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FOR UPPER CANADA.

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MUZZLE *versus* BREECH-LOADERS.

For the past three or four years a great deal has been published on the subject of improvements in fire-arms, both by American and European journals. We have heretofore almost wholly refrained from noticing either the inventions of new or improvements in old weapons; but as the Austro-Prussian war has brought the peculiar merits of breech-loaders, in contrast with muzzle-loaders, so prominently before us; and as this is also to us a most important subject, involving the efficient defence of our Province, we purpose giving a few extracts from articles thereon, culled from leading British and American journals.

The London *Engineer* of the 20th of July contains a very full description of the Prussian needle-gun, with illustrations of the weapon and the various movements necessary in loading and firing. The length of this article, and the number of illustrations, preclude its transfer to these columns. The following lucid description, however, from a Prussian correspondent of the London *Army and Navy Gazette* will be found interesting:—

" *The Gun.*—The 'needle-gun' was originally invented in 1835, although of course many improvements have since been made. The credit of the invention belongs to a Mr. Dreyse, a manufacturer of fire-arms at Sommerda; but in some respects the weapon is similar to (and an improvement upon) the breech-loading musket of Norway. It is simply a breech-loading rifle, the cartridge of which is exploded by the intrusion of a needle into the fulminate attached to it; the needle being propelled by a spiral spring. The rifled part of the barrel is thirty-six inches long, and it has a calibre of six-tenths of an inch, with four grooves having a twist of five elevenths in the length of the barrel. The breadth of these grooves is about a quarter of an inch. There is an unrifled chamber for a bed of the cartridge, of a diameter slighter larger than the calibre of the barrel and enlarging a very little at the rear to admit the cartridge after repeated discharges. Where the chamber unites with the grooves there is a gradual slope to facilitate the passage of the ball, and to prevent too sudden a compression. The barrel is screwed into a cylinder, which holds together the mechanism of the piece. The contrivance by which the trigger pushes forward the needle is too complicated to be described here without diagrams.

" *The Cartridge.* —The cartridge used in the 'needle-gun' is made of stiff card-board; the ball, powder, and explosive composition being contained in one and the same cylinder. Its great peculiarity is that the detonating charge is placed immediately in the rear and base of the ball, and between it and the gunpowder. The advantage of this is that, when the powder is ignited, that portion next the ball, in which combustion is first perfected, exerts its full force upon the projectile, the powder in rear also exerting its influence, as it becomes almost instantaneously ignited. Under the present system in which that part of the powder next to the breech of the gun is first ignited, a portion of the powder is frequently expelled from the gun with the ball in a condition of only partial combustion; the explosive force of the powder first consumed being adequate to expel the ball and the powder in its front before the whole charge has time to become entirely ignited. In the 'needle-gun' all the powder is consumed, and applied to the best effect, and so as to obtain its fullest force at the same instant and in the same direction. When the trigger is pulled a stout 'needle' or wire is thrust through the base of the cartridge, parallel with its axis, into the detonating charge, causing its explosion and the ignition of the cartridge. The ball is sphero-conical, weighing 450 grains. The charge of powder is 56 grains. The weight of a gun complete is under 11 pounds.

" *The Fulminate.*—The composition used as a fulminate is a compound of ingredients known only to one man—the inventor; and so determined is the Government that the secret shall not escape, that that man is guarded night and day by a squad of twelve soldiers; every letter which he writes is inspected, and he is not allowed to communicate orally with any person out of sight of his guard.

Advantages.—The advantages of the 'needle-gun' besides the great one of celerity of fire, are (1) the simplicity of the mechanism, which can be taken apart without a screw-driver or other implement; (2) the safety and ease with which it may be cleansed; (3) the convenience of loading in a limited space or on horseback; (4) the certain and uniform filling of the grooves; (5) the reduced charge upon the entire consumption of the powder; and (6) the disuse of the ramrod.

" *Range.*—In accuracy the 'needle-gun' cannot be surpassed, and its effective range is said to be about fifteen hundred yards. It is, however, doubtful whether it will be found to long bear with impunity the necessarily rough treatment of an active campaign. The Prussian sharp-shooters are all armed with this formidable weapon; and upon a skirmish line, whenever it can be used *with care and deliberation*, it must prove very effective; but the chief obejction brought against it has been that, firing so rapidly, the soldiers are apt to forget the aim, and to waste more ammunition than with the old weapons."

From the above it would appear that the needle-gun has been invented upwards of thirty years. It was introduced into the Prussian army in 1848.

A Mr. John Hansom, of England, claims the invention of this gun; as also does a Captain Whitey, of Ireland, who says he perfected his breech-loading needle-gun in 1828, and that the original and its cartridge can now be seen in Dublin. France has her claimants for the honor of the invention; and this Canada of ours has no less than two citizens who each claim to have been the original inventor.

As to the efficiency of this weapon, the Vienna *Medical Gazette* informs us that

"Of the 12,000 wounded men brought to Vienna, not 5 per cent. are so severely hurt as to be in danger of losing their lives. This confirms Dr. Russell's statement, in his letter to the *Times*, respecting the trifling nature of the needle-gun as a penetrating weapon."

The London *Engineer* says that

"Experiments are being made on a large scale at Chalons with breech-loaders. Military men in the camp declare that the worst of the various specimens of breech-loading arms which have been offered to the French Government are better than the Prussian needle-gun." And that—"The needle-gun was presented to the French Emperor six years ago, and immediately the committee of artillery engaged in the task of comparing together all the guns which load at the breech. Upwards of one hundred models were tried, and it was only last year that an arm was adopted, far superior, it is said, to the Prussian one."

The *Scientific American* thus expresses its opinion:—

"Judging it solely by its intrinsic value, it is not up to the standard of American breech-loaders. All military men know that an essential point in a fire-arm is simplicity and certainty in fire. Neither of these qualities is found in the needle-gun, for the mechanism is clumsy compared with recent inventions, and the ammunition is complicated and costly to prepare. The principal idea in this weapon is in firing the charge from the front instead of behind as in other weapons. To do this the percussion powder is put into a cavity in the base of a paper sabot, between the ball and the powder, the charge being exploded by a wire or needle thrust through the cartridge.

"The experience gained in the war of the rebellion shows us that the 'magazine arm,' or that weapon where the charges are contained in the breech, is most deadly, when in the hands of skilful troops. Other breech loaders have their good qualities, but all who remember the part the Spencer rifle bore in the contest will concede the point we make."

The London *Times*, on the Austro-Prussian war, says:—

"The great lesson to be learned by military men from the present war in Germany is *the irresistible superiority of breech-loading rifles in action.* In several sanguinary conflicts the Austrian troops fought obstinately and well; but they were fairly beaten (according to all the accounts that have reached us) by the more rapid fire of the Prussian infantry. From first to last, it is the 'needle-gun' that has carried the day; and that gun is simply a breech-loading rifle of very indifferent quality. In principle, as well as in construction, it is not to be compared with several breech-loading rifles manufactured by English makers; but imperfect as it is, it has proved quite good enough to secure victory for the Prussians in almost every encounter. The letter of our correspondent, at the headquarters of the first Prussian army, contains numerous proofs of its extraordinary effect. It was this gun which mainly enabled the Prussians to force the passage of the bridge over the Iser at Podoli. The Austrians had occupied the village through which the road passes toward the bridge, and commanded all the approaches from windows and barricades thrown up across the street. But the Prussian riflemen fired *three times* before the Austrians, armed only with muzzle-loading rifles, were able to reply. This more than compensated for any disadvantage in numbers or position, and the Austrians seemed to have been completely overmatched. In the street, the Austrian soldiers, huddled together and *encumbered with heavy ramrods*, were unable to load with ease, and could return no adequate fire to that of the Prussians, while these, from the advantage of a better arm, poured their quick volleys into an almost defenceless crowd. It was the same at the railway bridge, about 200 yards distant; here the needle-gun showed its advantage over the old-fashioned weapons of the Austrians, for the latter fell in the proportion of *six to one* Prussian."

From these extracts it would appear that the Prussian needle-gun is, after all, but an indifferent weapon; nevertheless, the advantages of it, or any other good breech-loader, over muzzle-loaders is very apparent. The disadvantages of the latter in actual warfare are shown in the following extract from the report of the master-armourer at Washington, on the condition of the arms gathered after the battle of Gettysburg:—

"The number of arms received here from Gettysburg was 27,574. The number found to be loaded was 24,000; of these 6,000 had one load each, 12,000 two loads each, and 6,000 from three to ten loads each. In many of these guns from two to six balls have been found with only one charge of powder; in some the ball has been found at the bottom of the bore, with the charge of powder on the top of the ball; in some, as many as six paper case cartridges have been found—these cartridges (regulation ball, calibre 58) having been put into the gun without being torn or broken. In one Springfield rifle musket there were twenty-three loads—each load in regular order. Twenty-two balls and sixty-two buckshot, with a corresponding quantity of powder all mixed up together, were found in one percussion smooth bore musket."

The trouble in England just now is, from the numerous inventions of repeating and single breech-loading rifles, of which there are upwards of sixty, to select the most efficient weapon. At the recent Volunteer Rifle Match at Wimbledon, a prize was offered by the proprietors of the London *Saturday Review*, for the breech-loader that would make the best score on time at 500 yards—covering both conditions of accuracy and rapidity. This prize was won by a Berdan-Enfield rifle. It is said that the military authorities were so satisfied of the superiority of the Enfield as converted to a breech-loader on Col. Berdan's plan, that an order was immediately given for the alteration of 50,000. The London *Mechanics' Magazine*, speaking of the improved guns used on the occasion referred to, says:—

"It is satisfactory to observe that the competition by these arms at the Wimbledon meeting is exciting unusual interest. The object is to fire the largest number of shots within a given time, and of course the value of the weapon is enhanced if accuracy is combined with rapidity. Among the various results of breech-loader shooting, it is reported that Mr. Dunlop fired 26 shots with a Remington rifle in 3 minutes, making 60 marks; but Private Kerr, of the London Scottish, who used the Remington carbine, for rapidity, shot 49 times, and only made 33 marks. Lord Elcho, with a Berdan's breech-loader, fired 23 shots, and Lord Mahon (of the Grenadier Guards), Robb, Mackie and Banting made 21 shots in the stipulated 3 minutes. For rapidity, Mr. Peterkin made 76 points in 29 rounds with a Spencer repeater; Mr. Dunlop in 20 shots made 59 points; and some other high scores were made. These last scores speak very highly for the Spencer repeating rifle, both as a rapid shooter and as an arm of precision. It appears from a recent statement of General Peel, in the house of Commons, that the Spencer rifle was brought before the War Department in 1864 and 1865, and was reported upon by the Ordnance Select Committee as ingenious, but liable to be damaged by exposure to weather. The committee at that time reported generally against repeating rifles. Since then, however, they have seen reason to change their opinion, and have now given orders that they should be supplied with six repeating arms of various patterns, of which a trial will take place. It is satisfactory to find the minds of the committee becoming open to conviction, and we think there can be little doubt that a fair trial will lead to conclusions in favor of a repeating arm. With regard to the rejection of the Spencer rifle on the score of liability to damage by exposure to weather, it is gratifying to find no worse reason given. We should like to see the arm that was not liable to damage under such circumstances. If hard service in the American war, as certified by generals under whose command the Spencer rifle was used, and successful experiments by the American Government to test this very point, go for anything, then the Ordnance Select Committee can dismiss all fears upon the subject. The weapon has proved itself equal, if not superior, to other rifles in its non-liability to damage by weather, both in practical use and under more than ordinarily unfavourable circumstances. Whatever system may ultimately be adopted by our Government, it is to be hoped that the merits which accompany an arm having a bore or small caliber will not be overlooked. This is an especially important point with a repeating gun; by increasing the number of rounds carried it meets the objection sometimes raised that the men waste their ammunition in firing away too rapidly. This objection in practice, however, is said not to hold good; the men are found to be careful of their fire, and gain confidence from having so many charges at command without reloading. A small bore is of still greater importance in another way; it enables troops to take the field with a much larger quantity of ammunition, speaking numerically, although of only the same weight as the supply for weapons of larger bore. It is highly desirable that the soldier should be able to carry a greater number of cartridges, in proportion to his increased facility of using them."

The same journal refers to an improvement in fire-arms, by Mr. Gale, in the following terms:—

"Mr. Gale, F.C.S., the discoverer of the process by which gunpowder can be rendered non-explosive and explosive at pleasure, has just invented a very ingenious piece of mechanism, which on being applied to small-arms, will enable him to discharge them with far greater rapidity than has been possible hitherto. It consists of a longitudinal piece of steel perforated for bullets, and fitting into a pistol between the stock and the barrel at right angles to the weapon. A revolving screw worked by the trigger moves this bar, and at each movement one of the holes in the bar is brought opposite the barrel of the pistol, and a shot is fired. The bar at last passes out at the other side with all its shot expended, and can then be loaded again and used as before. Supposing each bar to contain ten shots, and a soldier to be provided with half a dozen such, he could load and discharge at the rate of sixty rounds a minute, if necessary; thus far outstripping the famous needle-gun. The same mechanism can be applied to rifles and even to artillery, and a proportionate increase of rapidity in discharge is obtained. It is believed the British Government will adapt this invention to the present Enfield rifle, which can be done with comparatively little cost."

The *American Artizan*, speaking of another improvement says:—

"Captain J. V. Meigs, of Washington, D. C., has invented a new device for changing the common musket into a breech-loader, which can be applied to the United States arms with little difficulty. The invention consists in so constructing the guard that its *horizontal* motion opens and closes the breech vertically, thus obviating levers and protruding parts, or the necessity of changing the position of the hand which grasps the stock after firing, to extract the shell or preparing for reloading; and the extractor has no spring, but ejects the shell by a positive motion. Captain Meigs is engaged in perfecting and applying his invention to a magazine gun, which will enable the soldier or sportsman to dispense with ammunition boxes, and yet carry 50 rounds within the breech of this gun without increasing its size or weight. These fifty rounds may be fired without removing the gun from the shoulder."

A writer in a recent number of the *Scientific American*, thus sums up some of the many advantages of the breech-loading fire-arm:—

"A breech-loading carbine, or musket, when metallic cartridges are used, can be loaded and fired a thousand times without cleaning, when it is scarcely possible to load and fire a muzzle-loading musket fifty times without cleaning. This difference grows out of the fact that the principal fouling caused from each discharge of a breech-loading arm, is deposited within the cartridge shell, or case, which being removed at each discharge, keeps the gun clean. If a man will take the trouble to load and fire a muzzle-loading gun, say a Springfield musket, fifty times, and then remove the breech-pin, he will find a deposit of burnt powder at the breech where the charge lay, of about one-sixteenth of an inch in thickness. This incrustation is very hard and difficult to be removed. There is none of this deposit at the breech of a breech-loading arm, for the reason stated; the fouling engendered at each discharge is removed with the spent cartridge case. When a ramrod is used, the fouling is rammed home toward the breech; when in the breech-loading arm what little there is of deposit in and along the barrel, not removed with the case, as stated, is carried forward and out of the gun by each successive discharge.

"Greater penetration and range can be had from a breech-loader with same charge, than can be obtained from a muzzle-loader. This favourable result grows out of the fact that in a breech-loading arm, when used with a metallic cartridge, there is no escape of gas at the breech, all the force of the powder being expended in giving velocity to the ball, when in a muzzle-loading arm, there is an escape of gas at the vent at each discharge, which lessens the initial velocity of the ball.

"There is still another very important feature in favor of the breech-loading system: viz., the practicability of loading and firing with great rapidity. The Gatling gun which is a breech-loader, can be loaded and fired at the rate of one hundred shots per minute. Now it is evident that no muzzle-loading arm could be loaded and fired so often. By loading at the breech, the process of loading is simplified—ramrods, wipers, the biting of cartridges, capping, etc.—are all dispensed with.

"The prediction may be safely made, that muzzle-loading small arms will, within the next quarter of a century, become as obselete as the flint-lock musket is at the present time."

The *Mechanics' Magazine* of August 3rd, contains a long account of an exhibition and trial of a large "family of breech-loaders," at Beaufort House, the seat of Lord Ranelagh, when the different weapons were tried and their mechanism explained by their respective inventors or advocates; and says a similar exhibition is to be held at the same place, in the course of a few days, when it is hoped that the "earnest workers in this direction" will succeed in combining "in one arm the greatest possible facility of manipulation in all the operations of loading, firing, and cleaning, with the simplest mechanism, preserving the utmost capacity of power and accuracy of which any gun available for military use is capable."

