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THE WHITWORTH INDUSTRIAL SCHOLARSHIPS.

In publishing on this page a portrait of Sir Joseph Whitworth, a mechanic whose skill is known and valued wherever industrial knowledge has penetrated, we desire, not only to do honor to a master of his craft, but also to call attention to his liberal bestowal of a portion of his wealth to found scholarships to enable rising artisans to pursue their studies, and to the terms of the gift, which are commendable for their practical value to all who intend to employ their means for like noble purposes.

The rapid strides made by France, Germany, and other continental nations in the mechanical arts have forced the importance of technical education upon other people, and the English have recently made arrangements on the largest scale for embodying practical studies in the scheme of the common school *curriculum*. Sir Joseph Whitworth has taken the lead by presenting $500,000 to be disposed of as follows:

The interest (at 3 per cent, $15,000 annually) to be divided into 30 stipends of $500 per annum, to be awarded to young men, natives of the United Kingdom, selected by open competition for their intelligence and proficiency in the theory and practice of mechanics and its cognate sciences. Each successful competitor is to receive the stipend for three years.

The liberal donor further proposed that as much latitude as possible should be allowed to each successful competitor, in reference to the natural bent of his inclination. If he wished to complete his general education instead of continuing his special scientific study, he might be permitted to do so; he might go to the universities or colleges affording scientific or technical instruction; or he might travel abroad. "The successful artisan should be encouraged to study theory; while the successful competitor in the theory should be aided in getting admission to machine shops and other practical establishments."

Competition was proposed to be in mathematics, elementary and higher; mechanics, theoretical and applied; practical plane and descriptive geometry; mechanical and freehand drawing; physics; chemistry, including metallurgy; and such handicraft processes as smith's work, turning, filing, fitting, pattern-making, and molding. Sir Joseph proposed that theory and practice should be placed on a level, by an equality in the maximum number of marks for the two classes of merit—theoretical science and practical skill. This he did to render the competition accessible on fairly equal terms to the student who combines some practice with theory, and to the artisan who combines some theoretical knowledge with excellence of workmanship.

Sir Joseph, having promulgated his ideas in May, 1869, saw the desirability of encouraging competitors by giving them twelve months' opportunity of improving themselves. To this end he established sixty exhibitions or premiums of $125 each, to be held for one year: these were awarded to youths and young men under twenty-two years of age, who were required to undertake to compete for the more valuable $500 scholarships in May, 1869. In order to render these exhibitions as widely available as possible, they were placed at the disposal of a large number of educational bodies, including the universities of Oxford, Cambridge, London, Dublin, Edinburgh and Glasgow, and other colleges and schools.

The public value of this liberality is shown by the fact that in 1869, out of 106 candidates, only 10 reached the standard of knowledge set up as a necessary qualification, but the average acquirements of the youths have been steadily improving. The stipends, useful to the workmen for whom they were intended, have been coveted as distinctions by persons whose means were ample, so that an indispensable condition of two years' previous service in a machine shop has been imposed.

To encourage the young men to persevere with all their hearts, those who are successful at certain further examinations will receive money rewards over and above their three years' scholarship money, that is, over and above $1,500. It will thus be possible for the same artisan to receive $4,000 in all: a valuable aid to a youth whose hands have to find him with food, lodging, and clothes, as well as books and means of study and travel to perfect him in his calling.

The examinations are thoroughly practical, as the tests with tools will show:

The ax: Each competitor who tried this test was required to square up an octagonal block of wood, using the ax only, and to make the square as large as possible. He was also required to shape an ax haft to a given pattern, by means of an ax and spokeshave. The saw and plane: The competitor had to saw out of a piece of plank two square strips, and plane them up smooth and true; also to make two parallel strips 2 feet long, 2 inches wide, and $\frac{5}{8}$ inch thick. The hammer and chisel: The competitor had to chip a piece of cast iron all over the upper surface, leaving it as smooth as possible from chisel marks. The file: The competitor had to square any two adjacent sides of a cast iron tube, with a succession of 9 inch strokes of the file; also to file up an hexagonal nut on its six sides to match a pattern. The forge: The competitor had to weld together two pieces of square iron, using only a hand hammer; also to make the two halves of a pair of tongs from pieces of round iron. Turning: The competitor had to bore out a bevel wheel to $1\frac{1}{4}$ inches in the hole, using two drills and a punching bit; also to turn a piece of round iron to serve as a mandril, face it on the wheel with a mandril press, and turn and scrape it smooth and clean on the back, face, and teeth. Fitting: The competitor had to key a boss upon a short shaft, cutting a key way $\frac{7}{16}$ inch square, setting the key half into the shaft and half into the boss; to fill up the key and fit it well in; and to make the end of the shaft project 1 inch through the boss, to support the head of the key. Pattern-making: The competitor had to make a pattern of a short piece of iron girder, finished up ready for use in the foundry, including the core box for the two bolt boles in the flanges of the girder. The handicraftsman who could achieve these tasks moderately well could hold his own in any machine shop or engineering establishment of average character.

Such are the Whitworth scholarships, certainly the most munificent endowment ever made for technical education.

SIR JOSEPH WHITWORTH.

Cutting Wheat by Steam.

Lord Kinnaird, a large and enterprising farmer of Scotland, writes to Mr. Mechi that he has had a most successful and satisfactory trial of reaping by steam power. He attached his traction engine to an enlarged reaping machine; and though the ground was soft, owing to wet weather, and the crop laid and leveled so that it could only be cut one way, yet he has no doubt that, in ordinary dry, harvest weather, an acre could be cut down within half an hour, and he confidently expects to be able not only to cut but, by the aid of steam power, to bind up the cut grain in sheaves, and thus gather in the crops—employing only some half dozen hands.

IMPROVED STUCCO.—M. Landrin recommends the mixing of the crude plaster in water containing 8 to 10 per cent of sulphuric acid. After allowing the compound to rest for fifteen minutes, he calcines the plaster. This gives a stucco of excellent quality in which all organic matters are burnt out leaving the material of exceptional whiteness

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(Illustrated articles are marked with an asterisk.)

PUBLISHERS' CARD.

With the next issue, the time for which a large number of our subscribers have prepaid, will expire. In order that our readers may experience no stoppage in the receipt of the journal, and that we may not miscalculate the quantity of the paper to print at the commencement of a new volume, we hope our friends will signify their intention to continue the paper by early remittances.

The plan of discontinuing the paper when the time expires for which it is prepaid, we think preferable to the course, adopted by many publishers, of continuing their paper indefinitely and collecting afterwards. The latter course is too much like having a bill presented for a suit of clothes after it is worn out. We shall be gratified to have every old subscriber renew, and doubly grateful if each will send one or more new names with his own.

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THE PATENT OFFICE AGAIN.

We last week reviewed some of the errors which had crept into the *administration* of the Patent Office. We shall now refer to others which are embodied in the *statute*. Both these classes of errors have sprung mainly from the same source, and are alike prejudicial to the inventor.

The act of July 8, 1870, which was a revision of all our patent laws, corrected or removed some of the defects which previously existed, but it introduced more mischiefs than it cured. Its chief changes interposed needless and unreasonable obstacles in the way of the inventor.

For instance, nothing is more important to him than the right to amend his patent through a reissue. Rarely does a patent, as first obtained, embody the invention in a fully available shape, and often is its real gist mistaken altogether. The common law authorized amendments by means of a surrender and reissue, and the statute regulated and rendered more definite the rights of the patentee in this respect. The great purpose, in both cases, was to limit the new patent to the real original invention, giving the full benefit thereof to the inventor, but nothing more.

To guard against abuse and to prevent a patentee from enlarging the scope of his patent, or from wringing in a new subject matter through a reissue, the courts have—rather severely—held that oral proof of the full scope of the original invention was inadmissible, and that nothing could be claimed in the reissued patent unless either the model, the drawings, or the specification—as originally filed—showed the invention thereof.

The new law has taken a most indefensible step in farther limitation of a previously existing right, by rendering the most reliable of record evidence wholly incompetent in such cases. The model or drawings may still be called as witnesses, but not the specification. No matter how fully or how clearly the invention may be set forth in the latter, still, in cases where there are drawings, nothing can be claimed in a reissue which is not shown in those drawings or in the model. A credibility is thus given to a *sign* or a *mute device*, which is absurdly denied to a *written declaration*. Pantomime is regarded as more reliable than articulate language. This is all wrong.

Again, it has always been considered a sound and just rule of practice that an application for a patent should be wholly *ex parte*, that no outsider should be allowed in any manner to interfere in the proceeding, and that he should not even know of its existence. The reason for this rule is that, as inventors are generally poor, if wealthy companies were allowed to interpose, such expensive controversies and harassing delays would result as would often prevent the obtaining of a just patent. After having obtained his patent, the inventor will be in a better condition to face his antagonist by securing auxiliaries or otherwise.

The act of 1870 introduces the anomaly that, in all appeals from the Commissioner, he "shall notify all parties who appear to be interested therein." This would enable them to appear and oppose the grant of a patent. The applicant is also required in such cases to be at the extra expense of procuring certified copies of all the original papers and evidence in the case. Whether intentional or otherwise, these provisions would in many cases operate as the denial of undoubted justice. Quite as reprehensible is another provision connected with these appeals. When the act of 1870 was before the committee which framed it, the then Commissioner endeavored to so change the previously existing system as to render a decision by him final, by cutting off appeals to the court. This was, however, so strenuously opposed, by those who sought to protect the interests of inventors, that the committee refused to adopt it. They even went so far in the opposite direction as to determine that—in cases of interferences, where there are antagonist parties either of whom may appeal, and where cases of sufficient importance to be appealed to the Commissioner would generally be certain to be carried to the court—the unsuccessful party, before the Board of Examiners in Chief, might appeal at once to the court, without the useless necessity of an intermediate appeal to the Commissioner. But when the act came to be published, all was found to be so far most unaccountably changed, that in interference cases not only did an appeal still lie to the Commissioner, but his decision was made absolutely final. The appeal to the court was thus cut off in those cases which of all others it is best qualified to decide, while in questions of mere patentability, with which the Commissioner may be presumed to be most conversant, and therefore best qualified to judge, the appeal still lies to the court.

These are given as mere specimens of the mistakes and incongruities in the new law, not as an attempt at their enumeration. There are many others of no trivial importance, most of which equally militate against the interests of inventors. The only effectual remedy is to be sought for in a general change or codification of the statute. And in making this change, the spirit which dictated the provision in the Federal Constitution by which the statute is authorized should never be lost sight of. The law should be framed in aid of the inventor, and not as an instrumentality for circumscribing his rights within their narrowest limits, or for annihilating them altogether. This is a dictate of sound policy as well as of the plainest justice.

There are many unreflecting minds who honestly regard the whole patent system as being founded on error, and who look upon a patentee as the possessor of an odious monopoly. If their notions are correct, the institution of property of all kinds should be abolished, for every kind of property is a monopoly. A patent for an invention is no more so than is a patent for land. But who would build a house, or cultivate a field, or otherwise provide for the comforts or necessities of life, if he were denied all property in the fruits of his labor, in other words, if he were not to enjoy a monopoly in what he had thus created? Civilization could never have existed without the institution of property. It would soon take its departure from the earth if that institution should cease to exist.

These principles are as applicable to inventions as to tangible objects. The application of communist doctrines may sometimes seem enticing, but the general rule would operate as perniciously in the one case as in the other. Deny all property in inventions, and you paralyse the efforts of that class in the community which, more than any other, has contributed and is still contributing to human progress. The thousands of minds who are devoting their every energy to the promotion of human welfare would feel that their chief inducement to effort had ceased to exist.

Monopolies are justly odious when made applicable to what was before common property, but not when limited to the authors of new creations or even new discoveries. The government whose flag is first planted on an uninhabited island is, by common consent, the owner thereof. How much more complete would have been its title thereto had it created that island! Such is the title of the inventor. Under a proper administration of a sound patent system, the patentee is only protected in his property to his own discovery, and, more generally, to his own creation. He would be allowed a limited monopoly in what, but for him, might never have existed, or, at all events, was previously unknown.

But we have heard it asserted that the inventor is only entitled to protection in the *machine* he builds, and that any mechanic ought to be equally protected in the work of his own hands, though identical in form and operation with that of the inventor. But in what does a real invention consist? It is not in the materials, nor in the contrivances out of which the machine is constructed. These are the mere instrumentalities which give expression to the thought that lies beyond. They bear the same relation to the real invention that the visible Universe does to its Creator, or that the material body does to the human soul. An invention is a soul or principle, which has found a material means of evincing its existence and character.

That many wrongs have resulted from the defects and abuses of our patent system no one will doubt, but these are certainly not greater than the frauds and crimes which have had their origin in the institution of property in material things. In both cases these evils are infinitely overbalanced by the advantages which result from that institution. Correction, and not annihilation, is the appropriate remedy for these mischiefs.

Our conclusion, therefore, is: *First*, that a well regulated patent system is of incalculable importance to the public welfare: *Secondly*, that the laws on this subject should aim primarily to encourage invention by facilitating the means of obtaining patents and protecting property therein, and: *Thirdly*, that in administering those laws the Office should be actuated by their spirit and purpose, and govern its conduct accordingly. To aid in bringing about these results has been the main purpose of these articles.

TWO TYPICAL EXPERIMENTS.

