F. Randolph. Cl.—$3.
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Johnson. The Nicholson Pavement, and Pavements Generally. By Frank G. Johnstone, M.D. 8vo. pp. 128. N. Y.: W. C. Rogers & Co., Prs. Paper.

Leavitt. Facts about Peat as an Article of Fuel. With a chapter on the Utilization of Coal Dust with Peat. By T. B. Leavitt. Third Edition, revised and enlarged. 12mo. pp. 316. Boston: Lee & Sheppard. Cl.—$1 75.

Mackenzie's Ten Thousand Receipts in all the Useful and Domestic Arts. Revised and brought up to April 25, 1867. Roy. 8vo. pp. 500. Phila.: T. Ellwood Zell. Cl.—$4. (By subscription only.)

Munn & Co. The United States Patent Law. Instructions how to obtain Letters Patent for New Inventions, etc, By Munn & Co. Third Edition. 24mo. pp. 107. N. Y.: Scientific American Office. Paper, gratis; Cl.—25 cts.

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Selected Articles.

COMMON OBJECTS FOR THE MICROSCOPE.
No. I.

BY W. F. HUNTER.

There is no direction in which scientific research has made more wonderful advances within the last fifty years than in the investigation of those minute bodies and structures which are revealed to us only by the aid of the microscope. Upon the construction of the instrument itself a vast amount of skill and labour has been expended by those who have devoted themselves to the study of optics, and in the hands of the most talented mechanicians it has been brought to a marvellous pitch of perfection.

Wide, indeed, is the domain of microscopic inquiry; a great deal of light has already been thrown upon those mysterious processes of organic life, with reference to which our forefathers could make but the crudest and vaguest guesses.

As regards the growth and development of the animal tissues, the influence of disease in altering their structure and impairing their functions, and as regards the great problem of reproduction, much has been discovered, but much more remains to be discovered.

In the mineral kingdom microscopic research has led to many startling discoveries, and has shown the way in which many of the strata forming the crust of our globe have been formed. It has been proved that the chalk, which seems for the most part so uniform in structure, is mainly composed of shells and other organic remains, so excessively minute as only to be visible under a considerable magnifying power; the remains of animals that lived their little day in the primeval seas, then died, and sank to the bottom, there to accumulate for unnumbered centuries, till at last, ages before the advent of man upon our earth, the ocean bed was gradually upheaved, and the mountains of chalk that had been formed below the sea became dry land, preserving imbedded in them those relics of ancient life which the microscope has revealed to us.

The microscope has also taught us, that a process precisely similar is taking place in the existing seas, year after year, century after century, the hard shells of the *Foraminifera,* and other minute animals that inhabit the water, together with the silicious skeleton of *Diatomaceæ,* are falling to the bottom of the ocean, and forming there a soft deposit, destined perhaps to be one day lifted up, either suddenly, by some terrific subterranean convulsion, or more probably slowly by a gradual pressure from beneath, till at last, in its turn it becomes dry land, to be inhabited, ages hence, by some new race of terrestrial beings. It is doubtless well known to our readers that the Atlantic Cable of 1865, when recovered last year from the depths of the Atlantic, was found to be covered with microscopic shells of beautiful form, and probably ere long both cables will be completely buried in the soft Atlantic ooze, safe from any injury save that which may be brought about by gradual and natural decay.

But even for the amateur who knows little of pure science, and has not time or inclination to investigate the recondite problems of physiology, pathology, or geology, the microscope cannot but afford an inexhaustible fund both of rational amusement and instruction. Should he care only to look at that which is beautiful, and to admire the delicate patterns with which the most minute bodies are often marked, and the exquisite arrangement of the smallest parts of organisms, themselves so small as scarcely to be discernible by the naked eye, if he will but pursue his observations in a proper spirit, he must derive from them both profit and pleasure. In the vast domains of organic nature there is no class of objects, however apparently insignificant, that does not furnish to the attentive observer abundant proofs of beautiful design, and a marvellous adaptation of means to ends. Some there have been, and probably some there are, men of profound learning and subtle intellect, who deny that such proofs of design demonstrate the existence of a Supreme Architect and Creator of the Universe; they will tell us, perhaps, that everything is the result of an eternal and immutable law, or rather of a combination of such laws, acting blindly, and evolving by mere chance results which simulate the workings of an intelligent mind; such a theory as this seems to be opposed to all analogy, and to destroy the basis of all reasoning, since if, in this case, where the analogy can be supported by such innumerable instances, the argument from it does not hold good, there can be no means of proving anything which we do not know of our own certain knowledge, we can believe in the existence of nothing which we do not see with our own eyes. Enough of this; the writer only wishes to address those who are prepared to see, in the wonderful works of Nature, sure proof of the infinite wisdom and goodness of God.

In the present paper, it is proposed to point out a few objects of beauty, that can be easily procured, and which, when procured, can be prepared without dfficulty for observation.

The great class of *Echinodermata*, which include the sea-urchins, the star-fishes, and the sea-cucumbers, which are found upon our coasts, affords to the microscopist a vast number of objects of extreme beauty and interest. The animals of this class possess an external skeleton, composed of a multitude of plates of carbonate of lime, arranged often in a very beautiful manner, and furnished with spines and other curious appendages, varying in the different families.

Let us take a specimen of *Ophiocoma Rosula*, a species of brittle star, very common on our coasts; by placing it in a moderately strong solution of potash we shall be able to dissolve away all its soft parts, so that nothing will remain but the skeleton, composed of an immense number of separate pieces; this skeleton itself, if nicely freed by the potash from all organic nature, forms a very beautiful ornament. The five long tapering arms are densely covered with spines of considerable size; if some of these are separated and placed under a low power of the microscope, they will be found to present an extremely lovely appearance. They are slightly curved, and taper from base to point; they are serrated along their curved borders, the serrations being rather long and pointing upwards. The smaller and delicate spines that are situated towards the end of the arm are most beautiful; they are more transparent than the larger ones, are not curved so much, and the serrations are larger in proportion to the size of the spine; these spines have been termed the cathedral spines, from their resemblance to the spire of a cathedral; the comparison is not an inapt one. Each of the segments or vertebræ of which the arm is composed supports about six of these spines; on each side, the largest are situated most literally. There is a space free from spines along the centre both of the upper and under surface of the arm. Each spine presents a swollen base, and is attached by a regular articulation.

Just within the lowest spine on the under surface of the arm is situate a very curious and beautiful body. It consists of a kind of claw, resting on an enlarged base, which is attached to the limb in a manner somewhat similar to the ordinary spines. The claw itself has two points, which are sharp and curved; it is difficult to describe it in words, but it may be better compared to the head of a bird, with the beak widely open, than to anything else with which the writer is acquainted. These claws, when detached, appear to the naked eye no larger than specks of dust, but they may be well seen under an inch and a-half power; they look very transparent and glassy; they can readily be seen in their natural position by detaching a portion of the limb and holding it under the microscope by means of the stage forceps.

The structure of the mouth, or as we should perhaps say more correctly the stomach, in this species is very remarkable. The aperture of the mouth is situated as in other star fishes in the centre of the body or disc, and leads directly into a cavity formed by five bones of very curious shape, which touch each other at their edges. Each bone presents a very perfect resemblance to the sole of a shoe, coming to a blunt point at the toe. The sole of each shoe is turned inwards, and the toe is directed towards the mouth of the animal. Each of these curious bones is perforated with a series of holes along each side, those at the heel part are largest, and occasionally the corresponding holes run into each other in the centre; passing on to the constriction of the bone, which corresponds to that of a shoe beneath the instep, the lateral holes become much smaller and diverge from each other till, towards the toe they are completely lost, but along this part of the inner surface of the bone there is a groove or depression. The holes as well as the central groove are for the attachment of a number of teeth; these teeth which are attached to the part we have called the heel of the shoe are of considerable size, they are of conical shape, flattened above and below, and extend right across the bone; the edge which is attached presents two distinct pegs which fit into the holes already described; there are three or four of these teeth; the remaining teeth are much smaller and of a more rounded shape, resembling little pegs; they are disposed in four rows, the lateral rows, articulating with the holes, and the central ones with the central groove; they are very closely set. These shoe-bones may be easily separated by placing the disc of the animal in a very strong solution of potash; when nicely washed they make an interesting object to be viewed by reflected light under a low power of the microscope.

There is a small species of brittle star called *Ophiocoma neglecta*, a moderate sized specimen will easily lie on a shilling, it is very common in rocks between tide marks. The skeleton may be easily prepared by immersing the creature in a weak solution of potash, and afterwards washing it in spirit of wine; it may thus be made beautifully white. The whole skeleton may be mounted as an opaque object; each of the five plates which surround the mouth bears a very close resemblance to a trefoil leaf; the structure of the disc is exceedingly beautiful and complicated; when nicely prepared it looks under the microscope very much as if it were composed of frosted silver, and is particularly well adapted to be viewed with the binocular arrangement.

The objects that have been described above, may easily be mounted as permanent specimens. After being freed by the potash solution from animal matter, they should be washed with distilled water in a watch glass, or small porcelain basin, they should then be washed again with spirit, and allowed to dry thoroughly; they may now be transferred to a glass slide, upon which a ring of cardboard of sufficient depth has been fastened; the cardboard should be previously washed in asphalte. The black background necessary for throwing up the objects when they are viewed by reflected light, may be given by painting a dish of photographic black upon the reverse side of the slide. The thin glass cover being attached with gum, the whole may be finished with a coating of asphalte or other varnish.

(To be Continued.)

THE ROYAL ALBERT HALL OF ARTS AND SCIENCES.

On Monday last the Queen, the first time for many years, appeared in public life again, and laid the foundation stone of the proposed Hall of Arts and Sciences, at South Kensington. The occasion was an important one; no less than the commencement of a building destined to perpetuate the services which the late Prince Consort rendered to the advancement of science and art. The site chosen for the intended building, is on the land belonging to the Commissioners for the Exhibition of 1851, on the north side of the Royal Horticultural Gardens, and just in front of the Albert Memorial. The Hall is to be available for the following objects:—Congresses, both national and international, for purposes of science and art; performances of music; the distribution of prizes by public bodies and societies; conversazoni of societies established for the promotion of science and art; agricultural, horticultural and the like exhibitions; national and international exhibitions of art and industry, including industrial exhibitions by the artizan classes; exhibitions of sculptures, or other objects of artistic or scientific interest; and generally any other purposes connected with science and art. The Hall will be elliptical in plan, and the central portion will be occupied by an arena 100ft. long and 65ft. wide. Above and around the arena will rise the amphitheatre, extending over four-fifths of the ellipse in a gradually increasing curve of ascent. The remaining part of the ellipse will be occupied by sittings for an orchestra of 1,000 performers, and by an organ which is to surpass any instrument yet built. Above the amphitheatre again, will rise two tiers of boxes. Above the boxes will be a corridor 21ft. wide, which is to be fitted with moveable seating. This arrangement will allow it to be used for a sitting audience, a promenade, or exhibition space. It will give space for seating 2,700 persons. The wall of the corridor may be considered to bound the hall proper; and from wall to wall on the long diameter of the ellipse it will measure 230ft., and on the shorter 130ft. which enormous stretch is all to be covered in with a roof in one span, resting on piers. A gallery and promenade run completely round the Hall; the gallery will conveniently accommodate 1,000 persons. The total number therefore that could be conveniently seated in the building will be 8,000, including the orchestra. From the top of the piers, which separates the upper galleries from the main body of the Hall, the ceiling will rise in an elliptical curve to the great central skylight, both ceiling and skylight being suspended from wrought-iron arched ribs, which all converge on a central ring. The total height from the floor of the arena to the skylight will be 135ft. Colonel Scott, R.E. is the designer of the Hall, and Messrs. Lucas are the contractors for the building; and, to the liberality of the latter gentlemen, it is mainly owing that the work has been commenced so soon.—*Mechanics' Magazine.*

[The *Builder*, for May 25th, contains both exterior and interior views of this building.—Ed.]

DISINFECTANTS AND THE CHOLERA.

The *Scientific American*, commenting on the rapid advance in the price of Chloride of Lime, last season, remarked

"But happily we are not dependent upon chloride of lime; in fact, we may easily dispense with it altogether. The intelligent man who has made up his mind that his premises shall be more tidy, and that he will breath only the sweet air, will not be required to resort to chloride of lime or any of the high-priced nostrums.

We submit, in the first place, that water, air and fire are excellent disinfectants, which cost very little, and are within the reach of every one. These are the natural remedies, and are almost universally applicable. It is very observable in this city that when these are properly used there is no need of chloride of lime. The better class of houses, containing all the modern improvements, are so constructed, that unless the occupants actually choose otherwise to have it, the air within them cannot be tainted. Everything that is not desirable to have around is at once started on its way, through the sewers to the sea, or up the tall chimneys into the upper air, to be dissipated by the winds. The Croton water and the ventilating chimneys here are the purifiers.