Full illustrated descriptions of the Prussian needle-gun, the Berdan breech-loader, and the recently converted Austrian breech-loader, are given in the London *Engineer* for July 20th and 27th, and August 3rd respectively; and the Snider-Enfield, the Cochran breech-loader, and the Austrian breech-loader, are also described and illustrated in the *Mechanics' Magazine* of the same dates, from which latter Journal the following descriptions of the mode of conversion of the Snider-Enfield is taken:—

"The alteration consists in first cutting off about 2¼ in. of the breech end of the barrel, and then screwing on a breech-box for the reception of a solid breech-block. This cylindrical breech-block opens sideways on a hinge in front of the hammer, the block having longtitudinal play upon the hinge. This play is necessary to permit of the operation of the extractor for withdrawing the cartridge case after firing. The extractor is simply a tooth or projection formed on the breech-block, and against which the base rim of the cartridge abuts when in position for firing. The block is easily opened and closed, being retained in position by a spring-catch at the rear. The cartridge is on the central-fire principle, that is, the cap is placed in the centre of the base of the cartridge. A steel rod or needle passes obliquely through the breech-piece, and is held back by a spring, one end projecting slightly from a nipple joint below the nose of the hammer. On the hammer falling, the needle or plunger is projected beyond the front face of the breech-piece, and, striking the cartridge cap, explodes it and ignites the cartridge. The cartridge is on the Boxer principle, and was fully described in our last number. With these few particulars and the engraving, we think the Snider-Enfield rifle will be now well understood. It is very simple, and will not require very much drill to bring our soldiers up to the mark in its use."

The same journal, in its issue of June 22nd, has a full description with illustrations of the American Spencer Rifle, of which, during the latter part and immediately after the close of the late war, some 200,000 were supplied to the American Government; and which were spoken of in the highest terms by Generals Grant, Meade, Sherman, Thomas, Howard, Hooker, Sheridan and others as the best breech-loader in the hands of the troops, both as regards simplicity and rapidity of fire.

"It will be observed that the Spencer-rifle is a breech-loader and a repeater also. The cartridges, seven in number, are securely deposited in a magazine in the butt of the gun. These cartridges are thrown forward to the chamber, as needed, with the most unerring precision, and with a rapidity for successive firing which leaves nothing on that score to be desired. It has been found that an ordinary skilled marksman can discharge the seven loads in twelve seconds. When the seven charges are fired, seven more can be inserted in less than one-half the time required to ram and cap the single cartridge of a muzzle-loading musket. More rapid firing than this, even if attainable, would be wholly undesirable." So says the journal last referred to.

Captain Dahlgreen, the inventor of the Dahlgreen Cannon, in reporting the experiments with the Spencer-rifle at the Washington Navy Yard, in June 1861, says:—"The mechanism is compact and strong. The piece was fired five hundred times in succession—partly divided between two mornings. There was but one failure to fire—supposed to be due to the absence of fulminate. In every other instance the operation was complete. The mechanism was not cleaned, and yet worked throughout as at first. Not the least foulness on the outside, and very little within. The last time of firing seven rounds was ten seconds;" and the Superintendent of the Springfield Armoury says:—"I fired the Spencer repeating rifle some eighty times. The loaded piece was then laid upon the ground and covered with sand, to see what would be the effect of getting sand into the joints. No clogging or other injurious effect appeared to have been produced. The lock and lower parts of the barrel were then covered with salt water and left exposed for twenty-four hours. The rifle was then loaded and fired without difficulty. It was not cleaned during the firing, and it appeared to work quite as well at the end as at the beginning."

No stronger testimonials than the foregoing, as to the efficiency of breech-loaders over muzzle-loaders, could be given. If these are to be depended upon as generally correct, which we see no reason to doubt, ought not our volunteer soldiers to be armed with them as speedy as possible? The question of cost sinks into insignificance, as compared with the safety and efficiency of our brave defenders.

We are aware that great differences of opinion exist as to the comparative efficiency of the Spencer repeating rifles and the best of the simple breech-loaders; and the fact of the American Government not being now satisfied with the Spencer, but is looking for a weapon still more efficient, would seem to afford room for doubt as to its reliability. We know that one of the officers of the Queen's Own Battalion of Volunteers, who has had some experience with the Spencer Rifle, both at the engagement at Lime Ridge and in subsequent trials, is far from being satisfied with it; and, although admitting it to be an improvement on the present muzzle-loading Enfield, considers that a good breech-loading Enfield Rifle would be as far superior to the Spencer, as the latter is to the Rifle at present in use.

The presence of ozone in the atmosphere is a subject of dispute. A commission has been appointed by the Acadamy of Sciences to decide the question.

MUSEUMS OF MANUFACTURES AND INVENTIONS.

When the Board of Arts and Manufactures were established by the Legislature of the Province, in the year 1857, it was contemplated by their promoters and so expressed in the 30th clause of the Act, chap. 32 Consolidated Statutes of Canada, that the said Board should—in addition to various other equally important duties imposed upon them: "1st. Take measures, with the approbation of the Minister of Agriculture, to collect and establish at Toronto and Montreal respectively, for the instruction of practical mechanics and artizans, Museums of Minerals, and Material substances, and Chemical compositions, susceptible of being used in Arts and Manufactures, with Model rooms, appropriately stocked and supplied with models of works of art, and of implements and machines other than implements of husbandry and machines adapted to facilitate agricultural operations; and also free Libraries of Reference containing Books, Plans and Drawings, selected with a view to the imparting of useful information in connection with Arts and Manufactures. 2nd. Take measures to obtain from other countries new or improved implements and machines; (not being implements of husbandry or machines specially adapted to facilitate agricultural operations) to test the quality, value and usefulness of such implements and machines. 3rd. And generally to adopt every means in their power to promote improvement in the Arts and Manufactures of the Province."

For very good and sufficient reasons, these Boards have not been able to carry out to any great extent the objects so contemplated. Referring now more particularly to the Upper Canada Board—and the Board for Lower Canada is similarly situated—the first and chief difficulty has been the absence of funds for the purpose, except so far as from the small annual appropriation, an excellent free Library of Reference has been established; creditable indeed to the successive executive committees under whose management it has been formed, and beneficial to the general public—and especially to those engaged in industrial and inventive pursuits.

When the Government was last located in Toronto, all the models of Patents of Inventions were placed in charge of the Upper Canada Board, where they remain to this day. While these models—of which there are some 400 or 500—were new to visitors, and models of other new inventions were continually being added, an interest was kept up in the Museum. However, on the removal of the Seat of Government to Quebec, all new models by patentees had to be sent to the Patent Office, where the old ones will, no doubt, shortly follow. The rooms of the Board will then be available for the purposes originally intended, as expressed in a circular to the Mechanics' Institutes of Upper Canada, under date of February, 1858, asking their co-operation in establishing a "Museum to contain not only a collection illustrating the mineral and vegetable wealth of Canada, and all native substances of an economic value, but also of models of machinery and new inventions, or even, when practicable, of the machines themselves: specimens of all articles manufactured in this Province, both in their crude state and in all stages of completion; and generally of all such objects, the inspection and study of which may tend to the promotion of Mechanical and Industrial science."

At South Kensington, London; Dublin, in Ireland, and Edinburgh, in Scotland, extensive and interesting museums of this character have been established; and others are springing up in various places in the mother countries. The late Professor George Wilson, on this subject, said: "The whole of our public bodies have come forward to encourage the industrial museums;" and to give an idea of what should be their aim and object he says:—

"The Industrial Museum, like the College, the Court of Sessions, or the House of Commons, is at once a walled-in space, and an embodied idea or cluster of ideas. The walled-in space takes its character from the idea which it embodies, and that idea is fourfold. It includes the conception of—

"1. An ample exhibitional gallery, where the raw or workable and other materials of industrial art, the tools and machines employed to modify these, and the finished products resulting from their modifications, shall be displayed.

"2. A laboratory and workshop, where the qualities of industrial materials and products, and the effectiveness of industrial apparatus and machines, may be investigated.

"3. A library, where the special literature of industrial art may be consulted.

"4. Systematic Lectures on the contents of the galleries, the investigations of the laboratory and workshop, and the records of the library, as illustrating the nature of Technology or industrial science."

We will not be able, for many years to come, to establish an institution here on so comprehensive a scale as alluded to by Professor Wilson, but we may hope to soon make a beginning, and gradually go on increasing as circumstances may favour.

Connected with the Free Public Museum of Liverpool, we notice a "Gallery of Inventions and Science," lately organised, which possesses features likely to ensure a large measure of success. It is thus described by the *Mechanics' Magazine*:—

"This institution was founded by the late Sir William Brown, Bart., for the purpose of affording to inventors, manufacturers, and others the following advantages, gratuitously:—Firstly, space for exhibiting useful inventions illustrative of the practical applications of science or mechanical skill; secondly, publicity, which is effected by giving the public free admission to the gallery, which is a part of the Free Public Museum of Liverpool, the average daily number of visitors exceeding 2,000; and, thirdly, permission to affix a description to each object, to attach the price, when saleable, and to leave other information with an attendant, who will be the medium of communication between the public and the exhibitors.

"The object of the gallery is to bring under public notice inventions and manufactures calculated to economise labor, utilize natural productions, promote health, and open up new fields of industry. Thereby valuable instruction will be conveyed, a desire to adopt improvements induced, useful invention and production stimulated, and the interests advanced of those who have applied knowledge usefully. The gallery is under the management of a committee appointed by the Architectural and Archæological Society, the Chemist's Association, the Historic Society of Lancashire and Cheshire, and the Liverpool Polytechnic Society. For the attainment of the founder's object the committee rely, in a great measure, upon having it made advantageous to inventors and manufacturers to become exhibitors, and thus to benefit themselves while contributing to the instruction, improvement, and enjoyment of others.

"Every loan is received for a specified time, until the expiration of which it will not be removed. Subsequently, if the exhibitor desire to continue the loan, the committee will consent thereto if, in their opinion, the public continue to take a sufficient interest in the particular object, but otherwise it will have to give place to articles having newer or stronger claims for space—the chief aim of the committee being to render the gallery practically useful, rather than to make it a storehouse for things either abstrusely scientific or out of date. We wish to draw special attention to this peculiar feature of the Liverpool Gallery of Inventions, for by thus maintaining freshness of interest, withdrawing what has ceased to attract, and adding new illustrations of progress in the arts and sciences, a greater degree of utility will doubtless be secured, and the object of exhibitors more fully attained."

Within a very limited time confederation of the Provinces will, no doubt, take place; and as under the Quebec Resolutions it is provided that the promotion of Agriculture, Arts and Manufactures, shall be under the controul of the local Legislatures, it is but mere conjecture to speculate on what that measure of support is likely to be. We trust, however, that the encouragement of Arts and Manufactures, in Upper Canada, will be considered of more importance than has been heretofore indicated by the support given them by the Legislature of United Canada.

STEAM vs. HAND-POWER FIRE ENGINE BRIGADES.

In the *Journal* for May, 1863, we drew attention to the introduction, by the corporation of this city, of steam fire-engines, and their economical and efficient working results, as compared with hand-power engines. We showed, that with two steam engines the brigade of forty-five men had been enabled to extinguish fires more speedily than had the old brigade of 300 men with six hand-engines, and a larger number of hose companies; and at about one-half the expense of the old system, and the almost entire absence of the uproar and confusion always attendant upon the working of hand-power engines by volunteer brigades—often resulting in rioting, and invariably in the demoralization of a large proportion of the young men of which such companies are usually composed.

Ever since the date referred to—now upwards of three years—these steam engines have worked to the *intense* satisfaction of the citizens, who would no more think of returning to the old system than they would of voluntarily relinquishing their rights and liberties of British subjects. What surprises us is, that, in face of these facts, no other city or town in all Canada has yet availed itself of the advantages and economy of a steam fire-brigade.

Some of our cities—London and Quebec especially—have, during the last two or three years, suffered fearfully from losses by fires, which to a great extent might have been prevented had they possessed good steam fire-engines. London has lost more in taxes remitted on burnt premises than would, added to the sale of its old hand-engines to village municipalities, have purchased two good steamers, the cost of which is about $3,000 each.

Owing to representations recently made to the Government by the authorities of this city, that the Canadian demand for these engines is not sufficient to induce their manufacture here, and that their introduction from abroad is a public benefit, the Hon. the Minister of Finance has promised to recommend that hereafter they be admitted free of duty. This action on the part of the Government is but just, especially in regard to those cities where public or government property is situated and requires protection.

We are pleased to see that the City of Toronto has purchased a third engine of this class, so as to have one in reserve at all times; and we hope soon to hear of other cities, for the security of their inhabitants, following the example of Toronto in this respect.

With a good supply of water, an efficient steam fire-brigade, and a good system of fire-alarm telegraph in operation—the last of which Toronto does not yet possess, and the first to but a limited extent—comparative safety from destructive fires may be secured.

PROVINCIAL EXHIBITION.

Remember that entries in "Horticultural Products, Ladies' Work, Fine Arts, &c.," must be made on or before Saturday, September 15th; that "all specimens in the Fine Arts Class must be delivered on the grounds not later than Friday, the 21st of September, and all articles other than live stock not later than Monday, the 24th." The Judges in Fine Arts will meet on Monday, the 24th, at nine o'clock, a. m.; and the Judges in all the other classes of the Arts and Manufactures Department, at the same hour on the morning of Tuesday, the 25th of September.

The office of the Secretary of the Agricultural Department, and of the Treasurer of the Association, will be at the main entrance to the grounds, where the Judges of that department will also meet on the morning of Tuesday, the 25th of September, at nine o'clock. The Judges in Arts and Manufactures will meet in the office of the Secretary of that department, just within the main entrance of the Crystal Palace.

Superintendents of the several departments will be in attendance to receive goods for exhibition.

The attention of artists is particularly directed to the improved classification of the prize list this year—distinguishing originals from copies, and professional from amateur productions.

Board of Arts and Manufactures

FOR UPPER CANADA.

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* 200.)

Northrop & Lyman, Newcastle, C. W., "Darley's Heave Remedy, also a Universal Condition Medicine." Vol. A, folio 130, No. 384. Dated August 2nd, 1866.

Northrop & Lyman, Newcastle, C. W., "Canadian Liquid Hair Dye." Vol. A, folio 131, No. 384. Dated August 2nd, 1866.

W. C. McDonald, Montreal. Trade Mark—"W. C. McDonald, Manufacturer of Fine Tobacco, Montreal; Prince of Wales' 10s. Superior Honey Dew Tobacco, Montreal." Vol. A, folio 132, No. 401. Dated August 16th, 1866.

GOODS FOR THE PARIS UNIVERSAL EXPOSITION OF 1867.

The Minister of Agriculture, to whose department of the Government this matter has been assigned, has placed at the disposal of this Board the sum of $4,000 for the purchase of "Articles of Trades and Manufactures," to represent Upper Canada at the Paris Exhibition. Natural products of the Forest and the Mine; and Agricultural products and Implements, will be furnished through other sources.

The Executive Committee of the Board has met and determined to procure, if possible, a fair representation of the following articles, which they are now endeavouring to obtain; as also any other articles that may be presented, and deemed suitable. The list as agreed upon embraces Decorated Crockery; New Books, and Periodicals; Papers; Philosophical Instruments; Furniture; Edge Tools; Stoves; Cotton, Woollen and Flax Goods; Machine made Boots and Shoes; Native Medicinal Roots and Plants; Carriage and Sleigh Material; Ladies' and Gentleman's Saddles; Bookbinding; School Apparatus; Photographic Views; Maps and Charts; Paper Hangings; Lithography; Typography; Linseed and Petroleum Oils; Colors; and possibly some small articles of Machinery.

Should any articles *really* worthy be shown at the ensuing Provincial Exhibition, the Committee will avail itself of the opportunity of purchasing, if coming within its means to do so.

The following *Excerps* from the Programme of the Imperial Commissioners, will give all necessary information to exhibitors, or intending visitors:—

Dates Assigned.

Before December 1, 1866.—Finishing the palace and the buildings in the park.

Before January 1, 1867.—Notifying French artists of their admission.

Before January 15, 1867.—Finishing the special arrangements for exhibitors in the palace and in the park.

Before March 6, 1867.—Admission of foreign products at the seaports and frontier towns indicated in article 44 of the general regulations, with permission for them to be forwarded to the Exposition, which shall be used as an actual custom-house depot.

From Jan. 15 to Mar. 10, 1867.—Receiving and unpacking goods in the Exposition.

From Mar. 11 to Mar. 28, 1867.—Arranging the goods unpacked in the spaces ascribed for them.

March 29 and 30, 1867.—General cleaning of all parts of the palace and park.

March 31, 1867.—Inspection of the whole Exposition.

April 1, 1867.—Opening of the Exposition.

October 31, 1867.—Closing of the Exposition.

Nov. 1 to Nov. 30, 1867.—Removal of goods and of fixtures.

Exclusions.

(*Fine Arts*)—1st. All copies, even though reproducing a work in a style differing from the original. 2nd. Unframed Oil, water color, pastel, and miniature paintings and drawings, or cartoons of stained glass or of frescoes. 3rd. Works of sculpture of unbaked clay.

All explosive, fulminating, or other substances considered dangerous. Spirits or alcohols, essences, essential oils, corroding substances susceptible of injuring other productions exhibited, or of proving inconvenient to the public, shall be admitted only in strong suitable packages of small capacity. Of percussion caps, fire-works, matches, and similar objects, imitations only, containing no inflammable substances, shall be admitted.

