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STEAM: ITS INFLUENCE ON THE ARTS AND MANUFACTURES.

In a series of most instructive articles on this subject, from the pen of the late Prof. F. A. P. Barnard, occurs the following admirably written eulogium of the services rendered by this mighty agent of civilization in the maintenance of the commercial and industrial supremacy of Great Britain, and a graphic picture of the slowness with which the revolutions caused by the introduction of steam were brought about, because of the lack of due appreciation of its enormous powers of usefulness. We quote from Prof. Barnard in what follows:

There remains to be mentioned one additional and most important consequence of the invention of the steam engine, which has impressed profoundly not merely the industrial but the political history of the world. If the cotton-gin has been responsible for much in controlling the political and social destinies of the Western continent, the steam engine has been for still more in fixing for England her place among the nations of the earth. At the time when this splendid invention made its appearance, England called herself mistress of the seas, and assumed to be the equal, if not the superior, of any military power upon the land. This place she still claims, perhaps justly, though her title to the exclusive dominion of the waves can no longer pass unchallenged. But without the steam engine, the power of England would have long since suffered a hopeless paralysis. It is from the depths of her mines that she has drawn the aliment which has sustained her manufactures and fed her boundless commerce and built up the enormous wealth which is the basis of her present strength.

Her iron and coal have made her a hundred times richer than she could possibly have been if she had possessed instead of them all the gold of California and all the diamonds of Brazil. But a century ago, just as Watt was turning over in his mind his first crude notions of the motor which was destined to transform the constructive industry of the world, many a thoughtful patriot and statesman of Great Britain must have been regarding with anxiety and alarm the stagnation which seemed to be gradually creeping over the mining industry of his country, and the danger which menaced with speedy total extinction this great source of her national wealth. As the mines were sunk deeper, the expense of lifting to the surface the mineral extracted, of course increased; but this was a trifling consideration compared with the vastly greater expense of withdrawing the water which flowed in, in constantly increasing abundance, and which had to be raised from a constantly-increasing depth. In many instances mining had almost ceased to be remunerative; in many others quite. One after another the mines were abandoned and the water was allowed to fill them up. What had already happened in many instances could not fail to happen at length in all. An early ruin plainly impended over the mining industry of Great Britain, which could not fail to bring with it, and with the consequent failure of her fuel, an equal ruin to the manufactures, the commerce, the wealth and the political power of the British empire.

It was at this critical juncture that the new motor appeared. For some time after its appearance, it was only for the drainage of mines that its immense powers of usefulness seem to have been recognized; so imperfect at that time was the state of advancement of the mechanic arts! But applied to this purpose, then of paramount importance, it averted at once the imminent danger which menaced British industry, and restored to Britain the commercial sceptre just as it was about to fall from her grasp. The greatness of the British empire to-day is, therefore, clearly due to her early possession of the steam-engine. Without it she must inevitably and speedily have sunk to a level of comparative insignificance.

It is remarkable that, vast as was the revolution which the steam engine was destined to effect in the industrial world, the steps by which this was accomplished did not succeed each other with great rapidity. The first impression which the invention produced was in the relief it brought to mining. Its influence was next most distinctly felt in the development that it gave to textile manufactures. Then metallurgy yielded to its transforming power, and by degrees the same influence extended itself into every branch of mechanic art. But the application of the new power to locomotion upon the water and upon the land, applications which were destined to infuse into commerce a life and activity which it had never known before, and so to react upon production indirectly no less effectually than the same cause had already done directly, came at long intervals, and required the greater portion of a century for their full realization. It is interesting to observe how, in the infancy of a great invention, conceptions which are perfectly just, struggle painfully and often for a long time abortively, to embody themselves into form; and it is sad as well as interesting to observe what chilling lack of sympathy usually attends their announcement; what obstinate prejudices rise up to oppose their introduction; what ridicule labors to dishearten their authors; and what contemptuous refusal of substantial aid operates to paralyze effort. The practicability of applying steam to river navigation was repeatedly demonstrated before the close of the 18th century; but it was only after the lapse of forty years from the invention of the engine that Fulton, in presence of a great multitude, assembled chiefly in the hope of finding amusement in his discomfiture, made at length the decisive experiment which was to force this truth upon the convictions of men beyond the possibility of further question.

Twenty years more elapsed before it was clearly seen in what way the same power might be made subservient to the uses of locomotion on the land; and ten more still before the problem which had been so long completely solved for inland waters was admitted to be so likewise for the ocean. We stand at the end of the first quarter of a century since the Atlantic was bridged by steam; and within that brief period the entire naval and almost the entire commercial marine of the world has undergone a complete transformation. The tonnage of vessels has been doubled, the duration of voyages has been diminished more than half, and the interchange of wealth between nations has increased no less in quantity than in rapidity. The effect of all this upon productive industry everywhere is too vast to be computed.—*The Manufacturer and Builder.*

A WARNING TO AMERICAN INVENTORS.

There is a class of unscrupulous persons in this country that speculates, and doubtless with profit, upon the credulity of patentees, as multitudes of the latter have found to their cost. Their method of procedure varies according to circumstances, but it consists usually in sending to the inventor, whose name has freshly appeared in the *Patent Office Gazette*, a circular setting forth the facilities the senders of the circular possess for turning inventions into money, and ending by a request for the remittance of a sum of money upon one or another plausible pretext. The veteran inventor, to whom this sort of thing is an old story, simply looks at such communications long enough to read the head-lines, and consigns them to the hospitable maw of his waste-basket. To the inventor who receives for the first time in his life the official document certifying his rights as a patentee, the circumstance is an event of uncommon importance, and especially if he happens to be a dweller in some village remote from the centres of industrial activity, after experiencing the pangs of disappointment through the failure of his efforts to realize promptly the substantial and fondly-anticipated reward of his ingenuity, he is frequently tempted by the flattering bait held out by the speculators in his credulity, and falls into the waiting net, only to find, after having responded to several further demands for money, that he has been victimized. This experience is so common that every one who reads this will recognize the truthfulness of the picture.

It has remained, however, for a Frenchman to devise a scheme of coaxing money from the pockets of unsuspecting and credulous American inventors, which, for originality and simplicity, is worthy to be called an inspiration of genius, and which, we feel thoroughly well assured, has within the year or two during which it has been set in operation, netted its originator a handsome income.

Within the last two years thousands of American inventors have received an official-looking document, informing each recipient that the Paris Academy of Inventors, Manufacturers, and Exhibitors, impressed with the manifest importance of his invention, had, in recognition of his ingenuity, accorded him the medal of the Academy, and the honor of election as a corresponding honorary member. All this is so gratifying to the vanity of the recipient, if he be inexperienced and susceptible to flattery so unctuously applied, that the intimation conveyed, a little further on, that the diploma and card of membership in the Academy, and the medal, and the bulletin of the Academy (in which he will be entitled to an article eulogistic of his interesting invention), will be sent forward on receipt of the sum of ten dollars, may not excite his suspicions. This modest fee, as a consideration for the distinction of recognition by a body so eminently respectable as the "Parisian Academy," is a mere bagatelle; and, no one but the inspired parent of the Academy can tell in how many hundreds of cases the glittering bait has been swallowed, and the ten dollars is sent forward by return of mail. This is "the milk in the cocoanut."

To the credit of the author of the scheme, it must be recorded that he keeps faith with his dupes, for in due course they receive a really artistically-designed medal (of gilded bronze), bearing on the obverse the arms of the City of Paris, surmounted by the words, "Ville de Paris," and on the reverse, a wreath surrounded by the title of the Academy (Académie Parisienne des Inventeurs," etc.), and within, the words, "Décernée à" (granted to); also a large and handsomely-designed diploma, and a small card of membership (reduced photographically from the diploma).

These formalities are well calculated to impress the recipient with an exalted idea of the importance of the "Academy," and with the feeling that he is really a much cleverer fellow than he had before imagined.

We regret to have to say that the so-called Academy is a specious humbug, and its medals and diplomas worth just the metal and paper they contain—and no more.

The following statements will explain the character of the scheme:—During the past year or two, the editor of this journal, in conducting the large correspondence relating to the business of the Committee on Science and the Arts of the Franklin Institute (of which body he is the secretary), noticed occasional references, in the letters of inquirers concerning the medals in the gift of this committee, to the Parisian Academy of Inventors, which had honored (?) the writers with election to membership, and a medal, as above set forth; and in one case, the correspondent (residing in Leadville, Colo.) forwarded his card of membership and medal in confirmation of his statement. The fact that neither the editor, nor others qualified to know, had ever heard of the existence of this institution, having previously awakened the suspicion that it might be a clever fraud, the opportunity of investigating its status through the medium of the Consular service of the French Government was improved. The medal and card of membership were offered in evidence, and in due course the facts of the case were placed in the writer's possession.

The channels through which this information was received are official, and while we are not at liberty to disclose their source, we are permitted to vouch for the strict reliability of that which is disclosed. Here are the facts:—The Académie Parisienne des Inventeurs," etc., consists effectively of a single person, Bœttcher by name, with headquarters at 28 rue Serpente (suggestive name), in Paris. His so called academy has no existence in fact, and the diplomas and medals issued by him have, consequently, neither credit nor value. The business in which he is engaged bears evidence of being little more than a swindling scheme, devised for the purpose of imposing on the credulity of inventors in America (and probably elsewhere), by playing upon their vanity. His traffic in diplomas and medals appears to be his sole means of support.

This much we have learned from the source above indicated, and we have made the facts public in order to place American inventors on their guard against the fraudulent designs of a very clever swindler. His method of procedure is probably to take the *Patent Office Gazette* as it appears weekly, and to address his insinuating communications to the patentees named therein, with impartial hand. Just what percentage of those addressed fall into his trap no one but Bœttcher knows; but that he derives a handsome revenue from his ingenious scheme, must be obvious from the fact that the correspondence of the editor of this journal has brought to his personal knowledge, within the present year, the cases of at least half a dozen inventors who have been victimized, and of a score, or more, who have received the circulars of the "Academy."—*Manufacturer and Builder.*

PRESERVING AUTUMN LEAVES.

A few absolutely perfect leaves are better than the scores of common ones that we are tempted to collect. The leaves of the hard maple are always gorgeous in hue and delicate in outline. Those that wear the deepest tints of crimson or yellow are best for our purpose. Oak leaves are shiny and firm, and easily preserved. Nature has always been prodigal to the beech tree, scattering on her boughs the richest, brightest colors. The sumac glows with vivid crimson, and a clear amber shines through the dainty larch and chestnut leaves. Then there are the dull chocolate and mottled red of the blackberry vines, while the poplar and aspen shine out with a silvery white, all speckled over with touches of green. Gather these wild wood beauties, says *Good Housekeeping*, with as much care as would be bestowed upon a bouquet of garden blossoms, and hasten home with them before they begin to dry and curl. Upon reaching home let the first care be to have two hot irons ready. Cover the kitchen table with three or four layers of newspapers, over which fasten smoothly a soft cotton cloth. Have at hand a lump of beeswax, tied in a small bag, and a similar package of resin. Now smooth out a leaf with the hand, rub the beeswax lightly over the iron, letting the hot, smooth surface glide quickly over the leaf, first on the upper and then on the lower side, pressing a little more firmly a third and fourth time, until the leaf is thoroughly dry. The glowing colors will be firmly fixed, and will never fade, unless exposed to the sunshine. Having treated all the leaves in a similar manner, they are ready for the resin, or "the finishing process." With a moderately hot iron, which must be lightly and rapidly rubbed over the bag of resin, go over every leaf, first on the upper and then on the lower side. This gives them a brilliant, hard, glossy finish that makes them almost indestructible. Many persons complain that the glossy appearance is unnatural. While this is true, to some extent, yet the protection given by the coat of resin could be obtained in no other way. To preserve small branches, and boughs with leaves, one must proceed in the same manner, pressing the limbs and twigs with the iron until dry, being careful to avoid the point where the leaf is attached, as too much heat just there will cause it to drop off instantly. To achieve perfect success, be sure to take the leaves when freshly gathered. When the work has been finished, spread a number of newspapers upon the floor of some unused room, and there place the treasures. Give them plenty of space, so that they will not touch, or stick to each other. Cover them entirely with more papers, and let them remain in this cool, dark seclusion until ready to decorate the rooms, or otherwise use them as things of beauty and joy. Reserve a few of the brightest and more perfect specimens for the holiday times, when they will come out of their darkness so beautiful that they who see them will have no longing for summer flowers, but will revel in the unfading glories of the autumn leaves.—*Popular Gardening.*

THE MANUFACTURE OF OLIVE OIL.

The culture of the olive is an important industry in the Mediterranean countries of Europe, and in the south of France it still constitutes the leading source of income of the agricultural population. The methods of treating the fruit in common use throughout that country are still comparatively primitive, and a brief description of the manufacture of the oil may be interesting.

The pictures shown herewith exhibit a typical plant in use in the rural districts of the south of France, and the mode of operation is substantially as follows:—

The olives, after being gathered, are usually spread out in the sun for some time to dry out some of the contained moisture. The fruit loses no oil until all the moisture has been removed; but water, usually hot, or, better still, oil is added to olives that are too dry, in order to facilitate the flow of the oil.

Fig. 1 of the pictures is the crushing mill in common use, and is said to be substantially the same to-day as it was centuries ago. It consists of a huge stone bowl or basin, in which the olives are charged and crushed to a pulp by means of a heavy millstone placed on edge and carried around the interior of the bowl by gearing of the simplest character, the motive power being provided either by horses or by water power. The square, upright shaft is of wood, carrying on its upper extremity a horizontal wheel with strong oaken pegs serving as cogs, evenly spaced about the under side of its rim. These engage with similar pegs about the rim of the driving-wheel. Attached to the upright shaft, and forming a slight angle with it, and with its edge truncated to conform to the curvature of the interior of the bowl, is the millstone; and to the side of the shaft opposite to the stone is attached, from the end of a wooden bar, a scraper, adjusted so as to fit easily the inside of the bowl.

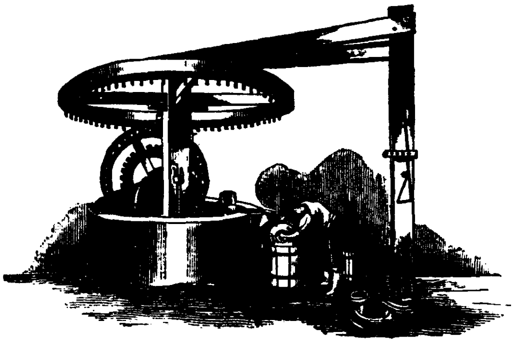


FIG. 1.—PULP MILL.

When the mill is set in motion, the fruit is crushed by the stone, and the scraper, revolving with the shaft, scrapes off such portions of the pulp as are forced up the sides of the bowl, throwing it back under the stone. This work goes on until the contents is reduced to the state of an oily paste, which is then shoveled out into flat bags of woven grass, which are then transferred to the presses. This portion of the plant is seen in Fig. 2. The presses are simply rough, heavy, wooden frames, fitted with large wooden screw presses worked by hand. The bags charged with the pulp are piled up on the oaken slab forming the bed of the press, and the pressure is then applied by means of a long hand-bar. The oil, as it is expressed, is allowed to drain off through suitable troughs into tubs placed to receive it, as shown. From time to time boiling water is poured over the bags, to facilitate the flow of the oil. When the operation is finished, the oil floating on the surface of the water is ladled off with large tin skimmers. Made in this way, as is the common practice, the oil from the fruit (the true virgin oil) and that from the kernel are mingled, and the product is always inferior in quality to that yielded when the kernels are removed; but the labor required to do this, with the crude appliances in the hands of the rustic community, is so great that pure virgin oil is only to be found in the house of the farmer who has his own mill and prepares it for his own use. Improved mills, which extract the kernel and throw it out as the pulp is crushed, have been devised, but the olive raisers are so wedded to the old methods, and so averse to adopt new ideas, that the old, clumsy methods of their ancestors are still practiced throughout the olive-growing region.

The best oil is said to be obtained from olives that are not fully ripe, the fully ripe fruit yielding an oil that is heavy and lacking in the delicate perfume that is characteristic of the finest qualities of the product. Olives of good quality should yield 20 per cent (by weight) of fine oil, and 4 per cent of inferior quality. First quality oil is that obtained from the first pressing, and without the use of water. A second quality, inferior to this, is obtained by throwing the contents of the bags, after the first expression, into a vat filled with water, warm or cold, stirring the whole so that the broken fragments of the kernels fall to the bottom, when the pulp, floating on the surface, is collected and again returned to the bags and pressed. As above stated, it is common enough to pour boiling water over the bags at the first expression. This simplifies the labor and greatly increases the yield of oil, but yields an inferior grade of oil.

After the oil is extracted, the skins, broken kernels, and other refuse, are used for firing the boilers.

To keep the oil in good condition, the clear oil should be decanted from the turbid portion that falls, as soon as possible, for the longer the oil remains in contact with the lees the more liable it is to acquire an acid taste and rancid odor. After it has been decanted several times, according as it may be necessary, the product is filtered through charcoal, and is then stored in some cool place where the temperature does not vary much winter and summer. It must be kept in vessels on which oil has no action, and which are kept tightly closed to prevent any access of the air, which would quickly render it rancid.