How different it is in and about some of the tenement houses, where everything is reeking with filth and alive with vermin. In front of these houses almost constantly you may find pools of stagnant water and boxes of decaying garbage. A blind man might walk through the streets, following only his nose, and unerringly point out all the places to which pestilence is invited. What these places need are water, air, and fire. One of the wisest acts of our very efficient Board of Health, was the removal, a few days since, of the inmates from one of these pestilence-breeding houses, which they then surrendered to the Fire Department for purification by water.

What our old-fashioned and modern cheap houses need are, better conveniences for washing and ventilation. In a large part of them, there is either imperfect connection with the sewers or none at all, and very few of them have any provision whatever for ventilation. Granted that the people who live in them care very little for cleanliness, would it not be well to so build the houses that cleanliness might be the easiest plan, or at least might be possible?

We have alluded to garbage, meaning by it, the worthless relics of vegetables and meats which of necessity are produced in the kitchen. The very simple and economical way of disposing of much of this, in this city, at least, is to put it into the fire. There is no easier place, and there is no nuisance about it. One would suppose from the quantities of such stuff which lies about the streets, that the fact that it will burn had not been discovered. It might perhaps be well for city councils to discuss the propriety of enacting laws which should require that all combustible garbage be consumed within the same building where it is produced. In the winter time, at least, when fires are constantly burning, everything which cannot be carried away by the sewers, might be burned up.

It is only where water, fire, or ventilation is inapplicable, that special disinfectants should be used. The cases of most importance. in the city, are water closets, which are not properly connected with the sewers, and stables. The most available disinfectants for the first, are lime, chloride of lime, or common copperas, either in solution or powder; there is nothing so cheap as copperas which is at the same time efficient. For stables and similar places where the iron stains from copperas might be objectionable, the bisulphate of lime or soda ought to be furnished at a cheap enough rate.

The question of disinfectants involves the old story about cleanliness; "cleanliness is next to godliness." If people understand it, they will find as much virtue in the scrubbing brush, the whitewash brush, and soap and water, as in almost anything else.

The delicacy of some of the ornamental cast-iron work, known as Berlin iron, is such that it requires of some pieces ten thousand to weigh one pound.

FUMIGATING.

The ancient Greeks, children as they were in science, and especially in chemical science, had, nevertheless, discovered that certain substances have the power to promote putrefaction; and this property they expressed by the word *septikos* from their verb *sepo*, to putrefy. Hence the word antiseptic to express the property of preventing putrefication.

Since it has been ascertained that yeast and other substances which promote fermentation are growing plants, which are propagated by means of minute seeds or germs, it has been supposed that some, at least,, of the antiseptics operate by killing these germs. Of all known substances the two which are most efficient in the destruction of septic germs are carbolic acid and sulphurous acid. Carbolic acid has been recently described in these columns; it is one of the many useful and wonderful substances that are produced when bituminous coal is subjected to destructive distillation. Sulphurous acid is the substance usually employed in fumigation, especially when fumigation is resorted to as a means of preventing the spread of cholera.

The advantage of sulphurous acid for fumigating is, that at ordinary temperature it exists in a state of gas, consequently it diffuses itself throughout a house or apartment, and enters every crevice in the walls and ceilings, as well as every crack in the floors. Nothing could be more searching, thorough and efficient in its operation. It destroys not only all septic germs, but also all kinds of animal life. When a house is filled with it, every rat, mouse, cockroach, and bedbug must flee from the premises or be instantly destroyed.

Sulphurous acid is composed of sulphur and oxygen, in the proportion of one atom of sulphur to two of oxygen ($S\,O_2$) and as the atom of sulphur weighs twice as much as the atom of oxygen, the proportion by weight is pound for pound. It is produced by the simple process of burning sulphur in the air. When the temperature of sulphur is sufficiently raised it enters into combination with the oxygen of the air in the proportion to form sulphurous acid.

There are some serious objections to the employment of sulphurous acid in fumigating. It clings to the surfaces of the walls, and nestles among the fibres of clothing, and, when thus exposed to the atmosphere, each molecule, $S\,O_2$, absorbs a third atom of oxygen, becoming $S\,O_3$, which is sulphuric acid—oil of vitriol. This liquid, it is well known, is almost as destructive to clothing and other organic compounds as fire itself.

Were it not for this objection, nothing would be more easy to rid vessels of rats and other small animals by burning a little brimstone in the hold. For this purpose carbonic acid would be equally efficient, and, after doing its work, it would all mingle with the air in its gaseous state, and be blown away with the wind. But the sulphurous acid produces that peculiar irritating effect upon the nostrils and lungs which is perceived in the burning of a friction match, and it would cause rats and mice to flee before its advance, while carbonic acid, being inodorous, would quietly kill the animals in their lurking places, where their bodies might become offensive in decay.

From the recent report of Dr. Elisha Harris, the learned Registrar of the Board of Health, it seems to be the general conclusion of chemists and physicians in Europe and America, that, 'by means of carbolic acid and sulphurous acid, 'both of those awful scourges, the rinderpest and the cholera, may be as completely controlled as small pox is by vaccination. This power of carbolic acid is one of the most beneficent discoveries of this fruitful century. *Scientific American*

Machinery and Manufactures.

WILDE'S ELECTRO-MAGNETIC MACHINE.

At page 140 of the May number of the Journal, this machine was referred to in connection with the " wholesale manufacture of ozone." The following notice of it we take from the *Technologist* for April:—

" On the 2nd ult. were collected at Burlington House perhaps, the greatest number of scientific and literary celebrities that have attended the Soirées of the Royal Society for some time. The greatest object of interest of the evening was, the marvellous electro-magnetic machine, invented by Mr. Wilde. Rarely have we seen men naturally so stately and reserved, so excited, and no wonder for never before has artificial light of such power and brilliancy been seen. Physicists, electricians, geologists, naturalists alike looked on at the brilliant experiment with admiration. We had written a description of Mr. Wilde's wonderful machine, but have since seen in the *Standard* an account we like so much better than our own, that we do not think we can do better than reproduce it at full length in our paper :

An ordinary steam-engine of 15-horse power, was placed outside the building, and a driving strap brought through the window of the room. Here, on the floor, guarded all round by plates of metal, stood a huge induction magnet surmounted by a battery of smaller natural magnets; wheels and driving bands connected its various parts with the steam-motive power. The main parts of the machine are two. First, a magnecto-electric portion; and, second, an electro-magnetic one—the former being only considered an accessory. Taking this part first, it consists of 20 permanent horse-shoe magnets fixed to a magnet cylinder; each of the permanent magnets being about 17 inches high and 1½ inches broad, and capable of sustaining a weight of about 30lbs. The magnet cylinder is formed of two segmental pieces of cast-iron, separated by two pieces of brass, 'the whole being bolted together in such a way as to constitute a compound hollow cylinder of brass and iron, the brass not being a conductor of magnetism, isolating each half from the other. The bore of the cylinder is 3½ inches in diameter. Into this is inserted an armature, of the form used by Mr. Siemens, and made of cast iron wound longitudinarily with about 80 feet of covered copper wire, the inner end of which is placed in good metallic contact with the armature, and its outer extremity connected with the insulated half of the commutator. This armature is made to revolve inside the magnetic cylinder at about 2,000 revolutions per minute, and consequently, as in each revolution it is magnetised in two directions, 4,000 waves of electricity are transmitted from it in that time. The magnetism so generated, is carried to the polar terminals of the great electro-magnet, consisting of two plates of rolled iron 48 inches in length, 39 inches wide, and 1½ inches in thickness. Bolted to the upper and lower extremities of the plates are iron bars 6 inches wide and 2 inches thick. The extremities of the plates are united by a hollow bridge, made of rolled iron, 43 inches long, and 16 inches wide. Each side or limb of this electro-magnet is coiled with an insulated conductor consisting of 13 strands of copper wire, 125 inches in diameter, bound together in a double covering of linen tape. In length this rope is 4,800 feet, and the total weight of the two coils is over 1¼ tons. The magnetic cylinder for this machine consists of two masses of cast iron 50 inches in length, separated from each other by blocks of brass. An armature, similar in plan to that used in the magneto-electric machine, but enormously larger in dimensions, being 10 inches in diameter, is driven round within the bore, there being a free space of about 1-20th of an inch allowed between them. Two armatures have been furnished, which are interchangeable with each other, according to the purpose required; one being for the production of heat, the other for light. The intensity armature is coiled with an insulated conductor, consisting of a bundle of 13 copper wires, the same as those coiled round the sides of the electro-magnet, the rope being 376 feet in length, and weighing 232lbs. The quantity armature is enveloped within the folds of an insulated conductor, consisting of four plates of copper, each 67 feet in length, 6 inches in width, and 1-16th of an inch in thickness. The plates are superposed in metallic contact, so as to form a single copper plate, one quarter of an inch in thickness, 67 feet in length, and nearly wide enough to occupy the entire space between the segmented sides of the armature. This division of the conductor into four plates is made for the greater convenience of binding round the armature. The inner extremity of it is held in intimate contact with the body of the armature by flat-headed screws, and the convolutions are insulated from one another by placing between them a band of thick cotton, the edges being also insulated from the sides of the armature by thin pieces of wood. The outer extremity of the conductor is terminated by a thick copper stud which connects it with the insulated half of the commutator. The convolutions in all the armatures are prevented from spreading out by the high centrifugal force of the rapid revolutions by being retained in place by broad brass bands. The whole of the larger armatures are cased in wood to save them from accidental injury. The weight of the laminated conductor of the quantity-armature is 334lbs., and the total weight is more than a quarter of a ton. Each of the large armatures is accurately balanced, so as to avoid whilst working in the bore of the magnet cylinder, those excessive vibrations which would otherwise be produced if any inequality in the weight of the ends existed, when the armature was being driven at the rate of 1,500 revolutions per minute. As the same double action takes place here as in the former case, 3,000 waves of electricity are thus propagated, and are conducted by large copper springs to the poles proper of the machine and thence connected with two insulated plates of copper at the under side of a separate experimental table. Upon the upper side of this table are two movable brass studs sliding in good metallic contact with the copper plates, and forming the polar terminals of the entire machine. By a most simple contrivance, the enormous stream of electricity is turned on or off at will. A handle, very like that of a tap handle, protrudes from the top of the experimental table; at the base of its shaft below, is attached a bar of copper. When the bar is turned across the conductors, short contact is made, and no electric current passes on to the terminals; but when this bar is turned parallel with the conductors, it rests inert between them. and the electricity passes on in its longer course, The weight of the large electro-magnet alone, is nearly three tons, and the total weight of the whole machine, is four and a half tons. The effects produced are astounding. With the quantity-armature running the evolution of dynamic electricity is so enormous, that pieces of cylindrical iron rod 15 inches in length, and fully a quarter of an inch in diameter, were melted down in a few minutes, and copper wire of .125 inch diameter as quickly shared the same fate. A A beautiful sight was, to see the thick iron bar between the poles reek, glow vermilion red, become tawny, orange, yellow, then white, and then perfectly incandescent, and finally to trickle with tears of molten metal that ran along and dropped. In the same way loops of stout iron wire such as is used for fencing, more than a couple of yards in length, were held by a hook, and the current of electricity passed through; the whole loop soon became incandescent, and tears of melted white hot metal trickled fast and quickly and ran along its length, spattering on the iron experimental table, and sometimes falling in countless sparks upon the floor. With the intensity armature 21 feet of 0·65 inch iron wire may be made red hot. When the 10-inch electro-magnetic machine is charged with a direct current from the small magneto-electric battery, the development of magnetic force is unprecedented, and is equal to the lifting of 50 tons. During the evening a large bar of platinum was laid across the poles. The glow was magnificent; but it suddenly disrupted under the powerful current into numerous fragments. Outside the building the effect of the light was very great; the lamps were paled almost into the hue of very pale-brown paper; the smallest print, such as that of the popular sixpenny editions of Cooper's novels, and even smaller, was perfectly legible at the entrance gateway; and the flame of a piece of lighted paper had, at that distance, its image distinctly shadowed on a card behind it. No opportunity, on account of the direction of the street and the wall of the court, was afforded of testing the light at any greater distance. The light produced by Mr. Wilde's machine may be compared with that derivable from a thousand Grove cells with platina of 6 inches by 3 inches; and it absorbs from 8 to 10 horse-power out of the engine."

THE BESSEMER STEEL PROCESS IN THE UNITED STATES.

Most of our readers are familiar with the general composition and nature of steel, and the principles upon which its conversion from pig-iron or cast-iron is effected. Steel, it is well known, is a mixture of iron and carbon; the proportion of carbon being less than in cast-iron, but greater than in wrought-iron, which is the purest form in which iron has been practically obtained. The proportion of carbon in steel varies considerably, being larger in what are termed the higher grades of steel. Steel, moreover, differs from cast-iron not only in containing less carbon, but in its greater freedom from silex and other impurities.