Exhibitors of troublesome or unhealthy objects shall, at all times, conform to the measures of safety prescribed to them. The Imperial Commission reserves the right of ordering the removal, at any time, of goods, from whatever source, which may, from their nature or their bulk, appear hurtful or unsuited to the object of the Exposition.

Classification of Subjects.

In each section assigned to exhibitors of the same nation, the objects exhibited shall be divided into 10 groups and 95 classes, namely: Group 1. Works of art, (classes 1 to 5); group 2. Materials and applications of the liberal arts, (classes 6 to 13); group 3. Furniture and other household articles, (classes 14 to 26); group 4. Clothing—including cloths—and other wearing apparel, (classes 27 to 39); group 5. Mining, rough and wrought products, (classes 40 to 46); group 6. Instruments and processes of the mechanical arts, (classes 47 to 66); group 7. Food, fresh and preserved in its various states, (classes 67 to 73); group 8. Live agricultural products and specimens, (classes 74 to 82); group 9. Natural horticultural products and specimens, (classes 83 to 88); group 10. Objects especially exhibited for the purpose of improving the physical and moral condition of the population, (classes 89 to 95).

Selected Articles.

POPULAR BOTANY.

AN ILLUSTRATION OF SOME OF THE MOST INTERESTING PHENOMENA CONNECTED WITH VEGETABLE LIFE.

BY H. A. GRAEF,

Chairman of the Society on Botany in the Long Island Historical Society.

(*Concluded from page 206.*)

I can hardly let this occasion pass without referring to the peculiar organisation of a plant which grows frequently in our ponds — namely, the *Utricularia vulgaris*, or bladder-weed. The stem of this plant is so herbaceous and weak that it cannot bear its own weight, and is therefore constantly submerged. These plants, however, belong to the annuals which, must bear seed every year in order to reproduce themselves anew; but as the production of seeds cannot take place under water, and as the stem is not able to rise above the surface, Nature has found an ingenious plan. The setaceous leaves have been provided with a great number of small bladders filled with light gas, and by means of these buoys, the flower-stalks are raised to the surface, where the fructification takes place, and after the seeds have grown to maturity they drop to the bottom of the water, from which they spring up again at the following season.

Having now paid some attention to those plants which are accustomed to grow in soil and water, we will now turn to the parasites—such plants, as are in the habit of growing on trees, or stones and rocks, &c. Those who have not visited primeval forests can form no idea of the beauty and the magnificence of such an appearance. In the forests of the tropics we frequently find trees of the greatest age and the most gigantic forms covered with those parasites from the bottom to the point. They generally belong to the tribes of ferns, lycopodia, bananas, orchids, &c. Such an old tree represents somewhat a botanical garden, where a botanist can easily spend a month or more in order to make his studies and collection. The most interesting among these parasites are the orchids, particularly remarkable for the shape of their flowers, the brightness and great contrast of their colours, &c., for which reason they are now so frequently cultivated in our hothouses. The parasites are used to live at the expense of the moisture of the atmosphere. We now arrive at that class of plants which commonly grow on mouldering wood, on stones, rocks, &c., namely, the mosses, ferns and lichens, and by illustrating their habits we shall find that their functions in natural economy are of much higher importance than would be generally supposed. These plants may be regarded as the true pioneers of vegetation. It has already been stated that the seeds of these families are so very light and dust-like, that they are taken up by the wind in large quantities and carried away to great distances, and frequently reach stones, rocks, and even distant barren islands, where they often germinate and grow, supported by the moisture of the atmosphere. When in course of time these plants or parcels of them die and decay, a small layer of humus will be produced, in which the second generation, however, will grow and prosper more rapidly. By this continued change of growth and decay such an increased humus is produced—though often not till the expiration of centuries—that larger plants and even the largest trees can grow and prosper in it. If we had the means of tracing back to its origin the history of many an island, especially of coral-reefs, we should in all probability become convinced that vegetation on them began and continued in this very manner.

Among all the different functions of vegetables none are more interesting and of higher importance in regard to our own existence and health, than the manner in which these are instrumental in puryfying the air by decomposing the poisonous carbonic acid gas of the atmosphere, and reproducing therefrom the necessary quantity of oxygen gas.

Although the explanation of this process is somewhat circumstantial and the comprehension of it requires some knowledge of chemistry, I will endeavour to the best of my abilities to illustrate this process in the most popular way.

In order to reach this my aim I am obliged to start with the explanation of many other facts, connected with the phenomenon alluded to. We are all familiar with the fact, that no being that breathes through lungs is able to live for even a short time without inhaling atmospheric air. Besides, that by the condensation of this air the animal heat is produced and sustained, the same effects also a very important alteration in our blood. When the air, consisting, as we all know, of about sixty-six per cent. nitrogen gas, and thirty-three per cent. oxygen gas—comes in connection with the so-called chyle in our lungs, both of them (namely, the air and chyle) undergo thereby a strange alteration. The white chyle deprives the air of a part of its oxygen, changes thereby its white colour into red, and is thereafter real blood, which is then pumped by the pulsation of the heart through the veins of the whole body, for the purpose of developing and nourishing the same to the remotest extremities.

As equivalent for the oxygen received, the chyle, however, delivers to the oxygen of the atmosphere a part of the superfluous carbon, producing thereby carbonic acid gas, which after this process is exhaled in company with the unchanged atmospheric air, nitrogen gas, and some moisture, which will intermix with the atmosphere.

Beside by exhalation, carbonic acid gas is produced by the process of burning, of fermentation, putrefaction, by volcanic eruptions, by escaping from natural mineral springs, and many others. If we now consider how many millions of human beings and animals have already lived and breathed since the Creation; how much combustion has taken place, and how many substances, both vegetable and animal, have gone to decay, &c.; and if we consider furthermore, that by all these occurrences oxygen is constantly absorbed from the air and carbonic acid gas produced in return, one would fear that after the lapse of time the oxygen would decrease, while the carbonic acid gas would increase in such proportions that animal life could no longer be possible.

The learned men of the olden times entertained this idea, hinting frequently at this danger, and as the effect of the carbonic acid gas is suffocating, when exceeding the proportion of four per cent. in the atmospheric air, they feared the time would arrive when animal life on our globe would entirely cease to exist. Most happily for us, however, as well as for our descendents, the apprehensions of the old naturalists have proved to be unfounded; for since the science of analytical chemistry has attained so high a degree of perfection that its results may be considered scrupulously correct, the atmospherical air has frequently been analysed at regular intervals and in very different places and localities, the result always demonstrates that the proportion of the carbonic acid gas to that of the atmosphere is nearly constant, and in no place whatever exceeds one per cent.

For a long period the scientific world had speculated as to what became of the carbonic acid gas thus produced, until finally the German chemist, Liebig, proved, by facts, that the plants dissolve and decompose the carbonic acid gas of the atmosphere by absorbing its carbon for the formation of their growth by leaving the oxygen to escape as gas, which, by again dissolving into the air, begins its work anew. By this important process the equilibrium of the constituents of the air will be restored and preserved for ever!

The facts stated in the foregoing demonstration will clearly show that, and for what reason, the atmospheric air in the country and in the woods must be purer and more wholesome than that of densely populated cities; and that the trees are very instrumental in this action. Furthermore, they prove that the shade trees in our cities should not only be regarded as sheltering ornaments, but also as benefactors to our sanitary welfare. The consequences will, therefore, be entirely different, when we keep our shade-trees sound and enable them thereby to perform their duty as air-purifiers —or allow rotten trees, or even stumps, in our streets, which, besides their disgusting appearance, *consume* oxygen gas, and will produce dangerous miasmas in return. And these are the reasons why I have tried so frequently in the last five years to lead the attention of the public to the poor condition and the constantly increasing mortality of our shade-trees, and why I have been in a state of war against the destructive measure-worm!

Another very interesting phenomenon in connection with vegetable life is that which we term growth. This is certainly one of the greatest wonders in creation; and if this fact does not more seriously attract our attention, the reason is to be found in its familiarity. Let us suppose, however, that a certain person had never seen a tree, and some one should step forward with an acorn in his hand and endeavour to make him believe that this small, lifeless object, when planted in the ground would become alive and commence to grow. After a while it would send out a root that grows into the ground, and a stem that grows into the air. The latter would gradually extend in size until it reached 100 feet or more. It would also bring forth branches, twigs, leaves, flowers and fruits, exactly of the same shape as that in his hand; and from the latter another would spring up, and it would go on in such succession for all time to come! Would such a person believe the assertions, although all that was said about this acorn was the truth—nothing more than the very truth!

You are all sufficiently acquainted with the phenomenon which is called growth; the explanation of this process, however, is somewhat difficult to comprehend. I will, therefore, confine myself to the description of the practical effects connected with the growth, and will commence with the very seed-grain.

The seed in general is composed of the germ, the cotyledons, and an external coat. The germ is the embryo of the future plant; the cotyledons serve as protection and as a supporter, and the coat as a covering to keep the cotyledons together. In the embryo the disposition of the future root and stem is already existing, and the cotyledons contain some albumen or amylum. The seed-grain, after having remained some time in close contact with the damp soil, absorbs so much moisture therefrom that the albumen or amylum becomes liquid, and in this state they serve as the nourishment for the embryo. Starting into life, the embryo gradually gains in size, presses on the cotyledons, and these again on the coat, until they burst, even if they were the hardest nut-shells!

The embryo begins thereafter to extend downward, forming the roots, and as soon as this penetrates the ground and is able to absorb nourishment from them, it supports the germ, which grows now upward, forming, in true time, the stem, leaves, branches, twigs, flowers and fruits.

What next will take us with surprise is the extraordinary diversity in the vegetable world. This is not less remarkable between the different kinds of plants, than between their parts.

Although the number of native plants, Cryptogams and Algæ included, may be estimated at 200,000 species; nevertheless it is a rare case, to find two species, whose leaves are entirely of the same form.

The correct knowledge and description of all these forms can only be regarded as one of the most difficult tasks in the study of botany. It is called the terminology of plants; and fills many immense volumes, with expressions, mostly derived from foreign languages.

For its monotony the terminology of plants may be regarded as the very touchstone for the earnestness and perseverance of young botanists and, in most instances, it becomes the rock where both may be wrecked!

Another very interesting quality of plants is the great diversity in their colours. The most prevailing is green, which colour is most pleasing and beneficial to the eye. Then follow white, yellow, red, and blue, with all the imaginable mixed colours, shades and nüances. The brilliancy of *flower* colours excels all that is found elsewhere.

It happens, not unfrequently, that the most brilliant colours in the most striking contrasts and in the most regular design are found in the small space of a petal of a more regular construction than the best artist would be able to produce.

Next to colours, the fragrance of many vegetables must be regarded as of great interest and value. In their delicate organism they frequently prepare fluids and gases which transpire through the leaves, flowers, and fruits, and produce that kind of sensation to the olfactory nerve which we call the smell. This odour is very agreeable in many cases, but often, however, it is the direct opposite and even dangerous.

The aromatic plants, or their parts, are frequently used for different purposes, as for perfumery, spices, medicines, &c.; in many cases, however, the essential constituents are extracted from them in the shape of extracts, tinctures, ethereal oil, &c.

Nearly all that has been said about odour, is also, in most cases applicable to the taste.

It has often been stated that it is the destination of the vegetable kingdom to spread over the surface of the earth. As, however, our globe is of very different construction, and particularly in the different zones, the plants, as a matter of course, must be organized in such a manner, as to answer all requirements in this respect.

In hot climates we find, therefore, most of the plants covered with very large leaves, as, for instance, the palm trees, bananas, caladium, and others, whose office it is to catch the hot sun-beams, and prevent the exsiccation of the ground.

In the cold climates the Coniferæ (pine tribe) are predominant, whose sap, as is well known, is of a resinous nature, and does not freeze, even in the coldest winters.

In the temperate zones the prevailing character of the plants is less distinct or observable, as they form, likewise, the transition from one climate to another. The general impression, produced by the predominance of one or another family of plants, is called the physiognomy of plants.

With regard to the facts just mentioned, the high mountains of the tropics offer a particularly interesting picture. From the base upward, to a certain height, the physiognomy is tropical; from thence farther up to about midway it is temperate, and the top is entirely that of a cold climate.

A great number of plants show a strong dependency on the geographical influence of our globe, while they grow only between certain degrees of latitude, over which they never extend without human aid. In this respect the conduct of different mountain plants deserves to be mentioned. These grow exclusively in certain regions, as, for instance, of the Alps, they do not cross their line, and disappear gradually towards the top and the foot, and are entirely lost at the lower flat ground. But, without meeting them somewhere else in any direction whatever, we find them at last back again on other mountains of the same character and the same region, often a hundred miles distant from the Alps, and separated from them by rivers and even by the sea.

That branch of botany which treats of the investigation of their natural boundary is called the geography of plants.

With regard to my former statements the most striking of the different phenomena connected with vegetable life can be attributed to their growth, the great diversity of their forms, and their colours, their odours, and their flavour.

The tiny grain of seed developed into a stately tree, which latter, by the periodical course of events, undergoes the same process, and assumes eventually the same shape. Beneath the mighty oak we find the pigmy moss; by the side of the majestic *Victoria Regia* grows the tiny conferva. In the diminutive space of the petal of a flower we often find the most beautiful, brilliant, and contrasting hues and most remarkable and regular designs. What immense diversity of odour and flavour we find in plants, and the different effects produced by them on their parts! Take, for instance, the fragrance of the rose, the heliotrope and the orange blossom; how delightful, yet how widely different! And how great are the contrasts in the different parts of the last named plant. The flower, so delightfully sweet, so different from the smell and taste of the orange-peel, and the refreshing juice, or the bitter taste of the kernels! And yet all these widely different tastes and properties have been imparted to it through the narrow tube of the fruit-stalk. We behold the bitter vermouth in company with the sweet sugar-cane, and the most useful medicinal herb growing peacefully at the side of the most rank and poisonous plants.

If we examine the seeds from which the different plants have sprung, and the earth on which they have grown, we shall be unable to find the least clue to either the difference in taste or smell of any of the plants. Where shall we seek the power that endows the tiny embryo with life, and causes it to grow? Where seek the laws that so strictly govern and direct them to assume their respective shapes and to perform the different functions which all individuals are required to fulfil? Where is the power which propels the sap from the roots of the trees up to its very top? Where, lastly, shall we seek the laboratory wherein the crude liquid of the earth is transformed into so many different products of such diversity of colour, taste, flavour and properties? Can we do better than call this a miracle; and is this miracle perhaps less greater because we see it repeated daily before our eyes?

Referring, lastly, to the practical advantages for which we are indebted to the vegetable kingdom, for our daily bread we are dependent on the seeds of certain grasses or on some roots. The indispensable daily vegetables come to us in the shape of roots, tubercles, stems, leaves, fruits and seeds. Our fruit trees furnish us with apples, pears, peaches, apricots, quinces, plums, cherries, grapes, raspberries, currants, gooseberries, strawberries, and many others, which are frequently used in the natural raw state, or will be dried, preserved, prepared into confection, jelly, syrups, or wines, cider, beer, vinegar and distilled spirits.

The almonds, nuts, hazel, chesnuts, pistachio-nuts and many others serve us as a welcome dessert.

Furthermore, there are coffee, rice, tea, sugar, all our precious spices; the greatest part of dye-stuffs, as indigo, sandalwood, camphor, tobacco, a great number of the most effective drugs; most of the fatty and essential oils, resins, gums, india-rubber, honey, wax, potash, and a thousand other articles of vegetable origin. Nor should we forget that cotton, flax, hemp, jute, and similar fibres, provide us with ropes and all the various spun and woven stuffs for our clothing, and even wool and silk belong to this class—however indirectly.

Plants, again, give us the means to feed our beasts of burden, whose services, bones, skin, hair, wool, horns, &c., and our domestic animals, whose meat, milk, cream, butter, cheese, &c., have become so indispensably necessary in our household. The trees of our forests produce lumber and timber for our houses, ships, and furniture of all descriptions.

For fuel we use the raw wood as well as peat, pitch, charcoal, coal, all of which are also of vegetable origin; and there is hardly any thing used to satisfy our daily wants of food, shelter and raiment, that is not either a product of this part of nature or, at least, in some way connected with it.

As with men, so a great many of the animals are dependent on vegetables. Not alone do the vegetables comprise their food wholly or in part, but a great many of the animals are dependant on the trees for their habitation, or as a shelter from the scorching rays of the sun, or against the rigors of winter, and also as a hiding-place against their natural enemies.

Nearly all animals are dependent on some particular kind of plant, or at least live on it in preference to others. Even poisonous plants have their votaries, and are particularly preferred by some animals, while the same food would cause the death of most others. This phenomenon is found most remarkable among the insects, as for instance, a great many of the caterpiller species would sooner starve than eat any other food than that to which they are used.