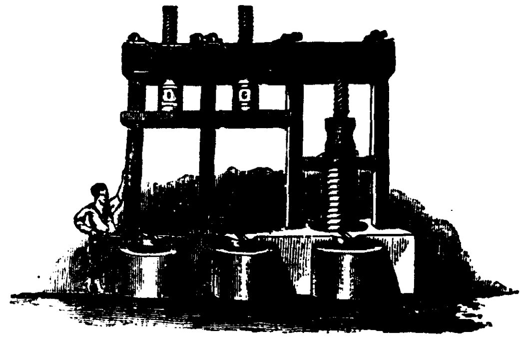
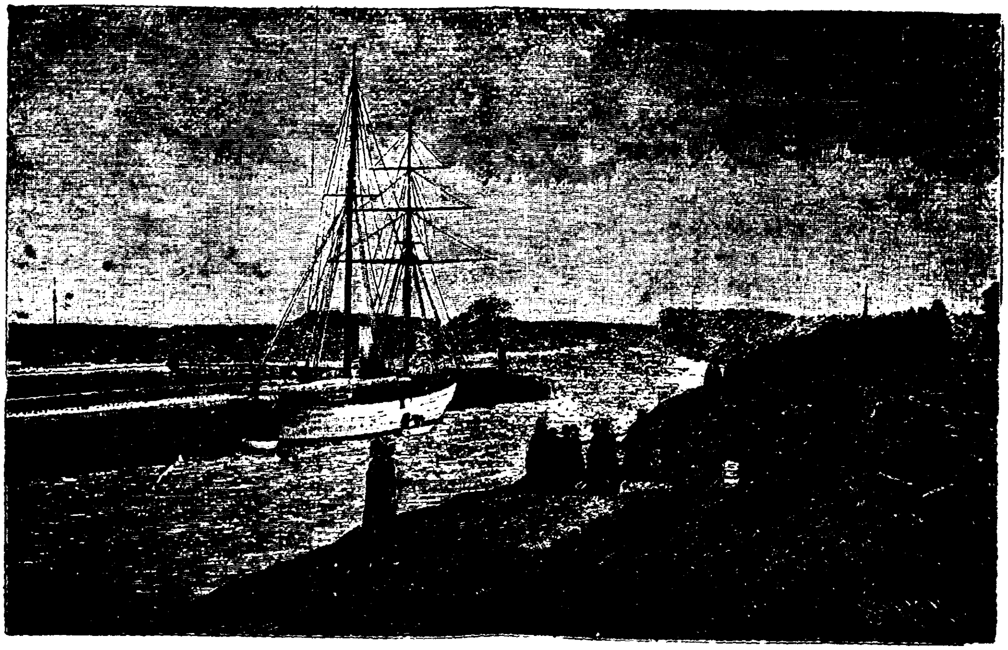


FIG. 2.—PRESSES.

It goes without saying, that a large proportion of the olive oil of commerce is adulterated. Of the enormous quantity of cotton-seed oil that is exported from the United States to the Mediterranean ports, by far the larger proportion doubtless finds its way back to this country, mingled perhaps with a modicum of olive oil, in the form of sardines prepared in oil, or as table oil duly labeled pure olive oil, and relished as such by the American palate, to which the mere suggestion of cotton-seed oil would be nauseating.—*The Manufacturer and Builder.*

The largest gasometer in the world is now being built for a London company. Its diameter will be 300 feet, and the height 180 feet. Its capacity will be 12,000,000 cubic feet, and weight 2,220 tons.



The Manchester Ship Canal—View from Locks Looking Along the Canal.

THE MANCHESTER SHIP CANAL.

This great engineering work is now rapidly approaching completion, and will soon be in full operation. The first completed section, from the entrance at Eastham on the river Mersey to Weston, was opened for traffic on the 29th of September. The length of this completed portion is eleven miles, being almost one-third of the entire length of the work.

The first consulting engineer was appointed (to look into the project and report) in the summer of 1882. It was only in August, 1885, after making three trials, that the sanction of Parliament was obtained for building the canal. Before a single sod was turned in the great work, $1,750,000 was spent in forwarding and contesting the canal project. In July, 1886, the contract for building the entire canal was let to Mr. Thomas Walker for $28,750,000. The allowed time for finishing the work was four years, with a large bonus for whatever time was gained in finishing.

The canal extends from Eastham Locks on the south bank of the estuary of the Mersey River to Manchester, having a total length of a little over 35 miles. The minimum width on the bottom is to be 120 feet. The depth throughout is to be 26 feet. This is a very large cross section when compared with existing canals, which are as follows:

Ghent canal 55 feet 6 inches wide on the bottom, 21 feet 2 inches deep.

Suez canal, 72 feet wide on bottom, 26 feet deep.

Amsterdam, 88 feet 7 inches wide on bottom, 23 feet deep.

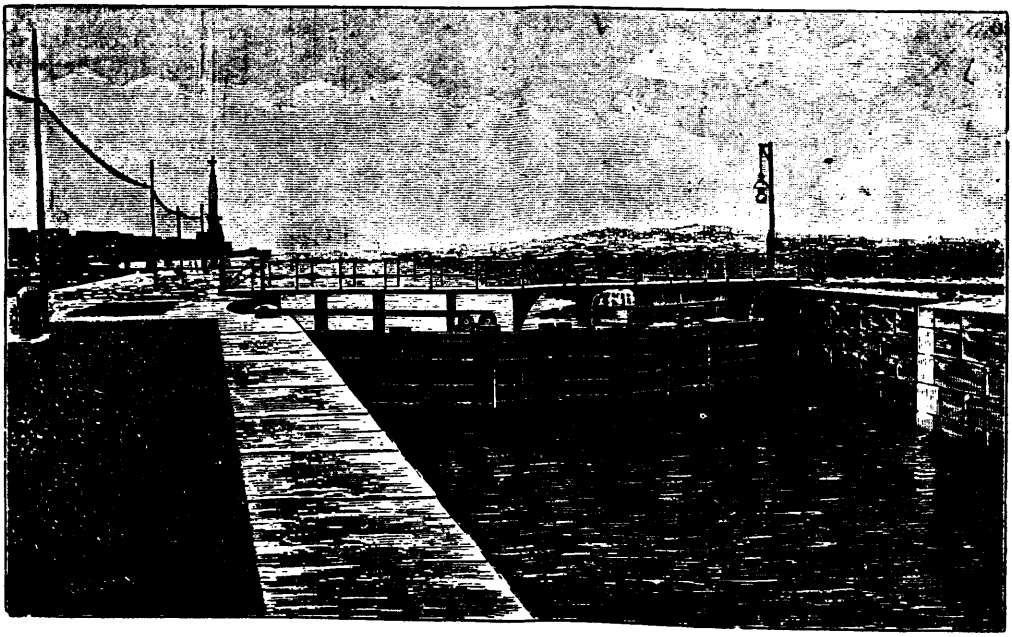
Quite satisfactory progress has been made on the entire work, but the sudden death of Mr. Walker, the energetic contractor, proved rather embarrassing.

Mr. E. Leader Williams is the chief engineer of the work and has been one of its principal promoters from the beginning.

The canal is 48 feet wider than the bottom of the Suez canal, while the depth is equal; so that the largest cargo steamers can pass each other in the Manchester ship canal. At several points, near the locks and near the docks, this canal is wide enough for such ships to turn. For a length of three miles and a half, approaching Manchester, the width at the bottom is 170 feet, so that ships can lie outside the docks along the wharves on the Salford side. There will also be open side basins, or widenings at ship building yards, or where cargoes are discharged or loaded, for manufacturing establishments or storehouses adjoining the canal.

Five sets of locks—at Eastham, on the Mersey sea estuary; at Latchford, on the Mersey, above Warrington; at Irlam, above the junction of the river Irwell with the Mersey; at Barton, on the Irwell; and at Manchester—raise the level of the canal, on the whole, 60 feet above the sea. Of its entire length, twenty-three miles, inland from Runcorn to Manchester, will have been formed by cutting a straight and deep channel for the rivers Mersey and Irwell. The lower section, from Eastham to Runcorn, forms a curved line of twelve miles along the Cheshire shore of the broad inner expanse of the Mersey estuary; but at Weston Point, meeting the estuary of the navigable river Weaver, which is connected with an extensive system of canals, it will obtain valuable local traffic, especially the shipment of salt. A large trade with Cheshire and the Staffordshire potteries, by the Bridgewater canal, will also reach the ship canal at Runcorn, as well as that of the chemical manufacturers at Widnes. The Shropshire Union canals will feed the traffic at Ellesmere Port, near Eastham.

The Manchester docks, formed on both banks of the Irwell, chiefly in Salford, but also in Manchester on the site of the Pomona Gardens, Cornbrook, and extending to Throstlenest and the Albert Bridge, near the Old Trafford road, will afford ample accommodation to the trade of that city. They occupy a space of two hundred acres. The water area of the dock basins is sixty-two acres and a half, and the quay frontages are three



THE MANCHESTER SHIP CANAL—VIEW OF ONE OF THE LOCK GATES.

miles and a half in aggregate length, to which may be added a mile of open wharves along the wide part of the canal just below; and there will be two miles and a half of the canal bank, lower down, available for discharging cargoes into barges and lighters, and putting them ashore. Fifty hydraulic cranes, some of great power, will be provided at the Manchester and Salford docks.

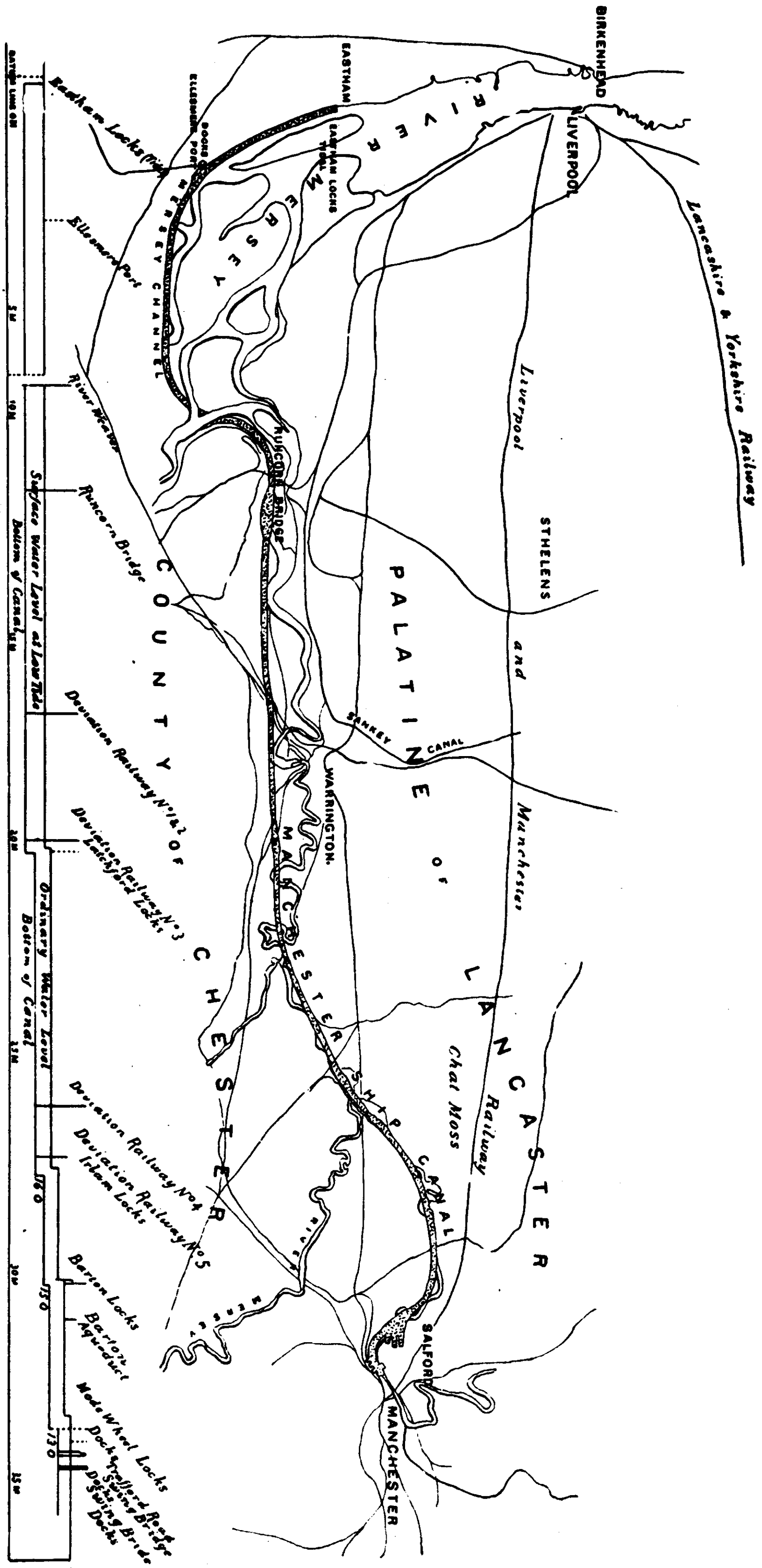
The docks at Warrington, twenty-two acres and a half in extent, will have a railroad connection with the London and North-Western and the Great Western Railway, which will bring a large coal and general traffic.

At Runcorn, at the head of the Mersey estuary, the docks belonging to the Bridgewater Canal Navigation, having been purchased by the Manchester ship canal, will always be accessible, instead of being entered only at spring tides as hitherto; the local trade advantages here, as well as those of the docks at Weston Point, for the Weaver navigation, have already been noticed.

The ship canal will be entered from the sea, or rather from the Mersey estuary, about four miles above Birkenhead, by the tidal locks at Eastham, all the gates of which will be open at high tides. The sills of these entrances will be 11 feet lower than the deepest dock sills at Liverpool or Birkenhead; and the channel approaching them will be dredged 3 feet deeper than the lock sills.

One of the great causes of expense has been the erection or reconstruction of railway bridges crossing the canal, each at a high elevation, to give a clear headway of 75 feet above the water, and with the approach lines of railway to rise by moderate gradients on each side. The Cheshire Lines Railway at Irlam, the Wigan Junction line, the Warrington and Stockport line, the Grand Junction line at Warrington, and the London and North-Western Railway at Runcorn, must be treated with such costly alterations. The Barton aqueduct of the Bridgewater canal across the Mersey is replaced by an opening swing bridge, which is an iron trough, closed at each end when the bridge is opened, to contain the water of the Bridgewater canal, held thus safely above the level of the ship canal. There will be hydraulic lifts by which laden barges can easily be transferred from the one canal to the other. The locks on the ship canal are not single, but each set of locks has receptacles of different sizes for vessels of different classes, to avoid the waste of water in using a lock much larger than the size of the vessel requires. The canal level descends 16 ft. at the Trafford locks, near Manchester, 14 ft. at the Barton locks, 14 ft. at the Irlam locks, again at Latchford, 16 ft. more, and finally at Eastham, to the level of the sea. The largest lock at Eastham is 600 feet long and 80 feet wide.

The line of the canal is cut through flat country, marsh meadows chiefly, pretty straight beyond the junction of the Irwell and Mersey, avoiding the many windings of those rivers, which are generally turned into a new artificial channel, somewhat to the south of the old left bank of each river. In a few places only, on the Mersey, where the ground is higher, the cuttings are 50 ft. deep, partly through sandstone, which has been utilized for the construction of walls, and here the sides of the canal, being of rock, are made more perpendicular than in the softer ground. The whole quantity of earth and stone to be excavated has been computed at forty-eight millions of cubic yards, which is more than the quantity of excavation required for the Panama ship canal, including the Culebra hill cutting; but the undertaking of M. De Lesseps had other difficulties to contend with, in the dam of the river Chagres. Mr. Walker, the contractor for the Manchester ship canal, set to work as large a number of men, not negroes, but English "navvies," with more numerous and powerful machines, and with about one-tenth the expenditure of money. It is stated that nearly 15,000 hands were at one time employed, with eighty steam excavators of four different kinds, pumping engines, steam cranes, and 150 locomotives, for



THE MANCHESTER SHIP CANAL—LONGITUDINAL SECTION FROM EASTHAM TO MANCHESTER.

which 200 miles of railway were laid down to remove the earth.

We give herewith a map of the Manchester canal and illustrations of some of the locks.

As originally designed, the canal was to extend several miles into the Mersey, and it was upon the effect of this extension that Mr. James B. Eads, of St. Louis, gave an opinion which was conclusive to Parliament that the works built as designed would lead to the deterioration of the channel over the bar at Liverpool. His argument on this subject, with the illustrations drawn from maps and notes, some of which were a century old, is one of the best engineering papers extant, and was so conclusive to the minds of the Parliamentary committee that the plan was thrown out immediately. It was for this, on which he spent about three weeks' time, he received probably the largest professional fee ever received by an American engineer, at least for an equal time spent on any subject, namely, nearly $17,000.—*Scientific American.*

A FEW WORDS TO THE APPRENTICE.

Every boy starting out in seeking a trade, must take into consideration the one thought, and that is, he must expect to commence at the bottom of the ladder, and do his best to reach the top by strict attention to the instructions given by older heads at the business. Boys are apt to know more in a few weeks or months than those to whom they must look for instructions. Our advice to the apprentice would be for him to be careful and willing to do everything that he is told, and by so doing he will find that he will make friends and have no trouble in getting along with his trade. We must admit that all boys are not alike; some boys seeking a trade have a determination to master the art, knowing at the same time that they must depend on this trade for future support, and for this reason expect to master the trade. We like a boy of this stamp, and would take great delight in giving him all the instructions to aid him to accomplish the desire of his heart.

There is a vast difference between the apprentice of twenty-five years ago and the one of to-day; the boy of to-day comes and goes like the journeyman; the one of bye-gone days had all his cleaning to do, such as sweeping, etc., after the men had gone, so that the shop would be in proper condition in the morning when the men arrived for their daily work. We think apprentices have a much easier time now than they had years ago, because there is nothing binding them like the old indentured apprentice. For all this, our sympathy goes out for the boy who has the push and determination to have a trade, and we will venture to say the boy of this stamp will be master of the situation. There are several points to consider: He must do willingly what he may be given to do, by taking into thought nicety and neatness; if it should take him much longer to accomplish it than some one else doing the same piece of work, it would be better to go slow and do his work neatly, and get speed after accomplishing the desired object; and whatever may be given him to do, it will require some one to instruct him, and this information should be given in kindness. Many willing boys have been ruined and made worthless in the shop by sour, grumbling journeymen who did not care to have the boys under them. We will venture to say that kindness will win any boy so that he will do anything that is possible for him to do.