The most common process hitherto practiced for the conversion of cast-iron into steel has been the preliminary conversion of the cast-iron into wrought-iron by the "puddling" or refining process, by which it is decarbonized, and the subsequent conversion of wrought-iron into steel by recarbonization to a suitable degree. This mode of making steel involves much labor and management of details and is very expensive. A low grade of steel termed "puddled steel" has also been made by subjecting the cast-iron to the puddling process as for making wrought-iron, except that the process is not continued until decarbonization has been effected, Puddled steel, though it is doubtful whether, strictly considered, it can be properly termed steel, is superior to wrought-iron on account of its greater strength, but has some of the defects of wrought-iron, particularly want of uniformity in a higher degree.

What is known as the "Bessemer process" of making steel, invented by Henry Bessemer, an Englishman, in the year 1856, consists simply in blowing air through molten cast-iron, and so depriving it of the carbon by effecting the combination of the latter with the oxygen of the air, which also removes all but a trace of the silex and causes the burning out of the other impurities. The process has been conducted in two ways:—1st, by blowing the air through the molten iron only until all but the requisite amount of carbon has been eliminated, and 2d, by continuing the blowing until *all* of the carbon has been removed, and then mixing with the decarbonized iron a small amount of melted crude cast-iron to get a proper proportion of carbon and a small proportion of manganese, the effect of the latter substance being to increase the ductility of the steel. The latter method is now, however, commonly practised, partly on account of its greater convenience and partly on account of the greater certainty with which the desired qualities are obtained.

The Bessemer, or, as it is sometimes called, the "pneumatic" process, is now in successful operation at the works of Messrs. Winslow & Griswold, at Troy, N. Y. These works, erected for the purpose, are of a capacity to manufacture at least fifty tons of steel every twenty-four hours or twenty tons in a working day of ten hours. The plant of the Troy Bessemer Steel-works was designed and arranged by Mr. A. L. Holley, who went to England to study the process as there carried on and the apparatus there used. Mr. Holley has made and introduced here several valuable improvements. On the 9th inst., we, by invitation from Messrs. Winslow, Griswold, and Morrell, the trustees of Mr. Bessemer's American patents, attended at these works an exhibition of the process, given for the purpose of bringing it to the notice of the leading American iron manufacturers, who were numerously represented; and we will now give a brief description of the apparatus used and the mode of operation.

The most important part of the apparatus is the "converter." This is a cylindrical vessel with dome-shaped ends. It is, for making five tons of steel at a charge, about fourteen feet high and nine feet in diameter at the largest part. It is mounted on trunnions, so that it can be turned completely over or either end upward. On one end is an inclined mouth or spout, and on the other a tuyere-box containing a number of fire-clay tuyeres to which air at a pressure of about twenty pounds per square inch is admitted from a blowing engine through one of the trunnions, which is made hollow for the purpose, and through one of the hollow iron columns forming the supports of the platform on which the trunnion bearings of the cupola are placed. The convertor is lined about ten-inches thick with a refractory material termed "ganister" which is composed of six parts by weight of silicious material, two parts clay, and two parts ground fire-brick. On the other trunnion is a toothed pinion gearing with a toothed steel rack for the purpose of revolving or turning over the converter. This rack is attached to the plunger of a hydraulic lift; and it may be here stated that all the operations of the apparatus are effected by hydraulic machinery, the whole of which can be controlled by a boy through the agency of suitable valves, the handles of which are conveniently arranged upon an elevated platform in view of the superintendent who directs the process. There are two converting vessels arranged side by side; but only one is used at a time, four charges being worked in each one in turn, to provide for the renewal of the tuyeres in the bottoms, which is necessary after working that number of charges, without any stoppage of the process.

The pig-iron to be converted is brought into the melting-house on trucks on a railway, from which the loaded trucks are lifted by an eight-ton hydraulic crane to the charging floor, whence the iron is fed into the cupola furnace, in which the melting is performed by anthracite coal. From this furnace the molten iron is run out into a ladle hung on trunnions and arranged upon a platform-scale, so that the charge of five tons for the converter can be accurately weighed and then tipped into a trough which conducts it to the converter. While the iron is being melted and the ladle filled the convertor is being heated internally to a red heat by a fire made inside of it. When the charge is ready the converter is turned over spout downward to discharge the remains of the fuel by which it has been heated, and then turned half-way back to bring its spout to a suitable elevation for the reception of the charge, which is then poured into the trough and thereby conducted into the converter.

The blowing engine is now set in operation to blow the air into the molten metal through the tuyeres in the bottom and the converter is returned to the upright position shown in the engraving. Combustion of the carbon in the iron, and a violent boiling then ensue, and the temperature of the metal is thereby raised from the yellow heat of molten cast-iron to an intense white heat. In a few minutes the flame blowing out of the mouth of the converter changes from a dull red full of sparks to white with splashes of cinder. After a few minutes more the flame gets thinner, shows purple streaks, and finally sensibly diminishes, till it assumes such appearance that to the practiced eye it is apparent that decarbonization is complete. At this instant which is generally at the end of about twenty minutes, the converter is turned back half-way over to bring the spout upward for the reception of the small quantity of recarbonizer, equal generally to about four per cent. of the quantity of decarbonized iron, and the blast shut off. The recarbonizer, which is generally a kind of iron known as "spiegeleisen," imported from Germany, and which has been melted in a small reverbatory furnace conveniently arranged for the purpose, is run through the trough before-mentioned into the converter. The chemical mixture of the recarbonizer with the decarbonized iron is almost instantaneous, causing a momentary boiling of the contents of the converter which have now become steel, and only require to be poured into moulds to be cast into ingots or slabs ready to be worked by the hammer or rolling mill into such forms as may be desired. Four charges of iron of five tons each can thus be converted into steel in ten hours, or ten to twelve charges in twenty-four hours.

As it would be impractible to pour the steel directly from the converter into the molds, the whole charge of the converter is first poured into a ladle of suitable capacity, arranged on a hydraulic crane so placed in front of the converters as to serve either or both of them. This crane is fitted with suitable gearing to move the ladle over a number of molds arranged in a circle, that the contents of the ladle may be poured through a teeming-hole in its bottom into the several molds in succession. While the ladle is being moved over the molds the mouth of the converter is turned downward to discharge the slag which consists of such of the impurities of the iron as have not passed off in a gaseous form in the decarbonizing process. The loss of iron in the whole process is from twelve to eighteen per cent. When the steel has solidified in the molds, the ingots are quickly removed from them, or the molds removed from the ingots, by means of three suitably-arranged hydraulic cranes, and the ingots are placed by the same cranes on trucks arranged on a railway running through the converting house. On this railway the ingots may be run out of the building to be supplied, according to the demand, to any establishments where they may be required to be worked into railway bars, axles, plates, or other articles. The ingots may, however, when taken hot from the molds, and without any reheating except to warm the exterior chilled by the molds, be taken directly to hammers, by which they are forged into the desired forms or merely condensed preparatory to being at once subjected to the operation of the rolling mill.

It has already been stated that the tuyeres in the bottom of the converters require to be renewed after every fourth charge has been converted. This is owing to the choking-up of the tuyeres by slag and impurities. To provide for the rapid removal of the old tuyeres and their replacement by new ones, the converter is made in sections, secured together by cottered bolts, and under each converter there is arranged a hydraulic lift, on to which there is run on a railway, a carriage which may be raised up by the lift to receive the lower part of the converter, so that when the latter has been taken off at a joint below the trunnions it may be run off by the carriage to an opening provided in the converter platform at the side of the converter, and here the old tuyeres are removed and the new ones inserted and secured by ramming ganister around them. By this contrivance, which is the invention of Mr. A. L. Holley, the entire operation of removing the old tuyeres and inserting new ones all ready for the repetition of the converting process can be performed in half an hour. In England the method of removing and renewing the tuyeres occupies a long time, as the practice there is to drive out the old tuyeres by rods inserted through the mouth of the converter, and after inserting new ones to pour around them a liquid mixture of ganister, which takes ten or twelve hours to dry and is then not solid. The same contrivance which provides for the renewal of the tuyeres also affords great facility for renewing the entire lining of the converter, which has to be done after about eighty charges have been converted.

Besides the above method of providing for the renewal of the tuyeres, Mr. Holley has introduced in the Troy Bessemer Steel-works several other improvements upon the English plant. One of these is the arrangement of the two converters side by side on one side of the ingot-pit instead of opposite each other on opposite sides of the pit, leaving more room for pouring and removing the ingots. Another improvement is the addition of top supports to the cranes, by which they are are made much lighter than when the only supports are the hydraulic cylinders. Another is the employment of three instead of only two cranes around the ingot pit, by which greater facility is afforded for the rapid removal of the ingots; and another is the substitution of the Worthington duplex pump for the English plunger pump to work the hydraulic machinery. He has also provided a screw adjustment for the fire-clay stopper of the teeming-hole of the ladle from which the steel is poured into the molds, by which much scrap is saved, and indeed in some cases the loss of a great part of the ladleful of steel is prevented.

A very great improvement here introduced is the substitution of the cupola for the reverbatory furnace for melting the iron, saving a great quantity of fuel. Mr. Holley provides for the relining of the bottom of the cupola in a very ingenious way, without any delay, by furnishing it with three separate bottoms, arranged to revolve about a central vertical pivot so that one can be removed and another brought into place. The central pivot is made hollow to serve as a conduit for the blast to either bottom which is in place.

The blast for the cupola for the melting of the iron and the reverbatory furnace for melting the recarbonizer is furnished by one of Dimpfel's and Root's blowers; and that for the converters is supplied by two blowing engines with 42-inch blowing-cylinders and 36-inch steam-cylinders, of four feet stroke and an aggregate horse-power of 350, built by Miers Coryell, of the Dry Dock Ironworks, New York. These engines are fitted with Dickerson's improvement of Sickles cut-off. The hydraulic machinery and steam pumps for working it were constructed at the works of H. R. Worthington in New York; and Mr. Holley was greatly aided by Mr. D. S. Hines, of the Worthington establishment, in the design, construction and arrangement of this machinery.

The iron which was used for the manufacture of the steel at the time of our visit to the Troy Bessemer Steel-works was two-thirds Iron Mountain and one third Willoughby and Fletcher Lake Champlain pig. We have before stated that spiegeleisen, which is a compound of iron, manganese, and carbon, was used as the recarbonizer. Franklinite, which is a compound of similar nature but with different proportions of the three elements, has been used with less success, and sometimes a factitious compound of the same elements obtained from England has been used.

From every charge of steel converted at these works a sample or test ingot is cast and taken to the blacksmith's shop and submitted to various tests of welding, hammering, hardening, and bending; notes are made of the iron and decarbonizer used, and of the indications observed during the converting process; and the test samples and corresponding notes are numbered, so that, by observing similar conditions, steel corresponding with the samples as to ductility, hardening property, etc., can be obtained. The tests are made under the direction of Dr. Adolph Schmidt. The converting process is conducted under the general superintendance and direction of Mr. J. C. Thompson.

The steel ingots which are manufactured by the Troy Bessemer Steel-works are supplied to forges and rolling mills at a distance, of various sizes, according to the purposes for which they are required. At the Renesselaer Works, near by, some of these ingots are made into boiler-plates, others into railway axles, others into railway bars, and others into various forms required for ploughs and other agricultural implements. For this latter purpose there is a large demand, which is constantly increasing. Boiler plates of Bessemer steel can be suppled at a cost very little greater than that of iron plates having similar flanging properties. Bessemer steel railway bars can be supplied at a cost not exceeding twice that of iron rails, and we were informed that their durability is more than twenty times greater than that of iron rails of ordinary quality.

The main cause of the cheapness of Bessemer steel is that manual labor is almost entirely dispensed with in its production. We see no reason why with increased demand it cannot be produced at a cost not exceeding that of wrought-iron, while its superiority for most if not all purposes is undeniable. It seems to us that the "age of iron," of which during the past few years we have heard so much, is fast passing away, and the age of steel is at hand.—*American Artizan.*

THE VELOCITY OF STEAM.