Dr. Bastian pursues his investigations touching the origin of life with praiseworthy energy. For every objection urged against the conclusiveness of his experiments, he straightway performs a new series to meet the difficulty, carrying the war into the very camp of the panspermatists, and keeping them constantly on the defensive. Results formerly denied are now admitted; but they are met by raising the thermal death point of certain germs to 227° or 230° Fah., and alleging that the organisms developed in boiled solutions, hermetically sealed, came from invisible germs not killed by the heat to which the solution had been subjected.

For the benefit of those raising this objection, he now reports the following experiments, selected from several, in some of which, he says, even higher temperatures were resorted to:

Experiment I: To a strong infusion of turnip, made faintly alkaline by *liquor potassæ* a few separate muscular fibers of codfish were added. Some of this mixture was then introduced into a flask of nearly two ounces capacity, and the neck of the flask was drawn out and hermetically sealed by a blowpipe flame while the fluid within was boiling. Thus closed, the flask was about half full of fluid. It was then placed in an iron digester, and gradually heated to a temperature from 270° to 275° Fah., at which it was kept for twenty minutes. For an entire hour the flask, heating and cooling, had a temperature exceeding 230° Fah., the alleged death point of bacteria germs. Withdrawn from the digester, the closed flask was kept at a temperature of 75° to 80° Fah., for eight weeks, a part of the time exposed to the influence of direct sunlight. After it had been ascertained that the flask was free from any crack or flaw, its neck was broken, and its contents examined. The fluid showed a decidedly acid reaction, and it had a sour though not fœtid odor, as though fermentation had taken place. It was also slightly turbid, and there was a well marked sediment, consisting of reddish brown fragments and a light flocculent deposit. On microscopical examination, the fragments were found to be portions of altered muscular fiber; the flocculent deposit was composed for the most part of granular aggregations of *bacteria*. In the portions of fluid and of deposit which were examined, there were thousands of bacteria, of most diverse shapes and sizes, either separated or aggregated into flakes. There were also a large number of morilated chains of various lengths, of a kind very frequently met with in abscesses and other situations (where pyæmia or low typhoid states of the system exist) in the human subject. There were, in addition, a large number of *torula* corpuscles, besides brownish nucleated spore-like bodies, gradually increasing in size from mere specks, about one thirty-thousandth of an inch in diameter, up to one twenty-five-hundredth of an inch. Lastly, there was a small quantity of the mycelium of a fungus, bearing short lateral branches, most of which were capped by a single spore-like body.

Experiment II: A strong infusion of common cress, to which a few of the leaves and stalks of the plant were added, was enclosed in an hermetically closed flask, and treated in precisely the same manner, and at the same time, as the infusion of experiment I. The flask was opened the ninth week after heating. Before breaking the neck of the flask, the inbending of the glass under the blowpipe flame showed that it was still hermetically sealed. The reaction of the fluid was found to be distinctly acid, though there was no notable odor. The fluid was tolerably clear and free from scum; but there was a dirty-looking flocculent sediment at the bottom of the flask, amongst the *débris* of the cress. On microscopical examination (with a $\frac{1}{12}$th immersion objective), much altered chlorophyll existed, either dispersed or aggregated among the other granular matter of the sediment; and among some of this, three minute and delicate *protamœba* were seen, varying in form, and creeping with moderately rapid, slug-like movements. They contained no nucleus, and presented only a few granules in their interior. In the same drop of fluid, and also in others subsequently examined, more than a dozen very active *monads*, one four-thousandth of an inch in diameter, were seen, each provided with a long rapidly moving lash by which neighboring granules were freely knocked about. There were many smaller motionless and tailless spherules of different sizes, whose body substance presented a similar appearance to that of the monads, of which, in Dr. Bastian's opinion, they were in all probability earlier developmental forms. There were also several unjointed bacteria, presenting most rapid progressive movements, accompanied by quick axial rotations. Many torula corpuscles and other fungus spores, also existed, as well as portions of a mycelial filament, containing equal segments of colorless protoplasm within its thin investing membrane.

Until the panspermatists offset these experiments by an exhaustive series, showing that living forms do not originate under the conditions described by Dr. Bastian, there would seem to be but one escape for them, and that is to assert (contrary to all experience) that the temperature of 230° Fah., or even 275° Fah., is lower than the thermal death point of the invisible germs of these simple organisms.

MICA MINES IN NORTH CAROLINA.

Among the most interesting relics thus far discovered of the mysterious race of mound builders, who occupied the Mississippi valley previous to the advent of the more barbarous Indians, are numerous ornaments of mica. Like the weapons of hammered copper from Lake Superior, the shells from the Gulf of Mexico, the implements of Mexican stone and of iron ore from Missouri, these plates, of a mineral not found in the Great Valley, give a plain hint of the extensive commercial relations of those prehistoric people.

The mica was evidently mined in Western North Carolina where their long-abandoned workings have lately been reopened, and made the scene of a very modern enterprise.

Seven years or so ago, a prominent citizen of North Carolina set some laborers to work in one of the ancient mines, in search of silver, supposing that metal to have been the one sought for by the original miners. A considerable quantity of mica was thrown out, but its value was not recognized until a sample, which had been sent to Knoxville as a curiosity, was seen by a Mr. Clapp, who followed up the clue and leased the mine for its mica, and revived an industry which has added immensely to the wealth of the region. The mine is known as Blaylock's, about twelve miles from Bakersville, the county seat of Mitchell's county. Four or five other ancient mines have since been reopened in the same neighborhood, besides many new ones in the same and adjoining counties.

A correspondent of the *Tribune* reports that the mica trade has given general occupation to the population of Mitchell county, and has made money plentiful and thereby enabled the county to pay off its indebtedness, which it would otherwise have been unable to do. Mines have also been opened in Yancy, Heywood, Burcome, McDowell, and other counties. The business is still in its infancy, and the methods of mining are exceedingly primitive; yet the amount of mica produced is more than enough to supply the large and growing demand for the article. Dealers and manufacturers supply the mines with patterns ranging in size from two by three inches up to fifteen inches square, according to which the mica is prepared for market. The dark or brandy-colored mica brings the best price. Associated with the mica is an abundance of decomposed snow-white felspar, which will no doubt be utilized, in time, for the manufacture of porcelain.

TYNDALL ON TYPHOID.

Professor Tyndall has dropped for the nonce the role of physicist for that of physician, and deals, in a recent publication, with the subject of typhoid fever, discussing the important question as to whether that disease can ever have a spontaneous origin from fecal fermentation or must of necessity always spring from a germ, the last derived from a pre-existing case of fever. Following closely the data obtained by Dr. Budd, as well as those of other investigators in the same field, Professor Tyndall asserts positively that the weight of evidence is in favor of the view that the disease, like small pox, arises wholly from contagion. He holds that the body is the seat of the development of the germ, and that the latter is not originated from noxious effluvia, however foul: and in support of this, he cites the fact that, during the foul condition of the Thames in 1858, the community residing upon the banks enjoyed a sigular immunity from fever. Even in rural districts, it is asserted that, where the air is purest, typhoid has been known to rage, and to be traceable directly to personal communication.

It would not be expected that so radical a denial of generally accepted views could be promulgated without arousing challenge from the medical profession, and already several of the most eminent English physicians have adduced strong evidence in contradiction of Professor Tyndall's assumptions. Dr. Alfred Carpenter states that typhoid is contagious only in a limited degree, and that by proper precautions its attack may be prevented. Dr. Murchison says that, during nine years, in the London Fever Hospital, 3,555 cases of enteric fever were treated in the same wards with 5,144 patients not suffering from any specific fever. Not one of the latter contracted enteric fever, although the use of disinfectants was exceptional, and they were brought in contact with the excreta of the former class. The same authority gives repeated instances, occurring in his own practice, confirming the opposite of Professor Tyndall's conclusions.

So many cases have occurred, where the existence of typhoid has been traced directly to sewers, foul drains, and similar receptacles of filth, that arguments far more cogent than those f Professor Tyndall will be required to convince us that nos odanger of pestilence lurks therein. Add to this that it ha been repeatedly shown that hospital attendants in personal communication with typhoid patients are remarkably exempt from the disease, and without further review of the great mass of confirmatory evidence brought by medical writers against Tyndall's theory, we cannot but conclude with the London *Medical Journal* that the Professor has in this case, as was charged against him in his recent researches on sound, studied but one side of the question.

It may be well to remark in this connection that Professor Tyndall's most recent efforts are not wholly bearing out the reputation for scientific acuteness and philosophical caution so ably won by him in his earlier labors.

Dr. Lionel Beale—himself a scientist of no inconsiderable celebrity—makes a strong point against Tyndall in a recent communication to the London *Times*, in stating that, though he has followed Tyndall's track for years, he is unable to comprehend Tyndall's course of reasoning. Referring to the latter's Belfast speech, in which the speaker said that the material ideas were not his belief "in hours of clearness and vigor," Dr. Beale rather pertinently suggests the question of which Tyndall we are to believe, Tyndall whose brain, when weak and unhealthy, produces materialistic theories, or Tyndall, when clear and vigorous, repudiating the same ideas? Altogether the eminent Professor has latterly contrived to encircle himself in a kind of fog as to his doings and sayings, which prevents people of ordinary discernment from relying so implicitly on his conclusions as they otherwise might.

HOW TO INVESTIGATE SPIRITUALISM.

There has been lately an extraordinary revival of spiritualism, and it again challenges the general attention. Nearly all the newspapers, and some of the most respected of the literary magazines, without reservation or protest lend their columns to its advocates. The *Daily Graphic* for more than a month has made spiritualism its specialty, pursuing it with such pertinacious enterprise as it did the Atlantic balloon project of last year. And, most significant of all, many distinguished scholars and clergymen, to whom the *Graphic* had addressed a circular letter, inviting their coöperation in an investigation, signify their approval of the *Graphic's* plan and a profoundly respectful appreciation of the spiritualistic pretensions. This revival of spiritualism is probably due to the new phase which the spiritual manifestations have taken on: Materialization. In place of raps, tips, trumpet blowing, tying, levitations, ponderations, etc., performed by or through the medium, we now have the spirits appearing *in propria personæ*, with bodies apparently of fleshand blood, and nicely dressed in such clothes as they wore when they dwelt in the mortal coil.

Now these things seem to justify us in recurring to the subject of spiritualism, and in improving the opportunity to point out some things which Science has to do with it. And to make the matter short, we will limit our remarks to the alleged physical phenomena, the movements or changes of matter. We leave out of view, of course, the religious aspects of spiritualism; and for its bearings on psychology and physiology, we refer to what Faraday, Carpenter, Tyndall, and others have written. We point out, however, the evident fact that spiritualism rests on the physical manifestations. Take them away, and its bottom is knocked out pretty clean.

In the first place, then, we can find no words wherewith to adequately express our sense of the magnitude of its importance to Science if it be true. Such words as profound, vast, stupendous, would need to be strengthened a thousandfold to be fitted for such a use. If true, it will become the one grand event of the world's history; it will give an imperishable luster of glory to the nineteenth century. Its discoverer will have no rival in renown, and his name will be written high above any other. For spiritualism involves a stultification of what are considered the most certain and fundamental conclusions of Science. It denies the conservation of matter and force; it demands a reconstruction of our chemistry and physics, and even our mathematics. It professes to create matter and force out of nothing, and to annihilate them when created. If the pretensions of spiritualism have a rational foundation, no more important work has been offered to men of Science than their verification. A realization of the dreams of the *elixir vitæ*, the philosopher's stone, and the perpetual motion is of less importance to mankind than the verification of spiritualism.

But some may say that we exaggerate the pretensions of spiritualism, and that spiritualists, in the ratio of their intelligence, make claims which are modest and moderate; and perhaps the average man says that, although a great part of spiritualism is deception and imposture, yet there is something about it which is new and true. To such we say that if there is any truth in it, of interest to Science, however small, it is worth while to seek for it with great diligence and labor; its discovery will surely bring an abundant reward. If we positively knew that there was contained in spiritualism a scintilla of new fact about matter, though it were as the needle in all the haystacks or as the grain in all the sands of the sea, we would not discourage the ambitious man of Science in his search for it. Mr. Crookes, as the discoverer of thallium, has achieved a great eminence in Science, and he is now nobly employing his talent in the investigation of spiritualism, if he find in it, positively, something new to Science. He does not need to be told that, if he really discovers his psychic force or any other unknown force capable of acting on matter, all the future ages will name him with Galvani and Newton. Finally, say we emphatically, if there be truth in spiritualism, in whole or in any part, let it be investigated. But concerning such investigations, in view of very serious harm which heretofore has often been caused by shallow and superficial dallyings with the subject, we thoughtfully and solemnly advise that no investigation is worthy of the name unless it is inspired by the passionless common sense of Science. Also remember this: The evidence required to establish a fact is proportioned to the improbability of the fact.

We come now to what with many readers will be reckoned the gist of the whole matter: How to investigate spiritualism. We name the plan which we are to propose, the scientific method of investigating spiritualism, and we thus name it, while feeling the most exalted respect for Science and knowing that some will discover in it only what they call horse sense.