The apprentice must be a close observer, and glean all he can from others around him, and be ready at any time to ask for information regarding his work; not be over-anxious to have his work done because he has had the same kind of work before. If it should be a back or cushion, he will find the more of them he makes the more perfect he will become in that part of the trimming.

Another important part for the apprentice; he must be supplied with the proper tools to work with, so that he will not have to depend on others in the same room with him; by having his own tools, he will be more apt to have more freedom in his work, and do more than if he were depending on others for implements to do his work with.

The apprentice may imagine he has a hard time while learning his trade, because he has to do many things that are not agreeable to him; but we all, old and young, have to pass through many disagreeable things in this life, and the apprentice can make his years shorter in his trade, learning, by willingness on his part, to do all that is given to him the best he can, trying to improve on every task he has to do, and not be backward in asking for any information pertaining to his work; and, last of all, he must be on time and always at his post to commence his work when the signal is given, and not over-anxious for the day to pass away quickly, so that he can attend to some other hobby that would deter him in his trade and make him sorry for it in after-years.

A HANDY COPYING PRESS.

To those who find it necessary to retain copies of letters and other documents, the following inexpensive method, suggested by a clerk in one of the Supreme Courts, is worthy at least of a trial. As will be observed, it dispenses with the necessity of using a copying press.

All that is necessary is a single sheet of plain white blotting-paper, which, after undergoing the following process, will make it available for making as many clear and distinct copies as would be necessary for all ordinary purposes:—Soak 4 parts of the best glue in a mixture of 5 parts of pure water and 3 parts of ammonia liquor, until the glue is dissolved, and add 3 parts of granulated sugar and 8 parts of glycerine, stirring the mixture well and letting it come to the boiling point. While it is hot, paint it with a broad brush on clear, white blotting-paper, until the latter is thoroughly soaked and a thin coating remains on the surface. Let dry for two or three days. The writing to be copied must be done with ordinary aniline ink; and to transfer it the blotting-paper should be wet with a sponge, and then, after it has stood for a minute or two, the letter should be pressed down softly upon the damp surface. After a few moments it can be taken off, and there will be an impression on the blotting-paper, from which several copies can be taken, and which can be partially renewed when the impression grows faint, by dampening the blotting-paper again. This process can be repeated at intervals with beneficial results.

ELECTRICAL

The large double-decked cars, a description of which was given in our columns last month, have been working with great success on the roads of the West-End Electric Railway Co. of Boston, and orders for more have been promptly filled by the Pullman Co.

If American firms could only understand the ways of our rigorous Customs, a great amount of trouble would be saved to Canadian purchasers. Complaints have been raised by several prominent electrical firms, and they but echo the sentiments of many more. It may be well, therefore, to mention that two certified invoices should be sent with the shipment of all goods whether taken through or in bond. One invoice should be marked certified and correct, and signed by the shipping firm for the Custom House, and the other similarly certified for the purchaser. Should this be followed, a great deal of trouble and worry would be avoided. We do not propose here to enter into a description of the endless amount of annoyance caused by the tardy way in which invoices are sent, but merely point out to any of our readers who may be more or less employed in shipping goods to Canada, that if they wish to continue the trade with their Canadian cousins, they must send the invoices promptly, and duly certified.

We publish in this month's issue of our Magazine a very interesting article on "A few Suggestions for Amateur Electricians," by Mr. Wm. B. Shaw, whose interesting papers have appeared more than once in our columns. Mr. Shaw makes some very valuable suggestions, and gives timely advice to the amateur in regard to the limited use of the primary battery. Our experience teaches us that too many are apt to rush heedlessly into electricity. They make some motor, perhaps, which they will never stop to consider how to run, believing in the use of some bichromate cell which, when tried, almost always proves unsatisfactory. It would be a good thing if they would save about half the time wasted on primary batteries, and turn it to reading upon the subject. Far more would be accomplished, and certainly much valuable time saved to the patient salesman now so often uselessly questioned. Not that we would for one moment check the spirit of amateur research, but anything can be carried to excess. Mr. Shaw speaks of the storage cell as a good means of obtaining power. It certainly is when properly cared for, but there is nothing so deplorable as a storage cell in the hands of one who does not understand it. An amateur would be doing well to procure a couple of good storage cells and a few bluestone cells with which to charge them, obtaining, however, particulars from the dealer as to their care. Such a plant would prove a very interesting addition to the laboratory of an amateur electrician, and would be found quite adequate to operate small toy motors and a few one or two candle-power lights.

A SUBSTITUTE FOR GERMAN SILVER.

The discovery of a substitute for german silver has been the result of a long list of experiments conducted by Mr. A. H. Coroles. This gentleman has endeavored to produce a wire which will afford the electrician a better and cheaper substitute for german silver in the construction of the rheostat. The alloy contains 18 parts of Manganese; 1·2 parts of Aluminium; 5 parts of Silicon; 13 parts of Zinc; and 67·5 parts of Copper. It has a tensile strength of 57,000 lbs. on small bars and 20 per cent. elongation.

A NEW PRIVATE PLANT IN QUEBEC.

A plant has just been completed in the premises of Z. Paquet, Dry Goods Merchant, Quebec.

The installation was in charge of W. B. Shaw, electrician for T. W. Ness, Montreal.

A "Wenstrom" machine, furnished by the Ball Co. of Toronto, was used.

The dynamo is of the 4 pole type and is remarkably "slow speed," giving 225 amperes of current at 110 volts potential with only 485 revolutions.

"Swan" & "Zurich" lamps were principally used; 4 green lamps illuminate the star shaped windows of the tower in the new building; while the 2 newel posts at the foot of the stairs on the ground flat are each supplied with 3 light fixtures carrying red, white, and blue lamps in order. The switchboard is of polished natural cherry, complete with ampere and volt meters, and 4 double pole "Hill" switches controlling 4 different circuits.

Two hundred and eighty lamps are now running, and the remainder of the 450 (the dynamo's capacity) will be placed in the Spring after alterations to the old premises.

The engine and boilers were supplied by Carrier-Lainé, of Levis, P. Q.

The engine is also running a 35 light T. & H. arc machine, the lights from which being distributed throughout the ground floors and front of the premises.

INCANDESCENT LAMPS AND THE EYES.

It is becoming quite the fashion now for doctors to discuss the evil effects of the electric light on the eye sight, and all sorts of paragraphs are going the rounds of the daily press describing the injuries to their sight that people have suffered from the use of the incandescent lamp. There would be very little of this talk if people would only use a little common sense in the matter. Many think that because an incandescent lamp does not give out much heat and will not singe their whiskers or their hair, that they must have the lamps right under their nose or half a foot away from their eyes and directly level with them. This sort of thing would be injurious even with a glow worm lamp, if there were such things. Incandescent lamps need to be properly placed and shaded so as not to cast their rays directly on the eyes, and if these very simple precautions were carried out, there would be no need for the silly talk about the injurious effect of the electric light on the eyesight.—*World's Progress.*

PICTORIAL TELEGRAPHY.

The advent of the telephone, which enabled us not only to converse through hundreds of miles of wire, but to recognise the voices of our friends, and the report of a few years ago that one's autograph could be faithfully reproduced at the distant end of a line (now an accomplished fact), set us all to wondering if the time would not come when we should see by electricity. On account of the subtlety of the light vibrations, compared with which those of sound are crude, it seems exceedingly improbable that the latter will ever be accomplished. But there has recently been invented a process by which photographs can be transmitted to any distance and reproduced at the further end in the form of half tones, similar to the photographic reproductions so much used in illustrated journals. This process is the invention of Mr. N. S. Amstutz, of Cleveland, O., and is known as the Electro Artograph.

The process is founded on the use of undulatory or varying currents of electricity, somewhat on the principle of the telephone—the transmitting instrument being actuated indirectly by the varying degrees of light instead of by sound waves, as with the telephone transmitter. To send a view or a portrait it is photographed on what is known as a "stripping film," composed of gelatine and bichromate of potassium. This mixture, as is well known, is sensitive to light, becoming exceedingly hard and insoluble when exposed, but readily dissolved where shielded from the light. A picture having been taken on a film of this kind, either by exposure in a camera, or, preferably, by printing through a negative, it is carefully washed with lukewarm water, which removes the portions not acted on by light, and leaves the other portions in relief. So far, there is nothing new in this process, which has long been used for newspaper work, and forms no part of Mr. Amstutz's invention. By this operation the amount of relief is in exact proportion to the light which has acted upon the gelatine, and there is produced a variable surface representing in elevation all the variations of light and shade of the picture.

This film is now stripped from the glass plate and mounted upon a sheet of celluloid, which is wrapped around a perfectly true cylinder, mounted on trunnions, so as to permit of revolution. In front of the cylinder is placed a bar, upon which rides a carriage containing a tracing point, which bears lightly upon the gelatine print, just as does the stylus of the phonograph upon the wax cylinder. In the latter the needle trips over the indentations produced in the wax by sound waves, and reproduces them in kind. In the former it rises and falls according to the greater or less relief due to the varying degree of light to which the film has been exposed, and by so doing varies, in a corresponding degree, the intensity of the electric current which actuates the receiving instrument. Thus far the analogy is very close to a telephonic transmitter, actuated mechanically by the

PICTORIAL TELEGRAPHY.—FIG. I.

diaphragm of a phonograph. It is clear that if this current can be caused to vary exactly as the elevations over which the stylus passes, the varying strength of the current at the distant point, if plotted, would be an exact fac-simile of the path described by the needle, or, as engineers would say, it would reproduce the profile of the path originally described. Now a single line does not make a picture, although it may form one element of a picture, as it does in this case. To transmit the picture, therefore, the whole of the gelatine film is gone over, the stylus describing a spiral around the cylinder with its returning paths quite close together, just as the phonograph stylus describes a spiral from end to end of the wax cylinder, and this is accomplished in exactly the same way.

Now, if the carbon button, which permits of sufficient variation in current for the transmission of speech, permitted of sufficient variation for this purpose, there would probably be no better way of varying the current than by its use, but carbon has not this flexibility, and Mr. Amstutz had recourse to another method. The "tracer," as he calls his stylus, is mounted upon a lever, which largely multiplies its up and down movement. This engages with a series of levers mounted on a common shaft, the further ends of these levers being platinum pointed, and serving, when depressed, to connect the source of current with the line wire. The current enters the machine through this common, or tappet shaft, as it is called, and passes to line through the one or more contact points that happen to be depressed into contact with a plate connected with the line wire.

Reduction of Fig. 1 made after Transmission

The action is this: Supposing the tracer were on a point of highest relief, only one of these levers would be depressed and the current would have but a single contact to pass through. Supposing, now, the tracer came across a place with slightly less relief, a second lever would be depressed, decreasing the resistance and permitting more current to pass, and so on until on passing a point of lowest elevation on the gelatine print, all of the levers would be depressed, reducing the resistance to the minimum and permitting the maximum current to pass. Of course, the more of these levers there are the more gradual the variation of current strength sent over the line. The number of these levers or tappets is not limited, but may be anywhere from two to fifteen or twenty, or more, according to the character of the work to be done. The larger the number, the greater the accuracy of the reproduction. For long-distance transmission, especially for newspaper work, a large number of tappets is not desirable, since the degree of delicacy obtained thereby would certainly be lost on the rough paper and in the rapid press work to which it would be subjected; for all practical purposes a less number of tappets would produce equal results in this kind of work. Furthermore, the adjustment of the sending machine to the varying thicknesses of different gelatine prints does not affect in any manner the receiving machines, so that a picture sent with great delicacy may be received in the newspaper office in sufficiently crude form for its purposes, whereas another machine connected with the same wire and receiving the picture at the same time could reproduce it with the same delicacy with which it was sent—all depending upon the adjustment of the receiving instrument.

The receiving machines are duplicates of the sending machines as far as the cylinder, the carriage, feed, &c., are concerned—the only difference being the graving arm, which is depressed by an electro-magnet whose strength varies as the current by which it is excited. It is clear that when the transmitting instrument is passing over a low place in the gelatine film, and all the contacts are down, permitting the maximum current to pass, the electro-magnet of the receiving instrument will be at its maximum strength, and the graving tool correspondingly pressed on the receiving matrix, and *vice versâ*. The receiving cylinder is wrapped with paper covered with a suitable thickness of hard wax. This wax is turned off by a turning tool preparatory to use, just as is the cylinder of the phonograph, and when the impression is complete the waxed paper cylinder is removed, cut longitudinally and rolled out flat, and is ready for the electrotypers.

Pictorial Telegraphy—Fig. 3.

As an illustration of the manner in which a picture is received, let us assume an hypothetical case. Suppose the wax used to be white and we color its surface black. Suppose the cylinder to be started and the graving tool but slightly depressed. A very delicate white line with slight depth will be traced. If the same pressure be maintained for several revolutions, there will appear a series of delicate white lines running closely parallel to each other. Now suppose the tracer on transmitting instrument to be passing over a portion of the gelatine print of greater depth, more current would be transmitted, and the triangular shaped graving tool would cut deeper into the wax, the white line would be broadened and the intervening black line made correspondingly narrower. A step further; when the tracer is passing over those portions of the film that are not intended to print at all, the graving tool will be buried so deeply in the wax as to cut away the black entirely, and in the electrotype made from this matrix this portion would be entirely cut away, so as not to print at all, thus producing in metal a line fac-simile of the gelatine relief from which it was originally produced. Thus it is seen that by variations in pressure of the graving tool all the gradations of light and shade found in the picture on the transmitting instrument may be faithfully reproduced on the receiving cylinder, and then in metal by the electrotype process.

Mr. Amstutz has also succeeded in reproducing impressions in papier maché directly from the wax, so that the engraving can be directly stereotyped in the ordinary manner.

PICTORIAL TELEGRAPHY—FIG. 4.

The time occupied in transmitting an ordinary column-wide illustration need not exceed eight or ten minutes, and the stereotyping of the reproductions should not occupy more than a few minutes more, so that the reproduction can be placed upon the newspaper printing presses along with the press despatches descriptive of the subject to be illustrated.

By a system of gears on both the transmitting and receiving instruments, it is possible to change the size of the picture at either end of the line. That is to say that a picture can be transmitted either larger, the same size, or smaller; and at the receiving end, if there be several instruments, they may each reproduce it on a different scale. Of course much greater accuracy is attained if large originals are used and they are reproduced on a smaller scale.

A single transmitting instrument is capable of actuating a large number of receivers at different points; thus the same picture may be simultaneously reproduced at a number of widely-scattered news centres.

If it is desired to send hand sketches, a process has been devised by which a special artist can make his sketches "on the spot" by suitable washes, preserving all the half-tones that he may deem necessary to the correct pictorial representation, and upon the completion of the sketch it is wrapped round a transmitting cylinder, and by a simple adjustment of the tracer, the machine can be left to itself until the whole picture has been transmitted to its destination, where it is automatically reproduced, a complete line engraving.

It is claimed for this process that the depth of engravings can be increased over 100 per cent, above that reached by the deepest half-tone engravings, thus adapting the work to uses for which the latter, on account of their shallowness, are unsuited.

Besides the use of wax as a receiving substance, Mr. Amstutz says it is quite possible to engrave directly on metal; and he expects to find large application of his device for reproducing portraits, photographs, and conventional designs, both singly and in multiplicate, on silver and other metal ware, principally at local points.

We have been fortunate in securing some of the very first results of the work of the Electro-Artograph, which show better than the more finished productions the operation of this process. Each of these was transmitted a distance of 20 miles over a single wire with a 110-volt current. These cuts will increase in interest as the years go by, and are therefore worthy of preservation.

The latest addition that Mr. Amstutz has made to his invention is a system using alternating currents, by which it is possible to carry on pictorial transmissions over very long distances.—*Electricity, N. Y.*

CORRESPONDENCE.

THE EDISON-LALANDE CELL A FAILURE.

MONTREAL, Jan. 6th.

Editor Electrical Department
CANADIAN MAGAZINE OF SCIENCE:—

DEAR SIR,—I note a letter in a prominent weekly electrical journal, issued in New York (Jan. 2nd), *re* "Primary Batteries and Motors for Sewing Machines." The writer of same is replying to another who complains of their low efficiency (primary batteries) and expensive maintenance. The reply urges the complainant to try the Edison-Lalande cell. I have handled nearly every type made of E.-L. cells, and from practical experience I would say "don't."

I positively deny the statement that there is no local action going on in the cells when not in use, for I have had zincs eat through and drop off when left *continually on open circuit.*

I was told the fault lay in not having oil enough on top of the potash solution; this also I proved was not the nature of the trouble by setting up an experimental set of 4 cells with different thicknesses of oil layers.

I went so far as to try painting some of the zincs with asphaltum, and others with shellac, at the solution line; this not even producing any marked benefit.

As motors is the question at issue, I will note the cost of renewals in their type M (motor model) cell :—

Per cell.	2 outer zinc plates........	.42	.... capacity 1 charge.
	1 inner " "	.38	.... " " "
	4 cop. ox. "	1.84	.... " 2 "
	Potash....................	.52	.... " 1 "
	Oil........................	.08	.... " 1 "
		$3.24	

Life = 600 Ampere Hours.
Max. Rate of Discharge = 20 Amperes.