The flow of gases and the discharge of fluids are matters of the first importance to the practical engineer, and, in fact, to all who are interested in promoting the economic use of steam. These objects have of late engaged the attention of Mr. R. D. Napier, who has studied them both in their theoretical and their practical bearings. The results of his studies and experiments have been embodied in a very interesting pamphlet, which he has recently placed before the scientific world. ["The Velocity of Steam and other Gases, and the True Principles of the Discharge of Fluids." By R. D. Napier, London; E. V. F. N. Spon, Charing Cross.] Mr. Napier discloses some very surprising effects on the expansion of gases on their velocities, from greater to less pressures, through tubes and orifices, as obtained by actual experiment. He also gives the reasoning by which he was enabled, in a great measure, to anticipate those experimental results; and it is remarkable how these agreed with his formulæ, considering that the latter were obtained without any assistance whatever from the former, but were arrived at entirely by reasoning on the probable effects of expansion. Two of the conclusions at which Mr. Napier has arrived are surprising, if not startling; first, he states that the greatest rate at which steam will flow from a boiler through an orifice into a vacuum is only half, or rather less than half, of that given in all published tables on the subject. Considering the vast amount of research that has taken place upon all questions relating to steam, this proposition certainly appears incredible. But what will be said of the next? Here the author states that steam at a pressure of two or more atmospheres will rush from a boiler, through an orifice or short tube, into the air at exactly the same rate as it will into a vacuum, or into any pressure less than that of an atmosphere; and, generally, that a gas of any given pressure will rush from one vessel containing gas of half that pressure at the same rate, as if there were a perfect recipient vessel, or any intermediate pressure between a vacuum and half the pressure in a cistern; both pressures being taken from zero. The author frankly tells us that he does not expect this to be credited, although it is a fact nevertheless, and one which he has taken a great deal of trouble to prove beyond the shadow of a reasonable doubt.

These results were first deduced theoretically by Mr. Napier, and were afterwards proved, as regards tubes, by two perfectly dissimilar kinds of experiments. Each kind consisted of two divisions, differing widely from each other, and, as regards orifices, by a sufficient number of experiments to show that the same law applied to them as to tubes. These experiments are all carefully detailed by Mr. Napier, and knowing that he was venturing on debatable ground, he has been very careful to make his arguments and demonstrations lucid and and indisputable. On perusal of the phamphlet itself it will be found that the author has fully succeeded in establishing the two main conclusions at which he has arrived. Wide discrepancies have hitherto existed between the theoretical and experimental laws, especially between those relating to gases, which many have in vain tried to reconcile. It is peculiarly satisfactory, then, to find, at least for once, a theoretical law in the latter, and more difficult branch of the question, corroborated by experiments to a remarkable degree of exactness. We must at once admit the superior force of reasoning that predicts extraordinary results which are afterwards verified by experiments, to that of reasoning which is simply employed to explain the facts themselves after their existence has been ascertained. All Mr. Napier's experiments were tried with steam only, but as they corroborate the the truth of reasoning which is applicable to all gases, what is proved of one may be predicted of all, allowanse of course, being made for their densities. The general theory of the subject is elaborated in the second part of the treatise. Here the author points out several radical errors in the usual reasoning, which, he observes has to a great extent been inverted. He shows that the main cause of the contracted vein has hitherto been overlooked, and explains all the difficulties which exist upon the subject. The formulæ in general use are very complicated, none bringing out the fact of the velocity into all outer pressures which are less than the inner pressure. Indeed, no formulæ yet published give results at all to be compared in point of accuracy with those given by Mr. Napier, even for moderate differences of pressure. It is, therefore with much pleasure that we welcome this addition to our stock of knowledge on a most important subject, and commend it to the careful consideration of all interested in the progress of steam engineering.—*Mechanics' Magazine.*

OVERHEATED STEAM BOILERS.

Much has been said and written to prove that there is no fear of a violent explosion being produced by turning on the feed into an empty boiler, with the plates even red hot. Experiments are also on record which have been instituted to prove the same thing. But notwithstanding the clearness of theoretical deduction and the self-evident nature of practical results, the opinion still obtains with some that the danger in such a case is immediate, and a disaster of moral certainty. We treated this subject both theoretically and practically in our issue for November 16, last year, and the views then expressed have been since endorsed by practical men. But on the other hand there are those who have attempted to refute them, and who, although silenced, have expressed themselves as not having been convinced. Had they even been convinced, if against their wills, they would not have been convinced at all. In order, therefore, to clear away the misapprehensions which still exist in some minds, and the doubts which still lurk in others, we purpose placing before our readers the particulars of a few practical experiments which were recently made to test the point in question. They were conducted by Mr. L. E. Fletcher, the chief engineer of the Manchester Boiler Association, and the results clearly showed that the danger of injecting water into red-hot boilers has been greatly exaggerated. The experiments were carried out at the works of Messrs. Isaac Storey and Son, of Manchester, who provided Mr. Fletcher, at their own expense, with three boilers, at the same time affording the assistance of their workmen, with all necessary appliances and the convenience of their works. This practical investigation was mainly due to the numerous household boiler explosions which took place during last winter. But as the question involved is one of very general importance, relating not only to the safety of household boilers, but also to the explanations so frequently given of the cause of explosions occurring to large steam power boilers, the following details of the experiments will be interesting to our readers.

The boilers experimented on were three in number, and were all of the ordinary household circulating class. The first of these boilers was made of copper, weighed 62lb, and measured 14¼in. in height, 11¾in. in width, by 13¾in. in depth at the bottom, and about 8in. at the top, which gave an internal capacity of about 1 cubic foot. This was placed, empty, on the top of a brisk fire, as well as surrounded with it, and allowed to remain so till the bottom became red hot, and lumps of lead freely melted, though but loosely laid on the top, which was the coldest part of the boiler, being out of the reach of the flames. Under these conditions water was suddenly let into it through a ½in. pipe. No explosion, however, took place, the boiler was not stirred from its seat, neither did it tremble or evince the slightest sign of internal commotion; all that took place was a rush of steam through an outlet ½in. in diameter, left on the top of the boiler. It was necessary to have this opening, or the water would not have found its way into the boiler at all, as was proved by actual experiment with it closed, when the first puff of steam generated forbade the entry of more water. This opening, however, could in no way have assisted the boiler, if the views entertained with regard to the explosive effect of dashing water on red-hot plates were correct. The action of water under these circumstances is supposed to be as irresistible and instantaneous as that of gunpowder. The result of this experiment was considered conclusive, but it was thought to be more satisfactory to repeat it with another boiler of slightly different dimensions by way of corroboration. The second boiler, which was also of copper, weighed 44lb., and measured 11¾in. in height, 11¼in. in width, by 10½in. in depth at the bottom, and 8½in. at the top, having a flue tube running through it 6in. diameter, so that it had an internal capacity of about ⅗ths of a cubic foot. This boiler was surrounded, just as the previous one had been, by a brisk fire, which operated not only on the bottom and sides, but also on the internal flue tube. It was allowed to remain perfectly empty, until lead, loosely laid on the top, freely melted, and nearly half of the boiler became red hot. Water was then suddenly turned into it through a 1in. pipe, which was connected to the boiler at one end and to a tank affording a head of from 6ft. to 8ft. in height at the other. It was supposed that in increased diameter of pipe would give a more sudden injection of water, and therefore prove more favourable to an instantaneous injection of steam. The result, however, was the same as in the previous experiment; there was no explosion—the boiler remained perfectly still, the only effect produced being the escape of a jet of steam through a hole in the top of the boiler, left open for the purpose.

Here, then, was a complete corroboration of the first experiment; both being thoroughly convincing as far as they went. But they were both conducted in boilers made of copper, whereas many in use for household purposes are made of cast-iron. The experiment was therefore repeated with a cast-iron boiler, which would possibly prove more favourable to explosion, as well on account of brittleness of the material as from its greater weight of metal, which would afford increased capacity for heat, and thus for the more rapid generation of steam. This third boiler weighed 85lb. and measured 15¼in. in length, 10in. in height, 11½in. in depth at the bottom, and 8½in. at the top, having an internal capacity of less than a cubic foot, while the bottom was arched, which increased the heating surface. This boiler, like previous ones, was heated till the greater part of it became red-hot, and lead melted on the top. Indeed, it was in such a glowing heat that it appeared on looking in through a small orifice as if the bottom had been burnt out, and the eye was looking directly into the fire itself. Water was then laid on by means of a pipe 1in. in diameter, connecting the boiler to a tank giving a head from 6ft. to 8ft., but there was no orifice left open on the top of the boiler as before, a safety-valve loaded to a pressure of about 35lb. on the square inch, being substituted. On opening the tap on the connecting pipe, and letting the water on, no result whatever was apparent. The safety-valve did not blow, and the boiler neither cracked nor trembled, but the feed-pipe was found to get hot up to the tap, some 15ft. from the boiler, as if the stream was heating back and forbidding further entry of the water. After allowing the boiler to rest in this position for some time, with the fire briskly burning around it, the safety-valve was lifted, when a very moderate escape of steam took place, and continued as long as the valve was kept open, but ceased as soon as it was allowed to fall. Finding that no result could be produced with the safety-valve attached to the boiler, it was removed, and an orifice 1¼in. in diameter left open instead. On turning the water on again, a jet of steam escaped from the orifice as before, and shortly afterward the boiler cracked on one side from the top to the bottom with a sharp report. This was due simply to the contraction of the metal, and the rupture did not spread, neither did the boiler stir from its seat. The water was kept on till the boiler was nearly filled, but no result followed different to those already described. In order to render the experiment as conclusive as possible, the last one was repeated for corroboration. The boiler was emptied and placed on the fire, the connections were made as before, but the safety-valve was taken off and the diameter of the opening on the top was reduced to ¾in. The water was again turned on and the result just as before. A jet of steam issued from the orifice on the top of the boiler in a constant stream as long as the feed-tap was kept open, and intermittently when it was opened and closed alternately. The pressure of about 150lb. on the square inch would have been generated within by the evaporation of a quarter of a pint of water in the two larger ones, and an eighth of a pint in the smaller one. Although they were heated all over, it is clear that that pressure could never have been attained or even approached, as the light, flat-sided copper boiler did not bulge in the least, while the rush of steam from the outlet never appeared more than could be taken off by an ordinary safety-valve.

The foregoing experiments prove most conclusively the impossibility of exploding a red-hot boiler by the sudden injection of a stream of water. Every endeavour, however, was made to succeed, and everything that glowing red-hot plates and cold water could do under the circumstances was done. Indeed, the test adopted appears to have been much more severe than could occur in ordinary work, either to a household boiler on the occurrence of frost, or to a boiler employed for engine power on the furnaces being over-heated, and feed suddenly re-admitted to the red-hot plates. In the case of the ordinary household boiler, the fire rarely operates over such an extensive surface as in the experimental one. The amount of heated surface was, therefore, far greater in the experiment than it could be in practice. In the case of the steam boiler for engine purposes, its capacity would be very much larger in comparison with the amount of heated surface exposed on the furnace crowns being laid bare, than in the experimental ones, so that the force of the steam would be proportionally reduced, and so much so in practice as to be completely swallowed up. It may, however, be urged by some that, inasmuch as steam power boilers are ordinarily constructed of wrought-iron plates, and have seams of rivits running along and around them, they were not fairly represented in Mr. Fletchers's experiments. To such as would raise this objection, we would observe that an ordinary wrought-iron boiler was thus treated some ten years ago. The boiler was 25ft. long and 6ft. in diameter, the safety-valve was loaded to 60lb. per square inch, and the empty boiler was then made red-hot, the feed suddenly let in, and the boiler filled up. The only result was a sudden contraction of the overheated iron, which caused the water to pour out in streams at every seam and rivet as far up as the fire mark extended. Although in each case the experimenters failed to explode the boilers, it is to be hoped they have done something towards exploding the theory the experiments were instituted to test. The results may be accepted as conclusive that the idea arising from the instantaneous generation of a large amount of steam through the injection of water on to hot plates is a fallacy. The metallic plates of a steam boiler are not capable of containing sufficient heat to change a very large quantity of water into steam. The total quantity of heat which would raise the temperature of 1 cwt. of iron through 1 deg., would impart the same additional temperature to 12½lb. only of water. The quantity of heat which would raise the temperature of 1 cwt. of copper, through 1 deg., would raise that of 10 2-3lbs. only of water to the same extent. It is clear then, both theoretically and practically, that overheating is not the cause of violent boiler explosions. And we, therefore, hope that such nonsence will cease to be imported into judicial investigations into the causes of accidents arising from steam boiler explosions. —*Mechanics' Magazine.*

An expert printer will set about 25,000 letters daily, his hand travelling more than nine miles, and in the working days of a year about 3,000.

Modes of Working Wood.

So much of the public mind has of late years been directed to the new preparations and applications of the metals, particularly iron and steel, that the merits of that old time friend of man, civilized as well as savage, wood, are likely to be overlooked. Volume after volume is issued from the press, and our periodicals are filled with articles devoted to the properties, qualities, uses, and manipulations of the metals, while those which treat on wood are few and far between. Still, it would be difficult to imagine, in our present state of advancement, where to look for a substitute which should combine so many qualifications of usefulness and such adaptability to diverse manipulation.

Besides the hundred applications of cutting, splitting, and sawing, wood can be worked in many more ways. It is doubtful if any substance with which we are acquainted is susceptible of so many changes—changes which alter the very structure of the material and adapt it to the most opposite uses. It can be torn into fibrous shreds which make elastic cushions or beds; made into a spongy, porous mass; hardened by chemicals which change its texture and make it semi-mineral in nature; compressed by mechanical means, closing its pores, until it is nearly as compact as the metals. It may may be molded into various forms; bent to keep its enforced position; dissolved into pulp and made into paper; separated into *laminæ* by percussion, and, in short, treated in any conceivable manner except melted and cast.