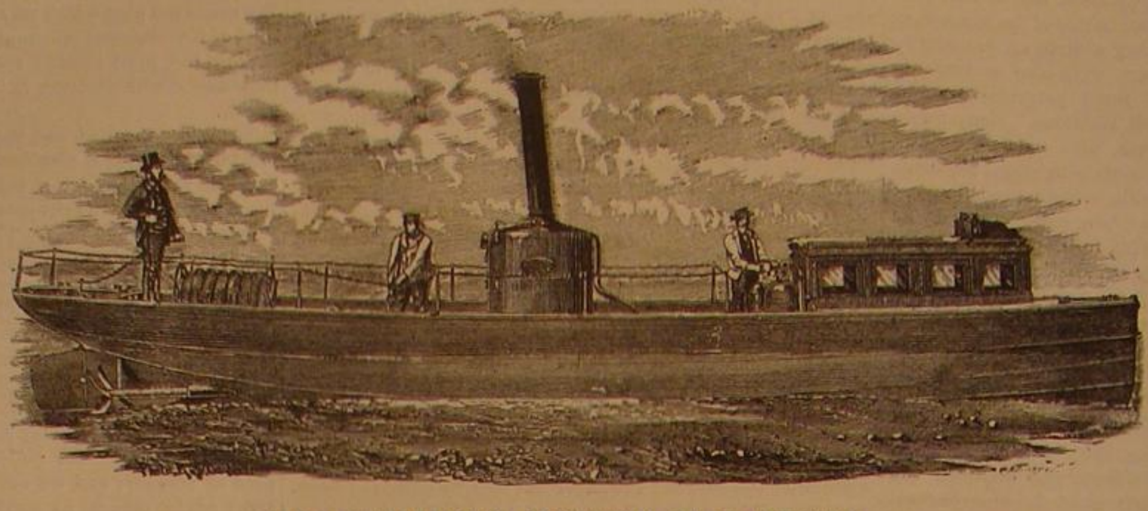
These two theories, and these only, are tenable regarding most of the spiritual manifestations: They are real, and true, and honest, or they are a culpable fraud. The mediums in these cases are either the most worship-worthy of mortals, or they are cheats and liars. The raps and the materialization, the first and the last of the spirit exhibits, are surely of the sort in question. (And here we venture to suggest that if we take away from spiritualism all the alleged phenomena which belong to the same category, almost nothing is left,) Concerning raps and materializations, there is a question of fraud or no fraud; and this is a question of such a fundamental character that the answer to it is conclusive of the whole matter. It may seem to some that the case ought to be referred to the police detective rather than to the man of Science; and we are obliged to confess that a detective's advice may be as good as ours. The methods of Science are direct, logical, and on the shortest path to the truth; the man of Science always aims at the bull's eye. The method of the skilled and intelligent detective is, without doubt, identical with the scientific. Cases somewhat similar to that of the fraud or no fraud of raps and materializations have often come up for decision; an allusion to some of these throws a clear light on the present discussion. Our ancestors believed in ghosts, and they fired stones and bullets to test their faith. The proceeding was scientific, but suited only to an age ruder than ours. We warn the over-zealous scientist that, although a bullet could not harm a materialized spirit, no medium or his confederate is bullet-proof. An action for murder or manslaughter would probably lie in a case wherein any one was killed in a scientific investigation of materialization. The well known story of Fulton investigating the motive power of a perpetual motion by means of a hatchet is a fine illustration of the application of the principles of Science. Lampblack, printer's ink, and green paint have been slyly smeared on the trumpets, ropes, etc., of the dark *séance*, and the truth was speedily declared in the unconscious ornamentation of the medium's lips or hands. And, best of all, strong lights have been turned on to the supposed spirits performing tomfooleries, and it was instantly manifest whether they were genuine or not. In all these cases it was a touch and a go, and the truth declared itself beyond any man's cavil. Devices which were so simple, and yet so sufficient, were surely scientific, and they indicate, and perhaps sufficiently describe, our notion of scientific investigation of one class of spiritual manifestations. But we add a few hints especially touching the investigation of materializations. Let the tests be applied directly, if possible, to the materialized spirit, with the intent to determine who or what it is. A dark lantern, or some other appliance for turning on light, is likely to be useful. A lasso would be very serviceable in the hands of one skilled in its use; it is said the Mexicans can lasso anything that runs or stands. A little squirt gun loaded with a few ounces of ink, or even the boy's blow-gun charged with Scotch snuff, might be available in eliciting truth where more pretentious instruments would fail. If the investigator, from doubts of his skill or other reasons, prefers to discard all the apparatus and appliances of art, let him, in the non-resisting spirit of a Quaker and in the name of Science, suddenly lay a strong and firm hand on the dress or the body of the spirit, and hang on like a Tartar till the whole truth comes to relieve him.

We repeat: Our scientific plan is simple, direct, conclusive. We commend it to Mr. Crookes and Colonel Olcott, and especially to all those who are in the road which leads to a faith which has lost its senses and is idiotic. To us, the Eddy materializations are supremely puerile and silly; they cannot appear differently until a scientific demonstration has shown that they are not the chicane of the practised and disreputable Eddy family. But the peace of society is disturbed, and something must be done for quiet, or many good friends will get to Bedlam. We earnestly hope that a scientific investigation of materialization will be made speedily; the investigator will receive our most cordial thanks. We have no hope of any good to come out of the class of spiritual manifestations which we have been considering. It is a notable fact that investigations so far have elicited absolutely nothing which was of moment to physical Science. Spiritualism has furnished striking illustrations to the expounders of mental pathology, but to the humanitarian it has seemed a terrible epidemic. In future times, it will probably be considered the blot and the shame of the nineteenth century.

AMERICAN apples, says the London *Grocer*, are now selling at moderate rates in provincial towns, both in England and Ireland. The highly colored and well flavored Baldwin is the commonest kind as yet. As usual, they come in barrels, without any kind of packing materials, and come, as a rule, in excellent condition. That apples should be sent several thousand miles, and then be sold as cheaply as home-grown fruit, is a noteworthy fact. At this rate of progress, fruitless and cold regions will soon be supplied with the finest fruits at a cost that places them within the reach of all classes.

FLOATING FIRE ENGINES.

We have heretofore called attention to the value of floating engines for extinguishing fires, especially to cities (like New York) having a large proportion of water front to the square mile. Messrs. Merryweather & Sons, of London, Eng., have been very successful in constructing these engines; and we illustrate, herewith, a vessel built for the Wear commissioners for protecting the shipping and docks of Sunderland and the adjacent ports from fire. It is intended, also, to use the engine for pumping purposes in general, such as for emptying sunken vessels, supplying ships with fresh water, etc.



MERRYWEATHER'S FLOATING FIRE ENGINE.

The boat is built of iron, and is 40 feet in length, with 9 feet 6 inches beam. It is propelled by a pair of independent vertical engines, each working a screw; this arrangement being adopted in order that the vessel may be steered in and out amongst the shipping. The draft is about 2 feet forward, and 2 feet 6 inches aft; the total depth is 4 feet 9 inches. The vertical engines are driven from the same boiler as the steam fire engine, and the speed averages 10 statute miles per hour; the diameter of screws is 28 inches.

In the fore part of the vessel is a cabin with sleeping accommodation for three or four firemen if necessary, and at the after part is a large hose reel fixed longitudinally, which will carry some thousands of feet of fire hose; there are in addition capacious fresh water tanks—these are fixed under the seats and platform, and are all connected. The steam cylinders are each $8\frac{3}{4}$ inches diameter, with 24 inch stroke; the pumps have a similar stroke, and are $6\frac{1}{2}$ inches diameter; the twisted bar motion, for which the makers' engines are so well known, is carried out in the above float. This engine, when in full work, is capable of discharging 1,100 gallons per minute through an open hose when used for pumping purposes; it also pumps, when in action as a fire engine, through a jet $1\frac{3}{4}$ inches diameter to a horizontal distance of nearly 300 feet. Arrangements are made whereby two, four, six, or twelve jets may be thrown advantageously. The pump is entirely of gun metal, and consists of one solid casting weighing about 7 cwt.; the valves have a clear unobstructed waterway; the pump buckets are self-lubricating; and the valves being beneath the barrels, there is no fear of the latter being damaged by grit, sand, or other foreign matter. The valves, which are also of gun metal, are faced with india rubber attached with copper screw bolts. We may speak a word in favor of this class of valve, when we state that engines of this make in the royal dockyards, and in the service of the Liverpool, the Manchester, and the London Brigades, have run for 8 and 10 years without a renewal of the facings. The boiler is fitted with the Field tubes. Surrounding the outer row of tubes is a water space, which is well stayed to the firebox. The boiler is fed by hand pump, feed pump on engine frame, arrangement for feeding direct from the main pump, and also by a Giffard's injector. It is capable of raising steam to 100 lbs. pressure within ten minutes from lighting the fire and from cold water. Had Liverpool been provided with such arrangements, says *Engineering*, to which we are indebted for the illustration, we should probably not have heard of the total destruction of the noble landing stage.

Animals as Motor Powers.

M. Marey gives some observations on the employment of animals as motor powers. He proves, by an instrument, that the movement of animated beings takes place by jerks, whence result shocks, and consequently a waste of labor. As an illustration of this theory, M. Marey cites the effort necessary to draw a burden behind one. If the necessary force be transmitted by means of a rigid or almost unextensible strap, for instance, of leather, the movement is jerky and more difficult than if it were transmitted by an elastic strap. It would, therefore be better to attach horses to the shafts with india rubber traces. He also gives in the paper (which was read before the French Association for the Advancement of Science), as an illustration, the manner in which boats are always dragged along the towing paths by long ropes. It would be impossible, or at least very distressing, to employ short ones. The length of the rope, which alternately tightens or slackens by slow oscillations, has in this case the same effect as india rubber or other elastic material. Mr. Marey's instrument, by which these facts were ascertained, is an elaborate and ingenious piece of workmanship.

THE CRYSTALLIZATION OF GLASS.

An engineer of a glass bottle manufactory at Blanzy, France, recently substituted for the crucibles, ordinarily employed in melting the glass, a large cistern furnace heated by gas. An accident occurring rendered it necessary to withdraw the fire; and on scraping the glass from the inclined portions, a quantity of magnificent crystalline formations were found, produced during the cooling of the vitreous contents. These masses, a representation of one of which is given herewith, were sent to M. Peligot for examination, and that scientist has pronounced them different from any similar formations yet noticed in glass furnaces. The crystals are entirely isolated, and are not mixed with transparent glass. They are prisms of from 0·6 to 0·9 inch in length. The explanation given for the phenomenon is that the dentification is due to a separation of the vitreous elements, which gives rise to a definite silicate, crystallizing in the midst of the residual mass. This seems to be proved by an analysis of the crystals, in which soda is almost entirely absent, and magnesium present in large proportion. We extract the engraving from *La Nature*

CRYSTALLIZATION OF GLASS.

Compound Engines.

Nothing is more common than the removal of a pair of ordinary engines from a steamer, their replacement with compound engines, and a laudation of the excellent results obtained, which are invariably attributed to the fact that the steam does its work in two cylinders instead of one. It is not often that we are favored with a means of arriving at any really valuable conclusion in such a case, because some factor is always absent. A notable exception is afforded by the case of the steamship Alexander, the property of a firm whose steamers trade between St. Petersburgh, Revel, Helsingfors, and Lubeck. She was originally fitted with ordinary engines of 80 nominal horse power. Messrs. Crichton were instructed to convert these into compound engines, retaining as much of the old machinery as possible. Cylinders wholly new were of course required. The old engines worked with 15 pounds steam, and consumed 36 cubic feet of coal per hour, with a speed of 9 knots and 60 revolutions in regular work. The engines were built by Earle Brothers, of Hull, fifteen years ago, and the Alexander was also built by the same firm. The engines were exceedingly trustworthy, and in their long life have cost very little for repairs.

A most important change was made in the screw, the pitch being considerably reduced. As to the results of the alteration, they may be briefly stated: With a pressure four times as great as that originally used, the engines make 90 revolutions per minute, and the boat goes at 10 knots, with 20 cubic feet of coal, per hour.

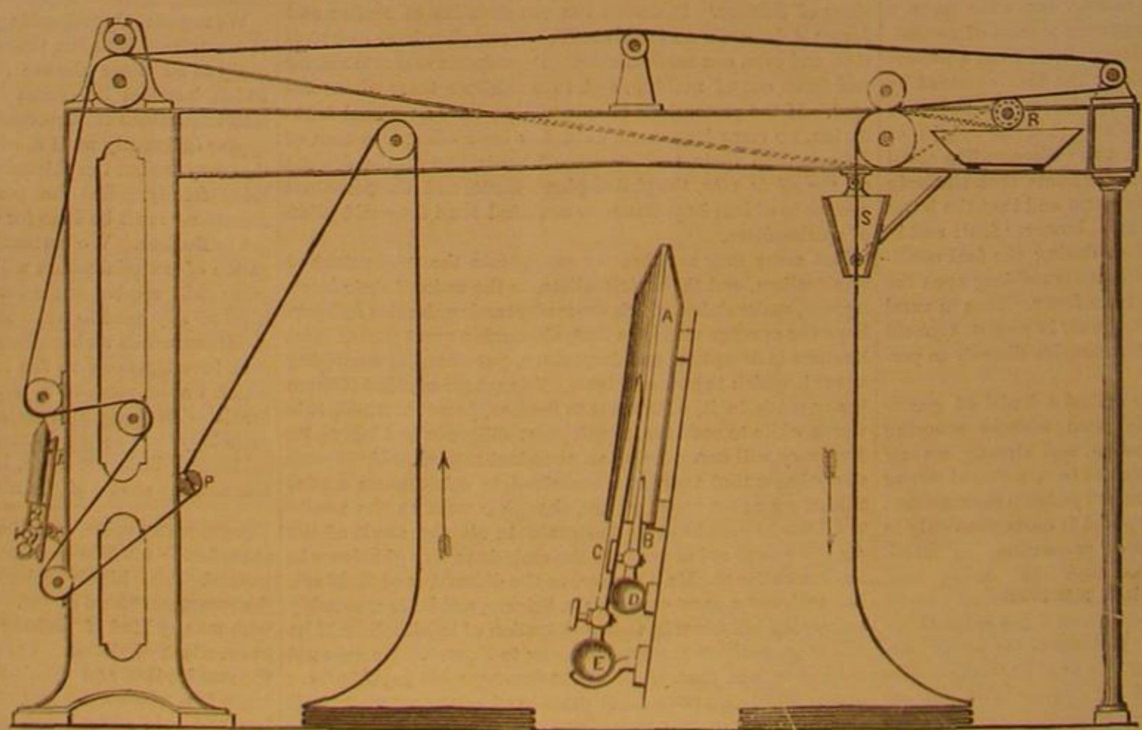
The boiler is so much smaller than the old one, and so much less coal is required for a voyage, that the midship bulkhead has been moved further aft, and 5,000 cubic feet of cargo space have been gained. The vibration, before excessive, has been greatly reduced.