It is, therefore, but natural that a kingdom in nature, to which we are indebted for so many advantages—even for our very existence—should for ages have drawn the most serious attention to its study.

Plants have, therefore, been both scientifically and practically examined, described, and classified in many, more or less, serviceable systems. They have been divided into classes, orders, families, genera, and species, and each described with two names, the first denoting the genus and the last the species.

On dividing the classes, orders, and genera, the calyx, the shape of the corolla, the number and situation of the filaments, and the number of pistils, and, finally, the shape of the fruits and seeds, are generally used as characteristics; in the determination of the species, however, the shape and position of the leaves are mostly used for this purpose.

Before concluding, I wish to say something about cultivated plants, hybridizing or producing new varieties. Among the great number of plants cultivated for some purpose or other, hardly any exist in their original natural state. Some of them have largely extended in size by proper management and manuring, others yet have to undergo an alteration by change or admixture of ground; by far the most of them, however, have gained a more constant character—namely, they have been improved by hybridizing.

In order to explain this interesting process more satisfactorily, I feel called upon to remark once more that each flower contains certain organs indispensibly necessary for the production of fertile seed. These organs are the filaments and styles. In most flowers these organs are combined, and they are, therefore, called hermaphrodites. The styles stand usually in the centre of the flower upon the germ and the filaments around them. In other plants the filaments and styles, though being both on the same plant, are separated from each other by different flowers; and there are still other plants where they are so entirely separated that each of them appears as a different individual, one bearing none but female, the other none but male flowers. The filaments bear on their top a little bag, the anther, filled with fine dust called pollen. This little bag bursts, when ripe, and thereby the pollen is communicated to the somewhat sticky stigma of the styles. In cases where flowers turn into the double state by one cause or other, the sexual organs change into petals, and, therefore, of course, they are not fit to produce any seed. The fructification of flowers is very much assisted by the aid of insects, as flies, bees, wasps, and by the wind, particularly in plants of separated sexes.

Experiments have frequently been made, and with a uniform result, to show that no fruit at all, or at least, no fertile seed will be gained, if the style or filaments, or both of them have been carefully taken from the flower before the pollen had reached the styles.

Since we have become aware of this process by attentively watching nature, and experience has convinced us of its sure success, we make use of the same process for our own advantage. When in the ordinary course of nature the style is fructified with the pollen of the same plant, the new individuals produced by the seed of them must of course, be of the same character.

If it is, however, our intention to raise new varieties or hybrids in an artificial way, then we have to proceed as follows: Suppose we are in possession of two apple trees, one of which bears small, green, sour apples; the other one, however, large, red and sweet ones. But we like neither sour nor sweet apples, but would prefer to possess some mixed varieties. Then let us take the pollen of the sour apple with a little brush, and bring it to the stigma of the flower of the sweet apple tree, or *vice versa* before the stigma of the latter has become impregnated by another pollen, and then we have done what is called crossing or hybridizing. This act does not produce an immediate effect or change on the fruit growing next after the crossing. When, however, the kernels of the fruit are sown, the new trees produced by them, when cultivated, will generally furnish about the following phenomenon:—

Most of the trees will bear fruits similar to those of their mother, but many others will be similar to their father; frequently they stand between both of them. Sometimes, however, some few trees will produce fruits which have not the remotest similarity to either of their parents, or any other variety of apples known. These we call a new variety, which will be named by the raiser, and frequently command very high prices. In this way, all the innumerable varieties of apples, pears, peaches, cherries, camellias, roses, dahlias, carnations, potatoes, carrots, cabbages, &c., were produced; and the larger number of good varieties is already, the more difficult it becomes to produce something new, which shall differ from all existing varieties, and surpass them in beauty or usefulness.

The law according to which these changes take place has not been discovered yet. In order to meet with a certain success we have to work on a large scale, and leave to our good luck what it has in store for us.

One certain condition of the act of hybridizing is, that the two plants operated on must belong to the same kind, genus, or at least to the same family or tribe.

The preceding statements will suffice to prove the high importance of the vegetable kingdom in regard to our bodily wants, as well as our spiritual employments.

I cannot omit to recommend strongly to the rising generation the importance of forming collections of natural objects, particularly plants, in the shape of a so-called herbarium.

Love for such objects drives young people into the free and pure air, forces them into healthy bodily exercise, teaches them to stedfastly pursue a fixed aim, and prepares them pleasantly for the future and more arduous duties of life. Beside all these, constant additions to their collections will afford them equal and often purer enjoyment and satisfaction than will many a successful speculation to a business man. Finally they lay up for themselves a rich treasure of interesting and useful knowledge, and in doing so, are prevented from spending their time in the streets or in dangerous company—a consideration well worthy the attention of parents or those who act in their stead.

THE SPECTROSCOPE & ITS REVELATIONS*

BY PROF. HENRY DRAPER.

Within the last few years a new form of chemical analysis has arisen, which ascertains substances by observation upon the color and properties which they impart to flames during combustion. It has been long known that the combustion of certain bodies gave certain colors to flames; strontia, for example, affording the beautiful crimson so well known in pyrotechny. But no sure method existed of using the facts of combustion for chemical investigations, until the invention of the spectroscope. Spectrum analysis enables us to detect the minutest trace of the constituents of substances burnt. It has already dscovered several unsuspected new metals; has given us the power of analyzing bodies whose composition we had not the means of ascertaining, and has proved to us that many of the elements of the earth are present in the inaccesssble sun, and even in those more remote stars whose distance the most refined researches of astronomy cannot determine.

The spectroscope is merely a prism to which light can be admitted throught a slit $\frac{1}{32}$d of an inch wide, with apparatus for examining microscopically the spectrum or decomposed ray beyond the prism. When this is done, the spectrum is found to be crossed by an infinite number of lines perpendicular to its length. These lines are called, from the name of the distinguished optician who discovered them, Fraunhofer's lines.

When the light, coming from a white-hot mass of metal is examined by the spectroscope, its spectrum is found to be perfectly continuous and unbroken by any Fraunhofer lines. This fact was demonstrated by my father, Prof. J. W. Draper, in 1847. What is the cause of the lines in the solar light, and in what does that luminary differ from the incandescent mass?

In order to fathom this questicn, we must investigate for a few moments the case of artificial lights, such as ordinary flames, and those in which there are purposely introduced elementary or compound bodies. The construction of the spectroscope must also be described.

The spectroscope is some times a very complicated instrument, but, for ordinary analysis, quite a simple form may be used. The one commonly found in laboratories consists of a prism, supported on a stand. Two telescopes of low magnifying power are attched by suitable supports. One of these is furnished with an eye-piece like any com mon spy-glass, but the eye-piece of the other is removed, and in its place is put a verticle slit. Opposite this slit the flame to be examined is placed. The light coming through the slit from the flame falls upon the object glass of the first telescope, and its rays are rendered parallel; it then passes through the prism, is refracted and decomposed, and enters the second telescope whence it falls upon the eye. Any flame may be put opposite the slit, and its peculiarities examined, or, by the aid of a reflector, the sunlight may be cast on part of the slit so that we can see a solar system spectrum alongside of the flame spectrum. Or we may have the spectra of the two flames at once and compare them. The third telescope carries a scale.

The use of a spectroscope merely involves placing the substance to be examined in a spirit or gas flame, and then looking through the telescope to examine the spectrum. The number, position and color of the transverse line are always the same from the same substance. A person soon becomes experienced enough to state in a moment what bodies are present. * * * * *

Undertanding, then, that various elementary bodies, when volatilized in a flame and examined by a spectroscope, give spectra distinguished by bright-colored lines, soda by yellow, strontia by red, etc., the reader is ready to grasp the next idea in the investigation.

If the light coming from such a source as a mass of white-hot iron, which is free from all Fraunhofer lines, be passed through a flame, where soda is volatilizing, before it is analyzed by the prism, instead of seeing the bright yellow lines characteristic of the soda, we shall find in their place two dark lines. In other words the soda flame has interfered with the continuity of the spectrum of the white-hot body, and produced therein two Fraunhofer lines. If a number of substances are burning in the flame at once, we shall get in the spectrum an increased number of lines. A flame refuses to permit the passage of rays of the same kind as it emit. White light passing through a soda flame has the yellow rays sifted out of it.

It is obvious at once, from such considerations, that we can ascertain the constitution of the sun, both as regards his physical character and chemical composition. From the fact that the lines in his spectrum are dark, we infer that he has an intensly hot solid or fluid nucleus, omitting light and surrounded by an atmosphere of flame in which there are many volatilized bodies. If he were solely an ignited gas or flame, the lines of his spectrum would be bright instead of dark.

As regards chemical composition, it is only necessary to ascertain what elementary substances can produce lines corresponding to those in the solar spectrum. We can then at once be sure that those bodies exist in their luminary. The presence of iron, sodium, and a variety of other materials familiar to us here, has thus been proved.

The reader will at once perceive what an important bearing these facts have on the construction and unity of the solar system. We have shown that on two members of it—the sun and the earth—the same substances are found, and may, therefore, infer that all the rest are similarly composed—for no other two, at first sight, seem more unlike. The sun, and all his attending planets, with their satellites, are composed of the self-same elements.

In this place it is interesting to refer to a theory by which such facts may be accounted for, and the reason of the similarity shown. The nebular hypothesis assumes that our solar system was at one time a gaseous mass, extending beyond the orbit of the furthest planet, Neptune. Its composition was necessarily uniform throughout, for the tendency of gases to diffuse into one another, or intermingle, would have free play. In this nebula the temperature was very high, for the elementary bodies were in a vaporous state in it, just as they are at present in the sun. But as soon as the mass commenced to lose its heat, there were established currents and a general movement of rotation, and on the exterior a shell, or rather, equatorial band of condensed materials, began to form. The cooling and consequent contraction still continuing, the band was left behind, but it sooner or later broke, in one or more places, and aggregated into one or more globular masses, which continued their rotation as planets.

The same thing occurring several times in succession, and rings of molten matter being left behind by the contracting gaseous mass, as it lost its heat, eventually all the planets, as we now see them, were formed, and the remainder of the nebula is the sun, still preserving the form partly of ignited gas, and partly, probably, of a liquid or solid. It is, however, even now radiating its heat away and cooling, though slowly. After, perhaps, giving off a few more planets, whose orbits will not exceed in diameter his present size, the sun, according to the hypothesis, will be no longer visibly hot, and life on the planets will come to an end.

This celebrated hypothesis has been very freely discussed, and has received much adverse criticism. Many strong objections have been urged against it, but the spectroscope confirms it. The reader will not be able to appreciate the full value of this support until the constitution of the nebulæ visible in the heavens has been spoken of. It will, therefore, be reserved for that place.

But let us not confine ourselves in these observations to our own solar system. Let us see whether this little instrument, which is scarcely any thing more than a small triangular piece of glass, will not enable us to establish a relationship with more distant bodies than the sun and planets—with other solar systems far away in the abysses of space.

To the naked eye, there appear scattered over the sky at night a multitude of stars of various colors. Even in our best telescopes they are only glittering points, and no glimpse of their chemical constitution could be presented before the spectroscope was applied to investigate them. We were satisfied that they shone by their own light, that they were suns, that they presented many analogies to our solar system, and also many dissimilarities.

How strange a sunlight, for instance, there must be in a world lighted by a pair of differently colored suns, for such must be the case if planets revolve around some of the binary stars. At one season of the year, a blue sunrise, followed by a yellow one, then a day of intermingled lights—a yellow evening and dark night. At another season reverse order of illumination; while at intermediate times there may be continuous day, first of one color then of the other: a yellow day inciting the growth of plants, a blue one delighting the photographer? Can we establish a connection with such worlds.

The stars, both single and double, when examined by the spectroscope, are observed to contain substances well known to us. One of them, Arcturus, closely resembles our sun, as has been shown by Rutherford. At once we perceive a fellowship between them and our own earth, and are led to the noble idea that Nature constructs everywhere out of the same materials. Bodies, so distant that the astronomer fails to give us an idea of their remoteness, are brought, as it were, into our grasp, and are analyzed with certainty. We recognize the same elements in them, that compose the soil we tread, the water we drink, the air we breathe.

And what are these materials? Chemists enumerate to us sixty-eight elementary bodies, that is, substances not composed of anything else and that cannot be further decomposed. Such are the gases: oxygen, nitrogen, hydrogen, etc.; the liquids: mercury, bromine, etc.; the solids: sulphur, iron, gold, etc. One is fifteen times lighter than the air, another twenty-one times as heavy as water. Truly, Nature has variety enough to chose from, for out of sixty-eight elements how many combinations may not be made? But this very variety creates at once a suspicion that the ultimate alimentary bodies are not in fact so numerous.

Among the reasons for doubting the multiplicity of elementary bodies, it may be stated: 1st, That many of them are so nearly identical that it requires a good chemist to distinguish one from another. 2d, That in our own times a number of elements have been stricken from the list, having been found to be compound bodies. 3d, That by quite trivial means one elementary substance may be made to assume a form having properties totally distinct from those it originally possessed. 4th, That we can form, from two or more elements, bodies, which have the attributes of elements, a case in point being cyanogen. 5th, That the infinite variety of organic substances, such as the various tissues of the bodies of animals and plants, diverse as they are, are all formed principally from four elementary bodies. A multitude more of such arguments might be advanced; but the general conclusion which they indicate can be summed up in a line. All the sixty-eight elements may be compounds of perhaps only two or three elements—may even be modifications of a single type of matter. But any further consideration of this part of the subject would lead us into an examination of the nature of matter, and its atomic constitution, and with that we have not room to deal.

But we will penetrate yet a step further into space. The stars, it has been stated, are exceedingly remote. Let us examine bodies so distant that the stars are near neighbours compared with them. Clusters, resolvable nebulæ, true nebulæ, shall carry us as far from the earth into space as the eye can see.

To the naked eye, or in a telescope of low magnifying power, there are visible in the sky certain patches of diffused light, differing in appearance from the glittering stars. Some, when examined with a higher power, are seen to be resolved into an aggregation of stars; some by the use of the highest attainable magnifying power, on the finest nights, are with difficulty resolved, while some resist every attempt. It is with the last that we are more particularly concerned.

The great reflecting telescope of Lord Ross is well known. It is six feet in aperture and fifty-four feet in focal length. By its aid, nebulæ that had, up to his time, been unresolved, were separated into stars, and from this circumstance the argument was advanced that all nebulæ would yield to a sufficient increase of power and be demonstrated to consist of stars, which, while in reality separated by immense distances, yet seem so closely packed together that their light is blended into one mass.

We have spoken of solar systems; there are, according to these statements, also stellar systems where, instead of a sun and planets, there are a group of suns. Our sun belongs to a group of resolvable nebulæ, the stars that we see individualized, and those of the milky way, being his companions.

Seen at a great enough distance, our nebulæ or stellar system would present a flattened or lima-bean-like shape, somewhat elliptical from one point of view, and like a narrow band from another. Is this group arrangement the only form in which luminous matter is found in the universe?

Here, again, the power of means apparently trivial, but rightly applied, is shown. Once more the prism of glass solves a question which hundreds of thousands of dollars expended in telescopes could not have settled. On applying the spectroscope to the investigation of the irresolvable nebulæ, Huggins finds that some of them present the spectra characteristic of an ignited gas, that is, of a flame. The Fraunhofer lines in that case are, as we have said, bright instead of dark, as in the solar specrum, and the evidence is of a very tangible and unmistakable kind.

There are, then, in space, masses of ignited gaseous matter of prodigious extent, shining by their own light, containing no star and resembling the nebulæ, which the nebular hypothesis declares to have been the original state of our solar system.

Now we can appreciate the assistance which the spectroscope has lent in establishing that noble conception of Herschel and Laplace. It has demonstrated the unity of the solar system by establishing the existence throughout it of the same elements; it has shown the same unity in the materials of the universe; and, lastly, it fortifies us in belief that that theoretical conception is in process of realization before our eyes; that we may see worlds in the act of formation, The spectroscope has also a bearing on a great geological hypothesis: the former heated state of our globe. Geologists assert, from the presence in high lattitudes of the fossil remains of tropical plants, that the earth was once in a molten condition: that it cooled gradually, and at one time reached such a temperature that the internal heat sufficed to maintain a warm climate on every part. The polar regions were not then dependant on the sun for their supply of heat, but needed that luminary only for light. Vegetation was somewhat like that of a hot-house in the north in winter, with plenty of heat, but lacking light for part of the year.

By this hypothesis, a great variety of facts, such as the formation of some mountain ranges, may be satisfactorily explained. For example, when the heated mass of the earth was cooling it was also shrinking, but as soon as an inflexible crust had formed over the liquid ball, that exterior could no longer gradually diminish in circumference, but was forced to pucker into ridges, just as we see in the case of an apple drying up. The apple assumes a wizened appearance, so did the earth. The wrinkles are mountain chains.