Perhaps one of the most interesting of the methods of working wood is that of separating one layer from another by percussion, or by compression joined to bending. Those woods only can be treated in this way which grow by external concentric accretions, as many of our hard wood trees. The wood for this treatment should be tough, elastic, and straight-grained.

The Indians of this country, and the basket makers in others, separate the layers of the wood by beating upon the surface of a log with heavy mallets, when the wood comes off in thin *laminæ.* This method of disintegrating wood is one of the oldest of human arts; probably no mode of working wood is older. What was formerly done by hand is now, however, performed by machinery. We saw the other day, in Jersey City, machinery which performed this work in a remarkably rapid and effective manner. It was run by the Wilder Hoop Machine Company, and was designed for making (rolling) hoops of wood from a "bolt" split from a log. The wood used was black ash, although any tough, straight-grained wood would answer. The bolt was a longitudinal cleft the cross section of which might approach either a parallelogram or a triangle. One end was presented to a space between two swiftly-revolving heads armed with cutters which almost instantly formed a wedge-shaped point, then to another disk with thin cutters which splits the V-shaped end at intervals corresponding with the thickness of the hoops to be made. These splits do not extend more than one or two inches from the end. The bolt is then run between circular saws and trimmed to nearly a square form, or to a parallelogram, one side of which corresponds with the width of the hoops.

Then the bolt is passed between upright corrugated feed rollers held in contact by powerful springs. Directly behind these were a set of smooth rollers, placed horizontally, between which the bolt passed, being compressed powerfully, and by means of a curved guide compelled to take a short curve. The result was a splitting from end to end of the bolt, forming perfect hoops, or rather slips of equal thickness throughout. The philosophy was not difficult to understand. The slits cut in the end of the bolt were starters for the thickness of the splits. The wood, being wet, yielded to the compression of the rollers, and the direction given the bolt by the curved shoe compelled one piece to slide upon another sufficiently to divide the cross fibers and insure a separation. The whole process is a very brief one, occupying no more time probably than would be spent in reading this description. It is very interesting and gives the observant man new ideas concerning the capabilities of wood. That its fibers can be cleanly separated, simply by compression and bending, to make as smooth a job as if sawed, and preserve the longitudinal grain and consequent strength as perfectly as if split by ordinary means, is at least surprising.—*Scientific American.*

SIR FRANCIS CROSSLEY'S CO-OPERATION MANUFACTORY.

A recent letter from Halifax, England, gives the following sketch of one of the most extensive and successful co-operation schemes in that country.

I am writing this letter from the manufacturing town of Halifax, in Yorkshire, where I have gathered much valuable information and enjoyed a peculiar gratification in visiting the celebrated carpet manufactories. One of my first objects was to see a mammoth establishment, owned chiefly by a Liberal member of Parliament and his family, famed throughout the world, and conducted on the co-operative pinciple, under which the "work people," as they call them, can purchase a direct interest in a most profitable concern out of the proceeds of their own labour. In this era of "strikes," it was very significant to watch the pro gress of a movement, which, if generally acted upon in this country, will remove many just causes of complaint on the part of the toiling classes. In conversation with Sir Francis Crosley himself, one of the owners, and the member of Parliament from Halifax, I found that he was highly pleased with this benevolent experiment. More than a thousand of his workmen have taken advantage of his offer and become interested in the business. These great works comprise a large number of patent looms for the weaving of tapestry, velvet, and Brussels carpets; also, table covers and hearth rugs—hand-looms for weaving Scotch carpets, and machinery for preparing and spinning worsted, wollen, linen, and cotton, which are carded, coombed, spun, dyed and printed on the premises. It is the largest manufactory of the kind in the world, comprising 18½ acres of flooring, using 2,000 horse-power in its steam machinery, and giving employment to over 4,000 men, women and children. I saw this mass of human beings dismissed for and returning from their noon-day meal—a sight I shall never forget. They seemed unusually contented and healthy. Afterward, I had an opportunity of seeing them at their labours. Taking the cotton and wool almost as they came from the growers' hands, from the early cleansing to the first dyeing, we followed them through their various processes until we stood in the department where the finished fabrics are stored, which have attained world-wide celebrity, and are used in all parts of the civilized world. The various inventions which have brought this class of manufacture so near perfection, from that now two centuries old to the great discovery of of one of our countrymen, here exhibited their amazing capacities. To see mere machines performing the work of human beings, sorting delicate threads, producing the most beautiful colours, and combining these threads and colours into pictures and figures, rivalling the genius of the individual artist, was an experience that awakened many reflections. The buildings in which these immense operations are carried on are proportionally gigantic. As I have said, they cover acres, and are alike substantial and ornate. Some of them are nine stories high; and as you stand upon these "floors" and cast your eye along the forest of looms and watch the persons engaged on them, you seem to be in the busy street of some curious old city. The town of Halifax is as unlike any American town as possible. It is a miniature metropolis, built of the inevitable stone of the country, with long rows of elegant stores, comfortabledwellings for the poor, a lordly town-hall, a fine hotel, churches, and other public buildings. Everywhere you mark the evidence of the wise generosity of the Crosleys. The park, almost as neat and beautiful as that at Liverpool, was a gift of Sir Francis to the people. The funds of his family contributed chiefly to the beautiful town-hall, and their liberality has founded what is styled an "Orphanage" for the education of the fatherless children of the better and emulous of their workmen.—*N. Y. Tribune*

Stone-breaking and Rolling Machine.

Blake's stone-breaker, in use at Leeds, is said to be rapid and simple in its action, and breaks up from 50 to 26 cwt. of stone every six minutes, to sizes suitable for macadamizing or road making purposes. Steam-rollers are in use both in England and Paris, which renders a newly macadamized road at once as smooth as possible for travel.

Scale Faucet.

An automatic scale faucet has been introduced which measures the liquid drawn with perfect accuracy as it runs out, cutting it off at the required point. Barston & Childs who now manufacture the article at Utica, are making arrangements to start a branch factory in New England.

It appears from recent experiments conducted by the London Pneumatic Co., that one hundred and twenty tons of goods can be sent through their eighteen miles of tubes every hour at a cost less than 1*d.* a ton per mile.

The metric system is in force in France, Belgium, Holland, Switzerland, Spain, Italy, Portugal, and the States of the German Confederation, and legalized in the United States, and Great Britain.

Useful Receipts.

How to banish Fleas.

A correspondent of the *Scientific American* says:—

Much the largest number of these insects are brought into our family circles by pet dogs and cats, and the pig sty is generally filled with them at this season of the year, where numbers will hop on to you when visiting it for the purpose of feeding or inspection.

The oil of pennyroyal will drive these insects off; but a cheaper method, where the herb flourishes, is to throw your dogs and cats into a decoction of it once a week. Mow the herb and scatter it in the bed of the pigs once a month. I have seen this done for many years in succession. Where the herb cannot be got, the oil may be procured. In this case, saturate strings with it and tie them around the necks of dogs and cats, pour a little on the back and about the ears of hogs, which you can do while they are feeding without touching them. By repeating these applications every twelve or fifteen days, the fleas will flee from your quadrupeds, to their relief and improvement, and your relief and comfort in the house.

Strings saturated with the oil of pennyroyal and tied around the neck and tail of horses will drive off lice; the strings should be saturated once a day.

To remove Stains.

Chloroform removes stains from paints, varnishes, and oils. Another very effective fluid for the same purpose, is a mixture of six parts of strong alcohol, three parts of liquor ammonia, and a quarter part of benzole.

Odour of Flowers.

Pure, inodorous glycerin will completely absorb the odors of flowers, if you submit them to a digestion for several weeks in a well-closed jar, and in a moderately warm place. The flowers should be covered by the glycerin.

Treatment of Itch.

The Prussian military authorities cure itch by smearing the parts with a mixture of two parts of liquid storax with one part of sweet oil. The cure is said to be complete in twenty-four hours.

Cements.

The following recipes will be found to produce very hard and durable cements:—1. Four to five parts of dry powdered clay are mixed with two parts of clean metallic iron filings, one part of peroxyd of manganese, one-half part of salt, and one-half part of borax. All these ingredients must be well powdered and mixed and must be made into a paste with water. The cement must be used up quickly. Applied to the parts to be cemented it is first dried at a slowly-rising temperature and finally exposed to white heat. The cement then is hard, resembling slag, and resists boiling water and red heat. 2. A similar durable cement may be prepared by mixing finely-sifted peroxyd of manganese and carbonate of zinc with soluble glass to a thin paste. It has to be used up rapidly.

Manufacture of Zinc-white.

Zinc-white may be prepared from any zinc ores or old zinc by roasting the same for the purpose of producing the oxyd and treating the latter with a hot solution of muriate of ammonia, which dissolves the oxyd of zinc, while other metals contained in the ore remain behind If the solution is coloured the addition of a small quantity of carbonate of soda will cause a slight precipitate, when the solution will appear clear. The solution is then filtered, when upon cooling the oxyd precipitates, together with a double salt of ammonia and zinc but slightly soluble in cold water. This precipitate is washed, treated with hot water, when the double salt becomes decomposed and the oxyd of zinc is precipitated as a dense white powder, which is washed and dried.

Soldering Solution.

Two ounces muriatic acid, in which as much zinc is dissolved as it will hold, to which add half an ounce sal ammonaic. Clean the metal well and the solder will run and adhere to any part of the metal to which the solution is applied. It will also solder brass and steel together.

Office Paste.

Glycerin paste for office use may be prepared by dissolving one oz. of gum arabic and two drachms of glycerin in three ounces of boiling water.

Solder for Brass Instruments.

An alloy of 78.26 parts of brass, 17.41 of zinc, and 4.33 of silver, with the addition of a little chloride of potassium to the borax, is recommended by Mr. Applebaum as the best solder for brass tubes which have to undergo much hammering or drawing after joining.

Welding Composition.

Fuse borax with one sixteenth its weight sal ammoniac, cool, pulverize, and mix with an equal weight of quicklime, when it is to be sprinkled on the red hot iron and the latter replaced in the fire.

French Polish for Boots.

Logwood chips, half a pound; glue, quarter of a pound; indigo, pounded very fine, quarter of an ounce. Boil these ingredients in two pints of vinegar and one of water during ten minutes after ebullition, then strain the liquid. When cold it is fit for use. To apply the French polish, the dirt must be cleaned from the boots or shoes; when these are quite dry, the liquid polish is put on with a bit of sponge.

A Good Whitewash.

At this season people generally set their houses in order and prepare for the hot weather. As whitewash is in great request it may not be inappropriate to publish the following recipe. It is intended for buildings or out door use but is also adapted for walls. Let us say here that we have never found anything equal to glue for fixing the lime on the walls. It should be liberally applied, say half a pound to a washtub full of whitewash, and if well stirred in will never fail. There is no greater nuisance than whitewash that rubs off on everything that touches it.—We quote from the *Chemical Gazette*:—

"Take a clean water tight barrel, or other suitable cask, and put into it a half bushel of lime. Slack it by pouring boiling water over it, and in sufficient quantity to cover five inches deep, stirring it briskly till thoroughly slacked. When slacking has been effected, dissolve in water and add two pounds of sulphate of zinc and one of common salt. These will cause the wash to harden and prevent it cracking, which gives an unseemly appearance to the work. If desirable a beautiful cream color may be communicated to the above wash by adding three pounds of yellow ocher. This wash may be applied with a common whitewash brush, and will be found much superior, both in appearance and durability, to common whitewash."

Silicated Whitewash.

M. Ch. Guerin called the attention of the French Academy to a new method of obtaining, by a cold process, a silicate completely insoluble which can be applied either as an external coating, as in the case of glass or iron, or made to penetrate through the interior of the substance, as for the preservation of wood and other vegetable matters. The process is very simple: a thin coating of slaked lime made into a paste with water, or whitewash, is laid on the object to be silicatized, and when this has been allowed to dry, silicate of potash is applied over the coating; the effect, it is asserted, being that all the portions touched by the solution of potash become completely insoluble, and of very great adherence. In order to obtain an insoluble silicate in the interior of a substance, all that is necessary is to impregnate it by immersing it in whitewash, or lime water, and when it is dry to steep it in a solution of the silicate of potash.

By this means it is proposed to prevent the decomposition of vegetable substances by petrifying them; also to protect porous building stones and bricks against air and damp; iron, by a coating of paper, pulp or other finely-divided woody matter, mixed with slaked lime.

Again, letters, characters, or any other device can be traced with the silicate on any surface spread with lime, and those portions touched by the silicate will alone adhere and become insoluble. Or, if they be traced with a solution of gum arabic, and the whole be washed over with the silicate, the parts protected by the gum can be washed off, the rest remaining in relief, as the letters etc., do in the first place.

The process sems to be substantially the same as the English process, known as Ransome's.