The usual $\frac{1}{8}$ H.P. sewing machine motor, 4 to 6 volts, would draw 18 amperes of current, consequently would give 33$\frac{1}{3}$ hours steady work ; then all but the copper oxide plates would require renewal, and the next renewal again would embrace the copper oxide plates as well.

As an E.M.F. of 8-10 volt per cell is all that can be depended on, about 7 cells would be required.

List price of cell complete, $6.75 = $47.25.

Query No. 1.—What did the sewing machine itself cost originally ?

It is stated that the E.-L. cells might be placed in the cellar and "heavy leads" (! !) run up to the room where sewing machine is located.

Query No. 2.—Required size of leads to carry a current of 18 amperes at an E.M.F. of 6 volts, at no loss, a distance of 50 feet (approx.)

(Size of E.-L. cells in question, 7″ x 13″ each).

By comparing the above with my remarks on "Electricity for Amateurs," in this issue, I think it will be found more practicable and economical all round to place, say, 8 bluestone cells in the cellar, connecting same by means of 2 No. 18 B. and S. gauge annunciator wires to two neatly boxed and sealed accumulators in the room.

Accumulator size, each, 7$\frac{1}{2}$″ x 5$\frac{3}{4}$″ x 9″.

The bluestone cells would cost about 90c each ; bluestone for re-charging same about 8c. per lb.

Heat evolved by the dissolving potash in the E.-L. cells not unfrequently causes a breakage of the jar. This does not occur in the accumulator, and the latter is being *constantly* filled by the bluestone cells (although slowly), so long as bluestone is supplied to them when needed.

The E.-L cell has good practical points, and is a cell demanded, but its present form will not give satisfaction to the consumer ; what the trouble is, exactly, I am not competent to state, but imagine it to be impurities in the potash ; varying strength of same, and too much used per cell.

Yours very truly,

W. B. SHAW.

EXPLANATION OF ELECTRICAL WORDS, TERMS, AND PHRASES.

(From Houston's Dictionary.)

Carcel.—The light emitted by a lamp burning 42 grammes of pure colza oil per hour, with a flame 40 millimetres in height.

One carcel = 9.5 to 9.6 standard candles.

Carcel Lamp.—An oil lamp employed in France as a photometric standard.

Fig. 81 shows a form of carcel lamp.

Carcel Standard Gas Jet.—A lighted gas jet employed for determining the candle power of gas by measuring the height of a jet of gas burning under a given pressure, and used in connection with the light of a larger gas burner, burning under similar conditions, for the photometric measurement of electric lights.

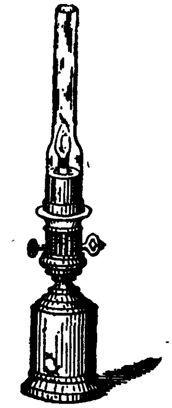


FIG. 81.

In Fig. 82, is shown a section of a *seven-carcel standard gas jet*, and, in Fig. 83, a section of a "*candle burner*," connected with the same service pipe. The gas for both burners is received in a chamber from whence it passes by an opening to the burner under the constant pressure obtained by the weight of the bell C, and the tube A The burner shown in Fig. 83, which is used as the standard of comparison, will give a candle power determined from the height of the jet of the burning gas. This height is measured in millimetres by a movable circular screen.

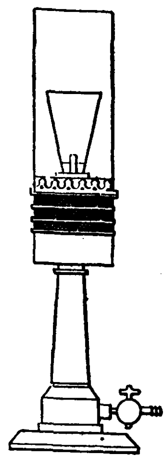


FIG. 82.

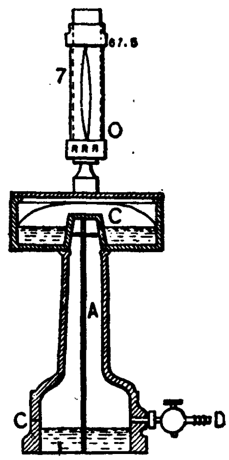


FIG. 83.

The determination of the candle power of gas by means of a jet photometer is only approximately correct, unless many precautions are taken.

Cascade, Charging Leyden Jars by.—A device for charging jars or condensers by means of the free electricity liberated by induction in one coating, when a charge is passed into the other coating.

The jars are placed with the inside coating of one jar connected with the outside coating of the one next it. There is in reality no increase in the entire charge obtained by the use of charging by cascade since the sum of the charges given to the separate jars is equal to the same charge given to a single jar separately charged.

The energy of the discharge in cascade can be shown to be less than that of the same charge when confined to a single jar.

Cathion.—A term sometimes used instead of Kation. More correctly written Kathion.

Cathode.—A term sometimes used instead of Kathode. More correctly written Kathode.

Cautery, Electric or Galvano-Cautery.—In electro therapeutics, the application of platinum wires of various shapes, heated to incandescence by the electric current, and used, in place of a knife, for removing diseased growths, or for stopping hemorrhages.

The operation, though painful during application, is afterwards less painful than that with a knife, since secondary hemorrhage seldom occurs, and the wound rapidly heals.

Galvano-cautery is applicable in cases where the knife would be inadmissible owing to the situation of the parts or their surroundings.

Cell, Voltaic.—The combination of two metals, or of a metal and a metalloid, which when dipped into a liquid or liquids called electrolytes, and connected outside the liquid by a conductor, will produce a current of electricity.

Different liquids or gases may take the place of the two metals, or of the metal and metalloid.

Plates of zinc and copper dipped into a solution of sulphuric acid and water, and connected outside the liquid by a conductor, form a simple voltaic cell.

If the zinc be of ordinary commercial purity, and is not connected outside the liquid by a conductor, the following phenomena occur :—

(1) The sulphuric acid or hydrogen sulphate, H_2SO_4, is decomposed, zinc sulphate, $ZnSO_4$, being formed, and hydrogen, H_2, liberated.

(2) The hydrogen is liberated mainly at the surface of the zinc plate.

(3) The entire mass of the liquid becomes heated.

If, however, the plates are connected outside the liquid by a conductor of electricity, then the phenomena change and are as follows, viz.:—

(1) The sulphuric acid is decomposed as before, but

(2) The hydrogen is liberated at the surface of the copper plate only.

(3) The heat no longer appears in the liquid only, but also in all parts of the circuit, and

(4) An electric current now flows through the entire circuit, *and will continue so to flow* as long as there is any sulphuric acid to be decomposed, or zinc with which to form zinc sulphate.

The energy which previously appeared as heat only, now appears as electric energy.

Therefore, although the mere contact of the two metals with the liquid will produce a difference of potential, it is *the chemical potential energy,* which become *kinetic* during the chemical combination, that supplies the energy required to maintain the electric current.

Simple Voltaic Cell.—A simple voltaic cell consists of two plates of different metals, or of a metal and a metalloid (or of two gases, or two liquids, or of a liquid and a gas), each of which is called a *voltaic element,* and which, taken together, form what is called a *voltaic couple.*

The *voltaic couple* dips into a liquid called an *electrolyte,* which, as it transmits the electric current, is decomposed by it. The elements are connected outside the electrolyte by any conducting material.

Direction of the Current.—In any voltaic cell the current is assumed to flow *through the liquid,* from the metal most acted on to the metal least acted on, and *outside the liquid,* through the outside circuit, from the metal least acted on to the metal most acted on.

In Fig. 85, a *zinc-copper* voltaic couple is shown, immersed in dilute sulphuric acid. Here, since the zinc is dissolved by the sulphuric acid, the zinc is positive, and the copper negative in the liquid. The zinc and copper are of opposite polarities out of the liquid.

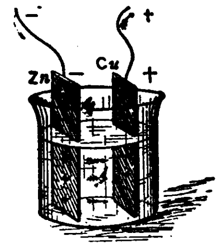


FIG. 85.

It will of course be understood that in the above sketch the current flows only on the completion of the circuit outside the cell, that is, when the conductors attached to the zinc and copper plates are electrically connected.

Amalgamation of the Zinc Plate.—When zinc is used for the positive element, it will, unless chemically pure, be dissolved by the electrolyte when the circuit is open, or will be irregularly dissolved while the circuit is closed, producing currents in little closed circuits from minute voltaic couples formed by the zinc and such impurities as *carbon, lead,* or *iron,* etc., always found in commercial zinc. As it is practically impossible to obtain chemically pure zinc, it is necessary to *amalgamate* the zinc plate, that is, to cover it with a thin layer of zinc amalgam.

Polarization of the Negative Plate.—Since the evolved hydrogen appears at the surface of the negative plate, after a while the surface of this plate, unless means are adopted to avoid it, will become coated with a film of hydrogen gas, or as it is technically called, will become polarized.

The effect of this polarization is to cause a falling off or weakening of the current produced by the battery, due to the formation of a *counter-electro-motive force* produced by the hydrogen-covered plate ; that is to say, the negative plate, now being covered with hydrogen, a very highly electro-positive element, tends to produce a current in a direction opposed to that of the cell proper.

In the case of *storage cells,* this counter-electro-motive force is employed as the source of *secondary currents.*

In order to avoid the effects of polarization in voltaic cells, and thus ensure constancy of current, the bubbles of gas at the negative plate are mechanically carried off either by roughening its surface, by forcing the electrolyte against the plate as by shaking, or by a stream of air ; or else the negative plate is surrounded by some liquid which will remove the hydrogen, by entering into combination with it.

Voltaic cells are therefore divided into cells with one or with two fluids, or electrolytes, or, into

(1) Single-fluid cells, and

(2) Double-fluid cells.

Very many forms of voltaic cells have been devised. The following are among the more important, viz.:—

SINGLE-FLUID CELLS.

The Grenet, Poggendorff, or Bichromate Cell.—A *zinc-carbon* couple used with an electrolyte known as *electropoion,* a solution of bichromate of potash and sulphuric acid in water.

The zinc, Fig. 86, is amalgamated and placed between two carbon plates. The terminals connected with the zinc and carbon are respectively *negative* and *positive*. In the form shown in the figure, the zinc plate can be lifted out of the liquid when the cell is not in action.

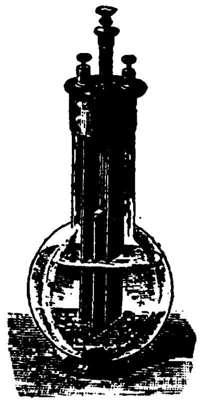


FIG. 86.

The bichromate cell is excellent for purposes requiring strong currents, where long action is not necessary. As this cell readily polarizes, it cannot be advantageously employed for any considerable period of time. It becomes depolarized, however, when left for some time on open circuit.

The following chemical reaction takes place when the cell is furnishing current, viz.:—

$$K_2Cr_2O_7 + 7H_2SO_4 + 3Zn = K_2SO_4 + 3ZnSO_4 + Cr_23(SO_4) + 7H_2O.$$

This cell gives an electro-motive force of about 1.987 volts.

The Smee Cell.—A *zinc silver* couple used with an electrolyte of dilute sulphuric acid, H_2SO_4.

The silver plate is covered with a rough coating of metallic platinum, in the condition known as *platinum black*. This cell was formerly extensively employed in *electro-metallurgy*, but it is now replaced by *dynamo-electric machines*.

A *zinc-carbon* couple is sometimes used to replace the *zinc-silver* couple. A couple of *zinc-lead* is also used, though not very advantageously.

The Zinc-Copper Cell.—A *zinc-copper* couple used with dilute sulphuric acid.

This was one of the earliest forms of voltaic cells.

In the zinc-silver, or the zinc-copper couple, the chemical reaction that takes place when the cell is furnishing current is as follows, viz.:—

$$Zn + H_2SO_4 = ZnSO_4 + H_2.$$

The Smee cell gives an electro-motive force of about .65 volts.

DOUBLE-FLUID CELLS.

Grove's Cell.—A *zinc-platinum* couple, the elements of which are used with electrolytes of sulphuric and nitric acids respectively.

The zinc, Z, Fig. 87, is amalgamated and placed into dilute sulphuric acid, and the platinum, P, into strong *nitric acid* ($H\ NO_3$), placed in a *porous cell* to separate it from the sulphuric acid. In this cell the current is moderately constant, since the polarization of the platinum plate is prevented by the nitric acid that oxydizes and thus removes the hydrogen that tends to be liberated at its surface. The constancy of the current is not maintained for any considerable time, since the two liquids are rapidly decomposed, or consumed, zinc sulphate forming in the sulphuric acid, and water in the nitric acid.

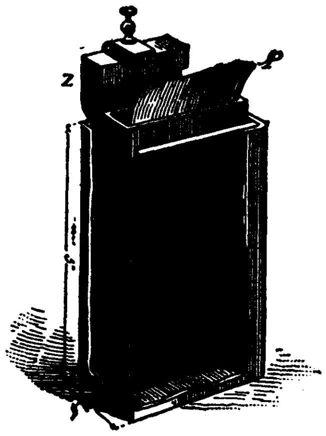


FIG. 87.

The chemical reactions are as follows, viz.:—

$$Zn + H_2SO_4 = Zn\ SO_4 + H_2\ ;$$
$$6H + 2H\ NO_3 = 4H_2O + 2NO\ ;$$
$$2NO + O_2 = N_2O_4.$$

This cell gives an electro-motive force of 1.93 volts.

Bunsen's Cell.—A zinc-carbon couple, the elements of which are immersed respectively in electrolytes of dilute sulphuric and strong nitric acids.

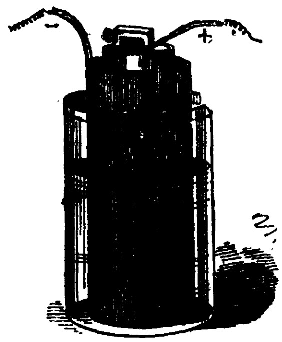


FIG. 88.

Bunsen's cell is the same as Grove's except that the platinum is replaced by carbon. The zinc surrounds the porous cell containing the carbon. The polarity is as indicated in Fig. 88.

The Bunsen cell gives an electro-motive force of about 1.96 volts.

Daniell's Cell.—A *zinc copper* couple, the elements of which are used with electrolytes of dilute sulphuric acid, and saturated solution of copper sulphate respectively.

The copper element is made in the form of a cylinder *c*, Fig. 89, and is placed in a porous cell. The copper cylinder is provided with a wire basket near the top, filled with crystals of blue vitriol, so as to maintain the strength of the solution while the cell is in use. The zinc is in the shape of a cylinder and is placed so as to surround the porous cell. This cell gives a nearly constant electro-motive force.

The constancy of its action depends on the fact that for every molecule of sulphuric acid decomposed in the outer cell, an additional molecule of sulphuric acid is supplied by the decomposition of a molecule of copper sulphate in the inner cell. This will be better understood from the following reactions which take place, viz.:—

$$Zn + H_2SO_4 = Zn\ SO_4 + H_2$$
$$H_2 + Cu\ SO_4 = H_2SO_4 + Cu.$$

The H_2SO_4, thus formed in the inner cell, passes through the porous cell, and the copper is deposited on the surface of the copper plate.

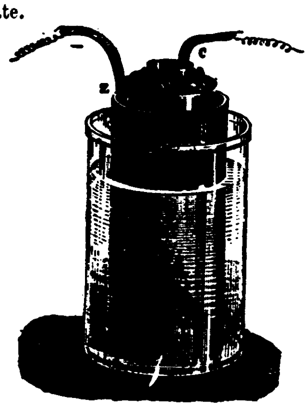


FIG. 89.

The Daniell's cell gives an electro-motive force of about 1.072 volts.

A serious objection to this form of cell arises from the fact that the copper is gradually deposited over the surface and in the pores of the porous cell, thus greatly varying its resistance.

Callaud's Gravity Cell.—A zinc-copper couple, the elements of which are employed with electrolytes of dilute sulphuric acid, or dilute zinc sulphate, and a concentrated solution of copper sulphate respectively. This cell was devised in order to avoid the use of a porous cell. As its name indicates, the two fluids are separated from each other by gravity.

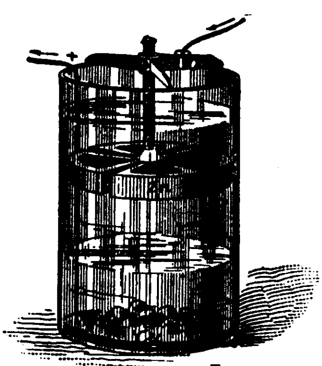


FIG. 90.

The copper plate is the lower plate, and is surrounded by crystals of copper sulphate. The zinc, generally in the form of an open wheel, or crowfoot, is suspended near the top of the liquid, as shown in Fig. 90.

The reactions are the same as in the Daniell cell.

A dilute solution of zinc sulphate is generally used to replace the dilute sulphuric acid. It gives a somewhat lower electro-motive force, but ensures a greater constancy for the cell.

The Leclanché Cell.—A *zinc-carbon* couple, the elements of which are used with a solution of sal-ammoniac, and a finely-divided layer of black-oxide of manganese respectively.

The zinc is in the form of a slender rod and dips into a saturated solution of *sal-ammoniac*, NH_4Cl.

The negative element consists of a plate of carbon, C, Fig. 91, placed in a porous cell, in which is a mixture of black-oxide of manganese and broken gas-retort carbon, tightly packed around the carbon plate. By this means a greatly extended surface of carbon surrounded by black-oxide of manganese, $Mn\ O_2$, is secured. The entire outer jar, and the spaces inside the porous cell, are filled with the solution of sal-ammoniac. This cell, though containing but a single fluid, belongs, in reality, to the class of *double-fluid cells*, being one in which the negative element is surrounded by an oxidizable substance, the black-oxide of manganese, which replaces the nitric acid, or copper sulphate, in the preceding cell.