The spectroscopic confirmation of these ideas, though indirect, follows necessarily from the support which that instrument lends to the nebular hypothesis. If the earth was once an ignited gas, it is certain that it also presented subsequently a molten form. And its geometrical shape, that of an oblate spheroid, the figure naturally assumed by a rotating liquid mass, is an important link in the chain of evidence.

Another reflection naturally suggests itself to any one thinking about these matters. We know that heat was the force concerned in keeping the materials of our solar system in the gaseous state, for by its aid we can again bring most of them into that form. The escape of heat was the cause of the solidification of the present crust of the earth. Where has all that immense amount of heat gone to?

It escaped altogether as radiant heat, moving in straight lines. Is it lost in the abysses of the universe, or is it somewhere collected together to melt worn-out worlds into nebulæ again, and cause them to run again the course they have before pursued? Can we discover the scheme by which perishing systems are replaced by new ones, and the grand East Indian idea, of a multiplicity of worlds in an infinity of time, realized? How, when the light of our sun has faded out, shall our solar system be revivified, and re-supplied with the force it has lost? These are questions that remain to be solved. We are satisfied that matter and force are eternal, but what their laws of distribution and operation in space and time are, the intellect of man has yet to discover.

And if there has been a gradual formation of planets within our solar system, beginning at its confines, one after another losing its internal heat and becoming dependant on the sun for warmth, does not another thought occur to us? Has not life followed the inward march of heat? Is it not possible that there was a time when plants and animals, such as we have here, were able to exist on the exterior planets, favored by their genial heat? The last traces may not have disappeared from them. And may not the types of low forms of organized things, that inhabited this earth in early geological times, have passed inward toward the sun, where surrounding physical conditions favored them in a manner that has ceased here? Are there on Venus the radiata, mollusca, etc., belonging to our planets ages ago? Do types of life exist in the more distant planets, of some grade higher than our own? We see on the earth the migrating animals that cannot stand vicissitudes of summer and winter, follow the sun southward in winter, and driven before him northward in the summer. Is there in the solar system a similar obedience to heat and its effects, and an ever inward flowing tide of life?

CHEMISTRY BY THE FIRESIDE.

Continued from page 209.

No. 19—Potassium.

We noticed last week the element called silicon, which when united with about equal parts of oxygen, formed silex, or sand, and we came to the conclusion that a soil composed of pure sand could not support vegetable life. Suppose we now examine into the properties of another element of the soil, potassium. Suppose we should take some caustic potash, which is composed of oxygen and the metal potassium and mix it with charcoal and then heat it in an iron bottle in a most powerful furnace. Now potassium has a tremendous affinity for oxygen, and it requires a powerful heat to separate these two elements. But it will separate, and the potassium will pass over into a vessel containing naphtha, a substance destitute of oxygen, and when not exposed to the air it remains unchanged.

Potassium is a white metal, and brilliant. It is lighter than water, and will float on its surface. Its affinity for oxygen is so great that it will instantly decompose water by taking from it its oxygen and burning it. The oxygen thus set free unites with the potassium and forms an oxide of potassium, or simply potash. Thus you now see that pure potash is composed of oxygen and potassium. We never see potassium in its metallic state in nature.

You can obtain caustic potash by a very simple experiment, which is instructive to you in your study of chemistry. Take a little saleratus, which is a carbonate of potash, and dissolve it in water, say one ounce of potash to ten ounces of water. Now take half as much quicklime, mix it with water so as to form a milky paste and mix them together in small portions while the potash is boiling. Let it cool and the lime will take from the potash all its carbonic acid, and leave it in its caustic state in solution, while the lime will precipitate to the bottom of the vessel. Potash has a powerful affinity for carbonic acid. If you leave it exposed to the open air, it will absorb carbonic acid from it and form carbonate of potash. You can now understand why, in soap making, you put quicklime into the vat for leeching your ashes. It is to take away the carbonic acid from the ashes, and leave the potash as caustic as possible. The reason why soap does not form is owing to carbonic acid. This may be driven off by boiling the ley, but it is much better to use freely some quicklime in the vat.

Potash is found in nature combined with silex, forming a silicate of potash. Your window glass is a silicate of potash. The mineral called felspar is a silicate of potash. It is from this mineral that the potash of your soils is chiefly derived. It forms a part of all good soils. It exists in trees and plants. When you take ashes, leech them, and evaporate the water, you have left potash. This is an experiment in a rough way in analytical chemistry.

But let us see if we can obtain a fertile soil from sand and potash. About twelve per cent. of a good soil is composed of potash. Do you think that plants would grow in a soil composed of sand and potash? Plants want several other elements to complete their growth. If you look at a large granite rock you may see a kind of moss or lichen called by botanists the parmelia. It spreads over the rock like a plate. Commencing at a central point it takes from the rock a small quantity of silex and potash, and abstracts a little carbonic acid from the atmosphere and grows there. This humble plant is then composed chiefly of silex and potash, and can grow where scarcely any other plant could exist. In our next article we will add another element to our newly formed soil, and see if it would be improved.

No. 20 Sodium.

We have seen that two elements, silicon and potassium exists in soils. Let us add to it another element. Sodium exists in common salt. If you take common salt and heat it with charcoal in an iron bottle, you will drive off all the other elements and have nothing left but the metal, sodium. It resembles potassium in its properties, though its affinity for oxygen is not hardly so great. On exposure to the atmosphere it combines with oxygen and forms caustic soda. When exposed to carbonic acid it forms a carbonate of soda, and if more carbonic acid is forced through it, it becomes a bicarbonate of soda, so common in breadmaking. Combined with chlorine it forms chloride of sodium, or common salt. This salt crystalizes in cubes from the evaporation of salt water. Unlike most salts, cold water will dissolve as much of it as hot water. It does not enter largely into the composition of most soils, yet it acts as a valuable stimulant in most soils. Combined with gypsum, it forms an excellent manure in conjunction with muck. Perhaps there is no artificial manure more valuable in proportion to its actual expense than this combination. Sodium is so nearly allied to potassium that one is frequently substituted for the other in the composition of rocks.

No. 21. Calcium.

One of the most important elements is lime. If we take a piece of quicklime, and by the powerful agency of heat can succeed in driving off the oxygen from it, we shall have left a metal called calcium It is a light, white metal, a little harder than lead, and readily combines with oxygen when exposed to the air and forms oxide of lime, or quicklime. Combined with carbonic acid it forms our limestone and marbles, called carbonate of lime. With sulphuric acid it forms gypsum, or sulphate of lime; with chlorine it forms chloride of lime. But it is in the form of carbonate of lime, or limestone that we find it most abundant. In this state it is generally found in beds in mica slate. If we burn limestone we simply drive off the carbonic acid and leave it an oxide of lime, or quicklime which you already know is very caustic. One ton of good limestone will yield a little more than half that amount of quicklime. When quicklime is exposed to the air it will rapidly absorb moisture and fall to a powder, and slowly absorb carbonic acid from the atmosphere when it will be deprived of its caustic properties and become a neutral carbonate as before it was burned. Whenever you suspect a lime rock on your land, just pour on a little sulphuric acid, or even sharp vinegar, and if it contains lime, you will see effervescence take place from the escape of carbonic acid.

Here is a pretty experiment. Take some chalk, which is a carbonate of lime, pour on some diluted sulphuric acid and the carbonic acid will escape and you will haye left sulphate of lime or gypsum. By pouring water on to quicklime it absorbs it by combination, and forms a hydrate of lime. If you put a little quicklime in water and allow it to rest you will have limewater, which is nothing more than water saturated with lime, and is perfectly transparent. If you blow into this limewater through a tube, the carbonic acid in your lungs will combine with the water and form a turbid appearance, and carbonate of lime will fall to the bottom of the vessel. Whitewash is only a paste of lime. If you make mortar of lime and and sand it will absorb carbonic acid, and by a union of the sand with lime it will become hard. When limestone has a portion of clay and iron in its composition it will form hydraulic cement, which will harden under water. Gypsum is a sulphate of lime. It is sometimes called Plaster of Paris, because it abounds beneath the city of Paris. Gypsum has about twenty-one per cent. of water in its composition, so that when you buy one hundred pounds of plaster, twenty-one pounds of it is water. Still the water is essential to its value as a fertilizer. Heat plaster in a vessel and the water is driven off and you have left calcined plaster. Mix a little water with it and it will *set*, and form stucco. This substance mixed with glue is employed for mouldings and cornices. About three parts of Spanish whiting and one part of calcined plaster make an excellent whitewash. You should mix but little at a time, and use the brush freely with water. Lime and plaster are valuable as fertilizers. Lime serves to neutralize any acids in soils or muck, and enters into the composition of plants. A granite soil ordinarily contains not over one per cent. of lime. Too much lime is destructive to vegetable matter in soils, and should be avoided. We have now a soil composed of sand, or silex, potash, soda and lime, but such a soil could not retain water and would parch up at once. In our next article we will see what we can add to it that will retain the water.

No. 22. Aluminum.

Thus far we have noticed the elements found in soils to oxide of silicon, (sand) potash, soda and lime. Suppose we should mix these earths with the idea of filling a lady's flower-pot. Set out a plant and pour in water and it will run through like a seive. We want then, some other earth which shall retain a portion of the water. We find this in clay. Pure clay is a sesqui-oxide of aluminum. It is never found in its metallic state, but as an oxide it abounds in all our soils in the form of clay. When pure it crystalizes into the beautiful jewels ruby and sapphire, which almost equal the diamond in hardness. Emery is also composed of the same elements in a massive form.

Alumina, or clay, is the basis then of our soils.— Unlike the other elements found in soils, it rarely, if ever, enters into the composition of plants, but serves to retain the moisture already in the soil. When dry it will absorb large quantities of water. As sand does not possess this property only in a slight degree, a suitable mixture of these will correct the deficiencies of each other. Hence clay soils are wet and cold, while sandy soils are warm and dry. Clay also posesses the property of absorbing carbonic acid and ammonia from the atmosphere and adding very essentially to the qualities of the soil. A clay soil has at least as much as 15 to 20 per cent. of sand in its composition, while a clayey loam will have from 30 to 60 per cent. of sand. You can perform an experiment yourself sufficiently correct without going to a chemist, if you wish to know the relative quantity of sand and clay in your soils. Stir up a portion of soil in a tall glass vessel, and the coarser sand will settle first to the bottom, then the finer sand and lastly the clay. You can see the relative height of the different substances through the glass. Pottery, bricks and porcelain are the products of sand and alumina; Alumina is also used in fixing the various colors on cloth. It also exists in the form known as Fuller's earth, and will absorb oils in a remarkable manner. Like the other earths, pure alumina is white, and is recognized as nearly pure in the white pipe clay. Thus far our soil would be of a dazzling white color. In our next we will see what we can find to give it the aspect of a soil as we are accustomed to notice it.

No. 23. Phosphorus.

We have thus far shown you how a soil is composed, consisting of the oxides of certain elements, known as silica, potash, soda, lime, magnesia, alumina and iron, the latter oxide being the great coloring substance of most soils. But there are other elements necessary to form the growth of plants, but which exist in soils in a very small proportion. Among these is phosphosus. It is rarely the case that more than one per cent. of phosphorus is found in granite soils. It is contained in bones, and it is from them that it is largely extracted. Although we would not advise you to repeat the experiment, as there is some danger from its great iuflammability, yet it will iuterest you to know how it is obtained. If you should take a quantity of bones aud burn them in an open fire till they turn white, so as to destroy all the animal matter in them, you will have left a white powder composed of nearly four-fifths of phosphate of lime. Now we want to get rid of the lime. Reduce the bones to a fine powder, put them into a glass vessel and pour on some strong sulphuric acid, with just enough water to form a thin paste. Now you will have two new salts formed, one of which will not be dissolved in water and can be fitted so as to separate it from the other salt, which is a superphosphate of lime. This latter salt is now evaporated to the consistence of syrup, mixed with about one-fourth weight of powdered charcoal and strongly heated in an earthen retort well luted with clay. The beak of the retort is put under water, the phosphorus passes over and is condensed in the water. Phosphorus very much resembles beeswax. It has a great affinity for oxygen, and will catch fire at a very low temperature. Mixed with sulphur it forms our friction matches. We remember paying a cent apiece for them in 1834. You will notice that in obtaining it from bones we produced the superphosphate of lime. It is essentially in this way that pure superphosphate of lime is made for agricultural purposes. It is essential to the growth of wheat and corn, hence it is eagerly sought for for this purpose. Sometimes the phosphate of lime is found in the rocks, but it does not dissolve so readily in water as the superphosphate. Most of the soils in Maine are exceedingly deficient in phosphorus, and everything should be saved that possesses it in abundance.

No. 24. Analysis.

Chemical analysis requires the most careful attention to every minute detail, of any known science. It is only those who are really expert in chemical research on whom any reliability can be placed. Even those find it difficult to take one hundred ounces of any substance, divide and subdivide it into its elements and still be able to account for the one hundred ounces employed. Still there is a kind of analysis within reach of every one which answers our practical purpose, and which we daily employ in the various avocations of life. Suppose we should take one pound of maple wood, and see if we can form any idea of its composition as based on the information gathered in these fireside lectures. If we could enclose the wood in an iron vessel, with only a very small aperture, put it over a hot fire, there would soon issue from the orifice a quantity of smoke. This smoke is chiefly composed of carburetted hydrogen and water. If we should weigh the wood left we should know what proportion of the wood was composed of the elements hydrogen and oxygen, in the form of water, and also what proportion of the carbon had combined with the hydrogen to form the carburetted hydrogen. Let us now take the remaining portion of the wood, which is now charcoal, or nearly pure carbon, weigh it and burn it in the open air. The oxygen of the air combines with the carbon of the wood, and passes off as carbonic acid gas. Take now the ashes and subtract their weight from the charcoal, and you have the amount of carbon in the wood when added to the carbon in the gases. Take now the ashes and leach them with hot water and you have a ley which, when evaporated, will present you with the amount of potash in the wood. The ashes left will contain a certain amount of silex, or sand, besides some potash not leached out, a little lime, and a trace of the oxide of iron. Thus in a rough way you will detect in your pound of maple wood, carbon, hydrogen, oxygen, potash, silex ,lime and iron. A more minute analysis might detect other elements in small quantities. If you should take these different elements, and add them, you would have restored your one hundred pounds of maple wood.

The impression has been somehow indelibly impressed upon the public mind that anybody could, and should, be a chemist if they would carry on the affairs of life successfully, especially in the pursuit of agriculture. No greater mistake was ever made. A knowledge of the general principles of chemistry furnishes an untold amount of information to every person. In a general and practical sense we are all chemists. In a limited sense very few are worthy the title, any more than those who study astronomy are entitled to the title of astronomers.

In writing this series of practical articles, we have endeavored to lay aside everything like superfluity, and present such truths as might lead some minds more thoroughly to investigate the science for themselves, and as the evenings have grown shorter and shorter, we close these articles with the wish that all our readers might enjoy the interpositings of nature as well as we have done while reading her pages. We close them with the following sensible remarks from the New York *Methodist:*

"We must not look for too great results from the application of chemistry to agriculture. Its suggestions may often serve as guides to experiments, but they cannot be confided in without experiment.— There are properties of soil too subtile for the chemist's retort. Only in nature's great laboratory can they be detected.

For example, it is found that a certain rock will be covered with the lowest lichens and mosses. Nothing else will grow upon it. In due time the action of this low vegetation, together with the action of the frost and rain, will crumble off the surface of the rock. This produces a coarse soil on which ferns and other plants a little higher than lichens will grow. Not till these have pulverized the soil still further, will it produce wheat and corn. Yet the chemist finds the same elements whether he analyze the rock, the gravelly sand, or the fine earth. And the difference is not merely one of fineness. Mechanical grinding will not convert the rock into a fruitful land. The particles which the moss assimilates, acquire a new power from having once been parts of a living organism. When they have been assimilated by a higher plant, this power is increased. The influence of the living plant over dead matter, chemistry thus far has been unable to test satisfactorily. To find whether a particular soil will grow barley sow a patch of it to barley. To tell whether a particular manure is valuable, try it. 'The proof of the pudding is in the eating.'

Chemical science has done much for the practical arts. The processes of Photography, Telegraphy, and Electro-plating, are purely the result of chemist's experiments, while to the art of printing and bleaching cloths, they have given a powerful impetus. Every year chemistry makes great advances, and we may yet hope that it is destined to render agriculture great and positive assistance.