Practical Memoranda.

Temperature of Heated Metals.

Pouillet measured the temperature corresponding to the colors which metal takes when heated in a fire, and found them to be as follows:—Incipient red, 525 deg. Cent.; dull red, 700 deg.; cherry red, 900 deg.; dark orange, 1,100 deg.; white, 1, 300 deg.; dazzling white, 1,500.

Gestation of Animals.

Kinds of Animals.	Period of Gestation and Incubation.		
	Shortest Period.	Mean Period.	Longest Period.
	Days.	Days.	Days.
Mare	322	347	419
Cow	240	283	321
Ewe	146	154	161
Sow	109	115	143
She Goat	150	156	163
She Ass	365	380	391
She Buffalo	281	308	335
Bitch	55	60	63
She Cat	48	50	56
Doe Rabbit	20	28	35
Turkey	24	26	30
Hen	19	21	24
Duck	28	30	32
Goose	27	30	33
Pigeon	16	18	20

A Useful Rule for Lumbermen.

To determine the number of feet of one-inch boards which can be cut from a log 12 feet in length, multiply the number of inches in diameter by half that number, and to this product add two for every fifty of the same—the sum will be the number of feet of boards which can be cut from the log. If longer than 12 feet add one-twelfth of the whole amount for each addittional foot in length.

Ground Stoppers.

The ground stoppers of caustic alkali bottles incrustate very rapidly; grease stops it but imperfectly, and introduces fatty bodies in the lye. Paraffine is the best agent, because lye is without action on it, and lubricates the surfaces in contact.

Boiling Water in an Egg Shell.

Water may be boiled in an egg-shell, or in a box the bottom of which is made of card-paper; and if the circulation of the water is unrestricted, the fragile material of the boiler, although held directly in the flame will be uninjured.

Strength of Iron and Copper.

The strength of copper is diminished one-third in rising from a temperature of 122° to 602°. Iron has been found to increase in strength up to 550°, above which point its strength diminishes.—*Engineering.*

Alloys.

An alloy of 3 parts tin, 5 of lead, and 8 of bismuth melts at a temperature less than that of boiling water.

An alloy composed of 9 parts lead, 2 of antimony, and 1 of bismuth will expand in cooling, and is therefore sometimes used for filling blow holes in iron castings.

Weights.

With four weights of respectively one pound, three pounds, nine pounds, and twenty-seven pounds, any number of pounds from one to forty may be weighed.

To Preserve Fresh Meat.

An exchange says that fresh meat can be kept good and sweet for several days by immersing it in buttermilk.

Durability of Timber.

Of the durability of timber in a wet state, the piles of the bridge built by the Emperor Trajan over the Danube afford a striking example. One of these piles was taken up and found to be petrified to the depth of three-quarters of an inch, but the rest of the wood was perfect.

Displacement of Water.

Every thirty-five cubic feet of salt water displaced by a floating vessel are equal to one ton burthen.

Origin of the Signs + and —

A recent writer in the *London Athenæum*, gives the following as the origin of the signs+and—. He says: The first of these signs is a contraction of *et*. The course of transformation from its original to its present form may be clearly traced in old MSS. *Et* by degrees became &. and & became+. The origin of the second(—)is rather more singular. Most persons are aware that it was formerly the universal custom, both in writing and printing, to omit some or all of the vowels, or a syllable or two of a word, and to denote such omissions by a short dash, thus—, over the word so abbreviated. The word *minus* thus became contracted to *mns*, with a dash over the letters. After a time the short line itself, without the letters, was considered sufficient to imply subtraction, and by common consent became so used. Hence we have now the signs+and —. *Annual of Scientific Discovery*.

Photography.

THE DARK ROOM.*

Development.

In former times the dark room in which the pictures were developed, the plates sensitized, &c., was properly called a dark room—it was dark, gloomy and disagreeable. It is no longer so now. From discoveries that have been made, this developing room may be the lightest room in the establishment, as long as it is the proper colour. Let the window of the room be glazed with orange-red colour glass, and in addition, fix up a curtain of thin red woollen cloth or flannel. The light that passes through this window exercises no action upon the sensitized plate; you may develop the plate in front of this window without any danger of fogging the impression. But be sure to shut up every avenue to *white* light; the smallest beam of this light is detrimental to your success; the light that comes through the keyhole is injurious.

This room ought to be called the *non-actinic* room, because the light with which it is suffused is non-actinic, which means that it has no action on prepared chemicals.

It is well to try the efficacy of your non-actinic room by experiment. Sensitize, therefore, a collodionized plate, and then expose it to the light which enters through the orange-red window for two or three minutes. Pour on the developer in the usual way. If the plate does not change colour in the least, it is an evidence that actinic light, at least, has not made any impression upon it, and you may then with full confidence, afterward perform all your developing operations with ease and certainty.

To facilitate the operation still further, we always prefer developing by the aid of a light which comes from below, and thus shows the progress of development by transmitted light. For this purpose let the developing corner or table be a projection beyond the wall of the building, and let a large square of non-actinic glass be glazed in an aperture on the top of this table; this pane can admit light only from below upward.

During development, the plate, whether large or small, may be held, it is true, between the thumb and finger, but it is much easier to hold it on a pneumatic plate-holder. In this position you can cover the plate with the developing solution with the utmost facility. It requires some experience before you can flow the developer evenly without any stoppage or interruption; the operation must be quick, and yet it must not be violent, otherwise much of the developer will rush off at the opposite side, and carry with it much of the free nitrate of silver which was still on the plate, and which is so very beneficial in producing intensity. If the developer proceed slowly over the exposed film the development will be uneven, one part being already out before the other has commenced. If the developer refuse to proceed in a given direction, there will assuredly be found in the finished negative a dark line or curve at that place, which will be very offensive in the print.

Furthermore, if the developer be poured from a great height (and we regard two or three inches high in this experiment) its momentum the moment it comes in contact with the collodion is sufficient to wash off the impressed silver from this part, and to produce in consequence, a very weak patch at this spot. To avoid all these troubles, and especially with a large plate, we prefer laying it at the bottom of a large dish of gutta-percha, at one end. In this case, the dish being slightly tilted, the developer can be poured in at the opposite end in sufficient quantity to cover the plate the moment it is again raised to a horizontal position or tilted

* From "Dr. Towler's Photographic Guide."

in the opposite direction. This is a very effectual plan of development, and, especially so, if the dish has a transparent bottom, for then you can watch the development by transmitted light.

A transparent developing dish is constructed in the following manner:—Take a thin piece of hard and well-dried wood, four or five feet in length, one inch wide, and half an inch thick, and a plane groove along the middle, about three-sixteenths of an inch deep, sufficiently large to allow the edge of an ordinary pane of glass to slide along it. Four lengths are then cut out so as to make a rectangular frame, the ends being cut in a mitre-box at an angle of forty-five degrees. A pane of glass is then tightly framed in the groove; and the frame is firmly nailed together. After this is done, a cement, consisting of five parts of resin, one part of beeswax, and one of red ochre, are melted together, and when fluid, a sufficient quantity is poured along each seam or groove all round on either side, and along all the corners. After the cement has set, the excess is set off and polished down smooth with a red hot pointed piece of metal The frame is finally covered with a coat of varnish made by dissolving sealing wax in alcohol, in a teacup over the stove. Coach or any other varnish will answer the purpose. We have a set of such frames, of different sizes, for the different size plates in use. Each transparent plate is at least two inches longer than the one to be developed; the excess of length is the part which is to receive the force of developing fluid as it falls out of the vial which contains it. If the plates to be developed are very large, the dish that is to hold them may be constructed so as to have two projecting handles, either screwed on to the ends of two parallel sides, or formed out of these two sides themselves, which are left projecting some four or five inches beyond the ends. The dish and plate are then easily supported by the two hands, whilst an assistant pours on the developer.

Developers—Intensifiers.

The image on, or in the collodion film after exposure, is a latent or invisible picture of the object upon which you focussed; by the application of certain chemical solutions to the collodion film, the image, before latent, gradually emerges from its prison-hold into being. Such chemical solutions are called developers; these act like other chemical substances that produce reductions or decompositions. Thus, if we add a solution of iodide of potassium to another of bichloride of mercury, a colour—a beautiful scarlet colour starts out from the previously transparent and colourless fluids; we have no power or knowledge whatever, that will enable us to tell *à priori*, the result of the admixture of two unknown solutions simply from their appearances, but if we know the solutions we do know with accuracy the result of such an admixture, because this result is simply that derived from previous experimentation. But notwithstanding a very extensive accumulation of facts, we are still in utter ignorance, and probably shall ever remain so, as to the true cause of chemical action; why for instance, the salts of the protoxide of iron are green, whilst those of the peroxide are red; why hydrosulphuric acid produces yellow precipitates with a salt of cadmium or of arsenic, an orange-red precipitate with antimony, and a black one with so many of the salts of other metals. We do not know what the precise action is; be it the result of electricity, of light, of heat, of gravity, which institutes some physical change in the ultimate atoms or molecules that constitute the new compound. And just as ignorant are we, for the experiments are very similar, of the *rationale* of the development of the latent photographic image. We know simply that a protosalt of iron, as well as other chemical substances, has the property of reducing salts of silver and of gold to the metallic state, and that, if the protosalt contain at the same time some organic material in admixture, the reduction will be complex, partly reguline and partly a compound; and we know, furthermore, or suppose at least, light institutes some peculiar physical changes in silver solutions, whereby they become predisposed to undergo this reduction on the application of the reducing agent. This is the extent of our theoretical knowledge at present. Here we stop on this subject, and proceed at once to the mode of developing a negative.

Prepare first the following solution:—

Developer.

Protosulphate of iron	1-oz.
Rain water	16-ozs.
Acetic acid	3 "
Alcohol	1½ "

Pulverize the salt, mix it intimately with the liquids until dissolved, then filter and preserve in a stoppered bottle for use.

We give the above formula in preference to any of the more modern formulas which contain more or less of gelatine, which is twofold in its action; it modifies the colour of the developed image, and acts at the same time like an acid in restraining the development.

The developer being poured upon the plate carefully and quickly, so as to cover the whole of its surface almost instantaneously, and still retaining whatever silver solution may have remained on its surface, you keep the plate in motion so as to mix up the developer thoroughly and to cover every part of the collodion film. If the picture starts out almost at once, the plate has been exposed too long; on the contrary, if a minute or half a minute expires before any change is produced on the film, the exposure has been too short. If the change of which we speak, begins the moment the developer comes in contact with the collodion, and continues slowly but distinctly, the exposure has been about right.

The great art of development is twofold: it consists in knowing when to stop, and to stop in all cases before or as soon as fogging commences. Fogging is the reduction of the silver solution into the reguline condition even where light has not acted, thus producing a veil on the parts that ought to be transparent. It frequently takes place when all the solutions are freshly prepared. Any saccharine or gelatinous substance mixed with these solutions, that is, with either the silver bath or the developer, has a tendency to prevent the silver from being reduced in those parts upon which light has not acted. Acids have also the same effect; it is on this account that acetic acid is found in the developer, and nitric acid in the silver solution. Much of the troublesome effects of fogging, too, may be avoided by understanding the extent to which the plate may be sensitized, and also by covering the plate with a substratum of albumen, as recommended in a previous chapter.

For instance, as an experiment, drop a little of the bath solution upon a plain glass surface, and add to it a little of the developer, the experiment being performed in the dark room; reguline silver soon begins to make its appearance on the surface of the glass, and thus to destroy its transparency. This is an example of pure fogging. But if the glass has been previously albumenized, the same amount of fogging will not take place, the albumen prevents the silver reduction, or at least restrains it. You see then one of the benefits of coating the plates with albumen previous to coating them with collodion.

It would appear from these circumstances that the naked glass surface has a tendency to institute the silver reduction, the moment the developer comes in contact with it; and hence it may be inferred, that if we can prevent the solutions from coming into contact with the glass surface, we shall at the same time restrain reduction and consequently fogging. This analysis of the subject teaches us how long to sensitize the plate. As soon as the collodionized plate is immersed in the bath, the nitrate of silver solution begins to permeate the collodion film, and at the same time to produce by double decomposition the iodide and bromide of silver on the surface and in the substance of the collodion. This decomposition is made manifest to the eye by the gradual whitening of the film. Naturally the front surface of the collodion film becomes first white, then the middle and finally the whole film to the glass is of a cream-white. But by a careful observation you may hit upon the exact time when the outer or front surface of the collodion film is cream-like in colour, whilst the back surface, or the surface which is next the glass, is of a slight blueish tinge. This indicates that the silver solution has just permeated the film as far as the glass. Now is the time to take the plate out of the bath and to expose it; that is, to expose it before all soluble iodides and bromides are decomposed. These lie between the free nitrate of silver and the surface of glass, and thus prevent or restrain the reduction of the silver salt into pure silver; they prevent fogging. But should fogging take place before the picture is thoroughly developed, or at least before the shadows are sufficiently opaque, your best plan will be to wash the plate immediately and then to fix the image and deepen the intensity afterwards by what is called redevelopment or intensification.