The benefits thus gained will, by some persons, be attributed to compounding. They are really independent of that principle, and better results would have been got by the use of two simple cylinders, new boilers, high pressure and expansion, and a screw of proper pitch. The change might have been effected by fitting two liners into the old cylinders to reduce their diameter sufficiently, and the surrounding space between the cylinder and the liner could have been utilized as a steam or air jacket.

We understand that Messrs. Crighton are about to alter a sister ship, the Nicolai, in the same way.—*The Engineer.*

NEW CLOTH-SINGEING MACHINE.

The annexed diagram exhibits the essential features of a new machine for singeing fabrics, recently invented in France, by M. Blanche. It is claimed to use but 141. cubic feet of gas per hour in singeing cloth 2 yards and 7 inches in width, thus effecting an economy of some 40 per cent on the apparatus commonly used for this important operation in textile manufacture. The arrows indicate the movement of the cloth. At the left of the vertical standard is a stretcher, P. R is a brush which cleans the surface after the singeing, and at S is an arrangement for governing the folding. The burner used is shown enlarged in section, and consists in air jet, C, and a gas jet, B, which mingle at the extremity of the conical tube, A. The tubes for the gas and compressed air are represented at D and E. The flame from the burner may be accurately adjusted, so that the singeing may take place, after dyeing, without any disengagement of smoke or odor. Two men at the crank work the machine with facility.



BLANCHE'S MACHINE FOR SINGEING CLOTH.

THE UNDERGROUND RAILWAY, NEW YORK CITY.

NUMBER V.

Continued from page 371.

In our last issue, page 371, we gave drawings of the peculiar masonry tunnels of this great work, especially of those portions which occupy the subsurface of the street directly in front of the large edifice known as the Normal College, on Fourth avenue, at its junction with 69th street. The excavation for the underground railway began directly on the sidewalk in front of the main stairway entrance of the College, shown in our engraving. The cutting extended down to a depth of 33 feet below the ground surface, and 21 feet below the foundation of the tower of the College. But the angle of repose of the soil was not disturbed, and the stability of the College building was therefore at no time endangered, although, at the time, it appeared otherwise to the unexperienced eye. The work was executed last July. The successful carrying along the front of the College of so great a work as this underground railway, the outer walls of which at this point occupy a space of 78 feet in width, while the foundations are 33 feet below the street surface, is an example of the facility with which such works may be prosecuted in New York city without danger to adjoining buildings. In the case of the College building, no special excavations were required, not even the use of sheet piling at the side of the excavations. Our main streets are in general so broad and straight that underground railways may be constructed under their surfaces without difficulty or injury to adjoining property. Fear has been expressed in some quarters that the building of the Underground Railway under our great thoroughfare of Broadway, which, it will be remembered, was finally authorized by the Legislature in May last, might interfere with some of the adjacent buildings; but all such objections are idle, in view of the successful completion of the present great underground railway on Fourth avenue, where the works are much wider and often deeper than will be required on the Broadway line. The width of the Broadway Underground Railway will not exceed 32 feet, whereas 78 feet is the width of the work on Fourth avenue in front of the College. In our next article, we shall give drawings and descriptions of the great single arch masonry tunnel north of the Normal College. The arch of this section of the underground railway is 68 feet in diameter, and is a remarkable work.

THE NORMAL COLLEGE, NEW YORK CITY.

The Normal College of New York city, Fourth avenue and 69th street, is one of the most enduring and splendid monuments of the public school system of this country. Its proportions are large, the building covering an entire block. It possesses great architectural beauty, and is fitted up and arranged in the most convenient and handsome manner; and eleven hundred female students daily assemble in the fine central hall, before proceeding to the rooms allotted to the different branches of study. It is a wise and foreseeing regulation of the New York Board of Education that all female teachers, appointed to the public schools, must be graduates of the Normal College. By this means, an unquestionably high standard of education and of personal character is assured among those on whom the welfare of our next generation primarily and chiefly depends. Admission to the Normal College can only be obtained by graduating from the public schools, in which, and also in the Normal College, the instruction is given *free of charge*.

The edifice was completed for occupancy on the 1st of September, 1873. The institution includes a training school to afford practice to teachers.

The course of study in the Normal College covers three years, and embraces many branches of instruction. President Hunter, in a recent address, made the following remarks concerning the *curriculum*:

"Geology, mineralogy, zoölogy, and physiology are taught in outline, and without requiring home study. The instruction is given in the form of lectures, and for the purpose of enabling the young ladies, when appointed to the primary schools, to become intelligent teachers. In order to impart instruction, particularly on natural objects, some acquaintance with the elements and outlines of the natural sciences is indispensable. Of course it would be absurd to expect profound scholarship in all of these, or indeed in any of them, in the short period of three years. It would take a whole life to make a scientific geologist. Nor can it be expected that we shall make profound Latin scholars; but we can impart such a knowledge of this completely inflected language as will make the graduates much better teachers of reading, spelling, and etymology. The study of Latin will increase their vocabulary, and strengthen their powers of thinking. We intend to make the young ladies so perfect in their German that they can pass from us to the regular staff of the grammar school. The English language, composition, rhetoric, literature, and history shall receive all the attention that their importance demands. Language is so interwoven with thought that the two are one and inseparable. They are almost synonymous. In cultivating language, apart from its intrinsic value, we are cultivating the highest faculties of mind—comparison and judgment. Perhaps we have a little more mathematics than may be necessary, and the Committee on Normal College may deem it proper to cut it down; and yet, young ladies, if you would have sound minds and habits of logical reasoning, you must study mathematics."

"The Normal College has more than fulfilled the expectations of its friends. By the testimony of experts and superintendents, it turns out the best scholars of any institution of the kind in this country. Besides the regular course of three years, a post-graduate course, occupying an additional year, is in contemplation. Every precaution is taken to insure the health of the students. Air, exercise, frequent change, and short recitations are among the means taken to promote this end. The college has an attendance of over 1,000 students, from all parts of the city, and of all creeds, classes and nationalities. The number of graduates this year," says *Harper's Weekly*, from which we select the engraving, "is 184—abou sufficient to supply the vacancies in our city schools."

Effect of Damp Air on Coal.

M. Varrenstrass finds by recently conducted experiments on this subject, that the loss in weight, due to a slow oxidation and to the disengagement of gases which form the richest part of the coal, may equal one third of the original weight. The heating power in such coal was lowered to 47 per cent of its former capacity. The same coal exposed to the air, but in a closed receptacle, did not lose more than 25 per cent of gas and 10 per cent of heating power. Bituminous coals alter most rapidly.

This shows the disadvantage of damp cellars ,and of leaving coal uncovered for long periods and subject to bad weather. Judging from the large loss incurred, it would seem much the better economy to provide suitable receptacles for the fuel, the saving in the latter being sufficient to compensate for the extra expense.

THE manufacturers of firearms in this country are as busy as bees in clover time. Large orders from foreign governments are now being executed. Turkey is having 600,000 of the Peabody-Martini rifles made, Prussia lots of needle guns, Russia 100,000 of Smith and Wesson's pistols, while Spain calls for all that can be made of the Winchester and other breech-loaders.

A NEW DREDGING PROCESS.—M. Bergeron suggests that deposits of sand and mud in harbors might be cleared away by forcing into them the perforated ends of large tubes, through which a powerful stream of water is forced. The numerous currents would, he thinks, act upon the deposit in the same manner as so many underground springs, washing it away so that the soil could be distributed by the flow of the tides.

IT is said in France that the quarries of lithographic stone in Bavaria are exhausted as regards the best kind, and that the only fine stones are now obtained by the Paris lithographers from Bruniquel, Tarn, and Garonne, in France. These stones are said to be well appreciated in the United States. There are quarries of the same stone at Vigan, France, but these are of an inferior description

Fig. 13.—THE UNDERGROUND RAILWAY IN NEW YORK.—THE NORMAL COLLEGE FRONTING THE WORK.

APID ESTIMATION OF PHOSPHORIC ACID, MAGNESIA, AND LIME.

I attack in the cold 30·86 grains of phosphate with 3 cubic inches of hydrochloric acid or weak nitric acid, and filter it. I take 0·3 cubic inch of this solution, add at first some citric acid, then ammonia in excess, and lastly precipitate by a solution of chloride of magnesium, the liquid being maintained ammoniacal.

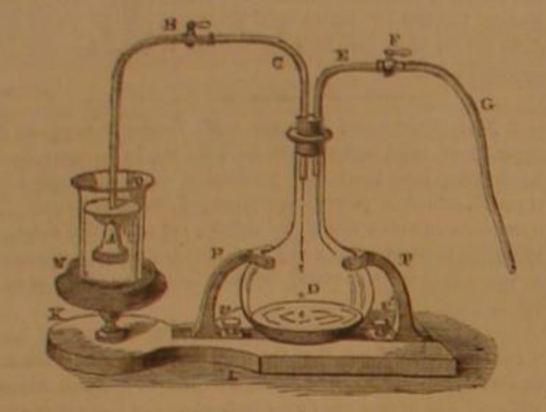
The phosphoric acid deposits in the form of ammonio-magnesian phosphate. By means of the exhausting filter I separate it from the supernatant liquid, wash it with ammoniacal water, exhaust again, and finally dissolve the precipitate, by means of some drops of nitric acid, and estimate volumetrically by means of acetate of uranium, according to M. Leconte's process, to which I have made several useful additions.

Thanks to my new apparatus, the union of the two methods is complete, and the quickness of the process is such that, in less than two hours, ten estimations, at the least, can be made. The estimation of phosphoric acid becomes as easy as that of nitrogen by soda-lime, while it is more general and not less accurate.

Suppose we have to analyze superphosphates of lime of commerce. The necessity of distinguishing phosphoric acid which is in the soluble state from that which is in the insoluble state requires two parallel attacks, one with distilled water and the other with weak nitric acid. The operation is always the same. We work on each liquid separately, as I have just pointed out in the case of natural phosphates.

I will now describe the apparatus that has so much expedited the work. A glance at the drawing is sufficient to understand their arrangement and mode of action (Fig. 1).

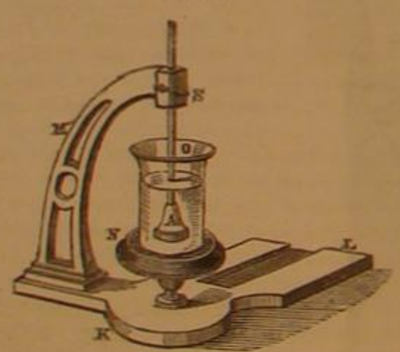
Fig. 1.



An exhaustion is formed, equal to a very few inches of mercury, in the globe, D, by the help of a small hand pump. The base of the cone, A, covered with one or two disks of blotting paper, held in place by a ring fitting tightly by friction, works as a true filter, which acts under pressure.

I have adopted two forms of apparatus, one of platinum and the other of glass (Fig. 2). The fragility of the latter is obviated by means of the consolidation arm, M, which firmly fixes the exhausting tube.

Fig. 2.



The facility which this method gives of multiplying estimations has led me to define, experimentally, all the conditions which could affect the precipitation of the ammonio-magnesian phosphate. Among other results, I have discovered a means of rendering the precipitation almost instantaneous. To effect this, it is necessary to operate on a moderate quantity of phosphate, and to employ an excess of chloride of magnesium. With a small quantity of chloride the precipitation is slow, with more it is quicker, with an excess it is immediate. After waiting a quarter of an hour, we may proceed with the estimation of phosphoric acid, only the filtration takes a little longer; after an hour the result is perfect.

An excess of citrate of ammonia holds in solution very appreciable quantities of ammonio-magnesian phosphate; the loss, however, which results from it is very slight.

Citrate of lime dissolves nearly three times more ammonio-magnesian phosphate than citrate of ammonia. The intervention of 1 grain of lime has sufficed, in fact, to raise the loss of phosphoric acid from 0·033 to 0·066 of a grain; but I have ascertained that an excess of chloride of magnesium, so efficacious in hastening the precipitation of the ammonio-magnesian phosphate, completely neutralizes the solvent action of the citrates of lime and ammonia, and confers on the results both accuracy and concordance.