A PYRENIAN WATERING PLACE,

Mont Vallier is one of the points of the Pyrenean chain, standing like a sentinel on the direct route from Toulouse into Spain. Under its shadow are the high valleys of Couserans. In these valleys are villages, poor, little known, and little worth knowing. But one of them, *Aulus*, has become famous for mineral waters which have great virtue in strengthening exhausted constitutions, and, as it were, galvanizing vital energy. These waters are pleasant to drink and have no metallic after taste, but leave a yellow ochreous deposit on the cup, which has a very disagreeable appearance. Their value was discovered by accident in 1823, when detachments of the French army were posted, under the name of a sanitary cordon, along the line of the Pyrenees. One of the detachments quartered at Aulus was under the command of a young lieutenant, who, in consequence of disease and unwise medical treatment, was in an almost desperate state. Walking one day in the valley which stretches out below the hamlet at the place where the baths now stand, he came across an unpleasant looking spring, almost hidden by flags and rushes. A margin of reddish slime marked the bed of the rivulet, air bubbles rose from the bottom and floated away amongst the herbage. A population of frogs, toads, and water newts, clustered about the banks of the waters attracted by the tepid temperature. The peasantry never ventured either to wash or water their cattle at this spring. The lieutenant, who had some knowledge of thermal waters, suspected that this was a mineral spring. He drank four or five cups of it, and very soon found by his uncomfortable sensations that at any rate it was not common spring water. The next day he dug out enough of the bed of the rivulet to be able to bathe, and in the course of a month's perseverance in drinking and bathing in the ochreous stream, he entirely recovered his health and became quite fat. The news of this extraordinary cure spreading amongst the officers and surgeons of the army founded the reputation of Aulus. It is a curious fact that the owner on whose land this famous spring was discovered had travelled to several bath towns for the cure of pains which were only removed when he applied his own waters. In 1865, the baths of Aulus were visited by 1900 patients. Aulus, besides its springs, has in its environs some of the most picturesque scenery of the Pyrenees—impetuous torrents, grottoes, forests, lakes, and mountain barriers crowned with eternal snow. Amongst the falls of water are some of remarkable beauty and grandeur. Until recently, the chamois, or izzard, the wild goat, and the bear, were not uncommon; but the demands of the water-drinkers for chamois ragouts and the persecutions of sportsmen are rapidly destroying these last living remains of a truly wild and savage country. The tame goat formerly occupied an important place in the domestic arrangements of the peasantry; until very recently every family had at least one she-goat, and the invalids who resorted to Aulus were wakened every morning by the song of the goatherd. At the first notes of the horn every goat left her stall to join the herd. The day was spent in skipping from rock to rock in search of grass and shrubs. In the evening the flock returned to the village in a long file. The herd marched first, his goats followed, and he never looked behind, as he knew that each would find her own dwelling, and that, when he reached his own hut, his own only would remain. But this branch of pastoral life is about to disappear under the influence of what, for want of a better term, may be called sanitary laws. "It was," says the writer of the article, "time; for the goats did enormous harm to the country." It is one of the objects of the French Legislature to encourage the growth of wood on the mountains. The entire chain of the Pyrenees was, according to the accounts of Diodorus Siculus, covered with dense forsets, when the Iberians first drove their herds there. The first colonists set fire to the forests, either to clear them away for cultivation, or to help them in collecting the small nuggets of gold which were found in the chinks of the granitic soil. The unprotected soil, subject to the direct action of the sun's rays, and no longer held together by the roots of trees, slipped away continually under the pressure of avalanches, melting snow, glaciers, and torrents. To replant the mountains was the only means of arresting the progress of denudation and consequent total barrenness, but that was impossible as long as herds of goats pastured over the mountains, for it is the particular delight of this animal to crop growing shrubs. A few years ago a law against goat-keeping was put in force, to the extreme disgust of the peasantry, who avenged themselves in their way. At the elections of 1865 they turned out all the municipal council. They marched up to the ballot-box with a degree of unanimity hitherto unknown in that part of the world, and replied invariably to those who enquired for whom they voted, *Pourtau les que soun pellas crabos*"—"We vote for those who are for the goats." Thus they tried to avenge themselves on the Government. The word *government* embodies all the peasant's idea of politics. Government in his eyes is an omnipotent monster, of a meddlesome disposition, with no feeling for poor people, who levies taxes, sends gendarmes, and lives in Paris.

The bear has not entirely disappeared from the mountains of Aulus, and when one is slain the demand of the Parisian cockney for bear's flesh raises the price to something like seven francs a pound. But it is seldom worth eating. A young bear may be tolerable, and retain, according to the tradition of *gourmets*, something of the flavour of the strawberries, raspberries, and cranberries on which he feeds; but the flesh of an old bear is rank and nauseous. The dancing bear is an established institution in the Pyrenees, and often forms the whole fortune of a family. When a girl marries she receives a bear's cub as her dowry; her husband trains it, and, when its education is completed he takes it on a tour, and, if economical, often returns home with a small fortune. But the greatest zoological curiosity in old Couserans is the peasant of Aulus—a specimen of a tribe almost extinct. He cannot be studied to advantage in the village, corrupted by contact with bath visitors, but at the foot of the snowy regions, in the midst of his cows, at the moment when he offers you a bowl of milk. His features are regular, his expression serious and decided; his nose, sharply hooked, gives the idea of a bird of prey or of a conquering race. The old Pyrenean costume sets off his lofty stature. It is the same as that of his neighbour, the catalan muleteer, but the presence of snow has made the stuff thicker, and modified the colour. All the garments are cut from one piece of cloth, of an earthen-grey colour. A broad sash of red or blue contrasts with his gaiters. The gaiters up to the breeches leave the knees bare when he is sitting down. A round hat with enormous brims turned up all round is placed on his Phrygian cap, and serves him as a parasol in summer and an umbrella in winter. On days of ceremony he casts over his shoulder an enormous tawny cloak, an heirloom, transmitted from generation to generation. These hardy pastors remind one of the Gauls of early history, before whom the ancient world trembled. The descriptions of Cæsar, of Diodorus and Livy seem realized. These are the descendants of the bold race whom Brennus and other chiefs led to the storm of the Capitol, to the sack of Delphi, and to the conquest of the rich empires of the West. It is from these mountaineers that the inhabitants of Bordeaux, Toulouse, and Marseilles obtain their porters and labourers. Those who remain in the villages migrate in summer with their live stock to the mountains. They make a wretched hut of turf and brushwood, into which they are obliged to creep on all fours, and sleep on a bed of dry leaves. The fine weather is employed in feeding their herds and making cheese. In July and August they make hay and store it for the winter. They live on black bread and the whey left from the cheese. On the first occurrence of frosts they descend into the valley, shut their animals up in stables, and twice a day go from the village to the grange to feed and tend them. This work done, you see them standing about the village, their hands thrust in their broad blue woollen belts, or resting on a long staff, motionless, impassive, their feet in the snow, their faces bare to the cold wind of the mountains—they look like the patriarchs of the Old Testament gathered together at the gates to discuss the affairs of the city. Here they have not many topics—whether the provender will last out the winter—whether the Government will continue to impose on the ancient rights of the commune. To this mode of life their lofty stature is attributed. Almost all the recruits from this district go into the heavy cavalry. "As you descend from the pastoral to the agricultural region, the height of the population diminishes." Is this so in Scotland? We doubt it. "The women are equally strong, and wear a costume like the Grey Sisters." But this costume, still universal in the higher valleys of the Couserans, has been almost abandoned at the watering-place of Aulus in favour of French fashions. But habits and customs are more difficult to change than costume; regular work is repugnant to this tribe of shepherds and herdsmen. Almost all the hotels are kept by the inhabitants of St. Girons in the lowlands, and women of the valleys bring eggs, poultry, vegetables, and fruit for sale. The writer says that he has only known two persons who have availed themselves of the demands created by the resort of strangers to the mineral waters—a father and son, who have become professional fisherman, and supply trout which abounds in the mountain streams. All the rest of the male population follow pastoral pursuits. In the exploration of the lakes glaciers, and cascades, you often come across a hut on the borders of a stream, and nearly hidden by surrounding rocks. The inhabitants are not far off. As soon as you are seen the young herdsman appears, his lips stained with wild cherries or bilberries, and offer you "*mountain milk.*" He takes from a corner of his cottage an earthenware jar of the freshest cream—a small carved wooden ladle serves for both spoon and bowl. When you examine curiously this primitive specimen of mountain manufacture, he offers to sell it, and observes that "last year a Parisian paid forty sous for one like it." The highest hope of these poor people is to obtain a few pence. The greediness characteristic of an extremely poor country produces curious results in the course of the bargains for purchasing land and erecting baths. A field containing a doubtful spring would often be the joint property of ten peasants. If one agreed to part with his share, the other nine often asked such a price as to render a sale impossible. Some years ago, a capitalist from Toulouse thought of establishing a company to erect a complete bathing establishment, after the fashion of the German towns. After many interviews, he had settled to purchase a suitable spring and plot of ground, but on meeting at the notary's to close the bargain, the wife of the peasant declared that she must have as much as her husband. After further negotiation, the Toulousian agreed, and all seemed settled; but, at the last moment, the mountain pair claimed to have a fourth of the future profits. "I intend," said the Toulousian, "to put down £1000, and you shall have a fourth of the income." "Impossible, my kind sir," said the herd: "we have not a farthing, but we are strong, and when we build my wife and I will work as labourers." It took time to teach these semi-savages that strangers brought prosperity; the first visitors were pelted when they ventured on a walk in the environs. Now they know better, and arrange their charges according to whether a visitor is from Toulouse or Paris. The Parisian is their idea of a millionaire, and is charged twice as much for lodgings as any inhabitant of the neighbouring district."—*Lon. Jour. of Gas Lighting.*

SODIUM AS AN EXPLOSIVE.

Of all the nonsense which the non-scientific journals are apt to talk when they venture to meddle with scientific matters, that "Occasional Note" of the *Pall Mall Gazette* on sodium as an explosive, which has just gone the round of the newspapers, is one of the finest examples we have lately seen. It makes out that sodium is ever so many times more explosive than nitro-glycerine, whereas the fact is, of course, that sodium is not, properly speaking, an explosive at all. Not only is it not an explosive in the sense in which nitro-glycerine is, namely, in the sense of being a compound the elements of which, on the application of a certain degree of heat, re-arrange themselves into new compounds, the total bulk of which is many times greater than that of the original substance; but it is not even an explosive in the sense in which coal-gas is—that is to say, in the sense of being capable of forming an explosive mixture with other bodies. Sodium, in fact, never "explodes," any more than charcoal does, and never acts as an "explosive" except in the sense in which charcoal acts as an explosive when the heat developed by the combination of the charcoal with oxygen is made to raise steam enough to burst the vessel in which the steam is raised. Sodium and charcoal are both simple substances, and the chief difference between them, as "explosives," is that the affinity of sodium for oxygen is so much more powerful than that of charcoal for the same element that sodium will combine therewith at a very much lower temperature than charcoal will. Thus, if a piece of metallic sodium be exposed to the atmosphere, at however low a temperature, for only a second, it becomes tarnished by oxydation, a coating of oxyd of sodium being formed upon it; but at ordinary temperature, the oxygen of the air has not the least action upon charcoal. Sodium, again, will decompose water in the cold; but charcoal will not effect the same decomposition below a red heat. As it is only when in contact with water that sodium is supposed to explode, let us see what really takes place when sodium comes in contact with that element. The sodium is so light that it floats upon water, and its affinity for oxygen is so intense that it instantly decomposes that compound, combining with its oxygen, and setting its hydrogen free. If you throw upon water a small piece of sodium, say of the size of a small pea, you hear a hissing noise at the instant of the piece of sodium coming in contact with the water, and what you see is a white globule, floating very rapidly to and fro, and gradually diminishing in size until at length it disappears. This hissing noise continues as long as the white globule is visible, but of course diminishes in intensity as the globule diminishes in size. This hissing noise is caused by the great heat developed by the combination of the sodium with the oxygen of the water, together with the further heat developed by the combination of the oxyd of sodium so formed and with an equivalent of the water itself, to form hydrate of sodium; and the white appearance of the globule is due to its being constantly incrusted with this compound. The incrustation of hydrate of sodium dissolves nearly as fast as formed, enabling the water continually to reach fresh free sodium, and so continually to form more hydrate, the process going on until all the sodium has combined with oxygen and water to form hydrate, and all the hydrate has been dissolved. If the piece of sodium employed is only of the size indicated above, the process goes on quietly, and nothing of the nature of an explosion occurs at any stage of it; but with a large piece of sodium the case is somewhat different. The heat developed is then so great that not only do both the liberated hydrogen and the sodium itself take fire, but the hydrate of sodium that is formed fuses, and so comes in contact with the water at nearly a red heat, and the result is that steam is generated in any crevices that there may chance to be in the coating of intensely heated hydrate which surrounds the lump of floating sodium, with such violence as frequently to shatter the lump to pieces, sending fragments of burning sodium flying about in every direction. Still, the explosion is clearly one of steam, and not of sodium, and is, indeed, simply of the nature of the explosion which would take place if water were made to penetrate into crevices in the interior of a mass of incandescent coal. The *Pall Mall Gazette*, however, evidently regards sodium has being itself explosive, just as gunpowder is—only it thinks sodium by far the more powerful explosive of the two.—*Mech. Mag.*

M. Pleateau's experiments show that the muscular force of insects compared with that of the vertebrates is enormous. The common cockchafer is capable of exerting a tractile force equivalent to fourteen times the weight of his body, while the drawing power of a horse is only ·67 of his weight.

Machinery and Manufactures.

SIR W. ARMSTRONG'S WATER-PRESSURE ENGINES.

The London *Engineer* of May 25th, contains an illustrated description of a water-pressure engine by Sir Wm. Armstrong, the inventor of the celebrated *Armstrong gun.* A description of these engines, as applied to cranes on the Newcastle docks, and at the docks at Great Grimsby and Birkenhead, the opening and shutting of locks of canals, &c., was given in Vol. IV of this Journal, page 48. The improved engine now referred to is thus described:—

"The engine illustrated, is supplied from an artificial head obtained with Sir Wm. Armstrong's accumulator, which has been fully described in recent numbers of *The Engineer*, with a working pressure of 700 lbs. to the square inch. The immense pressure thus at command enables the required power to be applied with a comparatively small engine; the engine only occupying a space of four square feet. A natural head is seldom met with sufficiently high to give the above-named pressure, but in mountainous districts a head of from 200 feet to 300 feet is often met with. The power derivable from a stream at this, or at a much lower height, could be very advantageously applied to various purposes by water-pressure engines.

Sir W. Armstrong has very wisely considered the necessity of producing, and we are glad to see he has produced, an engine which gives very satisfactory results, with pressure derived from natural heads. This mode of working admits of the water being stored up in reservoirs, from which it can be conveyed any distance to the locality where it may be required. At some lead mines in a hilly district at Alleuheads, Northumberland, Sir W. Armstrong many years ago erected water-pressure machinery deriving its supply from the hills, and applied to the purposes of draining the mine, raising, crushing, and washing the ore, with complete success.

In 1842, Mr. J. Darlington designed and erected at the Alport mines, Derbyshire, a direct-acting water-pressure engine, with a cylinder 50 inches in diameter; stroke, 10 feet; with a pressure column of 132 feet; average speed, four strokes per minute; total pressure on the piston, fifty tons. Mr. Darlington employed a double system of valves to admit the water gradually, for the purpose of producing smoothness of action. Sir W. Armstrong's system of "relief valves," which has since been introduced, has removed a great practical barrier which previously retarded the development of this kind of mechanism.

The principal improvement introduced recently is the mode of rendering it double-acting, which has superseded the single-acting engine by dispensing with one of the three cylinders and bringing the force to bear four times in the crank circle instead of three. The cylinders, which are placed far enough apart to put a winding drum or a gear-wheel on the crank-shaft, are made to oscillate; and the plungers are attached directly to the crank-pin; and a piston is formed at the inner end of the plunger with an area double that of the plunger. Water is admitted behind the piston while the front is placed in communication with the pressure-pipe. Thus, in the out-stroke, the water contained in front of the piston is driven back into the pressure-pipe, which absorbs half the force exerted, while the remaining force is transmitted to the crank-pin. In the in-stroke the force expended in driving the water back into the pressure-pipe during the out-stroke is brought into action, while the water at the back of the piston is exhausted. The slide-valve derives its motion from the oscillating of the cylinder, and is of the ordinary shape. These engines run at a very high velocity, and give much satisfaction.

Sole Sewing and Nailing Machine.

A recent number of the *Shoe and Leather Reporter* says:—"The sole-sewing machine has no strength of tension, no power of 'pull', if we may so express it, and added to this defect is the very faulty distribution or incorporation of wax with the thread, which, it appears, is a part of the business of the machine to attend to. Little or no wax is applied. This sole-sewing machine necessitates another defect. The upper has to be nailed to the inner sole. In a week after wearing, these nails begin to work through the shoe, and cut the stocking, and generally in thirty days, if there has been wet walking, the outer sole rips, although scarcely worn, and the shoe is ruined; for no ordinary shoe repairer can well re-sew a machine-sewed sole. He must own just such a machine to do it, and not one shoemaker, so called, in a thousand, can afford it."