Another method of proceeding in such a case consists in washing the plate thoroughly, then in pouring over it a dilute solution of either bromide or iodide of potassium, and allowing it to remain on the surface a short time. Naturally such a solution decomposes all free nitrate of silver in the collodion film, and free nitrate of silver is the main condition of fogging. Now this being removed, wash the plate again, and pour the developer again upon the plate and watch the proceedings. Gradually all the detail of the picture is brought out, and the picture apparently is complete, regarded simply as a picture, for the lights shades and middle tones are all there in regular gradation; but as a photograhic negative is yet incomplete; the opaque or dark parts are not yet sufficiently dense. Hold up the negative and place your fingers between the negative and the light; if they are distinctly visible through the shadows of the negative, the latter are not yet dense enough. You must proceed with the development. Previously pour off the old developer, wash the film, and then flow it quickly with the following solution:—

Nitrate of silver	36-grs.
Rain water	3-ozs.

Pour away all excess of the silver solution from one corner, and then cover the film with fresh developer. This proceeding will seldom fail to make the shadows sufficiently opaque for the printing operation. Take the plate out to the light, hold it up to a tree, and see if the leaves are visible through the dense shades; if not, the development has proceeded far enough. The plate may now be thoroughly washed and immersed in the fixing bath.

But should it happen that the development cannot be carried on to its completion without fogging being the result, wash the film and fix the image; which is supposed in other respects to be perfect, and is only lacking intensity.

Developer.

Cyanide of potassium	4-drs.
Water	10-ozs.

Pour the solution over the plate and keep it in motion; the yellow and cream-like parts will soon become transparent, and the picture will now appear much more beautiful than before. As soon as all the unaltered iodides and bromides have been dissolved by the fixing solution, wash the plate on both sides and until every trace of the cyanide has been removed.

This washing, like all other preceding operations of the same nature, may be performed at a jet of water issuing from a tap at the end of a water-pipe inserted in a barrel, or being the termination of the ingress of water from the public water-works. There is no danger of the collodion film being torn off the plate by means of the current of water if the surface of the plate has been previously albumenized; but the film may easily slide off, if there has been no substratum, by the manipulations of a novice, but not so in the hands of an experienced operator. Of course your aim will be to learn by experience, and finally to become perfect in this beautiful art.

Intensification and Toning of the Image.

Supposing that the picture possessed all the detail and gradations required, but that the shades are not sufficiently dense, you may flow the plate whilst the film is still moist with the following solution:—

Terchloride of gold	2-grs.
Water	4 ozs.

Whilst the negative is still moist pour a sufficient quantity of the above solution over the film so as to cover it quickly; the tone will change very rapidly, becoming more of a blue-black; if kept on, however, too long, a retrograde action sets in, and the tone gradually becomes fainter. Watch the opportunity when the whole picture has assumed its first bright blue-black tone; then pour the excess of gold solution back again into the stock bottle. This solution soon becomes exhausted, which is easily known by the disappearance of the yellow colour of the terchloride, and must then be replenished with some fresh salt. The double salt of gold and sodium, or gold and potassium, is well adapted, but not that of gold and lime.

Wash the negative, and place it upon a levelling-stand, with water on its surface.

The following stock solution is next required:—

Fill a 4-oz. vial with rain water, and throw into it an ounce or more of bichloride of mercury; shake the mixture well and set it aside to dissolve; take care to keep at the bottom of the bottle some of the undissolved salt, by which you recognise that the solution is concentrated. Label the bottle: Concentrated Stock solution of Bichloride of Mercury. Place side by side with this a bottle of acetic acid. These two stock solutions are required to make the following mixture for present use:—

Concentrated solution of bichloride of mercury	1-dr.
Acetic acid	1-dr.
Water	6-drs.

This mixture is now poured on the moist plate; hold the latter in such a position as to let the light pass through it from beneath; you can then easily observe the gradual darkening of the film, and stop the action when the intensity is satisfactory. By this means you can get any amount of opacity in the shade, and the tone of the negative is very pleasing to behold.

The only disadvantage it possesses, is the expense of the gold solution; after all this is a subordinate consideration, as long as the work is good. Should the expense be an objection to the above intensifying process, we give the following, which we formerly practised and found reliable. Make the following stock solution:—

Tincture of Iodine.

Stock Solution.

Iodine	40-grs.
Alcohol	1-oz.

Solution of Iodine for Present Use.

Of the stock solution	10-mins.
Water	1-oz.

Where it is convenient, take the moist negative and holding it where the sun can shine upon it, pour a sufficient quantity of the present use solution all over the film, and oscillate the plate, so as to keep the solution in motion. The tone of the negative will soon assume a faint rose colour, whilst the solution itself has gradually lost all its colour, the iodine having been taken up by the silver in the shadows of the picture. It is better to have the present use solution quite dilute, in order that the deposit may be free from granulation. Wash the plate and place it on the levelling-stand. Prepare the two following stock solutions:—

Stock Solution of Pyrogallic Acid.

Pyrogallic acid	24-grs.
Acetic acid	2-ozs.

Stock Solution of Nitrate of Silver.

Nitrate of silver	60-grs.
Rain Water	2-ozs.

Now take of the first solution half a drachm, water four drachms, and mix with this solution two or three drops of the solution of nitrate of silver. Add as little silver as possible, as long as the solution gradually increases the opacity of the shades, when poured upon the negative; for a rapid action can easily be instituted, but the deposit will be pulverulent and gritty. The slower the action, the more uniform and smooth the film becomes. As soon as the proper amount of intensity has thus been obtained, the negative is very thoroughly washed, and then placed on the levelling-stand for subsequent operations.

ON COLORING PHOTOGRAPHIC SLIDES FOR THE MAGIC LANTERN.

The following practical instructions for coloring photographic and other transparencies for the lantern are extracted from a manual on the Magic Lantern, published in London.

Apparatus.—The easel, an assortment of brushes and dabbers, an ivory and a steel pallet knife, a small muller and slab, a pallet, a penknife, an etching point, lithographic pens for outlines, pieces of linen or cotton rag.

Media.—Oil of spike, lavender, turpentine, varnish, oxgall, Canada balsam.

Colors.—Italian pink for yellow, Prussian blue, Antwerp blue, crimson lake, crimson.

These are the three primary colors, which are capable of yielding nearly all the rest by judicious mixture. The colors purchased should be those prepared for oil painting, in collapsible tubes, and the purpose for which they are intended should be explained to the color maker.

The use of the muller and marble slab in well rubbing these colors down will be learned. For black, ivory or lamp black is used; for white the glass is left uncoloured; for green, Prussian blue and Italian pink; for purple, lake and Prussian blue; for orange, lake and gamboge; for brown, either burnt sienna or a mixture of Prussian blue, lake, and Italian pink.

Glass.—Patent plate and flatted crown are the two kinds obtainable. The former is expensive and only necessary to be used when something of an exceptionally superior character is to be produced. The lattter will answer most purposes if the following precaution be observed:—The two sides differ from each other, one being smooth and the other having gritty particles, which may be distinguished on drawing the nail across. The painting should be done on the smooth side, or if the photograph be prepared with a view to subsequent coloring, it should be taken on the smooth side.

A good medium for mixing the colors is tranparent oil varnish to which a few drops of liquor ammonia have been added.

In the case of a photograph, no preliminary outlining is required, but where it is intended to reproduce a large engraving on a three-inch disk, a reduced outline of the required size is first made upon paper, and this being laid under the glass, the outline is traced through with the appropriate material. This outline is then protected by a coat of varnish, the coloring then begins, the sky first and then the extreme distance, and successively the middle distance, and the foreground, increasing in intensity of color and decision of outline as the objects approach the spectator. The required depth of color will regulate the amount of varnish to be used, and small dabs should be made on a piece of glass before beginning to paint, in order to ascertain the quality, transparency, and depth of colors. The remedy for excessive opacity is more varnish and ammonia. Two or three drops may be added to a teaspoonful of varnish.

The lithographic pen is to be used for tracing the outline.

Dabbers are made by burning down thick camel's hair brushes to a round, stumpy end.

Another and very satisfactory method of coloring consists in using aniline colors, known as Judson's dyes; or better still, those prepared by Dr. Jacobsen for coloring photographs. In using these colors the disagreeable smell of oil and varnishes is avoided, the only medium required being water.

Before using the colors, it is imperatively necessary that the glass on which the design is either sketched or photographed should be coated with albumen. When dry it is ready to receive the colors, the albumen acting as a mordant; a plain piece of glass should also be coated with albumen, on which to try the depth of colors; and great care must be taken to keep the coloring within the outlines, as, being dyes, these colors cannot be removed.

To prepare the albumen, take the white of an egg and add to it one ounce and a-half of water, beat all to a froth, and the liquid subsiding is fit for use.

The Photographic Art.

Sir David Brewster, in a recent address on the claim of science and art to national recognition and support, indulges in the following beautiful remarks concerning the photographic art:—

But while the artist is thus supplied with every material for his creative genius, society derives a still greater boon. The home-faring man, whom fate or duty chains to his birth-place, or imprisons in his fatherland, will without fatigue and danger, scan the beauties of the globe, not in the deceitful image of a hurried pencil, but in the very picture which would have been painted on his retina had he been magically carried to the scenes. The outlines of the Himalayas and the Andes will stand before him in their most favored aspect. The Niagara will pour out her mighty cataract of waters, while the dreaded volcano will pour into the air her clouds of dust and fragments of fire. At a lower altitude, Egypt's colossal pyramids will rise before him; the temples, too, of Greece and Rome, and the gilded mosques and minarets of the East. With a more affectionate gaze he will survey the hallowed scenes which faith has consecrated and love endeared. Mount Zion will stand before him "as a field that is plowed," Tyre as a rock on which the "fishermen dry their nets," Nineveh "made as a grave," and Babylon the great "cast up as a heap," covered with pools of water, and without even the "Arab's tent" or the "shepherd's fold." Yet, though, it is not only Palestine in desolation we see; the seas which bore on their waves the Divine Redeemer, the hills which bounded his view, the pathway which he trod, and the mount from which he spoke the message of salvation, stand unchanged, and appeal to us with immortal interest.

Improvements in Photography.

Mr. Claudet has contrived an apparatus for varying the focal plane during the act of taking a photographic portrait, so as to soften the hard lines, and lessen the area of blurred surface in a picture. Something has been done before, we are told, by other ingenious photographers to remove these evils; but Mr. Claudet would appear to have treated the defects scientifically, and to have overcome them, at least in part, by certain and legitimate means. His invention lends to the portrait a softness and uniformity of texture hitherto supposed to be unattainable by this process of transcription.

Drying Sensitized Paper.

A convenient and economical mode of draining and drying sensitized photographic paper, is by placing the sheets between clean white blotting paper to remove the superfluous solution, instead of hanging up the paper to dry.

Cleaning Glass.

A method of cleaning glass, which may be useful where other methods fail, is given in the appendix to the second edition of Major Russell's "Tannin Process," published by Robt. Hardwicke, Piccadily. Dilute the ordinary hydro-fluoric acid sold in gutta-percha bottles with four or five parts of water, drop in on it a cotton rubber (not on the glass), and rub well over, afterwards washing till the acid is removed. The action is the same as that of sulphuric acid when used for cleaning copper; a little of the glass is dissolved off, and a fresh surface exposed. The solution of the acid in water does not leave a dead surface on the glass, as the vapour would; if a strong solution is left on long enough to produce a visible depression, the part affected will be quite bright. This method is recommended in some cases for cleaning photographic plates, but we should think it might also be useful in cleaning the insides of bottles, flasks, etc., which have got stained through use.

Cheap Yellow Glass for Operating Rooms.

To some thick spirit varnish add a small quantity of iodine, sufficient to render the varnish of the requisite deep color. When a glass is warmed, and a coating of the varnish applied, it will be found to be beautifully transparent. In the case of a globe for a lamp or gas it should be warmed, and a little of the varnish poured in and turned round before a fire till properly covered.

Permanent Photographs.

At the last meeting of the members of the Inventors' Institute (London), Mr. Pouncy, of Dorchester read a paper on sun-painting in oil colors.