I have studied the precipitation of phosphoric acid in the presence of lime and aluminum, separately at first, then associated with lime; and I have arrived at the conclusion that, by keeping the quantities of citric acid, of chloride of magnesium, and of ammonia, and of the total volume of the liquid between certain limits which I point out, the process is of irreproachable accuracy.

Whether we are working with natural phosphates or with commercial superphosphates; whether the product contains sulphuric acid or is free from it; whether the proportions of alumina, oxide of iron, and lime are great or small; the indications of the process are always exact and concordant.

The method possesses the two characteristics of accuracy and swiftness, and a degree of generality which renders it applicable in every case which may interest physiology, industry, and agriculture.—*M. G. Ville, in Chemical News.*

Correspondence.

How to Line Shafting.

To the Editor of the Scientific American:

I noticed in your issue of November 28, J. F.'s query as to the best way to keep shafting in line. This is an important matter, as much waste of power is caused by working ill adjusted shafting. Every one operating long lines of shafting should provide an adjusting rod, as shown in the engraving.

A may be a rod of wood or a piece of gas pipe, of sufficient length to reach from the shaft, O, to within about four feet of the floor; an offset piece, B, is fixed to the top of this rod, which carries a right and left hand screw, C; two jaws, D, travel upon this screw, one upon the right and the other upon the left hand thread, as shown. The screw may be worked by a ¼ inch wire, E, with a crank, F, at its lower end; if a gas pipe is used, the wire may pass through the pipe, and the lower end of the screw, C, enter the top of the pipe as a bearing. If the rod, A, is of wood, three or four wire staples will suffice as guides for the wire, as indicated. A target, G, with a clamp screw, slides upon the rod, for the purpose of easy adjustment to the sights of the leveling instrument.

Now it will of course be apparent to every one that, whenever several sizes of shafting occur in the same line, this adjusting rod will always give the exact central distance, O, of the shaft from the target; hence we have only to plant the leveling instrument in a position to command a view of the target when suspended from each of the several bearings of a line of shafting, in order to adjust the level of a line with the utmost expedition and accuracy. An engineer's tripod and level is of course the best instrument for this purpose, but, when this is not at hand, an ordinary builder's level may be used: the longer it is, the better. Fix a temporary sight at end of the level; a piece of tin (with a small pin hole) next the eye, and a piece of tin or thin wood with a large hole at the farther end, with a vertical and a horizontal thread stretched across the hole, with their point of intersection the same distance above the level as the hole in the eye piece. The level may be used upon a level stand or table, some five feet from the floor.

To adjust a line of shafting laterally, the adjusting rod must of course be used horizontally in connection with a strong line, stretched as taut as possible, at such distance from the shafting as to need nearly the full length of the rod to reach it. The reason for placing the line at such a distance from the shaft is to prevent the difference in level between the line and the shaft from materially impairing the truth of the result. If the line is very long, it will sag so much that a plumb line suspended from the measuring point of the target or rod may be necessary for perfect accuracy.

The jaws, D, should be so formed that they may be applied to the inside of boxes. Pivot boxes are now so generally used, however, that this application of the rod is not so common.

F. G. WOODWARD.

Curious Apples.

To the Editor of the Scientific American:

Your correspondent Fletcher Williams, in his attempted explanation of the curious apple mystery, advances a novel theory which, I think, will interest pomologists.

This is the first time I have ever heard that sweet apples were sour when unripe, or sour apples sweet in a green state; and I cannot fully understand which was the "abnormal growth" he speaks of. Was it the sweet or sour part of the apple? I know all about that tree of Dr. Ely's, in Monson, having myself picked many bushels of fruit from it, each of the apples being partly sour and partly sweet. As you observe: "The sweet was very sweet, and the sour very sour." The flavor of each was excellent, and the apple well developed and fully grown. The color of the sweet part was a bright lemon, and of the sour part a green, like the Rhode Island greening. I have kept many specimens until they decayed, no change different from any other apple appearing. There was no "suture" between the sweet and sour parts other than the difference in color, which was usually in a straight line and very marked. One part of the apple was no more fully developed than the other.

Probably your correspondent never saw such apples, and his explanation has as little to do with the case mentioned as it has in explaining why some apples are red and others green in color, when both are ripe. Dr. Ely grafted the tree himself, and was not aware that the process was in any way different from many others he had grafted. He simply grafted a sweet apple scion on a tree that bore sour apples, and the fruit was as I have stated. The fruit, however, after a few years deteriorated, and became altogether sour and of a poor quality. Would not the best plan be to leave it as a *lusus naturæ*, and not attempt to explain it by assuming a more wonderful condition of things?

E.

New York city.

Our Lighthouses.

The annual report of the Lighthouse Board says:

The magnitude of the lighthouse system of the United States may be inferred from the following facts:

1st. The coast, from the St. Croix river on the boundary of Maine to the Rio Grande on the Gulf of Mexico, includes a distance of 5,000 miles.

2d. The Pacific coast has a length of about 1,500 miles.

3d. The great northern lakes, about 3,000 miles.

4th. The inland rivers, of 700 miles, making a total of more than 10,000 miles.

The following table exhibits a synopsis of what has been accomplished in aid of navigation along these standard lines, by far longer than those of any other nation in the world:

Lighthouses and lighted beacons, 608; lighthouses and lighted beacons finished and lighted during the year ending July 1, 1874, 25; lightships in position, 21; fog signals operated by steam or hot air engines, 40; day or unlighted beacons, 346; buoys in position, 2,865.

The board do not deem it expedient to attempt to introduce the electric light, or that of gas, on account of the complexity and cost of the apparatus. It is their intention, however, to adopt any improvements in the lamps, of the importance of which they are assured by the results of photometric experiment.

The recent introduction of an improved wick has increased the capacity of their lamps of the first order to the amount of a hundred candles. This, however, is at a proportionately increased expense, on account of the oil consumed.

As to fog signals, the coast of no other country is so subject to fogs as that of some parts of the United States. On this account, fog signals in many places are almost as necessary as lighthouses. But abundant experience has shown that a sound of sufficient magnitude to become an efficient aid to navigation can only be produced by a large amount of power derived from steam or heated air and applied by means of complex machinery, expensive in first cost and in continued maintenance. Improvements are about to be introduced in regard to the fog signals, which, while they will greatly increase the range to which the sound may be heard, will of necessity increase the cost of their maintenance.

The New Laboratory at Oxford.

The building consists principally of three floors, and is surmounted by a tower of fifty-nine feet in hight, and contains twenty-six large rooms and numerous apartments, each specially adapted and devoted to experiments in certain departments of physical science. In the magnetic room is placed the great electro-dynamometer of the British Association. The room used for the experiments in heat at present contains an apparatus devised by Professor Maxwell for determining the viscosity of air. The galvanic battery is connected by properly insulated wires with the lecture room and other portions of the building. The battery which will be employed is, of course, confined in a room fitted expressly thereto, and is of the style known as Sir William Thomson's tray battery. The lecture room will afford accommodation for about one hundred and eighty students, the seats for the class rising at an angle of about thirty degrees, and three doors providing sufficient means of egress for the audience. In the room allotted to experiments in electricity of high tension, an apparatus contrived by Mr. Latimer Clark has been introduced, for the purpose of keeping the air of the room dry. This consists of a heated copper roller, over which passes an endless band of flannel. The roller is heated by means of gas lights within it, by which, being constantly burning, every part of the flannel becomes hot. The vapor which arises from the heated flannel is carried off by the current of air which supplies the burners inside the roller. The flannel, when thus dried and cooled, passes into the open air of the room, where it again absorbs moisture, and thus the air of the room becomes so dry that the electrical instruments are preserved in a highly insulating condition. The electricity passes from the electrical machine to the table in the lecture room by insulated wires connected with the prime conductor of the machine. The highest room in the building occupies the upper portion of the tower. In this room will be placed a Bunsen's water-pump, the water from which will thus have a vertical fall of considerably more than fifty feet. This pump will be used to exhaust a large receiver, from which pipes will communicate with the different rooms; so that, if it be desired to exhaust the air from any vessel, it will only be necessary to connect it with one of these pipes, and turn on a vacuum. For a more perfect exhaustion, the Sprengel or other air pump can be employed. On the top of the tower will be fixed a wooden mast, carrying a pointed metal rod, for the purpose of collecting atmospheric electricity.

DR. A WYNTER BLYTH, medical officer of health to the county of Devon, Eng., has made a series of experiments which show that water containing organic substances is purified by running through iron pipes.

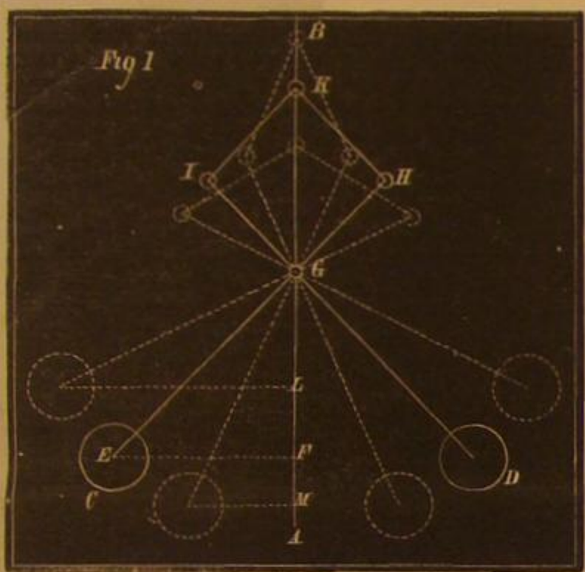
As an inducement to provide safety precautions, a reward of $2,000 is to be given to that colliery owner in Belgium in whose pits the smallest number of workmen shall have been killed by explosions in the ten years ending in 1883.

PENDULUM GOVERNORS.

Number I.

The essential features of the ordinary pendulum governor consist of a vertical spindle, which is made to revolve by suitable connections with the machine which it is to regulate; the spindle carrying, on opposite sides, a pair of arms, to which heavy weights are attached, forming revolving pendulums, which vary their positions at different speeds, and so control the machine. Such a governor is represented in Fig. 1, A B being the revolving spindle, C D, the balls attached to the spindle by the rods, E G, D G, forming the pendulums, which, as they assume different positions, act on the collar, K, moving up or down the spindle, being connected to this collar by the rods, G I, I K, G H, H K. A lever, not shown in the engraving, is ordinarily attached to the collar K, and thus operates mechanism which regulates the speed of the prime mover to which the governor is connected. The subject of steam engine governors is treated in nearly every work on the steam engine, and in numerous elementary treatises on natural philosophy, rules being given for proportioning the parts. In general, however, these rules, being founded on theoretical considerations which do not obtain in practice, are of very little value in designing governors. In works where the subject is presented in detail, the reasoning is often too abstruse for the general reader, and we propose, in these articles, to give the principal facts connected with the theory and construction of pendulum governors, in as simple a manner as possible.

A revolving pendulum, such as is shown in Fig. 1, assumes different positions if made to rotate at different speeds; and



supposing that there is no friction in the joints of the rods, and no other resistance to be overcome except the weight of its parts, the position assumed depends entirely upon the number of revolutions in a given time, no matter what may be the weight of the balls. In Fig. 1, the distance, F G, or the vertical hight of the point, G, above the centers of the balls, is commonly called the hight of the pendulum; and a revolving pendulum, under the conditions supposed above, makes just half as many revolutions in a given time as a common pendulum of the same hight makes vibrations. Thus, if the hight, F G, were 3·91 + inches, a common pendulum of the same hight would make about 60 vibrations in a minute, and the revolving pendulum would make 30 revolutions in the same time. In general, the hight of a revolving pendulum, in inches, when overcoming no resistance but that of its own weight, is equal to 35,208 divided by the square of number of revolutions per minute. If, for instance, the number of revolutions per minute is 100, the hight will be 35,208 divided by 10,000, or about 3½ inches.

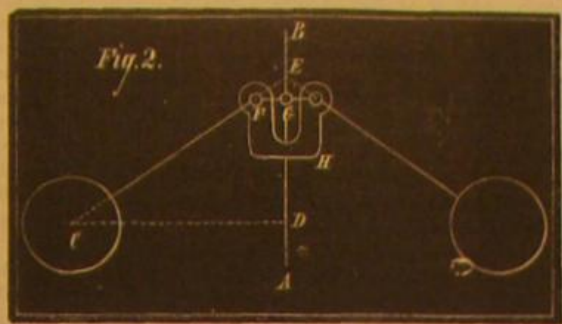
Strictly speaking, the hight of a pendulum revolving without resistance is slightly altered by the weight and centrifugal force of the connecting arms; but as governors are usually constructed, the weight of these parts is so small, in comparison with the weight of the balls, that the correction is unimportant in practice.

Below are given the hights, calculated by the foregoing rule, for different speeds:

Revolutions per minute.	Hight in inches.	Revolutions per minute.	Hight in inches.
10	352·08	275	0·4646
20	88·02	300	0·3912
30	39·12	350	0·2873
40	22·01	400	0·2201
50	14·08	450	0·1739
60	9·78	500	0·1408
70	7·184	550	0·1164
80	5·501	600	0·0978
90	4·347	650	0·08333
100	3·521	700	0·07184
125	2·253	750	0·06259
150	1·564	800	0·05501
175	1·150	850	0·04873
200	0·8802	900	0·04347
225	0·6955	950	0·03901
250	0·5633	1000	0·03521

A simple inspection of this table will suffice to show that the conditions under which these hights were calculated, do not occur in practice. For instance, it is not unusual to run a governor at a speed of 250 revolutions a minute; but our readers must have observed that in such a case the vertical distance from centers of balls to point of suspension is always more than $\frac{9}{16}$ of an inch, which is about the hight given by the table. The reason for this, and the proper correction for the hight, will be found in another part of this paper.