The *Mining and Scientific Press, San Francisco, California*, says:—

"Mr. E. T. Barlow of this city, has submitted to our inspection a machine of his invention, designed for nailing boots or shoes. The machine takes a small coil of wire into its embrace, and with the boot or shoe firmly placed upon an iron last, makes its nails as they are driven, The nails are forced firmly and squarely into the leather, and headed upon both sides by the upsetting power of the machine. It can be set to make and drive any desired length of nail from a sixteenth of an inch to a foot or more in length. If the nail by any small inaccuracy in setting the machine, happens to be a trifle too long for the thickness of the leather designed to be fastened together, the excess of length is taken up by upsetting or kinking, which latter always occurs in tho center of the leather, at equal distances from the two points of contact. The sole of the boot is readily directed by adjustable guides, and the nails may be driven at any distance apart, so that the same machine may be used for both the finest or the coarsest work. The machine is also applicable to harness or any similar work, or for nailing small boxes, such as cigar-boxes, etc., where great accuracy or speed is desirable in driving the nails. The entire machine is so simple in its construction that it may be operated by a child, and may be driven by hand or the application of power. It is worked by a crank or by pulley motion. Only one other machine devised for this kind of work has ever been invented, and that is a French invention, which was exhibited for a few days during the last fair of the Mechanics' Institute. There are many defects in that machine which are entirely obviated in this, to say nothing of the fact that Mr. Barlow will be able to sell his machine for less than half the price of the French invention. Mr. Barlow's machine will work two or three times as fast as the French, and requires no after-finishing, as is the case with that. The French machine, we are informed, is not allowed to be manufactured in this country; the inventors, holding patents both here and in Europe, manufacture in France only. This machine may be seen in operation on and after Monday next at the residence of the inventor near the railroad machine shops on Brannan Street."

[These are both ingenious inventions, no doubt, although the character of the work done by them is very questionable. No machine work in putting on the sole of a boot is equal to good hand-work, either for durability, appearance, or comfort; and as for sewing machines in general, a large portion of the work done by them is far inferior to good hand-sewing, in every particular, Ed.]

Gun Paper.

Mr. G. S. Melland. of Lime street, London, who has distinguished himself among British makers of fire-arms, has recently invented a *gun paper* to supersede the old gunpowder. The invention consists in impregnating paper with a composition formed of chlorate of potash, 9 parts; nitrate of potash, $4\frac{1}{2}$; prussiate of potash, $3\frac{1}{4}$; powdered charcoal, $3\frac{1}{4}$; starch, 1-12th part; chromate of potash, 1-16th part; and water, 79 parts. These are mixed and boiled during one hour. The solution is then ready for use, and the paper passed in sheets through the solution. The saturated paper is now ready for manufacturing into the form of a cartridge, and is rolled into compact lengths of any required diameter. These rolls may also be made of required lengths, and cut up afterwards to suit the charge. After rolling, the gun paper is dried at 212° F.; and has the appearance of a compact grayish mass. Experiments have been made with it, and it has been reported favorably of, as a perfect substitute for gun powder, superseding gun cotton and all other explosives. It is said to be safe alike in manufacture and in use. The paper is dried at a very low temperature. It may be freely handled without fear of explosion, which is not produced even by percussion. It is, in fact, only exploded by contact with fire, or at equivalent temperatures. In its action, it is quick and powerful, having, in this respect, a decided advantage over gunpowder. Its use is unaccompanied by the greasy residuum always observable in gun barrels that have been fired with gunpowder. Its explosion produces less smoke than from gunpowder; it is said to give less recoil, and it is less liable to deterioration from dampness. It is readily protected from all chance of damp by a solution of xyloidin in acetic acid. The xyloidin is prepared by acting on paper with nitric acid, one part thereof being dissolved in three parts of acetic acid of specific gravity of 1·040.

In experimenting with this new explosive substance, six rounds were first fired with cartridges and containing 15 grains of gunpowder, a conical bullet, at 15 yards range, which gave an average penetration of 1-16th into deal. Six rounds were then fired with 10 grains of gun paper, and a conical bullet, at same range, and gave an average penetration of 1⅝ into deal. Here was 33 per cent. less of paper than of powder, and greater penetration with paper. Six rounds followed with an increased charge of 15 grains of gun paper, and a conical bullet, at the same range, and at each shot the bullet passed through a 3-inch deal. At 29 yards range 12 grains of the paper, fired from a pistol of 54 guage (·44-inch) sent a heavier bullet through a 3-inch deal. A fouled revolver was preserved four days, but betrayed no symptons of corrosion after using gun paper. It is expected that gun paper will be manufactured cheaper than gunpowder.—*London Artisan*

Importance of Rags.

The wealth that is brought into existence by manufactures, or reproduced from apparently valueless substances by the marvellous, transforming power of human ingenuity, impelled by human wants, is a subject of surprise, even to the thoughtful observer. Enormous quantities of refuse matter are transformed into healthful fruits, grains, vegetables, and flowers, by the liberation of their gases and the dissolution of their salts. Bones, discarded by the housewife as useless, are wrought into forms of use and beauty, but in no instance is the value of articles which have outlived one condition of usefulness, and been submitted to the recreative power of manufacture, more apparent than in the change which rags undergo.

From time immemorial rags have been the symbol of poverty, worthlesness, and vileness, and, as such, are referred to in the Bible and in the earliest profane works. Their usefulness as a material for paper seems, however, to have been discovered several centuries ago. The oldest specimen of paper made from linen rags contains a treaty of peace between the kings of Aragon and Spain, bearing the date of 1178. Raw cotton was, however, used for paper making before this time. It is tolerably certain that mills for making paper from rags were operated in Spain as early as 1085 (*vide* "Chronology of paper and Paper Making," by J. Munsell.)

Rags, particularly cotton and linen rags, have been for many years one of the housewife's perquisites, and many a shining treasure in the kitchen and many an elegant teapot on the table, has borne witness to the thrift of the good woman in her practice of economical saving. All these rag-savings find their way to the paper mill. Their price has more than quadrupled since the diminution in the supply of cotton caused by the war. But the supply of this country is wholly inadequate to the demands of the manufacturers and the public. Once writing paper was not very generally used—at least, the people generally required but a small portion compared to the quantity they now demand. It might have been supposed that the increasing facilities of travel would have diminished the necessity for writing; but the contrary seems to be the case. Personal contact and mutual acquaintance beget new commercial alliances, and correspondence is necessary. The rags made in this country constitute but a small portion of those used by American manufacturers. We imported for the quarter of the present year ending June 30th, rags to the value of $426,766, In the ten years ending with 1865, the amount of rags imported was 209,883,718 pounds. Italy furnishes a large proportion of the rags brought into the United States. Everybody has heard of the Italian lazzaroni, who wears the scantiest dress of the filthiest rags, yet from this unpromising source nearly three-fourths of our supply comes.

Italy is the country of the open palm, and begging and rags go together. Begging there and in other parts of southern Europe, is as much a profession as any industrial pursuit in this country, and the uniform of rags is more important to its succesful prosecution than is the Government livery to the soldier. Still, valuable as rags are to the professional beggar, and important as they may be to abject poverty, they are far more important to the world at large; for up to the present time no other material has been found to usurp their place as the basis for paper. Their scarcity and constantly enhancing value have stimulated ingenuity to provide a substitute. but it has not been so successful as could have been wished. Straw, wood, and other substances have been, and are now extensively used in the manufacture of the coarser papers, but nothing equals linen and cotton for the production of the firmer and finer qualities. Some of the European Governments, for this reason, have prohibited their exportation.

It is a little singular that advances in knowledge and refinement—the triumphs of intellect and the spread of intelligence—are so closely dependent upon the contributions of ignorance and poverty. Possibly the sheet upon which we are now writing, and the page that will bear to our thousands of readers these printed lines, were once the filthy rags that but half concealed the nakedness of a Neapolitan beggar or an Egyptian fellah. It is to be hoped that the transformation they have undergone is typical of the improvement which education and the arts are yet to work upon the meanest of the race.—*Scientific American.*

Heavy Forgings.

The most interesting and one of the most important problems in the production of heavy masses of wrought iron is that of the manufacture of large naval guns. Steel appears to be quite unsuited to the requirements of large-bore ordnance, and cast iron, despite the American practice, is a material upon which no one in this country would, we think, like to venture. As for wrought iron, it has a greater dynamic resistence than steel, that is, what it wants in tensile strength it makes up in extensibility. It may require a steel inner tube, but rather to prevent the percussive action of the powder gases upon the wrought iron than as a direct provision against bursting.

There are three modes of working by which we may expect to make perfectly sound iron forgings of any weight. The first is the forming of the pile from bars or slabs which have been surfaced by machine cutting, either planing, turning, boring, or drilling, as the form of the parts may require. This mode is followed by Mr. Ames in the manufacture of his guns, and it obviously affords a complete guarantee against flaws, etc., in the parts of which the pile is formed. The second point is to heat the pile wholly by gas, as in the regenerative furnace. In this furnace the iron may be almost melted, but never burnt, as it is exposed only to heat, and not to an oxidizing flame as in a common heating furnace. With clean surfaces to begin with, and a bath of intensely hot but non-corrosive gas, the iron may be made as plastic as the softest wax, and its perfect welding may be insured. This is attended with no loss or injury by burning, and for large masses and quantities of iron there can now no longer be any doubt that the gas furnace affords also the cheapest as well as the best mode of heating. The third point in forming large forgings is to subject them to sudden and powerful hydraulic pressure, as may now be done by the various hydraulic forging presses, one of which, as now fitting at Messrs. Platt Brothers', at Oldham, we not long since illustrated.

Experience has shown that the forcibly pressing together of clean surfaces of wrought iron at a white heat insures perfect welding, and is, in fact, the next thing to founding in wrought iron. Wrought iron, when sufficiently carburized to be fusible, is commonly called "homogeneous metal," and in this form it appears to be wanting, too, in dynamic strength, although it is believed to be stronger in this respect than cast steel. Great pressure is of very great value in the case of steel ingots. Mr. Ramsbottom has greatly improved the quality of Bessemer ingots by squeezing them in his enormous "cogging machine," which we illustrated a few months ago (Vol. I., p. 42). Mr. Whitworth is, we believe, about to employ great pressure in the manufacture of cannon; and Messrs. Firth & Sons, of Sheffield, are also about pressing cast-steel shot. The advantage might not prove wholly of the same kind in the case of pressing wrought iron while hot, but it would secure perfect welding where, by the means pointed out, care had been taken to prevent the formation of scale.—*Engineering.*

Division of Profits.

A firm in Manchester adopted the plan of dividing its profits, over fifteen per. cent. on capital invested, among its workmen. The *London Spectator* says:—

"The first result was a sudden decrease in waste, the men not seeing why they should waste their own property any more than any other master's; and waste is, perhaps, next to bad debts the greatest source of manufacturing loss. The next was an advance in the pace of the work done, the men putting their hearts into it as hired people will not do, and scolding each other for neglect, as if each man was overseer. The last was a great increase of orders, every man being as anxious to obtain work, and profitable work, or, as he himself expressed it, to 'carry some'ut to bonus,' as if he had been the sole master. The result was a first dividend at the rate of fifteen per cent per annum. and four or five per cent over for division among the men."

This plan is worthy of earnest consideration, as likely to work well for both employer and employee.

Esparto Grass for Paper.

The import of Esparto grass for paper continues to increase. Last year the imports into England were 51,522 tons, against 19,190 tons in 1853. Mr. West, the British Secretary of Legation at Madrid, says:—"This grass, which grows wild in almost all parts of Spain, resembles very much the common spear grass which is found on the sandy sea-shores of Lancashire. Its botanical name is, I believe, *Stipatenacissima.* It has long been used in Spain for making matting, cord, baskets, etc., and appears to have been used for such purposes by the Phœnecians, who gathered large quantities from the coast of Spain."

Granulation of Blast-furnace Slags.

For the past two years the granulation of blasturnace slags has been successfully accomplished in France, the whole of the inconvenience usually arising from the accumulation of masses of vitreous matter being thus avoided.. The slag is simply permitted to run into water instead of running upon the ground, as usual. The water used is the waste from cooling the tweers, etc. A suitable pit is formed to receive the water, and the molten slag is run through a gutter into it—of course, becoming finely divided and friable. The slag-sand is raised by an endless chain of buckets, and removed in carts, or otherwise. It is useful for making mortar and silicious bricks, as well as for agricultural and a variety of other purposes. The invention of the process is due to Mr. Minary, and may be seen in use at the works of the Franche-Comte Forges Company, in the department of Jura. The sands vary in color from dingy-gray to dark brown or black, and weigh about 1,200 kilogrammes the cubic inch.—*London Mining Journal.*

Useful Receipts.

Black Ink.

Ink of the very finest and most intense black may be prepared by adding a very minute portion of vanidic acid, or vanadiate of ammonia, to a solution of nut-gall. This ink is much more lasting than ordinary ink.—*London Engineer.*

Permanent Ink for Writing in Relief on Zinc.

Bichloride of platinum, dry, one part; gum arabic, one part; distilled water, ten parts. The letters traced upon zinc with this solution turn black immediately. The black characters resist the action of weak acids, of rain, or of the elements in general, and the liquid is thus adapted for marking signs, labels, or tags which are liable to exposure. To bring out the letters in relief, immerse the zinc tag in a weak acid for a few moments. The writing is not attacked, while the metal is dissolved away.

To Render Wood Uninflammable.

Make a saturated solution of potash, and thicken it with paste as for distemper painting, then add sufficient clay to give it the consistence of thick cream, adding yellow or red ocher or other mineral coloring matter, if desired, for the sake of appearance. Wood painted with this composition is said to be proof against rain, and to be incapable of being inflamed, although it may be carbonized by a fierce heat.

Enamel for Earthenware.

A good white enamel for earthenware may be prepared as follows:—Melt and oxidize 60 lbs. of pure lead, and 40 lbs. of pure tin; 100 lbs. of this oxidized metallic compound should be melted with 50 lbs. of fine white sand (free from iron), 50 lbs. of common salt, 20 lbs. of powered feldspar, 6 lbs. of nitrate of potash, and 6 lbs. of litharge. Grind the melted enamel finely in a mill and apply it to the ware.—*Scientific American.*

Liquid Blacking.

Boil one ounce each of powdered galls, starch, and copperas, and two ounces of white Castile soap with two quarts of water, then strain and mix with three ounces of fine ivory black, and six ounces of molasses.

Bedbug Poison.

In a pint of strong decoction of quassia, dissolve 60 grains of corrosive sublimate, and two drachms of muriate of ammonia. Label accordingly.—*The Druggists' Circular.*

Incorrodible Black Ink.

A black ink, not corroding steel pens, and neutral, may be prepared by digesting in an open vessel 42 ounces of coarsely powdered nutgall, 15 ounces of gum senegal, 18 ounces of sulphate of iron (free from copper), 3 drachms of aqua ammonia, 24 ounces of alcohol, and 18 quarts of distilled water. Continue the digestion until the fluid has assumed a deep black color.

Practical Memoranda.

WEIGHT OF OILS.

Table of the weights, per gallon, in avoirdupois, of petroleum and its products, is from the *Titusville* (*Pa.*) *Herald.* The degrees of gravity are from Beaumè's hydrometer:

Common Burning oil at

40 deg. gravity weighs.........6 pounds 14 oz.
41 deg. gravity weighs.........6 pounds 13 9-22 oz.
42 deg. gravity weighs.........6 pounds 12 18-22 oz.
43 deg. gravity weighs.........6 pounds 12 5-22 oz.
44 deg. gravity weighs.........6 pounds 11 14-22 oz.
45 deg. gravity weighs.........6 pounds 11 1-22 oz

Benzole Commonly used in Painting.

62 deg. gravity weighs.........6 pounds 1 oz.

Gasoline.

70 deg. gravity weighs.........5 pounds 12 6-20 oz.
80 deg. gravity weighs.........5 pounds 6 8-20 oz.
90 deg. gravity weighs.........5 pounds 00 10-22 oz.
100 deg. gravity weighs.........4 pounds 10 12-22 oz.

Variegated Slate Pencils.

The Government authorities at Cologne have issued a circular cautioning the public against variegated slate pencils. Schweinfort green, which contains arsenic, is used for the green chromate of lead for the yellow, and red lead for the red varieties. The circular points out the danger of this practice, especially to children, by whom slate pencils are chiefly used.

Production of Cold.

Dr. Phipson has found that when 207 parts of lead, 118 of tin, 284 of bismuth, and 1,617 of mercury are mixed together, the air being at a temperature of + 17 deg. Centigrade, the temperature of the mixture falls to—10 deg. Centigrade. The mercury in such a mixture being readily recoverable for use over again, by distillation, Dr. Phipson is of opinion that the production of cold by this method is susceptible of numerous useful applications.—*Mechanics' Magazine.*

Cheap Ice Pitcher.