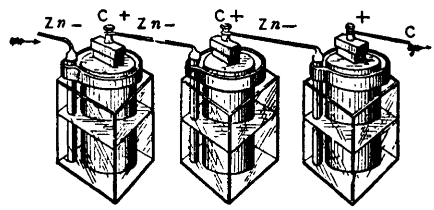


FIG. 91.

The reactions are as follows, viz.:—

$$Zn + 2(NH_4\ Cl) = Zn\ Cl_2 + 2NH_3 + H_2.$$

The $Zn\ Cl_2$ and NH_3 react as follows :—

$$Zn\ Cl_2 + 2(NH_3) = (2NH_2)\ Zn\ Cl_2 + H_2.$$
$$2H + 2(Mn_2\ O_2) = H_2\ O + Mn_2\ O_3,$$
$$\text{or, possibly, } 4H + 3Mn\ O_2 = Mn_3\ O_4 + 2H_2\ O.$$

The Leclanché cell gives an electro-motive force of about 1.47 volts. It rapidly polarizes, and cannot, therefore, give a steady current for any prolonged time. When left on open circuit, however, it rapidly depolarizes.

Of all the voltaic cells that have been devised two only, viz., the *Gravity* and the *Leclanché*, have continued until now in very general use. The gravity cell being used on *closed-circuit lines* and the *Leclanché* on *open-circuit lines*; the former being the best suited of all cells to furnish *continuous constant* currents employed in most systems of telegraphy, and the latter for furnishing the intermittent currents required for ringing bells, operating annunciators, or for similar work.

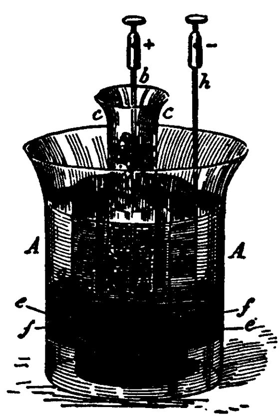


FIG. 92.

The Siemens-Halske Cell.—A *zinc-copper* couple, the elements of which are employed with dilute sulphuric acid and saturated solution of copper sulphate respectively.

This cell is a modification of Daniell's. A ring of zinc, Z, Z, Fig. 92, surrounds the glass cylinder, *c*, *c*. The porous cell is replaced by a diaphragm, *f*, *f*, of porous paper, formed by the action of sulphuric acid on a mass of paper pulp. Crystals of copper-sulphate are placed in the glass jar, *c*, *c*, and rest on the copper plate, *k*, formed of a close copper spiral. Terminals are attached at *b* and *h*. The entire cell is charged with dilute sulphuric acid. The resistance of the cell is high.

The Meidinger Cell.—A *zinc-copper* couple, the elements of which are employed with dilute sulphuric acid, or solution of sulphate of magnesia, and strong nitric acid, respectively.

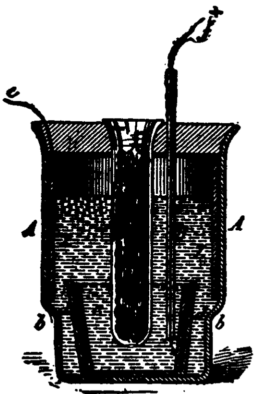


FIG. 93.

This is another modification of the Daniell cell. The *zinc-copper* couple is thus arranged: Z, Z, Fig. 93, is an amalgamated zinc ring placed near the walls of the vessel, A, A. The copper element *c* is similarly placed with respect to the vessel *b*, *b*. The glass cylinder *h*, filled with crystals of copper sulphate, has a small hole in its bottom, and keeps the vessel, *b*, *b*, supplied with saturated solution of copper sulphate. The cell is charged with dilute sulphuric acid, or a dilute solution of Epsom salts, or magnesium sulphate.

"A FEW SUGGESTIONS FOR AMATEUR ELECTRICIANS."

BY W. B. SHAW.

There are some who, although not professionals in the true sense of the word, yet have made considerable study of the subject, and can hardly be classed as amateurs. These remarks may not prove of assistance to such, but we trust will to those, such as young lads at school, who often have not much money to spend on experimenting, and who are sometimes gulled by catchy advertisements.

As an instance of the latter class, we might mention the Primary Battery frauds (of which there are many), who claim "the earth" for their batteries; the dynamo might, in fact, be laid aside; their batteries will run innumerable electric lights, motors, etc., not to speak of electric welding! at little or no cost.

If we go back to the fountain-head of the electric current in both cases, I think the absurdity of such claims will readily be seen.

For the dynamo, the coal under the boiler is consumed. For the primary battery, zinc (by acids or other chemicals). Which is cheaper?

As, however, the dynamo is out of the question to the class that this paper is intended for, we will see what can be done with batteries as a source of current.

In the first place considerable time must be reckoned on as required to be spent for cleaning batteries, and money for new fluid, zincs, and re-amalgamation of same.

What is the best battery? is often asked. There is *no* best battery that will suit all cases. By looking into the terms Volt and Ampere, we will see fairly well how a battery can be chosen for certain work. In a steam boiler there is a certain volume or amount of steam; we will call this "amperes of steam;" this steam is also under a pressure of several pounds to the square inch; we will call the *pounds pressure* "volts." When we speak of a 50-volt lamp, then we mean that this lamp will require a certain amount of amperes, or volume of electricity (steam), forced through it at a pressure of 50 volts (pounds per square inch), in order to produce its rated candle-power of light. We will not go into how the other figuring is done at present, but substitute the following table:—

1 Lamp of Candle-power draws		
16 C.P.	@ 110 Volts........	$\frac{1}{2}$ Ampere.
" "	75 "	$\frac{3}{4}$ "
" "	50 "	1 "
" "	20 "	$2\frac{3}{4}$ "
1 to 6 C.P.......	4 to 10 Volts...	$1\frac{1}{2}$ "

Of course a 32 C.P. will draw double the amount of a 16 C. P. The small lamps vary, but the above is a fair average.

Thus the higher the voltage, *i.e.*, the greater number of cells we have grouped together in series, the less amount of current each lamp will draw, consequently more of them can be lit at one time; or one for a correspondingly longer time.

The same holds good in regard to small motors, the higher the voltage they will stand, the less *amount* (amperes) of current will be used by them.

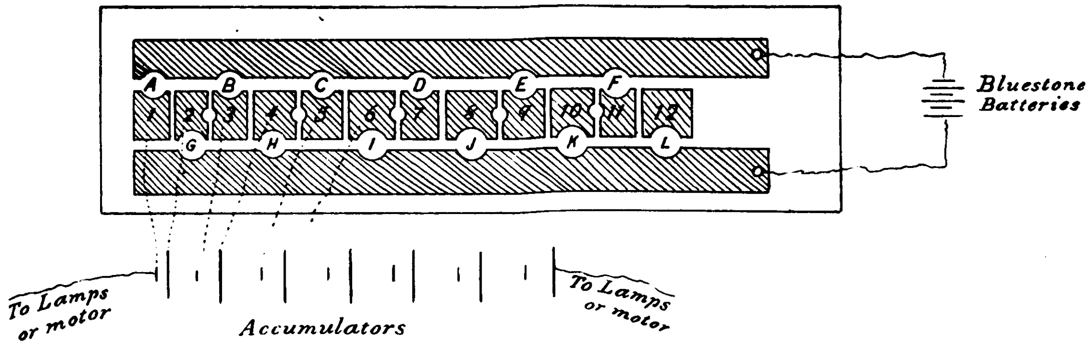
The following table of batteries may prove acceptable:—

	Name of Battery.	Volts per Cell.	Solution.	
1...	Smee......	.64	Sulphuric Acid, 1 Part; Water, 10 Parts.	Single Fluid Cell.
2...	Grenet.....	2.00	Sulphuric Acid, 25 Parts; Water, 100 Parts; Bichromate of Potash, 12 Parts.	
			N.B.—Called "Electropoion Fluid."	
3...	Grove......	1.94	Nitric Acid, Pure in Porous Pot, 1 to 10 Sulp. Acid and Water, outer jar.	Double Fluid Cells.
4...	Bunsen....	1.93	Same as Grove, or substitute Electropoion Fluid in Porous Pot.	

No. 1.—1 Platinized Silver Plate, and 2 Amalgamated Zinc Plates
or 1 Roughened Carbon Plate, and do. do
No. 2.—2 Rough Carbon Plates, and 1 do. do.
No. 3.—Sheet Metallic Platinum, and 1 do. do.
in Porous Pot. in Outer Jar.

No. 4.—Block of Square Carbon, and 1 thick Cylinder of Amalgamated Zinc.
in Porous Pot, in Outer Jar.

No. 1.—For Electro-plating and depositing.
No. 2.—Small motors, and intermittent work.
Nos. 3 and 4.—Small lights and motors.



Several modifications in regard to shape, etc., of the above four types exist under various names, but for the purposes now under consideration, *i.e.*, running small motors and lights, nothing of practicable value has been added.

The larger a battery is, the greater volume (amperes) it will supply, but the voltage is not affected by size. To increase the voltage (pressure), couple enough cells in series together to give it. Do not join batteries together whose solutions or plates are different.

It is hard to say what style of small motor will suit your purpose best, but as easy a style to make as any is an upright horseshoe form electro-magnet for "fields," wound with No. 18 gauge single cotton covered magnet wire, and a Siemens or H type of armature, wound with No. 20 gauge single cotton covered magnet wire. This form is not "self-starting," but is easily built, and has only two commutator segments, as the armature is all one coil. A piece of brass tubing with two slits in it, diametrically opposite, and insulated from the shaft, easily disposes of the commutator.

Do not use Carbon Brushes on a motor of low voltage, on account of its resistance being higher than that of copper.

The foregoing remarks apply to the type of motor generally built by amateurs, which is ⅛th H.P., or sewing machine size.

Now, as we have one more source of power to speak of, we will close the foregoing, recommending for fuller details Trevest's "How to make Batteries at Home." Supplement to *Scientific American* No. 641, on Small Motor Building.

The other source of power before referred to is the Secondary Battery or Accumulator. The flow of current from same is very steady and regular, and the drop in their voltage when doing work is small. Each cell gives two volts, and the amperes vary with the size and number of plates.

Taking a style of plate very often used, viz., 6″ × 8″, or 6″ square, we can safely reckon it will stand a charge and discharge of four amperes per each positive plate; the voltage at which this is delivered in charging is immaterial, provided it is more than the voltage of the accumulator itself, else the latter, instead of being charged, would act as the charge-r.

We will not give details of the manufacture of these, but simply recommend any amateur who makes one to have the "forming" and "first charging" done from a dynamo circuit. Needless to say, not an alternating one. After that the accumulators may be kept fairly well charged by means of ordinary bluestone cells, such as are used in telegraph offices.

Four cells of bluestone to each accumulator; or if the accumulators are placed in multiple, they can all be charged from one set of four or five bluestone cells, but of course at a much slower rate.

The accompanying design shows a plug switch for accomplishing this object:—

i.e.,—Charging—in Multiple.
Discharging—in Series.

Two long strips of brass with segments cut out as shown, are screwed to a wooden base. To one of these is attached the positive (copper) pole of the bluestone or other suitable battery; to the other strip—the negative (zinc) pole is attached. Small brass pieces, as shown, are screwed between the strips. Dotted lines show accumulator connections; positive of each accumulator to each alternate centre-piece of brass.

Now, by inserting metal plugs in holes marked A, B, C, D, E, F, G, H, I, J, K, L, all the accumulators are connected (in multiple) to the four or five bluestone charging batteries (connected in series). By taking these plugs out and inserting others between pieces 2 and 3, 4 and 5, 6 and 7, 8 and 9, 10 and 11, your charging batteries are disconnected, and accumulators connected in series ready for discharge.

In this way many accumulators can be charged from one set of charging cells.

Note.—You can never charge too much with bluestone cells; also, always see that there is sufficient bluestone in the charging cells.

This latter form of power (accumulators) for experimental work, where a fair amount of steady power is required, will be found far ahead of other methods, and we trust these few remarks may prove of value to those experimentally inclined.

POISONS AND THEIR REMEDIES.

The first remedial effort in case of poisoning should be to enable the system to reject the poison; the next, to counteract its serious effects; and, finally, to begin the restoration of its normal tone. The poisonous substances usually found in the household may be divided into three classes, which include: (1) the *corrosive* mineral and vegetable acids, such as sulphuric, nitric, carbolic, and oxalic acids; (2) the *simple irritants*, like strong alkalies—potash, lime, zinc, etc.; (3) the *specific irritants*, like arsenic, iodine, and phosphorus. Prussic acid, chloroform, and opium belong to the neurotic poisons, some of which simulate in their effects the symptoms of diseases of the brain and spinal cord, producing delirium, convulsions, paralysis, and syncope. Tanner says that morphine and alcohol specially affect the brain, strychnine the spinal cord, antimony and arsenic the stomach, and digitalis the heart. The solid poisons are less active than fluids and gases, while those soluble in water or in the digestive fluids are most injurious, because they are the most rapidly absorbed.

When after eating or drinking a person is attacked with violent pain, nausea, purging, convulsions, delirium, or great drowsiness, the supposition is probable that poison has been taken, and immediate medical aid should be obtained. While the use of the stomach pump is the most thorough means of emptying and cleansing the stomach, its operation by an inexperienced person may cause serious injury, either by flooding the lungs or by lacerating the surface of the stomach, which has already been injured by the corrosive action of certain poisons. The safest course of procedure by non-medical persons is the promotion of the nausea, which is one of the indications of poisoning, until free vomiting has been effected. The simplest means to this end is the safest in the hands of any one but a physician, that, is, the use of lukewarm water in which mustard has been dissolved ; a teaspoonful to a half-pint of water, repeated until the stomach is entirely empty.

The second remedial action is the application of some antidote calculated to counteract the effect of the poison either by combining with it, or depriving it of its deleterious qualities. The combination of antidote with poison forms harmless chemical compounds, or those which are insoluble in the gastric fluids. It then remains to neutralize the effect of the poison upon the system, and to overcome any depression or shock it may have caused ; these are purely the physical offices.

Of the corrosive poisons, those most frequently used in the household are oxalic and carbolic acids, creosote, and the caustic alkalies, potash, soda, and ammonia. Oxalic acid has sometimes been taken by mistake for Epsom salts ; the salt of sorrel, or the essential salt of lemons, used, like oxalic acid, for cleaning purposes and bleaching, has caused poisoning.

The symptoms of oxalic acid poisoning are a burning sensation during swallowing, burning pain in the stomach, and almost immediate nausea. When there is no vomiting, great prostration, feeble pulse, and convulsions, death is likely to follow from collapse. The antidote is lime in any form—plaster or mortar—chalk, whiting, or magnesia, mixed with water ; but no fluid without an antidote, because it would favor the absorption of the poison. As is the case with most poisons, white of egg is a useful remedy.

Creosote and carbolic acid are so often in use as disinfectants that they may prove dangerous, especially as death so rapidly follows a dose of the poison. The mouth and lips are whitened by contact with the acid, the pupils of the eyes are very much contracted, the breathing becomes stertorious, and coma is soon followed by death. The possibility of relief is small, but oil may be freely given, and immediately removed by the free use of emetics before it can be absorbed.

Crude potash, pearlash, caustic soda, washing soda, and household ammonia have an acrid burning taste extending to the throat and stomach, accompanied by great pain, tenderness upon pressure, abdominal pains, and suffocation. The immediate relief may be followed by death from starvation, owing to the closing of the œsophagus by stricture. Even the common remedy for sore throat, chlorate of potash, has been known to cause death. In a recent instance an ounce of the chlorate was taken in mistake for Epsom salts, and death ensued within a few hours. The remedial treatment consists of neutralizing the poison by the use of weak acid, like vinegar and water, and the free consumption of the acid from fruit juices, lemons especially, followed by draughts of salad oil.—*Manufacturer and Builder.*

Paint for Shingle Roofs.—One barrel of coal tar, ten pounds of asphaltum, ten pounds of ground slate ; mix by the aid of heat, and add two gallons of dead oil.

GOOD WOOD FOR PASSENGER CARS.

In a recent Western fire it was again demonstrated in the clearest manner possible that California redwood, as a building material, comes nearest being fireproof than almost any other material of which buildings are constructed. In this instance a fire broke out in the upper part of a one-story building while the wind was blowing a gale that was recorded at the United States signal station as moving at the rate of 30 miles an hour. But notwithstanding this, and the fact that it was several minutes before water got to the building, the fir laths under the plaster were burned downward nearly to the floor, and whole squares of the side plastering were thus loosened and fell in before the fire had burned through the thin redwood shingle roof.

It was a most wonderful illustration of the fire-resisting qualities of redwood. Had the whole building been as combustible as the laths, nothing could have saved the city. The roof was old, and as thoroughly ready for the flames as redwood ever becomes, yet the fact remains that it resisted the ignition, and bystanders could see a seething furnace of flames through the apertures under the eaves, while nothing but smoke issued through the roof. The peculiar manner in which redwood smothers flame, and prevents its flashing forth, is an important fact in suppressing conflagrations, as fires are communicated to neighbouring buildings by means of external flames and sparks which they send up.

A wood that resists fire in this fashion ought to be an excellent material for the building of passenger cars.—*National Car and Locomotive Builder.*

INERTIA AS A MECHANICAL FACTOR.