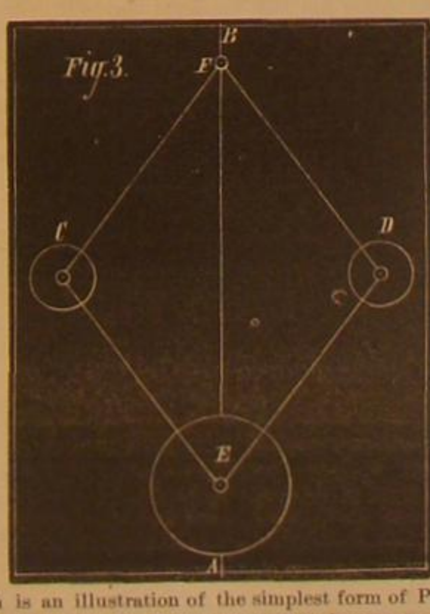
Referring again to Fig. 1, suppose that the full lines represent the position of the balls when the engine is running at the proper speed under the usual work, the lower dotted lines, the position at which the greatest opening of the regulator is effected, and the upper dotted lines, the position corresponding to the greatest slowing effect. These positions of the balls correspond to different speeds of the governor spindle, and consequently to fluctuations of speed in the engine,



which gives motion to the spindle. Suppose, for instance, that some work is suddenly removed from the engine; it will commence to run faster, and must increase its speed considerably before the governor can effect the regulation, since the required position of the balls corresponds to an increased speed. A sudden increase of work put upon the engine produces a contrary effect, the engine being slowed down considerably below its proper speed before the necessary regulation can be made. All that such a governor can do, then, under great variations of load in the engine, is to keep checking and increasing the speed, which will continually vary in inverse proportion to the load. This difficulty is partially obviated, in many forms of governor, by arranging the controlling mechanism so that a slight change in the position of the balls will produce a consierable movement of the regulator. The general idea is shown in Fig. 2, where the ball arms are not jointed to the center of the spindle, and are connected to the regulating collar, K, by direct levers, which are very short in comparison with the length of the arms. In estimating the hight of the balls of such a governor, it is to be measured from E, where the center lines of the ball arms produced cut the center of the spindle.

An inspection of the table of hights will show that, where a governor is run at a high number of revolutions, considerable variation in the speed only affects the hight in a slight degree. Hence, in addition to a direct and effective connection, it is generally a good plan to give the governor a high speed.

A steam engine governor, when connected with the regulator, encounters some resistance in changing its position, and this resistance keeps the balls at a greater hight than that given in the table. For the purpose of obtaining a considerably greater hight of balls, when running at a high rate of speed, many governors have weights or springs attached to them. The most prominent governors of this form are: Porter's, in which a heavy weight revolving on the spindle is attached to the balls by rods, and Pickering's, in which the balls are attached to the spindle by stiff springs; but our readers must have noticed weights on many ordinary governors, connected with the spindles by levers. The general principle of all these arrangements is represented in Fig. 3,



which is an illustration of the simplest form of Porter governor. The weight, E, is connected to the governor balls by rods, E C, E D, of the same length as the ball rods, C F, D F. In such an arrangement, if there is no other resistance than that of the weight of the parts, the hight of the balls corresponding to any speed of governor, can be found as follows:

Add twice the weight on the spindle to the weight of both balls, and divide that sum by the weight of both balls; multiply the quantity so obtained by the number in the preceding table.

For example, suppose that the weight of the two balls is 100 pounds, and the weight on the spindle is 500 pounds, the hight corresponding to any given speed is 11 times the hight in the table. It is evident from this that such a governor is much more sensitive than one in which no resistance is encountered, since the position of the balls changes much more rapidly with a given variation of speed.

Electrical Countries.

Certain interesting phenomena have recently been noticed by the Hayden Expedition in the mountains of Colorado, showing the high electrical state of the elevated position known as Station 9, Uncompahgre Peak, during the passage of a storm. Although the indications of the change in the weather could be seen at a distance, the electricity at the point of observation did not become plentiful until a characteristic buzzing was heard. Painful sensations followed, and at the back of the head and at the elbows a sharp pricking, like that of needles or a sharp knife, was felt. By this time the party came to the conclusion that they were standing on dangerous ground. Those standing on the very summit of the peak and along the sharp ridges leading from it experienced the severest shocks. After beating a hasty retreat, and remaining on the sides of the mountain to continue observations, it was noticed that after each discharge or flash of lightning a short rest ensued until a sufficient quantity of electricity had again accumulated. Those nearest the point struck would feel a heavy shock pass through them. These same phenomena were noticed during three days of continuous storms. At many places the rocks were glazed where the electric current had passed. The formation of tubes in sand from the same cause is well known.

A French meteorologist, M. Fournet, has suggested that it would be an interesting question for Science to determine whether certain countries or regions are in a higher electrical condition than others, and whether meteorological reactions do not result from the unequal distribution of the electricity. Similar phenomena to those detailed above have been noted upon the elevated plateaus of Mexico, and nearly a century ago Volney recorded remarkable noises occurring during thunderstorms in the neighborhood of Philadelphia. In South America, at Popayan, province of Granada, Boussingault says that thunder is heard every day and electrical phenomena are common. The extreme dryness of the Andine table lands also favors similar effects, and it is said that in the Chilian desert involuntary erection of the hair upon animals, as well as the appearance of sparks leaping from clouds to soil, is common. Dr. Livingstone notes that during the spring, a period of great dryness, the African deserts are traversed by a warm north wind so highly charged with electricity that the plumes of the ostrich stand upright, and that sparks are produced by the mere attrition of the garments.

In India, at certain localities, telegraphic wires are maintained with great trouble. It is stated that during storms of exceeding violence the conductors become charged almost to melting. Professor Loomis has observed abundant electricity in the atmosphere about New York city, especially during winter. We have repeatedly remarked the high electrical condition of the hair on cold nights, and also that the mere act of walking on a soft carpet in a heated room will cause a crackling sound under the foot.

From all the various examples which have been collected of this curious condition, it would appear that the abundant presence of electricity is not due necessarily to heat of the season, since in this country it is never more strongly manifested than after a cold northwest wind; nor are indications in any other region more clear than in the dry and icy air of Siberia. It would appear that reservoirs of electricity exist in the most widely separated parts of the globe. If it be admitted in accordance with the opinions of Fournet, Maury, and Admiral Fitzroy, that the ordinary winds are in relation with these great electrical sources, further and more extended observations upon them would be in the interest of meteorological progress. If, for example, the electricity of each great atmospheric current, tropical or polar, is regularly positive or negative, it may be, as Fitzroy suggests, believed that the changes of weather which supervene, at the moment when one electrical current succeeds the other, have on a small scale a certain analogy to the changing of the trade winds. Fournet remarks upon a natural relation of these phenomena with the meteorites produced during storms. These views are, however, mainly conjectural, so that there remains a large field for definite research.

Reform Needed at the Patent Office.

Unless there is an early and decided change in the practice of the Patent Office in its treatment of inventors, the institution will lose its character for usefulness. The annual report shows the enormous number of 7,500 applications for patents rejected last year, while probably as many more were delayed and their claims emasculated. We hope that the rejected applicants will all write to their members of Congress in complaint, and ask for official enquiry. The press is beginning to take the matter up. *The Technologist* says: "Commissioner Thacher will most promote the welfare of the Patent Office, and the rights of inventors, by putting his foot firmly down upon this uncalled-for practice of standing in the light of inventors, instead of giving to their applications the full, fair, and impartial consideration to which, in law, justice, and equity, they are entitled."

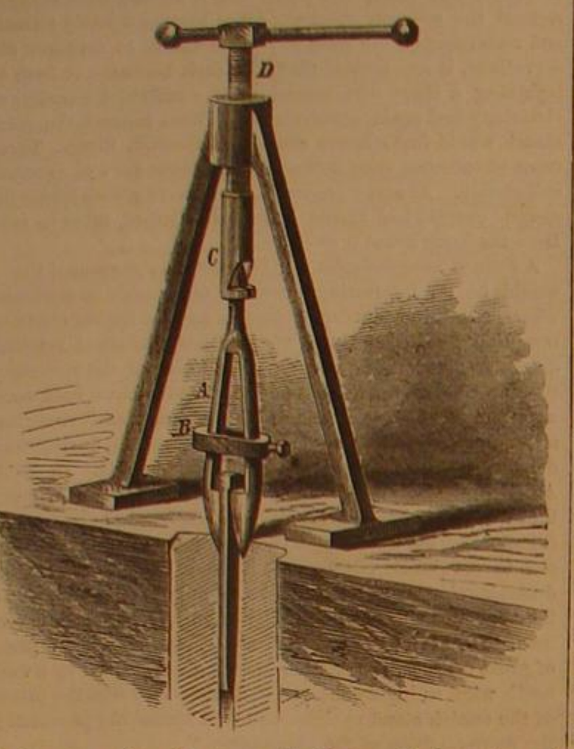
Blood Coloring Matter Free From Iron.

MM. Paquelin and Jolly announce that they have obtained the hematic pigment in a state of perfect purity and free from iron. Hematosine, as it is termed, burns without ash, similar to resinous substances. It is insoluble in pure water, and dissolves in small proportion in ammoniacal water, to which it gives a light yellow tinge. It is altered by potash and caustic soda solutions, to which it gives a brown color, and is lightly soluble in alcohol. The solvents of hematosine are ether, chloroform, benzine, and bisulphide of carbon. With these bodies the weak solution is amber-colored; when concentrated, red.

IMPROVED SPIKE EXTRACTOR.

The object of this invention is to remove railway spikes, heavy nails, or similar fastenings from wood, quickly and without bending the iron, so that the spike or nail can be used again without straightening. The arrangement of the device is also such that the extraction is easily accomplished, even when the spike is headless.

The arms of the grapple, A, may be hinged, or arranged to spring together, as shown in our illustration. The sharp corner ends of the jaws are driven into the wood on each side of the spike, and then, if hinged, further compressed by the becket, B. The head of the grapple passes through a notch into a tube, C, which last is swiveled to the lower extremity



of the screw, D. By turning the latter, the grapple and with it the spike—under the head of which the jaws catch—are lifted. The jaws have sharp cutting edges, which, when they are forced together, bite into the nail, so that a good purchase is gained on the latter, whether it has a head or not. A stout standard is provided, supporting the apparatus. The device seems to be an efficient and useful invention, and doubtless will meet a favorable reception from railway builders and others having occasion for its use.

Patented through the Scientific American Patent Agency, September 29, 1874. For further information, address the inventor, Mr. William Devine, Brownsville, Cameron county, Texas.

THE ERICSSON PNEUMATIC TORPEDO.

Through the courtesy of the inventor, Captain John Ericsson, of Monitor fame, we have been favored with sketches of the craft, from which the accompanying illustration has been prepared.

The body of the torpedo consists of a box of thin steel plates, 8 feet 6 inches long, 30 inches deep, and 20 inches wide. The explosive is placed at the bow. During the experiments a block of wood 27 inches long represented the containing vessel. A tapering block 18 inches long and secured to the rear of the box forms the stern, immediately aft of which are the propellers. These are of the two-bladed type, 3 feet 2 inches in diameter, with a pitch of 5 feet. Both revolve around a common center, yet in opposite directions, a necessary condition, since the powerful rotary movement of a single screw would cause the small hull to keel and probably revolve, unless retained in a vertical position by the ingenious expedient of causing the rotary tendency of one propeller to counteract that of the other. The displacement is greater than might be supposed, considering the small dimensions of the body, 2,000 pounds being barely sufficient to balance the weight of the whole apparatus.

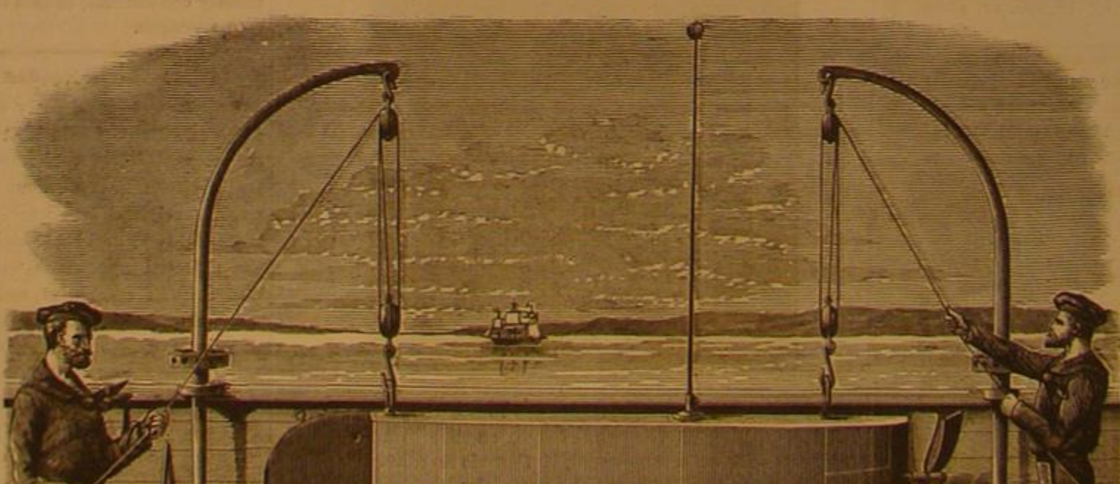
The motive power is a small double cylinder oscillating engine, driven by compressed air, which is transmitted through a tubular cable, connected just abaft the stern, as shown in our engraving. The air pressure also governs an equipoise rudder, secured under the bottom and near the bow. The steering is effected by applying the force of the air against the tiller on one side, counteracted by the tension of a spring on the opposite side. The action of the apparatus is such as to be wholly independent of the differential force of the compressed air and the spring tension, and it is set in motion by admitting more or less air into the cable, thereby opening, more or less, a small connecting valve.