The following simple mode of keeping ice-water for a long time in a common pitcher is worth knowing. We have tried it:—Place between two sheets of paper (newspaper will answer, thick brown is better) a layer of cotton batting, about half an inch in thickness; fasten the ends of paper and batting together, forming a circle; then sew or paste a crown over one end, making a box the shape of a stovepipe hat, minus the rim. Place this over an ordinary pitcher filled with ice-water—making it deep enough to rest on the table so as to exclude the air—and the reader will be astonished at the length of time his ice will keep, and the water remain cold after the ice has melted.—*Scientific American.*

Fire Crackers.

An American Journal says:—"It is reported in the newspapers that on the 4th inst., a boy, in the city of Portland, lighted a Chinese fire cracker and carelessly threw it among some shavings in a cooper's shop. The consequence was that the greater part of the city, since accurately surveyed, and found to cover an area of three hundred and twenty-seven acres was burned, and upwards of $10,000,000 worth of property destroyed. The destruction of life and property in consequence of the free use of this mischievous explosive ought to cause stringent laws to be made, prohibiting its importation."

A Table,

Showing the number of days from any day in one month, to the same day in any other month, throughout the year. In leap year, for any term in which the 28th day of February occurs, one day will have to be added to the number given in the Table.

MONTHS.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
January	365	31	59	90	120	151	181	212	243	237	304	334
February	334	365	28	59	89	120	150	181	212	242	273	303
March	306	337	365	31	61	92	122	153	184	214	245	275
April	275	306	334	365	30	61	91	122	153	188	214	244
May	245	276	304	335	365	31	62	92	123	153	184	218
June	214	245	273	304	334	365	31	61	91	122	153	163
July	184	215	243	274	304	335	365	31	61	92	123	153
August	153	184	212	243	273	304	334	365	31	61	92	122
September	122	153	181	212	242	273	303	334	365	30	61	92
October	92	123	151	182	212	243	273	304	334	365	31	61
November	61	92	120	151	181	212	243	273	304	334	365	30
December	31	61	90	121	151	182	212	243	273	304	333	365

Look for April at the left hand, and September at the top; in the angle is 153.

Sizes of Books.

	Page.	Leaves.		Sheet.
Folio books are the largest, of which..	4	or 2	make	1
Quarto, or 4to	8	" 4	"	1
Octavo, or 8vo	16	" 8	"	1
Duodecimo, or 12mo	24	" 12	"	1
Octodecimo, or 18mo	36	" 18	"	1

Sizes of Drawing Paper.

Wove Antique	48	inches	by	27	inches
Double Elephant	40	"	"	26	"
Atlas	33	"	"	26	"
Columbia	34	"	"	23	"
Elephant	27	"	"	23	"
Imperial	31	"	"	21	"
Super Royal	27	"	"	19	"
Royal	24	"	"	19	"
Medium	22	"	"	17	"
Demy	20	"	"	15	"

Petroleum as an Illuminator.

The following table, prepared by Prof. Weethe, of Mt. Auburn, Ohio, and published in the *American Artizan*, will show the value of petroleum as an illuminator:—

Articles Used.	*Quantity of light.*	*Quan. of light from an equal meas. of oil.*	*Cost of equal quantity of light.*
Coal-oil or Petroleum..	13·70	2·60	4·00
Camphene	5·00	1·30	4·95
Whale-oil	2·40	·85	12·00
Lard-oil	1·50	·70	17·60
Sperm-oil	2·00	·95	26·60
Burning-fluid	·65	·40	29·34

Miscellaneous.

Misuse of Oils.

For want of a little knowledge of oils, many persons missaply them. We have seen a clock which would not go because it had been oiled with linseed oil; and we have seen newspapers that blackened the fingers, six months after they were printed, because olive oil was mixed with the ink to thin it. Olive oil never dries, and a little of it will prevent any other oil from drying; hence it will not do for ink or paint; but may do tolerably well for clocks; very well, indeed, if it be purified from acid by treatment with lead. Linseed oil will surely dry; fish oil will become gummy; therefore neither will do for clocks; and it is not convenient to use fish oil for machinery; and of course none but green hands need be told that linseed oil will not do for machinery.

We saw a fellow at the fair of the American Institute who was celebrating cotton-seed oil; it was good for lubrication, good for printing, and, when carefully prepared was the best oil for salads. Such a humbug might easily induce ignorant persons to buy it to oil their clocks with or print with. As we don't happen to remember anything about this oil except what we heard from him, we can't say what it is good for; but we should like to see it tried by others before we would use it for lubrication or printing or salads or medicine.

The best way for one who does not understand oils, and wants oil for painting, is to buy it of a practical painter, who can tell him which kind is best for his special use; not buy it of a dealer in painter's materials, for he may be ignorant of everything but the name and price of it; so with oil for his clock, sewing machine or other machinery; go to the men who work or run them. As for salads and physic, we must all "go it blind" no one can know what he swallows unless he has seen it made. Olive oil is made from lard, more or less; and few are so expert as to tell the difference between the imitation and the genuine oil. The only advice we can offer about it is, first, to smell of it; if it smells agreeably, then taste it; if it tastes well, then eat it; but don't use it because it is in fashion. Your natural taste, if unbiassed by your judgment, or by your ideas of gentility, will be a tolerably good index of what is good for your stomach; and it matters little whether it is lard, olive oil or butter. But we seriously advise certain printers not to put any kind of oil into their ink, unless they have learned from certain experts *what* oil is proper for it. A lady in a white dress who sits on a newspaper, and gets the news transferred to her dress, is apt to scold about it; and of course gallantry should look to avoid such a case.—*American Artisan.*

Value of Forests.

The *Scientific American* says:—"While the attention of our people is drawn to the necessity of introducing a cheaper material than coal, as a fuel, our forests are rapidly wasting away. In localities not possessing good facilities for transportation, the trees in the forests are ruthlessly sacrificed, and, if the waste continues in the same ratio for the next half century as it has for fifty years past, there must be portions of our country which will be changed from fertile farms to barren wastes. This is no fancy or sensational statement. The grand reservoirs of our springs, brooks, and rivers are our forests, except on the slopes of mountain ranges. They conserve the moisture deposited by rain and dew, by frost and snow, and deal it out through the arid and thirsty months, giving fertility and verdure to land that otherwise would not feed a goat Forests serve a grand object in the economy of nature. They should be valued and protected. For this utilitarian reason, as well as for others of a more æsthetic character, we desire to see our forests preserved."

Revolution in Steam Navigation.

The *Liverpool Post* in describing the launch of a vessel at Birkenhead says:—"The *Sleigh of the Wave* is a splendid steel yacht, of first rate model, finish, and workmanship; and, what is more to the purpose, the machinery constructed for her is of an entirely novel character, the motive power being water under pressure, which, it is expected will entirely supersede steam. The invention of steam sinks into insignificance beside this new discovery. The hydrostatic engine is now about being erected in the *Sleigh of the Wave*, and doubtless in a few weeks' progress will be reported.

Scientific Experiments.

[1.] An agreeable experiment in electro-magnetism may be made by placing a magnet in the circuit of a galvanic pile; then break the circuit at any point, and place the two ends in a box containing iron-filings; then very carefully and gently raise one wire and draw it from the box, and it will draw away the filings in a long chain. If the very greatest care is used, every particle of iron may be in this way taken from the box and suspended in the air. The union of the metallic particles is not supposed to result from any attraction between them, but from a kind of soldering due to a superficial fusion.

[2.] Dissolve a teaspoonful of salt in a wine-glass-ful of water; and place in it some coarse sewing cotton. In about an hour take out the thread and dry it. Tie a piece of this prepared cotton to a small ring, about the size of a wedding-ring; hold it up, and set fire to the thread. When it has burnt out the ring will not fall, but remain suspended, to the astonishment of all beholders. Philosophers account for this effect by stating that the salt in the thread forms, with the ashes of the cotton, a fine film of glass, which is strong enough to support the ring, or any other small weight.

[3.] Procure a basin of milk-warm water, throw into it half a dozen pieces of camphor about the size of a pea; they will soon begin to move, and acquire a rotary and progressive motion, which will continue for a considerable time. If now one drop of oil of turpentine, or sweet oil, or gin, be let fall upon the water, the pieces of camphor will dart away, and be deprived of their motion and vivacity. Little pieces of cork, that have been soaked in ether, act much in the same way as camphor when thrown upon water. Camphor, being highly combustible, will burn if ignited while floating upon water, producing a singular effect.—*American Artisan.*

What do you do with Soap Suds.

The Scottish *Farmer* says, although generally deemed only fit for being run off into the common sewer in the easiest and most expeditious manner possible, they are nevertheless highly beneficial vegetable feeders, as well as useful insect preventives; hence they should never be wasted, more especially by parties having gardens, as their application to the ground, whether in winter or summer, will show beneficially not only on ordinary crops, but also on berry bushes, shrubs, border flowers, and even window pot-plants; while if poured or syringed over roses, cabbages, ect., they will prevent, or at least mitigate the mischievous doings of the green fly and caterpillars.

Rinderpest, Pleuro-Pneumonia, and Cholera Disinfectant.

A communication has been received at the department of State, from our legation at London, inclosing two pamphlets relating to certain experiments by Dr. James Dewor, of Kirkcaldy, Scotland, for testing the efficacy of sulphurous acid gas as a disinfectant. Results are cited which lead to the conviction that the diseases—cholera, rinderpest, pleuro-pneumonia, and others—may be not only very much modified, but even wholly prevented by this means. The method of generating the gas is very simple and inexpensive. it is only necessary to have a chaffer of red-hot cinders. Set a small crucible into them and drop a piece of sulphur stick about as large as a man's thumb into it. This will fumigate a large cattle shed in twenty minutes.

The animals seem to enjoy it, and it acts as a tonic on man and beast. The shed must be well ventilated during the fumigation, as well before as after it, and sanitary rules must be enforced in regard to cleanliness, removal of dung heaps, ect. During the prevalence of such epidemics as above named, the fumigation may be made according to the foregoing directions four or five times a day; and not only is this treatment said to cure these diseases, but it is stated that mange, ringworm, and lice have also vanished before it, and that grease heels in horses have also been cured by it, while severe cases of phthisic and tubercular affections of the lungs have also been relieved in human beings.

The Tomato as Food.

A good medical authority ascribes to the tomato the following very important medical qualities:

1 That the tomato is one of the most powerful aperients of the liver and other organs; where calomel is indicated, it is one of the most effective and least harmful medical agents known to the profession.

2. That a chemical extract will be obtained from it that will supersede the use of calomel in the cure of disease.

3. That he has successfully treated diarrhœa with this article alone.

4. That when used alone as an article of diet, it is almost sovereign for dyspepsia and indigestion.

5. That it should be constantly used for daily food. Either cooked or raw, or in the form of catsup, it is the most wholesome article in use.

Chlorine as a Disinfectant.

A French chemist has recently brought forward a cheap method of generating chlorine as a disinfectant, in place of the comparatively expensive chloride of lime. The preparation consists of common salt, red lead, sulphuric acid and cold water. The red lead is mixed with the salt, and introduced into a bottle full of water; the sulphuric acid is added afterwards gradually, and shaken at intervals. By this process sulphate of lead is formed and precipitated, and sulphate of soda and chlorine, remain dissolved in the water. The chlorine, which gives the liquid a yellow color, is disengaged as soon as the bottle is opened. This preparation presents another advantage, in addition to that of cheapness, namely, it does not disengage the chlorine too rapidly, and is, hence, not so rapidly exhausted. If, however, a rapid disengagement be required, the liquid may be poured into flat plates, so as to offer a large surface for evaporation. Managed according to this method, the preparation is found to realize the most satisfactory results as a disinfectant.—*N. Y. Methodist.*

Hints to the Thoughtless.

Persons who eat onions should not stand within five feet of those whom they talk to, and should not follow them up when they back away.

Kitchen refuse should be burnt, while fresh, especially when there is danger of cholera. It is of some use as fuel; but the great advantage of burning is to avoid the stench, which will surely arise in less than a day in summer.

Ash-boxes on sidewalks are obstructions, and do not become men who own buildings on Broadway. Some of them have lately disappeared, much to the credit of those who ordered them away. The best disposition of ashes is to put it in a bin in the cellar or vault, and have it taken away when the bin is full. With the usual amount of unburnt coal in it, it is valuable, and if it were saved in bins, it might be sold for a dollar per load. No organic matter, unburnt, should be put into an ash-bin. —*American Artisan.*

Disinfecting by Steam.

The use of steam at a high temperature as a disinfectant, was tested on Thursday, July 12th, at the house of Metropolitan Engine Co. No. 1, in Center street, this city, under the superintendence of Dr. Bell, the introducer of the process. Steam was raised on one of the fire engines, and discharged into an iron chest three or four feet square, containing a coil of iron pipe. A small quantity of carbonic acid was placed in the super-heater. Under this vessel a fire was built to give the requisite degree of heat to the steam. It was found, after a trial of fifteen minutes, that, by a self-registering thermometer, the temperature of the room to be disinfected was raised to 150 deg., and oysters and eggs were thoroughly cooked.

That a sufficient degree of heat can be evolved by this process to destroy the germs of disease which may exist in the atmosphere, seems to be probable, but the one objection is in regard to its want of facility of application. In hospitals and similar institutions this objection would not have the force it would applied to private dwellings. It is probable that the usefulness of this process will be greatly limited by circumstances. Its use cannot become so general as its claimed advantages would seem to warrant.—*Scientific American.*

Dr. J. G. Webster on Cholera.

The *American Artizan* says:—"We have received from the publishers, Miller, Wood & Co., 15 Laight street, New York, a pamphlet, being the subject of two lectures delivered in the New York University, on the causes, mode of communication, and means of preventing cholera. A few extracts from it will do no harm, and may do some good. The author believes the germs of cholera to be in the discharges from infected persons; and to be taken up by the air, and carried to some miles distance at least. Persons of good health are able to resist the influences of germs; but those whose digestive organs are impaired by the use of improper food, stimulants, and irregular habits, are very liable to be affected if they inhale air that is tainted by contact with cholera patients. Air from putrid matters is a predisposing cause of cholera; hence he advises the removal of all matters that can putrefy, *before* they putrefy. Fire is a safe means of preventing putrescence; and should be used when not inconvenient. Lime is slow, but permanent in its effects; charcoal absorbs but not destroys atmospheric poisons, and is not so safe; chloride of lime is quick, and may be best for general use. Strong fumigations are worse than useless, as they merely render the senses unconscious of the presence of foulness in air, without destroying its poison. The best plan is to heat rooms up to 220,° which is sufficient to destroy any species of animal or vegetable poison.

The food should be plain and nutritious, and taken at regular hours, and in moderation. All indigestable and badly-cooked food should be avoided. Healthy beef and mutton, good bread, and fresh ripe fruits are recommended; but unripe and stale fruits are deemed dangerous. Watery vegetables, such as turnips, cabbages, cucumbers, and pickles of all kinds, and onions, lettuce, horse-radish, and seasoning sauces are tabooed. Pickled and smoked pork, fish, and sausages, lard, rancid butter, old cheese, gravy, pastry, sweetmeats, and candies are also condemned. Alcoholic drinks are to be avoided. Wine to be used very sparingly, by those who are constrained by habit to use it: so with tea and coffee. The general reason for these cautions is that the digestive powers should be kept in their highest efficiency, so that the system may be able to resist the effects of the poison in the air. Moderate exercise, regular sleep, personal cleanliness, and avoidance of dejection and mental excitement, are to complete the guards against cholera.

Now if these preventives were observed by all, cholera would disappear from the earth; but until there is an approximation to this state of defence, we must expect occasional visits of the scourge.

Quick Railway Travelling.

A feat of almost unrivalled travelling was recently accomplished on the Great Northern Railway. On the occasion of the late fire at Newcastle, when the safety of the high-level bridge was endangered, a telegram was sent to London requiring the attendance of Mr. Harrison, the engineer of the North Eastern Railway Company, and that gentleman was conveyed by an engine belonging to the Great Northern Company from King's Cross to York, a distance of 191 miles, in 3 hours, 43 minutes, including a stoppage of 8 minutes at Newark for water and lubricating the engine.—*Mechanics' Magazine.*

Steam Rollers for Pavements.

A SERIES of experiments has been conducted for some time past by the municipality of Paris in order to test the comparative merits of the Lemoine and Ballaison steam Locomotives, employed in crushing and consolidating the broken granite laid on the streets of that city. It has at last been decided that the Ballaison locomotive is the better of the two. It has two rollers, the engine being between them and the boiler on one of them. The motion is communicated by a chain. With fuel and water the weight of the Ballaison steam roller is 13½ tons with springs; and an iron framework, 15¼ tons. Its force is 10 horse-power, and its consumption of coal about 16 lbs. per horse. It does its work in half the time and at half the cost that would be required were the work done by rollers drawn by horses; and the work is done more rapidly and completely. It may now be seen at all hours of the day crushing smooth the granite of the new boulevards of Paris; in the more crowded thoroughfares it works only at night.—*Engineering.*

Kind Words.

So that they be in season, it matters not how simple are the flowers that one gather from the wayside. A kind word, when the heart needs it, is always grateful, though the grammar is very bad of him who speaks it.