All ponderable bodies possess property known as inertia, which, although not regarded as synonymous with gravity, yet the degree of inertia manifested depends directly on the weight of the substance. Inertia is what might be termed a passive or negative quality, which manifests itself only upon certain conditions of action. This property or circumstance has to be regarded in a large part of mechanical operations. The most familiar example is the cars of a freight train, the couplers of which must be provided with cushion springs against both butting and pulling of drawheads, because, if this were not the case, it would be utterly impossible to avoid crushing and breaking of parts dozens of times on a single trip. If one attempt to drive a nail through a shingle suspended freely by a string, the task will be tedious and uncertain, although normal force be given the hammer. An axe or heavy block held behind the shingle will, by its inertia, hold the shingle, and the nail will promptly pass through. This is not here given as a receipt, but merely to cite an example familiar to almost every one. It is well known that a body falling, as, for instance, a rock from a precipice, will start slowly and rapidly accelerate in downward speed, striking with terrific force under some circumstances. The slow initial movement is due to the property of inertia, the attraction of gravitation having to get the inert mass under headway. Velocity once attained must be stopped, if suddenly, with a violent shock. A small stone will drop with the same facility as a much larger one, and this fact brings up a point which is applicable to certain mechanical features ; for instance, elevators as now used have means by which catch bars are instantly thrust outward, to engage in the step recesses of the vertical ways the moment the rope breaks, the bars being impelled by strong spring pressure, but held retired by the force exerted on the suspension rope, so that if the rope breaks, this retaining force abates and the springs dart the catch bars into engagement, locking the cage to a fixed position. Some inventors have worked on the idea of substituting gravity weights in lieu of the springs, so as to force the catch bars into engagement by a leverage impelled by a gravity weight. The fallacy of this idea is readily apparent, and may be demonstrated by the example shown in

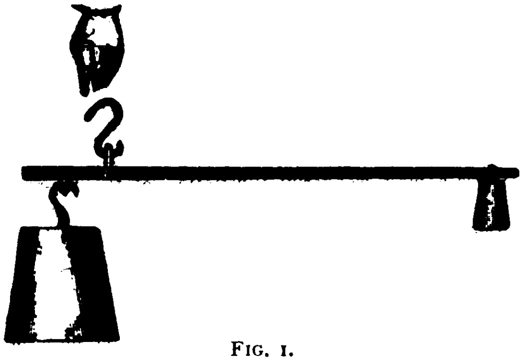


FIG. I.

Fig. 1. In this example an unequally weighted bar (or it may be a beam scale) is perfectly balanced. If this balanced beam is allowed to drop, as shown, it will retain its horizontal position, as it also would if suddenly jerked upward, so that it becomes clear that any weighted lever mechanism, no matter how powerful, would be absolutely passive while the cage is falling. Should the elevator be occupied when dropping, under such circumstances, it might be suggested that the occupants, if practical athletes, could squat down and give a violent leap upward at the moment of impact; but this could not be accomplished, as it would be impossible to stoop without gravity, which, for the time, is absolutely neutralized as between the falling bodies. Should a person, under such circumstances, attempt to stoop, he could only draw up his legs, which would be done with scarcely any effort whatever, but it would fail to bring his body any nearer the cage floor. The nearness would come later on.

It will be evident that gravity mechanism, in connection with a cage which is liable to drop, could not be relied on except with a trusty rope.

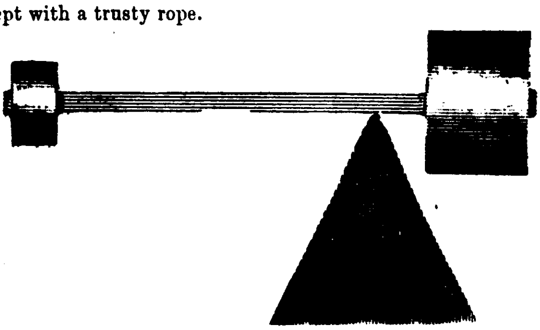


FIG. 2.

If a bar weighted at each end, as shown in Fig. 2, be dropped horizontally on a poised fulcrum block, striking at the point of equilibrium, the impact force would correspond only to the aggregate weight of the large and small weights and bar, although it may be urged that the larger weight, being counterbalanced by the smaller, would be doubled in its striking force. To explain: Suppose the larger weight be 50 pounds and the smaller weight 10 pounds, (we might leave out the bar from consideration). Now, while in ordinary circumstances 50 pounds balanced by 50 pounds makes 100 pounds, in this case 50 pounds is balanced by 10 pounds, making the aggregate gravity weight 60 pounds. The inertia of the larger falling weight is exactly offset by the inertia of the smaller weight, through the medium of leverage, which leverage does not contribute to the gravity weight of the falling aggregate mass. This, however, would seem to be a debatable question, and presents some nice points to the mechanical mind.—*World's Progress.*

A HINT TO INVENTORS.

One of the largest manufacturers and patent buyers, in a conversation with us some time ago, made a significant remark concerning a peculiarity of patent buyers. Commenting on the number of patents sold in proportion to the number issued, he said that buyers, as a rule, preferred to pay double price for an invention if once allowed or even applied for, than for the bare invention, and that he has known instances where speculators refused to take interests in inventions where they could have obtained them by merely paying the patent fees, but that after the patents were once allowed, big sums were paid for them by the same men. We have frequently noted this peculiarity on the part of patent buyers, and confess that we are unable to account for it. The fact is that buyers, as a rule, cannot appreciate that fifty or one hundred dollars is sometimes as hard to raise on the part of the inventor as so many thousands, and the natural presumption is that the inventor has no confidence in his device. A man who has an invention and seeks aid or capital, is at the mercy of the capitalist or speculator, and the latter knows it; and the better the invention, the more exacting will be his terms. On the other hand, if the patent is once applied for or allowed, even though it may not be issued, the inventor has an advantage in negotiations which he never could command otherwise. We cannot suggest a remedy for this, but we note it as a situation which is worth consideration.—*World's Progress.*

NEW TOWER BRIDGE OVER THE THAMES.

To accommodate the ever-growing traffic across the Thames in London, it has been found necessary of late to provide another bridge across one of the lower reaches of the river. This structure, of which we present a view in the accompanying picture, has several features of novelty in its construction which are worthy of notice, and which will appear in our description. It appears, from last accounts, that it will be finished and opened for traffic about the end of the present year.

The new bridge spans the river from the St. Catherine Docks on the Middlesex side, just below the site of the historic Tower of London (whence its name), to Tooley street on the Surrey side.

In designing the structure, it was necessary, from its location, to provide both for the free transit of ocean-going vessels and of foot passengers. To accomplish this, the center span is so constructed (in two sections) that each half can be raised up from the pier ends by hydraulic apparatus, to allow of the free passage of steamers and sailing craft, while the foot traffic may proceed uninterruptedly over the upper span, seen in the picture. Passengers will reach this either by means of the staircases provided in the towers, or by hydraulic elevators.

The bridge, in addition to possessing this unique feature, is an imposing and very substantial structure. The following

NEW TOWER BRIDGE OVER THE THAMES AT LONDON.

data respecting its measureme ts will be of interest to place on record :

The towers are 275 feet high ; for the piers, an aggregate weight of 235,000 tons of granite and other stone has been employed, while 31,000,000 bricks, and 19,500 tons of cement besides fifteen thousand tons of iron and steel will enter into its construction.

Sir William Arrol & Co., who have already done much good work in the Forth and Tay bridges, are the constructors, and the masons are Perry & Co. The following are the principal measurements : Total length of the bridge and abutments, 940 feet ; total length of the bridge and approaches, 2,640 feet ; width of the draw-span, 200 feet ; headway of draw-span above high water when opened, 139 feet 6 inches ; headway of draw-span above high water when closed, 29 feet 6 inches ; length of side spans, each 270 feet ; headway of draw-span above high water, from 20 to 27 feet ; width between parapets of draw-span, 50 feet ; width between parapets of side spans and approaches, 60 feet. The construction of this bridge is undertaken by the corporation of the city of London.—*Manufacturer and Builder.*

CAR VENTILATION.

Volumes have been written on this subject ever since railroad cars were first built, and yet, strange to say, but little has been accomplished toward this desirable end. Perhaps there is a reason for it. Ordinarily, the trains make frequent stops, the doors are opened, the ride is short, and even if the air is bad nothing is said about it. It is well known that no cars are built of any kind but some pretense of ventilation is provided. What there is, however, is rarely used with any degree of intelligence.

One gets into a crowded street car, and at once the nostrils are invaded by odors most foul. All the little wickets in the roof are closed. Again we get into another car and all are open ; cold draughts assail the head and shoulders. The same experiences apply to the steam cars, only they are far worse, because the trip is longer. Who has not experienced the horrid atmosphere of a crowded sleeping car in a long night of travel ? The ordinary passenger car is only a little better in the night time.

If this disagreeable state of things was a necessary adjunct of the conditions, it could be borne. But is it ? Let us consider. The R. R. car is a vehicle of power (in its movement). Is it not possible to force into the car a portion of the fresh air, and then screen it from cinders and smoke, and distribute it throughout the car in such a way that no one will feel a cold draught ? Good mechanical engineering can surely accomplish this simple problem. The air should not be taken in from the roof, as there is too much risk of coal gas and smoke.

Of course for every cubic foot of fresh air that is admitted an equivalent quantity of spoiled air must go out, and unless there is provision of this kind, there will not be good ventilation. How shall this be done ? One needs only to go in the gallery of a crowded theatre or church to realize that the bad air goes up ; just so in the car, and there should be strong suction ventilators provided for the upper part of the car which would derive their power from the movement of the train. Under no circumstances should air come in through the ventilators just spoken of. Fresh air should come in only at the places provided for it, and distribute without offensive draughts.

It will be readily understood that the methods or mechanisms to accomplish the end aimed at must be susceptible of adjustment for the varying conditions of temperature. What railroad company will be the first to offer a premium for the best devices to accomplish perfect ventilation? Improvement in this direction is the great want of the times.—*Railroad Car Journal.*

ENGINEERS' SPECIFICATIONS AND INSPECTION.

Few, if any, important contracts for railway material or machinery are now completed without being subject to the provisions of more or less elaborate specifications with regard to quality, accuracy, and time of delivery, and the duty of seeing that such provisions are duly complied with is entrusted to an inspecting engineer. Specifications vary in stringency, from the mild and easy-going "manufacturer's specification" to the almost laboriously severe compositions drawn up by the consulting engineers of Colonial Governments or Crown Colonies, or by the locomotive superintendents of great railway companies. In some of these specifications the leading idea seems to be to throw, as far as possible, the whole burden of responsibility upon the contractor, and those who have the drafting of such documents often appear to vie with each other in making the provisions as severe as they can. The efficacy of a specification, however, depends entirely upon the manner in which its provisions are enforced, and here the individual character and qualifications of the inspecting engineer come in. So well known is the uncompromising adherence to the letter of the law of the technical advisers of certain Government departments and certain great companies, that many manufacturers prefer to abstain from competition rather than run the financial risks involved and submit to the vexatious and unnecessary restrictions which would be imposed on them in the event of their securing and executing the contract. Sometimes it happens that the duty of inspection is entrusted to some individual whose practical experience is of the slightest, and who, therefore, is afraid to deviate in the slightest degree from the most literal and pedantic interpretation of the specification. Such men, not unnaturally, are regarded with abhorrence by manufacturers, and probably do more harm than good, by acting as a direct incitement to foremen and managers to exert their inventive faculties in "dodging" the provisions of the specification. At the other end of the scale is the inspector, whose principal concern, apparently, is to keep on pleasant and friendly terms with the contractor. In this, as in most other matters, there is a middle course, which in the long run leads to the best results. In the case of complicated mechanical structures, however, the most careful inspection can hardly guard against the tricks of dishonest manufacturers, and instances sometimes occur in which the inspecting engineer is almost obliged to do the work of a shop foreman if he wishes to secure good results. If it were not for the annoyance and delay occasioned thereby, wholesale rejection would be the best course in such cases, and would act as a well-deserved chastisement for "scamping."

As regards the drafting of specifications, the quality of the materials required should be adapted to the necessities of the case. For a light steam tramway, for example, on which the speed will never exceed, say, ten miles an hour, it would be unnecessary to prescribe the same quality of iron or steel, and exact the same tests, as for a first-class railway, where the trains may run at a velocity of sixty miles an hour. Similar remarks apply to workmanship; but since good workmanship, where proper appliances are used, costs no more than bad, the former should always be insisted on. For locomotives and rolling stock on main lines nothing less than the very best material and first-class workmanship is admissible, but a difference of opinion still exists among railway engineers as to what material should be used for certain parts. For instance, on some English railways and on the Indian State lines the axles of carriages and waggons are specified to be of "the best Yorkshire iron double fagoted," and manufactured by certain firms, while on others steel is employed. Both for iron and steel axles the very severe test of being doubled while cold without fracture is often exacted. In the specification for the rolling stock of the Indian State Railways it is stated that the axles are to be "bent cold over a 4in. bar," and "the journals at each end of the tested axles must be bent cold to an angle of 45°." While some railway companies are content to subject one axle in every hundred to such treatment, the consulting engineer of the Indian State Railways requires that 2 per cent. of the axles supplied shall be thus tested. Instead of being doubled cold, it is sometimes prescribed for axles to receive "five blows from a weight of 2,000lb. falling from a height of 20ft. upon the axle, which shall be placed upon bearings 3ft. 6in. apart, and turned after each blow, the test having to be continued until the axle breaks. Also, each axle must be guaranteed to stand a tensile load of not less that 35 tons per square inch with 20 per cent. of elongation in 10in." Some engineers content themselves with testing tyres by compressing them, when cold, by hydraulic power into an oval shape; others subject the tyres to a drop test. With regard to locomotive crank axles, a diversity of opinion, similar to that which we have noticed in the case of waggon and carriage axles, exists, as to whether steel or wrought iron is the better material to employ. It is not our intention here to discuss the relative merits of wrought iron and steel for the purpose in question, but we may remark that, while the breakages of steel axles appear to be less frequent than those of wrought-iron axles, the life of the latter is longer.

For no part of the work required in the manufacture of locomotives and rolling stock is careful inspection so necessary as for the riveting of the underframes—where the latter are of iron or steel. If the riveting is badly done, the various parts of the frames soon work loose, owing to the continual jar and vibration at high speeds. It is now usual to insist on the employment of hydraulic riveters, wherever possible, for waggon and carriage frames, and also that the rivet holes shall be drilled. Now, while there can be no question at all as to the desirability of using material capable of enduring the severest treatment for structures liable to the sudden shocks, racking strains, and vibrations to which railway rolling stock is subject, it is quite unnecessary to make the same demands on, say, the wrought iron or steel forming a girder required to support a constant stationary load or that used for the construction of a line shaft in a cotton mill. To do this would result in an unnecessary increase in the cost without any corresponding practical advantage.

A mistake, of which consulting engineers are occasionally guilty, is that of restricting the contractor too closely to certain methods or processes of manufacture. In general, provided the quality and workmanship of the articles supplied are what is demanded, it should be a matter of indifference to the engineer in what manner the results are obtained. As a rule, those firms which have the most perfect appliances and adopt the best processes for turning out their work, will in the long run come to the front, if, while a high standard of excellence is insisted upon, the competition is at the same time fair and unrestricted. Another undeserved source of annoyance to manufacturers is the want of uniformity in the specifications relating to certain materials, even when required for the same class of work. In prescribing tests for steel, for instance, the desired percentage of total elongation, is frequently referred to different lengths, or the length on which it is to be measured is not mentioned at all. In one case it may be 18 per cent. in 8in., in another 18 per cent. in 4in. or even 2in., although the material in every instance is wanted for a similar purpose. The subject of standard shapes and dimensions for test pieces has been frequently under discussion in the engineering world, but so far no general agreement appears to have been arrived at in this country; although in Germany, we believe, a standard form has been universally adopted. To the diversity in specifications for Portland cement we have recently drawn attention (see *Industries*, Vol. X., page 553). Inconsistencies of this kind are not calculated to promote respect on the part of contractors for consulting engineers, but tend rather to foster a suspicion that the latter concoct their specifications with insufficient practical knowledge of the subject with which they are dealing, and frequently protect themselves from the results of their own want of knowledge at the expense of the manufacturer.—*Industries.*

THE BOOT AND SHOE INDUSTRY.

Special Examiner Hyer, of the Patent Office, has just returned from a tour of inspection through the great boot and shoe factories of Lynn and Haverhill, in Massachusetts, which may be said to turn out footgear for pretty nearly the entire people of the United States. He was much impressed with the gigantic scale on which the manufacture is carried on at these establishments, some of which have a capacity of from eight thousand to ten thousand pairs a day. A large percentage of the goods thus produced are sold to retailers at from eighty-five cents to $1.50 a pair, although the "stock" used costs from eighty cents to $1.10. Inasmuch as the labor averages thirteen cents on each pair, there is necessarily an actual loss on the cheapest grades, which are merely intended to serve as "leaders." It is an interesting fact that sixty per cent of all the shoes and boots worn in this country are retailed for less than $2 a pair.

"Machinery," said Mr. Hyer recently to a Washington *Star* reporter, "has nowhere been put to more effective use for the saving of labor than in the manufacture of shoes. It is a wonderful thing to see a pair of boots turned out within a few minutes from the raw material, finished and all ready to wear. At the time of the Centennial Exposition in Philadelphia there was a contrivance exhibited which was called by its inventor the 'iron shoe maker.' It made shoes and turned them out complete, but they were clumsy affairs, and the process was a slow one. It has been found best to employ for the purpose a number of different machines, which together perform the operations necessary.

"With the aid of one ingenious device one man can sew together soles and uppers for four hundred and fifty pairs a day. On what is known as the 'standard nailer,' a single operator can nail three hundred pairs, the machine making its own nails by wire, pointing them, driving them, and at the same time automatically regulating the length of each nail to thickness of the sole. With loose nails or pegs one person can do six hundred pairs a day, though the toes and heels must be made additionally secure afterward. One pegging machine will peg two pairs of women's shoes per minute, cutting its own pegs from strips of white birch at the same time. A thousand cords of wood are cut into shoe pegs every year in the United States. The wooden peg was invented in 1818, by a Massachusetts man named Joseph Walker.