The submersion is regulated by two horizontal rudders turning on a transverse axle, which projects from each side near the bow. These wings or rudders are so contrived and governed that they keep the torpedo at a depth of from 7 feet to 12 feet below the surface, and are provided with automatic devices, so that the latter limit cannot be exceeded. In order to note the course of craft, a light steel mast is secured to the deck. This is 12 feet in length and terminates above in a wooden ball, the forward side of which is painted sea green, so as not to be perceptible to the enemy, and the rear white, so as to be easily distinguished above the water by those dispatching the torpedo. Openings are made in the engine compartment, through which the water enters, completely filling the interior space. The machinery is made of bronze with boxwood bearings, so that the water serves as a lubricant to every portion, thus doing away with stuffing boxes at the rudders, and, besides, avoiding any danger of the mechanism failing to operate through rust or neglect to oil.

To the engine power of the torpedo, no precise limit can be set. The whole force of the heavy engines of the torpedo boat, from which the weapon is dispatched, may be used to compress air up to almost any desired point. Captain Ericsson informs us that, small as the craft is, it towed a scow, forty feet long by fourteen beam and drawing two feet of water, without trouble. Driven at a high velocity by its large screws, it seems probable that the machine would make light work of piercing ordinary torpedo netting, or at any rate the explosion of its heavy charge of 400 pounds of nitro-glycerin, at such a short distance from a vessel as the length of her lower booms, would be sufficient to accomplish its purpose. Of course the torpedo hull is destroyed by the explosion but this would be a trivial loss in exchange for the total wreck of an enemy's man-of-war. The cable, however, remains uninjured, for it necessarily becomes detached and may be readily hauled in.

Our illustration represents the mode of launching the torpedo from the deck of the vessel. To this end the apparatus is hoisted up on swinging davits, the arms of which are previously turned over the deck. When lifted clear of the rail, the torpedo is carried outboard by revolving the davits, by bars inserted in the sockets in the broad portion of the davits, as shown. Nothing remains but to lower the machine into the water by the falls. The whole operation, we are informed, is accomplished in one minute.

A series of trials with the Ericsson pneumatic torpedo has lately been conducted on board the Intrepid, Commander A. P. Cooke, U. S. N., commanding, which has demonstrated the invention to possess a remarkable degree of efficiency. If further experiments, soon to be instituted from another torpedo boat, the Nina, prove, with the slightly modified steering gear, as successful as the initial tests above referred to, we may fairly conclude that that long-sought weapon, a reliable fish torpedo, has at length been devised. As to the probable result upon naval warfare, it is only possible to surmise. Against the attack of the torpedo, there is practically no defense, for its approach cannot be seen. Armor plating, even did it extend to the keel, would prove no shield, and the Inflexible's one hundred and twenty watertight compartments, which the English constructors hope will render her proof against such attacks, would fare badly under the terrible effects of 1,200 pounds of gun cotton, with which Captain Ericsson says he couldbreak any ironclad completely in two. We do not doubt but that the same ingenuity which can devise a weapon of offense is equally competent to provide a means of defense, at least such has been the experience of the past, as evidenced by the almost uniform progress in guns on one hand and armor on the other; but what defense, save that of giving an enemy the widest berth possible, and fighting at enormously long range, is likely to prove efficacious, we are at a loss to conjecture.

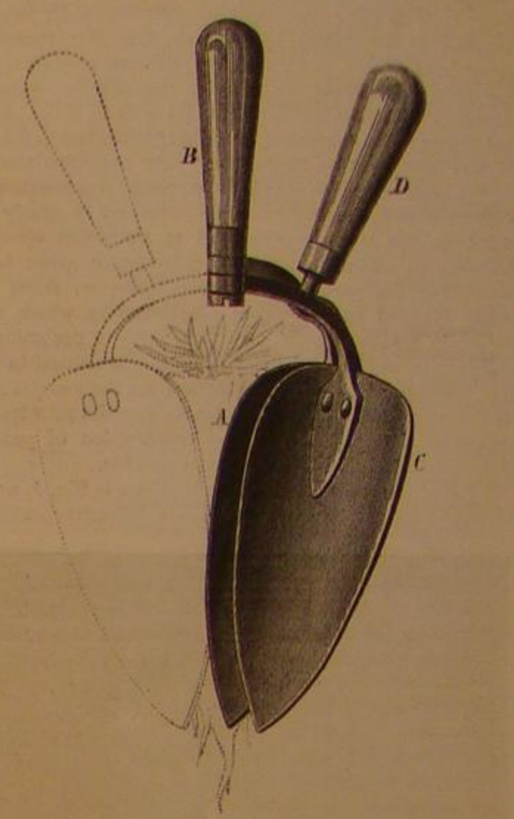


THE ERICSSON PNEUMATIC TORPEDO.

COPPEN'S IMPROVED TRANSPLANTER.

This is an ingenious arrangement of a double-bladed trowel, the object of which is to remove plants from the ground and set them in another place without destroying the soil around the roots.

The outer blade, A, has a curved shank, and a tong which enters and is secured to the handle, B. The shank of the inner blade, C, is curved to fit upon the inner side of the shank of the outside blade, and is pivoted thereto, at its extremity, by



a screw. Upon the middle part of the outer shank is formed a bend to receive the tong, which, on the inner shank, supports the handle, D.

In using the device, the blades are brought together, and thus thrust into the ground at one side of the plant, as shown in our illustration. The handles, B and D, are next operated to force one or the other of the blades around the roots, bringing the two directly opposite each other (see dotted lines). The instrument is then raised from the ground, taking the plant with it, and holding the soil undisturbed. The plant may easily be set in the desired place, the blades turned back to their former position, and the implement removed. By taking off the movable blade, the device may be converted into an ordinary garden trowel.

Patented through the Scientific American Patent Agency, October 27, 1874. For further particulars regarding sale of rights, address the inventor, Mr. George E. Coppen, P. O. Box 686, Evansville, Ind.

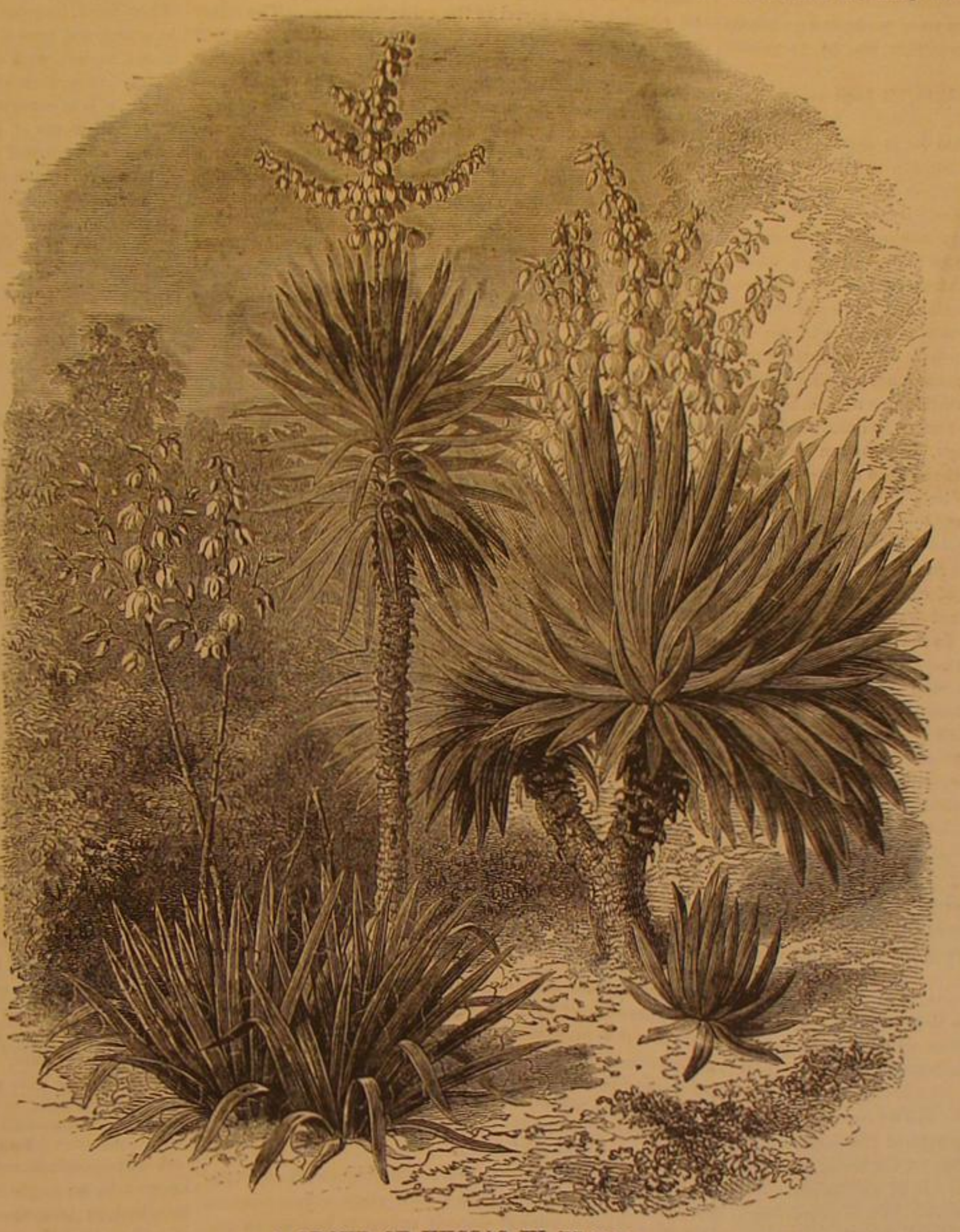
Electric Railway Whistles.

The French have lately introduced a system by which a stationary electric battery is made subservient to blow the whistle of an approaching locomotive, in case the road is not clear, without the engineer having to give any attention to it. Such an arrangement is, of course, exceedingly valuable at night, and especially during a fog, when signals cannot be seen at a distance. It is the reverse of the system introduced on the Hudson river railroad, by which every approaching locomotive sets a stationary electro-magnetic alarm bell at the depot in motion. In the French system referred to, the obstruction at the depot starts the steam whistle on every approaching locomotive when the train is still far enough away to slacken speed and stop. It has now been in uninterrupted operation on the line of the Northern Company of France for some time, and has been found practically successful in use, regularly informing the engineer whether the way is clear or not. The signal tender turns a disk and sends an electric current in the direction of the coming train to a bar placed between the rails; when the engine reaches the spot, a metal brush, placed between the wheels, sweeps the bar, the current passes to the engine, and, by means of an electro-magnet, presses upon a lever which opens the steam whistle, thus making it blow automatically. The rapidity with which the danger signal can be sent appears to be much in its favor.

THE YUCCAS.

Much might be written, and that to good purpose, on the stately effects to be obtained by the judicious planting of yuccas of different kinds in garden scenery. It is impossible to overlook their beauty, even when planted singly or in formal lines; but if arranged in bold groups and masses, they are unsurpassed as flowering and foliage plants for outdoor decoration. Their great panicles of pearly white, bell-shaped blossoms contrast so well with bright green conifers and low-growing shrubs of less distinct contour that all through the summer and autumn it is possible to form charming pictures by massing them either on the margins of shrubberies or in sheltered nooks on the lawn and pleasure grounds. These plants are simply invaluable if properly used in forming picturesque groups and clumps, instead of being, as is too often the case, dotted indiscriminately here and there on turf in unmeaning regularity. It has often been said that the hollyhock is the only decorative flowering plant of any importance to the landscape gardener. But the yuccas are even more stately, however; and they are permanent in character, being quite as ornamental in winter as in summer. They succeed nearly equally well in any soil, but a deep, rich, well drained loam is preferable; and they make finer specimens, if sheltered from rough, cold winds, than they would do if more exposed. The flowers of all the species (and these are more numerous than many imagine) closely resemble each other, being mostly of ivory-like whiteness within, the backs of the thick, wax-like segments being more or less tinted with purple. Much may be made of yuccas by associating them in well arranged masses along with other distinct and gracefully habited plants, such as the pampas grass, *arundo conspicua*, hardy bamboos, dwarf fan palms, and a score of other valuable decorative plants too seldom seen in our gardens.