The paper was illustrated with many fine specimens of the applicability of his process to pictorial and decorative art. The photographic prints exhibited were on paper, canvas, panels, copper, ect., and showed a fine gradation of tone, quite as perfect as the finest silver photographs, while it must be admitted they possess over the latter the immense advantage of absolute permanence. In the course of his remarks, Mr. Pouncy went through the various manipulations connected with the process, explaining them as he proceeded. The sensitive medium used is bitumen of Judæa, dissolved in turpentine, benzole or other hydrocarbon, with which is ground up oil color of any desired tint. The pasty mass is then brushed over a thin sheet of translucent paper and dried in the dark. When dry, the sheet is exposed under a photographic negative to daylight or a strongly actinic artificial light, which hardens, or renders insoluble those parts of the sensitized pigment to which the transparent parts of the negative have permitted access of light. After some minutes' exposure to light, the embryo picture is washed in turpentine, benzole, or any other solvent of bitumen. This dissolves those portions which have not been affected by the actinic rays, leaving the remainder of the pigment firmly attached to the paper, in quantity proportional to the amount of light which permeated the different parts of the negative. The picture is now complete, and may be transferred, as in the lithographic process, to card-board, canvas, wood, stone, etc., or, if ceramic colors are used, it may be transferred to potters' "biscuit" and burnt in as usual. Mr. Pouncy may be congratulated on having at last, after years of patient toil, so far perfected his process that it will now in all probability receive many commercial and artistic applications.—*Mechanics' Magazine.*

Miscellaneous.

Synthesis of Organic Compounds.

M. Berthelot pursues the new and wonderful line of achievement opened in the chemical creation of the products of organic life, with unflagging zeal and steady progress. Having heretofore succeeded in forming acetylene by the direct union of carbon (4) and hydrogen (2) he has lately built upon this structure by the addition of oxygen (8) which makes the exact constitution of oxalic acid, and that substance is the actual result. Other carbides of hydrogen are oxidized with the same success, giving a variety of appropriate products. The coal tar products have been proved to consist of a small number of relatively simple bodies, and the great variety of these products to be due to the various combinations which these take on under the influence of heat. In this manner acetylene is artificially condensed into benzine, its equivalents of carbon and hydrogen respectively, being exactly tripled. With an addition of hydrogen under the same influence, it forms ethylene; ethylene with benzine forms styrolene; and again, styrolene with more ethylene gives napthaline. It is reasonable therefore to conclude that the distillation of coal produces these substances in the same way. M. Berthelot's latest success has been the synthesis of toluene, the base of the new and toluen red, which we noted not long since. The composition of this substance (carbon 14, hydrogen 8) indicates the addition of marsh gas (carbon 2, hydrogen 4) to benzine (carbon 12, hydrogen 6) with the elimination of two equivalents of hydrogen. Means adopted to realize this combination, resulted in the successful production of toluen from marsh gas and benzine.

How to get the Cholera.

If we were asked to state what seems to us to be the surest method of contracting the cholera, we should specify some such rules as these:

1. Reduce at once the quantity of food that you are accustomed to take.

2. Avoid everything but what you feel sure is adapted to your constitution, and if you are in the slightest doubt as to any article promptly eschew it.

3. Scrutinize whatever you eat, and by all means keep up a constant watch on your digestive organs with a view of ascertaining the effect of the various articles of food in which you may indulge.

4. Eat no fruit and very few vegetables, however much you may hanker for them throughout the spring and summer.

5. Keep the thought always in mind that you are liable to have the cholera at any moment, and that the way to exemption from it lies in refraining from doing almost everything that you would do were not the fear of the disease before your eyes.

6. In a word, reduce your system as much as possible, and, so far as in you lies, make yourself about as uncomfortable as you can.

The mention of these rules, we are aware, is in a great measure supererogatory, for, to our certain knowledge, very many persons have unconsciously adopted them; though with a different end in view than that specified above. It need only be added that if every man, woman and child in this city, will adhere to them strictly from this date until the first of October next, the cholera will become a pestilence instead of the ordinary epidemic that it promises to be.

The inference is not to be drawn from these remarks that a disregard of the self-evident rules of health is a preventive against this fell disease. On the contrary, we hold that such rules should be observed with more than usual care—no more and no less.

Every sensible person is, or should be more careful of his diet in the summer than in the winter. The system does not require as much meat in warm weather as in cold, for instance, and it is a violation of one of nature's laws to act upon an opposite theory. Again the vegetables and fruits which a kind Providence prepares for man in the warm season are intended to be eaten, and, more than that the human system craves for them. The person, therefore, who eschews them, really does violence to a natural law, and deprives himself of a preventive against disease. Vegetables and fruits are palatable, cooling and nutritious, which are just the properties to be desired in food during the time of the warm weather, and should not be discarded by reason of a false theory of hygiene. The point where care is to be taken is that they be fresh, for the moment that the process of decomposition begins, that moment they are deleterious.

To sum up in a few words what we would consider the surest way of escaping the cholera, we would say:

1. Eat just such food as you ordinarily would in warm weather.

2. Partake of vegetables and fruits without hesitation, only take care that they be ripe and fresh.

3. By no means allow your system to run down, for you will need all the vital energy you can command to withstand the depressing influence of the season, cholera or no cholera.

Do not worry yourself about your health any more than usual, nor watch the workings of your system as if it contained nitro-glycerine and were liable to explode every moment; rather let it take care of itself, and nine times out of ten any little irregularities which you might mistake for symptoms of cholera will be rectified by nature without your help.

5. In two words—be sensible—*Round Table.*

Rules of Conduct.

Twenty-four things in which people render themselves very impolite, annoying, or ridiculous:

1. Boisterous laughter.
2. Reading, while others are talking,
3. Leaving a stranger without a seat.
4. A want of reverence for superiors.
5. Receiving a present without some manifestation of gratitude.
6. Making yourself the topic of conversation.
7. Laughing at the mistake of others.
8. Joking others in company.
9. Correcting older persons than yourself, especially parents.
10. To commence talking before others are through.
11. Answering questions when put to others.
12. Commencing to eat as soon as you get to the table.
13. Whispering or talking loudly in church, a lecture or a concert, or leaving before it is closed.
14. Cutting or biting the finger nails in company, or picking the teeth, or the nose.
15. Drumming with the feet or fingers, or leaning back in a chair, or putting the feet upon furniture.
16. Gazing at strangers, or listening to the conversation of others when not addressed to you or intended for your hearing.
17. Reading aloud in company without being asked, or talking, whispering, or doing anything that diverts attention while a person is reading for the edification of the company.
18. Talking of private affairs loudly in cars, ferry boats, stages, or at public table, or questioning an acquaintance about his business or his personal and private affairs anywhere in company, especially in a loud tone.
19. In not listening to what one is saying, in company—unless you desire to show contempt for the speaker. A well-bred person will not make an observation while another of the company is addressing himself to it.
20. Breaking in upon or interrupting persons when engaged in buisness. If they are to be long engaged, or you are known to have come from a distance, they will offer to give you attention at the earliest moment.
21. Peeping from private rooms into the hall when persons are passing, coming in or going out; or looking over the banisters to see who is coming when the door bell rings.
52. When you are in an office, or house, or private room of a friend, never handle things, asking their use, price, etc., nor handle or read any written paper; it is a great impertinence, and most intolerable.
23. Never stand talking with a friend in the middle of the sidewalk, making every body run around you; and never skulk along on the left hand side, "take the right in all cases." Two persons abreast meeting one person on a narrow walk should not sweep him off into the mud, but one should fall back a step in single file.
24. Mind your own business, and let your friend have time, without annoyance, to attend to his.

Rewards to Inventors.

The British army estimates for 1867–8 contains provisions for rewards to inventors to the extent of £22,800. Of the sum we believe £15,000 will go to Major Palliser for the projectile which bear his name, and £6,000 to Mr. Frazer, of the Royal Gun Factories, for the modification which he has suggested in the Armstrong system of gun building, with a view to cheapening the manufacture.—*Builder.*

Water supply at Lynn, England.

At Lynn the water-works supply is constant, and the water is furnished to consumers by meter, at about 7d stg. per 1,000 gallons.

The Mortality of Bachelors.

Dr. Stark of the Scottish Register Office, has compared the vital statistics of married and unmarried men, and announces that the mean age of the married at death is 60.2 years, while that of the bachelors is only 47.7—excluding those who die before 25 in both classes. We don't wish to set *everybody* against the poor bachelors, but this point seems to demand the attention of life-insurance companies—if indeed bachelors ever imagine their lives worth enough to anybody to deserve insuring. We did not know that to the command "increase and multiply" was tacitly attached the promise "that thy days may be long in the land" etc.; but it seems, so far, that if bachelors wish to recover an average of twelve and a half years of life, or such part thereof as may not be already irretrievably forfeited, they should make haste to be married. Celibacy appears to be one of Nature's capital offences.

Destruction of Gas-Pipes by Rats.

We often hear complaints from consumers, that no matter how much they may diminish their consumption of gas, either as to number of lights or time of burning, their *gas bills* are the same; and this anomaly they attempt to account for by charging the gas company with fraud. If such things occur at all, may they not in some cases arise from the same or similar causes referred to in the following communication to the London *Gas Light Journal:*

As gas has become one of the necessaries of life, and superior to every other artifical light, and at the present increased rate of consumption doubles itself in every seven years, it behoves all of us to make it as secure from danger as we possibly can. I could give you several cases where gas-pipes have been gnawed away by rats or mice. I will give you one instance in particular. A short time ago I was called upon to examine a gas-meter where the consumption had been three times as much as the corresponding quarter. I asked if they had increased the number of lights, or had larger burners put on, or if they had any escape in their fittings. Their reply was the number of lights was the same, and they had no escapes. I then took the index of the meter, and ordered them not to light the gas till my return. After a few hours absence I again looked at the index of the meter and found it had registered 150 feet. Of course, they at once condemned a meter that would register whether the gas went through it or not. In order to convince them, I ordered all the pipes to be examined, and in the attic, where a pipe was laid, the rats had gnawed through it; there was plenty of ventilation, which accounted for the gas not smelling. About three years ago I had gas put into my room; the pipe was laid between the joists, and to my surprise I soon found out that the rats were constantly gnawing at it; it behoved me, therefore, to find out a remedy or give up the gas. I had the boards taken up and the pipes coated with coal-tar varnish; the rats did not come for six months after. Although I can now often hear them gambolling about, I have not heard one nibble at the gas-pipe. I believe if all gas managers would insist upon their pipes being varnished, there would be fewer complaints from the public, and, what is better still, fewer explosions.

Gas Light Improvement.

Any of our readers who burn gas can test for themselves a simple device by which a Mr. Scholl of London proposes to increase the illuminating power of a common gas burner by more than 50 per cent. Hold a strip of thin sheet brass or other metal, one third or half an inch wide, in the center of the flame, splitting its thickness (not its breadth) and nearly touching the two holes whence the gas issues, so as not to obstruct the passage, but to divide the jets and check the velocity of their upward current. The division and the check will favour a more intimate access of oxygen to the gas, and hence a more perfect and brilliant combustion. Mr. Scholl uses a platinum strip resting in slits in a brass ferrule fitted over the burner tube.

Orchard Culture.

1. We believe in selecting a good site.
2. We believe in a thorough preparation of the soil.
3. We believe in enriching the soil according to its wants.
4. We believe in planting none but good trees.
5. We believe in planting trees not more than two or three years old, if bought at the nursery.
6. We believe in "setting" said trees after the most approved manner.
7. We believe in pruning and training said trees.
8. We believe in setting the branches low down on the trunks.
9. We believe in keeping those branches and trunks free from moss, caterpillars and all other pests.
10. We believing in cultivating orchards.
11. We believe it to be a great fallacy to suppose that cultivating an orchard means to grow crops in it.
12. We believe the perfection of orchard culture consists in giving up the soil exclusively to the trees.
13. We therefore believe in excluding all grass, roots, weeds, cattle, mice, borers, and every "unclean thing."
14. We believe that orchard trees may sometimes be profitably root pruned.
15. We believe that this should not be done "promiscuously" with a plow.
16. We believe that orchards may be cultivated without injuring the roots of the trees.
17. We believe that orchards may be planted in too rich a soil, and make too rank a growth, thereby becoming unfruitful, and also liable to "winter killing," and other ills.
18. We believe in checking this redundancy of growth.
19. We believe this may be done in various ways, such as summer pruning, root pruning, laying down to grass, growing crops, &c.
20. We believe that summer pruning and root pruning are the most direct, certain and satisfactory modes of accomplishing the end proposed.
21. We believe that grass robs the tree of nourishment very little if any less than some root crops.
22. We believe that an orchard in grass suffers much more in time of drouth than one well cultivated.
23. We believe that an orchard laid down to grass, and kept so, should be top-dressed from time to time.
24. We believe that lime, ashes, ground *raw* bones, compost of muck, &c., are capital top-dressing.
25. We believe that orchards laid down to grass should be plowed up at the first sign of "giving out."
26. We believe that old and decaying orchards in grass may often be renovated and made good by manure and cultivation.
27. We believe that a cultivated orchard yields fairer and better fruit than one not cultivated.
28. We believe it is a great mistake to except fruit trees from the universally recognized laws of cultivation.—*Horticulturist.*

Dr. de Briou, of Paris, has succeeded in producing an enamel paint, made from india-rubber, which, though of film-like consistency when applied to iron, renders it absolutely proof against atmospheric action. The invention is thought highly of by the Academy of Science.