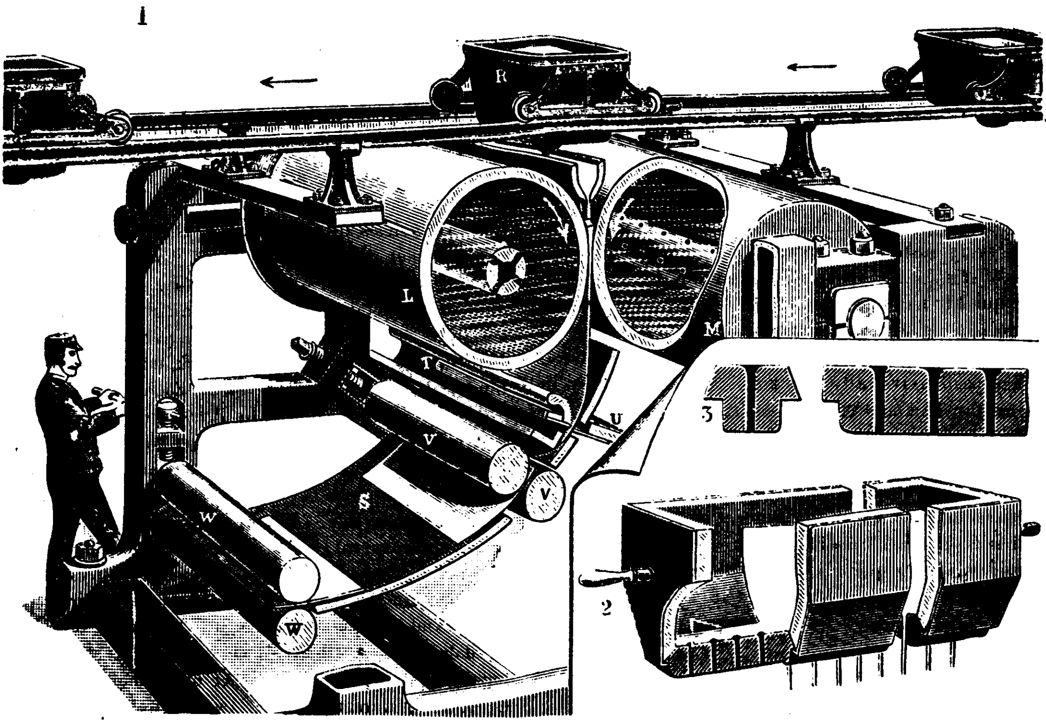
"The Yankees have always been years ahead of Europeans in the art of making shoes, although the French excel to this day in the finest work for women's footwear. All machines for sewing shoes are of American invention. The last census showed that the manufacture of boots and shoes was the greatest single industry in America, employing the largest amount of capital and the greatest number of individuals. The employes of the trade are about equally divided as to sex. Men do the heavier part of the work, while women sew uppers, bind and fasten on the buttons. Each New England factory—most of them are owned by Boston men—has its specialty. One makes ladies' shoes exclusively, another slippers, another men's boots, another children's footgear, and so on.

"The oldest form of shoe was the simple sandal, which was nothing but a sole. Egyptian priests wore sandals of palm leaves and papyrus, while those of the common people were made of leather. The shoes of Roman soldiers were studded with nails. Heliogabalus had his shoes covered with white linen, and Caligula ornamented his with precious stones. Sandals were worn by both sexes among the Romans in the house, as we wear slippers. At one time the Parliament of Great Britain regulated by law not only the quality of the leather, but the number of stitches to be taken in every shoe. Top boots were introduced in the sixteenth century. In China the cobbler goes from house to house, and announces his coming with a rattle. In all history, as shown in pictures and bass-reliefs, the shoemaker seems to have assumed the same attitude as now in doing his work. It is a very unhealthy one, and few of the craft live to old age. A hollow at the base of the breast-bone is often produced by the continual pressure of the last."—*Washington Star*.

BESSEMER'S FLUID METAL ROLLING MILL.

In a paper by Sir Henry Bessemer, recently read before the British Iron and Steel Institute, is described a rolling mill for producing sheets and plates of malleable iron and steel direct from the fluid metal. This mill, shown in the accompanying illustration, is an improved form of one patented by him in 1857, and allowed to rest without development on account of the difficulties attending the perfecting of the steel-making process.

The rolls consist of two hollow drums, L and M, to each of which a tubular steel axis conveys water for keeping the rolls cool. The brasses supporting one of the rolls are fixed, while those of the other are movable and are pressed upon by a hydraulic ram in communication with an accumulator, whereby, should the feed of metal be excessive, one of the rolls will yield to prevent undue strain, and the only fault will be a slightly increased thickness at that part of the sheet, to be removed by subsequent rolling. The rolls are preferably three to four feet in diameter, and each has a flange at one end only, thus forming, when they are in position, a trough with closed ends to receive the fluid metal. For the regular and quiet supply of the metal, a small iron box or reservoir is employed, having a bar or handle at each end, by which it is supported on the side frames. This reservoir, the construction of which is shown in Figs. 2 and 3, is lined along its bottom with plum-



ROLLING PLATES DIRECT FROM FLUID IRON AND STEEL.

bago or fire clay, some ten or twenty holes about a quarter of an inch in diameter each being here neatly moulded by a row of conical brass pegs. The reservoir should be well dried, and its interior surface heated to redness prior to use, and in this state it is placed in position only when the first ladleful of metal is ready to be supplied. The ladle, R, is conveyed to the reservoir on rails, and has one or more valves or stoppers for regulating the flow.

An almost constant quantity of metal is thus delivered to the rolls, without splashing, through the several apertures of the reservoir, and these streams do not fall directly on the rolls, but into a small pool formed between thin films solidifying against the cold surface of the rolls, the metal at all times being free from floating slag. The speed of the rolls also affords a means of regulating the quantity of metal retained between them.

The sheet of metal as it emerges from the rolls is received between curved guide plates, S and T, to one of which a cutting blade, U, is bolted, the piece so cut passing between a second pair of rolls, V, V, and thence to a third pair, W, W, from which it is delivered on a table, or may be allowed to slide into a cistern of water. The construction allows for the cooling and stacking of the plates without labor or trouble.

The thickness of the plates it will be possible to make in this manner will depend largely on the size of the rolls, it being estimated that rolls of ten or twelve feet diameter will be capable of producing plates of about three-quarters of an inch in thickness. In the production of the thin sheets, as described, their exposure to the oxidizing influence of the atmosphere, prior to their immersion in the water, is for so brief a period that they will not acquire any scale, and in consequence of there being no overlapping of plates in rolling, there will be but little loss of metal in shearing.—*Scientific American.*

THE ART OF LENGTHENING LIFE.

Dr. Ebstein, of Goettingen, delivered a long discourse on this subject, from which we take the following:—

The question as to the natural duration of life is first to be answered. According to the latest discoveries, the average length of life, in the natural order of things, is from seventy to seventy-five years. Women live somewhat longer than men. The mortality among children, particularly less than a year old, is very great. From the age of puberty till the fiftieth year the death rate is small; from that time it becomes greater each year. Too great an old age is a questionable blessing, because a renewal of youth can be reached in no way whatever. It is evident, therefore, that the normal limit of the age of man is that which is attained without bitter breaking down and suffering. The first condition is a good foundation, a descent from parents physically and mentally healthy. Of further importance is suitable maternal care of the child. Then comes the school and military training for the increase of the powers of resistance. In advancing life, a proper activity must not be neglected. "An unused life is an early death." The correct means toward reaching a good old age were given by Moltke, when that question was going the rounds. These were "temperance and work." Not only temperance in regard to eating and drinking, but the same must be practiced in every direction. A great number of deaths in the prime of life occur through accidental wounds. (In business and industrial life and in war.) Another part on account of so-called constitutional illnesses, which are generally the result of some innate physical defect of the human body. These can always be combated. A third part result from contagious diseases. The danger of infection can generally be met by capable measures of defence. The art of lengthening human life has made little advance up to the present time. The age of man, in the average, has become no greater.

Also the common principles of long life have been substantially the same in all times, only the relationships of culture and differing eras imply different occurrences and details. The speaker also insisted that the use of alcohol is entirely unnecessary, and that the danger of shortening human life is not to be found in the greatness of intellectual work, but in its unsuitable organization.—*Translated for Public Opinion from the Cincinnati Volksblatt.*

NEW PROCESS FOR TONING BLUE PRINTS.

W. P. JENNEY, E.M., PH.D.

The intense blue colour of the ordinary blue print gives unnatural effects in prints from photographic negatives; also in architectural drawings where views and elevations of buildings are reproduced. The following method of toning such blue prints has been found to be easy of application and to give tones varying from a brilliant blue through violet blue to neutral tint and warm shades of gray, according to the intensity of the action of the bath.

The paper employed may be common blue print paper, sold ready for use in rolls, or the specially made paper sold in packages of cut sheets by the dealers in photographic supplies. The solar printing is carried out in the usual manner. The best results are obtained with dark prints, as the intensity of the colour is somewhat reduced by the toning process. The following baths are employed:

BATH A.

Muriatic (hydrochloric) acid	3 to 4 drops.
Water	16 oz. (1 pint)

BATH B.

Aqua ammonia	5 to 10 drops.
Water	16 oz. (1 pint).

BATH C.

	Apoth. weight.
Alum	2 oz.
Tannic acid	1 drachm.
Water	16 oz. (1 pint).

The prints are immersed face downward in bath A until all the soluble salts contained in the paper are dissolved and removed, then dipped into bath B until the negative turns a violet blue and the whites are clear, care being taken that the immersion in the ammonia be not continued too long, as the definition of the picture may be injured. The prints are transferred from the ammonia bath, placed face upward in a tray filled with bath C, and exposed to bright sunshine for from 5 to 10 minutes, until no increase in the strength of the picture can be noticed. The pictures are finished by toning in bath B until the desired shade of colour is obtained, the picture becoming first a brilliant blue, then violet, and finally, by prolonged action, bluish gray or neutral tint. The toning may be varied by a second immersion in the tannic acid bath C, followed by a second toning in bath B. After toning, the prints are dried in the sunlight in the usual manner.

The above process is specially applicable to prints from photographic negatives, enabling the amateur in the field, provided with a printing frame, some sheets of prepared blue print paper, and the above easily procured chemicals, to test the printing quality of his negatives with results only slightly inferior in detail and definition to those obtained by the complicated process of silver printing.—*Scientific American.*

THE CARE OF A BOILER.

The proper care of a boiler is one of the most important things about a steam plant, and yet less attention is commonly given to the boiler than any other part of the machinery. There may be several reasons for this, and one which shows up the most frequently is that the engine with its finished parts and brass oil cups and steady running gives a better chance for display than does the boiler. The engine room seems to be an important part of the establishment and the place that receives the most attention, while the boiler is generally located as far out of the way as possible and receives the smallest amount of attention that can reasonably be given it. This is not the case in all plants, but in the majority of them the boiler is neglected, so that more time and attention can be given to the engine and its surroundings, and it is usually noticed that wherever there is a fine engine on which a show can be made, the boiler room will be found quite dirty, most of the apparatus required therein is in an uncleanly condition, more so than should be necessary from the amount of dirt and dust usually made in such places. Where the engine receives the larger amount of the attention, the boiler must of necessity be neglected and usually is, to a considerable extent, and is nearly always the case where the engineer does his own firing. All engineers know that the boiler is the most important piece of machinery about the plant, or at least should receive the greater amount of attention. Owing to the duties required of boiler and engine and the means employed for working them, it is understood that there is a possibility of accidents occurring in a short space of time which may be the cause of the destruction of the whole apparatus. When an engine breaks down, the destruction is usually confined to the one room and is seldom disastrous, for such accidents rarely occur, while anything that may happen to the boiler, and the possibilities are many, may be the cause of a large amount of damage. We have no indicators for boilers that serve the purpose so fully as the steam engine indicator, and the noises produced are practically indications of the condition of the engine, but in a boiler there is nothing which corresponds to this, for although braces may be loose or broken, rivet heads corroded and eaten off, boiler plates grooved or pitted, initial strains present from the too free use of the drift pin, necessitated by the low price at which the boiler was furnished, crystallized plates, produced partly from the same cause, may either one be capable of causing a terrible accident, which coming as it will, without warning, may make the results most terrible. All these defects have been found in boilers, in some cases before an accident has occurred, but in others only from an examination of the wreck produced and of the fragment left, but in most cases their presence is unknown until the boiler is in a decidedly dangerous condition.

In plants where a fireman is employed a much cleaner fire room is usually found, and, occasionally, the fireman takes sufficient pride in his surroundings to keep the boiler front and other parts exposed to view reasonably clean, and some go so far as to keep all the fittings bright, the ceilings and walls whitewashed, pipes, dome, etc., nicely painted a deep jet black, and an air of tidiness all around. In such a place, it may be inferred, from a casual view, that the machinery of all kinds has excellent care and that the inside of the boiler receives fully as much attention and as close examination as the outside parts which make the show, and this is as it should be.

Some engineers have claimed, with a show of pride, that they have not had their boilers open for over six weeks, two months, or longer, as the case may be, apparently considering that such things are complimentary to their ability as an engineer. In some cases it is all right, no doubt, for any engineer that gives his boiler a careful examination and inspection every two or three months may be reasonably assured of its safe condition for that length of time, providing everything was found as it should be when the last examination was made. The use of mechanical boiler cleaners tends to increase the length of time between which examination of the interior of the boiler is made, as some of these devices are capable of keeping a boiler free from scale for several months time without special attention. But no boiler should be allowed to go so long without careful examination, for a sufficient amount of corrosion can take place within the time to change the condition of the boiler from that which would be considered safe to that which might be positively dangerous and unreliable under ordinary conditions of usage. A practical knowledge of the subject would indicate that every engineer, worthy of the name, who had charge of a boiler, would make a careful examination of both the inside and outside, at least, every month, closely examining all parts for signs of corrosion, grooving or pitting, sounding plates and laps in joints for unusual and unsafe conditions.

The safety valve is a factor that cannot be ignored, and the usual practice of opening the valve or causing it to blow off at least once per day, does not really seem sufficient to be a guarantee that it will perform the duty required of it just at the time it should work to best advantage. A safety valve may readily stick, especially those that are constructed to prevent the steam blowing into the engine room whenever the safety valve performs its duty. A valve of this kind is usually fitted with a cap surrounding the stem through which it is intended to move without friction, and also without permitting an escape of steam around the sides of the stem, and for this reason there is great danger of its sticking, and that without any indications which will call attention. Valves of this kind, whenever inspected, will be found to have the stem thickly covered with mineral matter which has been carried off with the steam and finally adheres to the stem with such tenacity that it can only be removed by filing or sand-papering. Such accumulation enlarges the stem and a similar deposit in the cap often produces such a condition of affairs that to start the valve from its seat, even when the lever is removed, requires considerable of an effort. Under such conditions the valve is not corroded to its seat as usually expressed, but the stem and cap are caused to adhere on account of the accumulation deposited from the flow of steam, which carries with it more or less water from the boiler, which in turn deposits the sedimentary matter carried over.

As near as can be judged from what we find, the water in a boiler while in a state of ebullition is covered with scum formed from mineral and vegetable matter introduced in the water, and in some cases oil is also found which is brought in from the exhaust. It is generally shown that when water is carried over with steam, a large amount of this sedimentary matter is carried over also, and frequently a great quantity of it passes through the engine and out of the exhaust pipe, as may be noticed by the streaks of whitewash with which the exhaust pipe is marked. These substances when blown out through the safety valve are what cause such trouble, and to keep a boiler entirely free from such accumulation on the surface of the water would require the frequent use of a surface blow off, or the constant use of a mechanical boiler cleaner. But as the proper care of a boiler requires a consideration of a number of points that cannot be given in a single article we will continue the subject in another paper.—D. Rivers, in *Invention*.

"STEPHANITE."

Several experiments with a new aluminium flux called Stephanite were carried out at Leeds recently. It is pointed out that the addition of metallic aluminium to iron and steel in a molten state greatly improves their quality, but the high cost of the metal, the impossibility of using it in a blast furnace, owing to its easy volatilization, and the great difficulty of obtaining a perfectly uniform alloy with the iron or steel in the crucibles, had so far limited its use, and stood in the way of generalizing its employment in the iron industries. These difficulties, the promoters say, promise to be overcome by the patent flux; composed of alumina and emery, which they are now introducing. It contains about 70 per cent. of alumina. In its natural state this flux is not volatilisable, like the refined commercial aluminium, but in a blast cupola or reverberating furnace it gives off its metallic gases or vapours, which unite with the iron, for which they have great affinity, and which acts as a condensing agent, whilst all the impurities go to the liquid slag and are drawn off in the usual manner. Metal manufactured by means of this flux it is claimed, works equally well under the hammer with the most malleable wrought iron, and will harden up to the hardest steel. It is also stated that the metal will work over and over again, becoming hard or soft at the will of the operator; and tests have proved that in its soft state it will stand a tensile strain of 38.8 tons per square inch. Another point upon which stress is laid is that the use of flux causes the iron to flow in a much more liquid state, and to remain in that condition a considerable time longer than by the ordinary process, thus preventing blow holes and faulty castings. By means of this invention, the promoters affirm, iron-founders will be able to make their own steel castings, independent of steel works, by simply melting scrap steel in their own crucibles. The cupola was charged in the ordinary way with common pig iron and coke, and then the flux, which is in the form of briquettes, was added. In due course the molten metal was run off and several castings were made. Some of these were immediately chilled and examined by the experts present, who considered the experiment had been successful. It may be added that about eighty pounds of the flux is required for every ton of metal.—*Mechanical World*, London.

POOR ENGINEERS AND GOOD BOILERS.

Boiler explosions are constantly taking place which ordinary precautions would have served to prevent. If any one doubts this let him investigate the causes of such disasters. On an average, the serious ones occur about twenty times a month, at least this has been the rate for the past two years, during which time the writer has carefully noted them. One potent cause is undoubtedly to be attributed to the employment of ignorant or careless men in the engine room, and another to the parsimony of some steam users, who "cannot afford" to get new boilers, though the old ones have been rendered dangerous by ill usage; perhaps they were only cheap tank iron affairs when first set in.

A few, happily the minimum, come from causes which the most painstaking manufacture and the most skillful handling would not always avail to prevent, for there are conditions of generation and expansion of gases within boiler shells which even at this late day are not thoroughly understood.

Let us inquire into the causes of some of the recent explosions. There were twenty-five serious ones between October 15th and November 15th. In the case of the disaster in the boiler house of the Louisville (Ky.) Electric Power Co., the exploding boiler was connected with another by a large steam drum, so that when one had a certain pressure the other had the same. Each had an independent feed pipe entering at the top, and also separate gauge cocks and glass water gauges. They were connected at the bottom with a two inch equalizing pipe. It was shown conclusively that there was plenty of water in one, and none in the exploded boiler. Close inspection of the inner sides of the plates showed this. The feed valve had become closed and the equalizing pipe stopped up by scale and sediment. The indications of the back head and the flue, which showed the blue line, indicated low water, and even the engineer admitted that that was the cause. The result of this explosion was the death of one man, the wounding of several others, and a disastrous fire.

The engineer trusted to the equalizing pipe, and did not even trouble himself to keep his boilers free of scale and to watch his gauges. Even his brother engineers in Louisville condemned him in a special meeting.

A somewhat similar case occurred at the Enterprise Mills, St. Jacob, Ill. The boiler that exploded let go along the horizontal seam of the first sheet, just below the water line, one flue was collapsed its full length. There were two boilers set in battery, connected at bottom with mud drum with seven inch legs, and on top with four inch pipe only. The boiler that did not explode showed no signs of low water, while in the other they were unmistakeable. This seems to have been a clear case of driving the water from one boiler into the other. There had been a big fire under the one that exploded, and but little under the other. That and the small steam connection is thought to be sufficient to account for it.

Here is a fairly representative list of explosions for thirty days, with the causes given where known :—

Bessemer, Ala.: Electric Light Works. Cause : Low water.

Anderson, Ind. : Am. Straw Board Co. Engineer went out for his lunch. He "thought it would be all right."

Tifton, Ind. : Coleman's Mill. Cause : Not known.

Medina, N.Y. : Sanderson's Mill. Cause : Boiler scaled an inch thick.

St. Paul, Minn. : Kansas City Lime Shops, locomotive boiler. Cause : Unknown.

Manchester, N.H.: Amoskeag Mill. Fly-wheel exploded. Cause : Imperfect casting.

Chicago, Ill.: Tug-boat Parker. Foaming, caused by using Chicago River (sewage) water.

Whitcomb, Wash.: Str. Evangel. Engineer forcing boiler beyond safety limit.

Pottsville, Pa.: New locomotive, cause unknown.

Brookhaven, Miss.: Brookhaven Machine Company. Boiler hadn't been cleaned and examined in three months.

Highland Park, N.J.: Raritan Brewery. Gauges stopped up and safety valve out of order.

South Stillwater, Minn. : Stillwater Lumber Co.'s Mill. Improperly constructed boiler.

Marion, O.: Schaffner's Furniture Factory. Low water.

Philadelphia, Pa. : Conroy Boiler Co. Boiler thick and cumbered with incrustation.

Sanborn, N.D.: Thrashing machine. Low water.

Tokio, O. : Portable engine. Engineer "didn't know it made any difference how much steam he got up."

McDonald, Pa.: Drilling engine. Engineer playing cards with a friend.

Eckelson's, N.D.: Thrashing engine. The water was low, and engineer couldn't remember just how much steam he was carrying.

Kildare, Tex. : Steward's Saw Mill. Scale and lack of water.

Van Wert, O.: Steam picket saw. Engineer had to go out for his lunch.

Sundridge, Ont.: Tookey's Planing Mill. Boiler worn out.

Venedocia, O.: Saw mill. Low water.

In most of the cases where there were deaths, the coroner's inquiry brought out the fact of gross imcompetence. Indeed, the evidence in many of these cases is calculated to amaze the reader. It seems to be a fact that there are those who employ steam in their business without the smallest idea of its dangers. They hire an engineer as they hire a wagon driver, and trust to luck for the rest.

In some sections the laws bar out incompetence from the engine room, and such laws should be in force everywhere.

The Stationary Engineers of Louisville, Ky., who met recently to consider the cause of the explosion in that city, declared it as their belief that "engineers as well as boilers should be inspected." A sentiment, it may be said, which does credit to their intelligence.—*Scientific American.*

OIL AS FUEL FOR STEAMSHIPS.

A great saving in weight and cost of stoking is to be effected by using oil as fuel on steamships, instead of coal, according the "remarkable results" discovered by a New York paper, which says :

It is a great advance toward the employment of petroleum instead of coal for generating steam in the boilers of marine engines to find that the question is now nearly reduced to one of cost. When it comes absolutely to that point its use for some branches of navigation will be assured. There will be petroleum regions which can employ liquid fuel for their locomotives and ship engines, while many naval vessels will not allow the increased expense to stand in the way of increased efficiency. Provided safety in stowage and use can be assured, and provided no danger of explosion need be feared should an oil tank be hit by a shell, there will be positive advantages enough to insure its introduction. The most conspicuous of these is its superiority over coal in evaporative power. A given weight of oil will produce nearly twice as much steam as the same weight of coal, so that in order to keep up the fixed amount of steam required by a naval engine only about half as much fuel need be expended. That means, of course, nearly doubling the ship's radius of action, which is a point of high importance to war vessels. In the case of the London and Pacific company's steamship Ewo, it is said that while she had made eight and one-half knots with the use of seven tons of coal per day, she reached nine knots on less than four tons of fuel oil. It must also be noted that a ton of coal occupies about one-eighth more space than a ton of oil residuals. Hence the customary proportion of 7 to 4 in favor of the evaporative power of oil is increased to nearly double in a ship's fuel supply.

In a recently published review of the present state of the oil fuel question by Assistant Engineer Allerdice of our navy, stress is laid on the fact that petroleum refuse, or the residuum after refining is used instead of crude petroleum, which would be much more dangerous. Italy, which is well-known to be enterprising in naval matters, has employed a mixed fuel of coal and petroleum on her man-of-war Messaggiero, whose speed was thereby increased from 15 knots to 17, but at some cost of injury to the boilers. Like trials at Spezia on the Castelfidardo and the Ancona have also been favorable. The oil thus used is petroleum refuse, which stands a fire test of about 300 Fahrenheit. Two competitive locomotives were run for five months on the Oroya railroad in Peru, pulling equal trains alternately over the same ground, and being exactly alike except that one used coal and the other oil for fuel. The consumption of oil per mile was 38.55 pounds; that of coal was 7.93 pounds. As a result, that railroad and one other are using oil for fuel. Indeed, along the South American coast some of the most striking instances of progress in this direction are found.

This consideration of the subject by Mr. Allerdice includes a citation of the views of Capt. Carmichael, the commander of the Ewo, already spoken of. He says that the petroleum residuum is perfectly non-inflammable until heated to 350 degrees, and consequently is safe to carry and use; that it has no smell, does not evaporate perceptibly, and does not deteriorate in metal tanks or injure them. The engineer can get the steam he wants without being dependent on firemen or on the weather, and the pressure on the boilers is steady and constant. There are no fire doors to open in coaling, and in the Ewo the tubes were only swept once in six months, and even then were not dirty. Large tank steamers could fuel a fleet, even in heavy weather, by the simple apparatus of hose and pump, whereas coaling at sea is a difficult process. Capt. Carmichael especially dwells on the safety of oil fuel, and its being "handled without risk of fire or explosion," while if stored on shore and bombarded by a fleet "shells could not set fire to the tanks." Of course combustibility is one of the great points to be considered, although it has sometimes been urged that, even admitting this liability, it could be obviated so far as danger from an enemy's shells is concerned by storing the oil under the water line. But bunker protection, now a great element in naval construction, would be sacrificed entirely by using oil for fuel. The cost of oil is admitted to be greater, but this is partly offset by a reduction in the number of firemen and in the expense, also, of their provisions and quarters. It is also evident that since there are no ashes to be disposed of and no tubes and grates to be cleaned the work of the stokers is much reduced. The total absence of smoke is as obvious an advantage as smokeless powder for armies, and it would aid alike in creeping upon a foe undetected and in escaping.—*American Engineer.*

SPONTANEOUS BLAZES.

In our last issue, mention was made of the burning of Siegel, Cooper & Co.'s mammoth store, in Chicago, when quite a million dollars' worth of property was destroyed. It was a great wonder and "the talk of the town" for two or three days, and then forgotten—except by some three thousand clerks, salespeople, teamsters, porters, janitors, and other wage-earners who temporarily are thrown out of employment by the destruction of their former place of work. "So great is the wealth, so numerous are the enterprises, so swift the motion of Chicago, that a disaster which would be date-making in the metropolis of an agricultural State is talked of for but a few hours, and then is forgotten as the manner of the death of Amenophis III.

"Twenty-five hundred people form quite a city in a farming country; most of the county seats in the forty-four States of the Union fall under this standard of population. Some of our great stores are filled, from morning till evening is far advanced, by a number exceeding the population of many a town that has its mayor, town council, and electric lights. This simple statement of fact throws the magnitude of Chicago's trade into strong relief, but it also emphasizes the necessity of protection against sudden fires."

The paper from which these quotations are made puts great stress on the necessity of making our great stores fire-proof—a very wise thing to do. But the reason for that necessity is much strained by the paper referred to. It says, "If such a fire had broken out, and consumed everything so rapidly as it did when the store was open, and with 2,000 or 3,000 customers and salespeople present (as was usually the case, especially on Mondays and Saturdays), hundreds of men and women would have been literally roasted to death, as they could never get away rapidly enough."

The fire broke out about 7 o'clock on Monday morning—just as some of the employees were beginning to arrive. No doubt it was the opening of the premises that started the fire—by letting in a flood of oxygen. If the cause of the conflagration was an overheated boiler, as is believed, the heat had penetrated the whole building, and its contents, more or less, and consumed the oxygen, for want of which the heat could not break out into a flame. But when the engineer (Seaferth) entered the building, smoke was immediately noticed over the boiler room; thereupon the foreman of one of the departments, smashed a window in that quarter, and thereby unwittingly let in a flood of the very element which the intense heat was waiting for, so to speak, and then the whole building was ablaze as suddenly as a match is lighted. If they had kept out the fresh air, and diminished the great heat first, then that immense fire might have been avoided.

At all events that is how spontaneous combustion generally occurs, namely by letting in fresh air on intense heat. In fact, fire will not burn where oxidized air is excluded. And in the daytime, in a large store where thousands of people are present at one time, it is some consolation to think that a terrific blaze cannot sweep over the building all at once, as occurred on opening up Siegel, Cooper & Co.'s store on Monday morning. If a fire had broken out in the neighbourhood o the boiler room when the store was open, in the middle of the day, the flames would have consumed that portion first, and extended as the surrounding portions became heated, from the original blaze, which of course would be rapidly enough. But the point we wish to emphasize is, that to enable a blaze to spread like lightning, so to speak, the heat from the boiler must have been kept up for many hours, and absorbed the oxygen from the heated air throughout the building in a manner that could not possibly occur if the doors or windows had been open.

In this connection it may not be inopportune to remark that whenever an engineer finds, on reaching his place before a building is open, that the air is intensely heated, the slower he lets in fresh air (until the atmospheric heat is reduced) the safer will it be. And when a fire is discovered in a part of a big building (or in any building) it is the greatest folly to smash a window, and thus let in fresh air, as was done at Siegel, Cooper & Co.'s. Firemen often commit this great mistake. And we often read that, "when the windows were smashed, the flames broke forth like fiery tongues which licked up everything before them," or something to that effect. Every effort should rather be made to keep out the fresh air until the heat inside is reduced by means of water. And when a hole has to be broken to let in the hose, the smaller it is made the better.—*American Engineer.*

WHAT IS STEEL ?

Steel has been defined as any kind of iron which, when heated to redness and suddenly plunged into cold water, becomes hard ; and every kind of malleable or flexible iron that can be hardened by that process is steel. But this definition, says "An Occasional Contributor" in the *Mechanical News*, is not applicable to the steel of mild quality now made for many mechanical uses. One of the requisites for this mild steel is that it will not harden after being heated to a cherry red and plunged into water. To include all the kinds of steel now used in the agricultural and mechanical, the better definition of steel will be a malleable iron combined with a percentage of carbon. Chemically considered, steel occupies a half way position between wrought and cast iron ; wrought iron being simply iron almost entirely free from carbon, while steel that is to be tempered contains from 1 to 1½ percent of carbon.

The reason why this very slight change in the chemical construction should produce such wonderful results in the properties of iron and steel, is as yet an unsolved mystery. We know that a bar of iron converted into steel becomes more granular or open, and while it loses to some extent its toughness, it gains, instead elasticity, greater strength and closeness of fibre.

Blister steel is made by heating bars of iron packed in charcoal, in a furnace, for a period of from 6 to 10 days. When the metal is withdrawn, the bars are found to be of a crystalline texture, and have a blistered surface—hence the name. Cast steel was formerly made of blister steel broken into fragments, melted in crucibles and cast into ingots ; but the modern practice is to charge the crucibles with pieces of good Swedish or American bar iron, adding charcoal and black oxide of manganese. The heat of the furnace soon seals the lid of the crucible, and the melting iron absorbs carbon from the fumes of the charcoal, thus shortening the tedious process of making "blister" bar. The cast steel is rolled or hammered from the ingot to any desired bar, sheet or plate.

The chief characteristic of steel consists in its capability of being hardened and tempered, and when exposed to heat it takes on in succession the following colours :

1. A faint yellow, which indicates a proper temper for lancets or small cutters that require the finest edge, with but little strength of metal.
2. A pale yellow, which indicates the temper for razors and surgical instruments.
3. Full yellow for penknives, etc., with increased toughness.
4. Brown, with purple spots—that being for axes and carpenters' tools.
5. Bright blue, for swords and watchsprings.
6. Full blue, for fine saws, daggers, etc.
7. Dark blue, for large saws or instruments that may be sharpened with a file.

The above colours are based on steel suitable for the requirements. A piece of steel suitable for razors, lancets, etc., would not take the colour indicated for large saws, as that quality of steel is but little above the "blister" quality. The finer steel is, the less heat it will temper at, requiring a lower temper of colour. Recently there have been some valuable discoveries in tempering, welding and restoring steel, both from burnt or a low grade.

COPYING INK WITHOUT PRESS, BLACK.

Nigrosine, C. P. fine	10	ounces
Glucose "A"	1½	"
Hot water	1¾	"
Glycerine	1½	"

Dissolve the nigrosine by trituration in the hot water and then add the other ingredients and strain through a piece of silk. If too thick when cold, dilute to the proper consistence with water.—*Ex.*

HOW TO DRILL GLASS.

Glass can be drilled with a common drill, but the safest method is to use a common broach drill. No spear pointed drill can be tempered hard enough not to break. The broach can be either used as a drill with a bow or by the hand. It should be selected of such a bore that it will make a hole of the required size, at about one inch from the end. It should be broken off sharp with a pair of pliers, at about an inch and a half, and when the sharp edges are blunted by drilling, a fresh end should be made by breaking off an eighth of an inch, and so on, until the hole is bored. It is always desirable to drill from both sides, as it prevents the glass from breaking. Drill lightly and lubricate with spirits of turpentine and oil of lavender. Holes may be drilled through plate glass with a flat ended copper drill and coarse emery and water. The end of the drill will gradually wear round, when it must be re-flattened, or it will not hold the emery. The best means of drilling holes in glass is by using a splinter of a diamond. A brass drill is made to fit the drill stock, sawn down a little way with a notched knife to allow the splinter to fit tight, and the splinter fixed in the split wire with hot shellac or sealing wax. The drill is to be used quite dry and with care. If the hole to be drilled is wanted larger than the tool, drill a number of small holes close together to form a circle as large as the hole required ; then join the holes with a small file.—*Ex.*

ARTIFICIAL IVORY.

Attempts have been made to produce a good artificial substitute for ivory. Hitherto none have been successful. A patent has recently been taken out for a process based upon the employment of those materials, of which natural ivory is composed, consisting, as it does, of tribasic phosphate of lime, calcium carbonate, magnesia, alumina, gelatine, and albumen. By this process, quicklime is first treated with sufficient water to convert it into the hydrate, but before it has become completely hydrated, or "slaked," an aqueous solution of phosphoric acid is poured onto it ; and while stirring the mixture the calcium carbonate, magnesia, and alumina are incorporated in small quantities at a time, and lastly the gelatine and albumen dissolved in water are added. The point to aim at is to obtain a compost sufficiently plastic and as intimately mixed as possible. It is then set aside to allow the phosphoric acid to complete its action upon the chalk. The following day the mixture, while still plastic, is pressed into the desired form in moulds, and dried in a current of air at a temperature of about 150 deg. C. To complete the preparation of the artificial product by this process, it is kept for three or four weeks, during which time it becomes perfectly hard. The following are the proportions for the mixture, which can be colored by the addition of suitable substance : Quicklime, 100 parts ; water, 300 parts ; phosphoric acid solution—1·05 sp. gr., 75 parts ; calcium carbonate, 16 parts ; magnesia, 1 to 2 parts ; alumina precipitated, 5 parts ; gelatine, 15 parts.—*Ex.*