Our engraving shows how a shrubbery recess may be made a charming picture by the use of yuccas alone; and it is in positions such as these that the flowers show to the best advantage. The kinds here shown are *y. filamentosa* on the left, a kind which bears rather lax but graceful spikes of flowers. The central specimen is *y. aloiolia*, a form generally met with in cool conservatories, although perfectly hardy in sheltered positions; and it is a rather curious fact that the variegated form of this plant is found to resist cold better than the normal kind. Both, however, make noble plants. The right-hand figure represents the common Adam's needle (*y. gloriosa*), one of the most robust of all the species; and associated with it is the free and vigorous *y. recurva*. These last rarely fail to flower every year.—*The Garden.*



A GROUP OF YUCCAS IN BLOSSOM.

The Diamond Drill.

The diamond drill is now extensively used in preliminary mining, to ascertain the exact location and thickness of ore or coal at given points. It is not uncommon to bore into the sides of hills or mountains for hundreds of feet with a 2¼ inch diamond drill of tubular form. By this means solid cores or specimens of the borings can be had. Conglomerate rock cores, 12 feet in length, in one piece, have thus been obtained.

The Yarn Congress.

The second session of the Congress, held first at Vienna last year, to establish a uniform system of numbering yarn, has recently concluded at Brussels.

It was unanimously admitted that all textile fibers should be numbered upon one universal system; that the metric system is gradually becoming generally employed for weights and measures, and that it is the only one that is admissible in the reform sought for by this commission; that, although it would be possible to adopt one perimeter for all classes of threads, it is advisable to take into consideration established customs, and the difficulties that would have to be overcome in introducing so great a change; and considering that there is no real necessity for fixing in an absolute manner the reel perimeters for each class of threads, and, moreover, that the perimeter of the English reel for cotton of 1·37 meters (1½ yards) is that which offers the best chances of bringing England to admit the metric system, it is therefore decided:

1. That the international numbering of threads shall be based on the metric system.

2 The number of the threads shall be determined by the number of meters (meter 3·28 feet) of thread contained in a gramme, (15·43 grains).

3. The length of the skein admitted for all kinds of threads is fixed at 1,000 meters (1,100 yards), with decimal subdivisions.

4. Any system of reeling, provided that it gives 1,000 meters of thread per skein, is admissible.

5. The numbering of silk threads to be 1,000 meters as a unit of fixed length, and the decigramme (1·54 grains) as a unit of variable weight.

6. In order to provide for the commercial relations of all countries, the scale of numberings for silk will be based on the variable weight of the unit of fixed length, and trials will be authorized on 500 meters (550 yards) weighing 50 milligrammes (0·772 grains).

THE HYMENOCALYX UNDULATA.

The genus *hymenocalyx* was founded by Herbert, who sepa-

rated it from the genus *pancratium* of Linnæus. The species which forms the subject of this note (*h. undulata*, or *pancratium typhyllum*), is a native of Caraccas, New Granada, and is one of the handsomest stove plants in cultivation. From an elongated bulb, it sends up a stout compressed scape or flower stalk, about 1½ feet high, terminated by an umbel-shaped inflorescence, at the base of which are numerous scarious bracts of a greenish white color. The flowers are tubular, very fragrant, about 6 inches long, pure white, slightly greenish at the ends of the petals, which are five in number, linear in shape, reflexed and twisted, and from 3 to 4 inches long. "In the center of each flower," says W. M., an English amateur, "is a shallow cup, from which issue six long stamens. The leaves are radical, persistent, stalked, oval-elliptical in shape, and a foot or more in length; the leaf stalks are winged, and sheathing the flower stem." This very striking plant, the habit of which is well shown in our illustration, deserves more attention than it appears to receive at present. It is easily multiplied by separation of the young bulbs, which should be taken from strong plants after they have done flowering. It may also be multiplied by means of the suckers which the plant frequently produces.

Deep Mining.

Many of the leading mining companies on the Comstock lode are now down to the depth of 2,000 feet, and a few still deeper. When mining first began on the great lode, such a depth was not thought of, or, if thought of, no one expected to see mining operations carried to such a depth as 2,000 feet in less than fifty years. Now we not only do not feel startled at hearing the great depth of 4,000 feet spoken of, but when we see preparation in actual progress, for sinking that far, we think but little of it. The Savage company, whose works we yesterday visited, have broken ground for the foundations of new machinery, which is to be sufficiently powerful to sink their main incline to a depth of 4,000 feet. This incline is already some distance below the 2,100 foot level, and is still being vigorously pushed downward. The new hoisting machine will be supplied with two 24 inch horizontal cylinders, of 4 feet stroke, and will be of over 400 horse power. The foundations of this engine are being laid about 80 feet to the westward of the present hoisting works. A building, 50x60 feet in size, will be erected over the new hoisting engine and the machinery connected therewith. The carpenters are already at work framing the timbers for this building. The steel wire rope to be used is to be 4,000 feet in length, and will weigh about 24,000 pounds. It is now being manufactured by John A. Roebling's Sons, Trenton, N. J. It will be a round rope, and the upper end will be two inches in diameter, but 2,500 feet of its length will be tapered, and the lower end will be 1¾ inches in diameter. The reel on which this cable will wind and unwind will be conical, and the cable will wind about it spirally. The Ophir company contemplate the erection of similar machinery, and propose pushing their works to a like depth. The Crown Point company already have in operation machinery of much the same character as that being erected by the Savage folks, and having a cable of sufficient length to sink to the depth of 3,500 feet. The Hale & Norcross company, Consolidated Virginia company, and other leading companies at this end of the lode will erect similar powerful works, and will at once plunge down into the great unknown "depths profound," in which lie hidden the silver roots of the Comstock. —*Virginia Enterprise.*

The Imitation of Lace on Silk by Photography.

A new and beautiful application of photography has lately appeared in England, by the aid of which any lace design can be transferred to silk, so that the latter material appears to be covered with the delicate and costly fabric. The lace to be copied is secured in a frame in contact with sensitive albumenized paper, and exposed to the light until a very deep impression is obtained. This is then fixed, and the paper, washed and dried, forms a perfect negative. Another piece of paper is then sensitized with bichromate of potash and gelatin, and exposed under the negative. Inking with lithographic transfer ink follows, and the paper is placed in water and lightly rubbed with a sponge. This throws out every detail of the inked spaces, the rest remaining white or free from ink. The impression is lastly transferred to a lithographic stone, and thence printed upon the silk by the usual process.

EIGHT pounds of oxygen gas and one pound of hydrogen are combined in nine pounds of water.

Spectroscopic Art in England and America.

Within the past few months, a series of independent efforts have been made in England and the United States, under the auspices of the two governments respectively, by able experimenters, to subject the spectroscope to practical purposes in the arts, more especially in the quantitative analysis of metallic alloys.

In England, the experiments have been conducted for the Royal Mint, by J. Norman Lockyer, the distinguished astronomer and spectrum-scientist, and William Chandler Roberts, chemist of the Mint.

In this country, the experiments were conducted on behalf of the United States Mint, Philadelphia, Pa., by Alexander E. Outerbridge, Jr.

The several experimentalists have, it appears, reached widely different conclusions.

Mr. Lockyer has announced that he is satisfied that by means of the spectroscope very minute differences in the composition of gold-copper alloys can be ascertained, but refrains from describing the process.

Mr. Outerbridge announces that a comparatively large proportion of gold may be present in an alloy, and the presence of the gold will not be indicated at all by the spectroscope. He also concludes that, in the present state of spectroscopic science, assaying by means of spectrum analysis is, for the present, impracticable for the purpose of Mint operations.

There appears to be as great a divergence on this subject between Mr. Lockyer and Mr. Outerbridge, as there is between Professor Tyndall and Professor Draper, on the subject of the heat power of the sun's rays, or between Professor Tyndall and Professor Henry, on the subject of the propagation of sound. When the doctors disagree, who shall decide?

The experiments of Mr. Outerbridge are confirmatory of a statement, made, we believe, by Professor Young, in reference to spectroscopic observations of the sun, to the effect that because we fail to discover the lines of carbon, silicon, oxygen, etc., in the solar spectrum, we are not warranted in drawing the conclusion that these elements do not exist in the sun.

Mr. Outerbridge has made a full report of his experiments to the chief assayer of the Mint, and he also gives, in a recent number of the *Franklin Journal*, a variety of interesting facts, from which we take the following:

The beautiful parti-colored band of light, resembling a section of a miniature rainbow, resulting from the passage of a ray of white light through a prism, is familiar to every one; this simple experiment forms an appropriate introduction to the fascinating study of spectrum analysis.

Every kind of light not strictly monochromatic may, by means of the prism, be resolved into its component colors. The spectroscope is a simple combination of prisms and lenses for the scientific examination of these different colors or spectra.

The numerous terrestrial elements, when in the state of incandescent vapor, give their own distinctive colors, which appear in the spectroscope as lines of light arranged in definite position, whereby each element may be easily recognized.

The passage of powerful electric sparks (from an induction coil), between two terminal points of the metal to be examined, vaporizes a small portion of the metal, and this incandescent vapor transmits to the eye of the spectroscopic observer its luminous autograph, which Nature never counterfeits. Should either or both of the metallic points, or electrodes, consist of an alloy of two or more metals, the autograph of each may be clearly read.

Mr. Lockyer noticed, while studying these luminous autographs, that when he separated the metallic electrodes, causing the spark to leap a greater distance through the air, the spectral lines no longer continued to cross the entire field of vision; but certain of them broke in the middle, and, upon further increasing the distance between the electrodes, the hiatuses in the spectral lines increased proportionately, but unequally with different alloys. As the proportion of either metal of an alloy is increased, its lines lengthen, and conversely with the lines of the other metal. Upon this discovery, Mr. Lockyer based the theory of a possible method of quantitative analysis.

The spectroscope was known to be marvelously sensitive to the impression of these autographs, and it, therefore, appeared plain that, could such a method of analysis be reduced to a practical basis, its value would be immense in assaying metals used in coinage. For although the present modes of assaying precious metals have been brought to great perfection, yet the process is slow and tedious, requiring many chemical operations and great delicacy of manipulation; and "there is something captivating in the idea of a determination, as it were by a flash of lightning or in the twinkling of an eye, what proportion of gold or silver is present in any bar or coin." It was with the hope of reducing this beautiful theory of Mr. Lockyer to practice that these experiments were undertaken.

A powerful induction coil, reinforced by Leyden jars, in connection with a two-prism Browning spectroscope, was employed, and it was found possible, after repeated comparisons of the spectra of different known alloys of gold and copper, to map the difference of fineness between specimens having respectively 500 and 750 parts of gold in 1,000 of the alloy, and even to recognize the variation between coin ingots 895 and 902 fine.

The spark, in passing through the air, vaporizes its constituents, namely, oxygen, nitrogen, etc.; these of course write their signatures in the spectroscope, and it is necessary to eliminate the numerous bright air lines which thus appear in all the spectra. Some of the lines of different metals appear in close proximity, and might readily be misinterpreted. Thus a bright blue line of bismuth is almost identical in position with one of zinc. A green line of iron is nearly coincident with a bright gold line. The difficulty which presented itself in the exact comparison of these proximate lines, was overcome by using a pure metal as one electrode and another pure metal as the other electrode. The effect thereby produced was very curious. With pure gold and pure copper as the electrodes, the gold lines extend across only one half the field of the spectrum, and the copper lines extend across only the other half, the medial termini of both sets of lines being perfectly sharp and bright. By this means a double spectrum of copper and gold is obtained, or rather a section of a complete gold spectrum and a section of a complete copper spectrum are visible in immediate juxtaposition, thereby enabling a most accurate comparison of lines, which in reality are not identical in position, but which by the previous method were apparently so.

By a slight modification of the experiment, substituting pure copper as one electrode and an alloy of silver and gold as the other, the proximate lines of these three metals are presented, mapped, as it were, on a natural scale.

By using as one electrode an alloy of gold and copper of comparative fineness, and a baser alloy of the same metals as the other electrode, a result not before observed presented itself. The lines of both copper and gold crossed the entire field of vision, but in the section representing the fine alloy, the gold lines were strong and bright; while in the section representing the base alloy, the gold lines were very faint.

By now gradually increasing the distance between the electrodes, the faint gold lines of the base alloy cease to join their bright counterparts of the fine metal at the central line.

The general principle was thus satisfactorily proved, that where two alloys of different grades are subjected to this treatment, the gold lines of the baser compound are noticeably the fainter of the two; and what is more important, they may be reduced in length by separating the poles, until they disappear.

Although Mr. Cappel has shown that 0·0162 of a troy grain of gold will show a spectrum, yet a comparatively large proportion of gold may be present in an alloy, the presence of which will not be indicated at all by the spectroscope.

In a slip composed thus: Silver, 708 parts; copper, 254 parts; gold, 38 parts: the spectra of silver and copper are alone visible.

In fact, in a base alloy of gold and copper containing from 20 to 25 per cent of gold, the gold spectrum is barely visible; while in a fine alloy of gold and copper, it was found that one per cent of the latter suffices to show the copper spectrum. Also in an alloy of nickel and copper, containing 25 per cent of nickel, its spectrum is scarcely visible. It seems evident, therefore, that the spark selects the more volatile metal as its vehicle.

If the spectroscope fails to reveal the presence of anything less than 200 parts of gold in a base alloy, even a theorist must admit that one could scarcely expect to be able to discriminate with certainty a variation of 1-10,000th in a fine alloy.

For the foregoing reasons, the conclusion seems inevitable, that, in the state of spectroscopic science as it now exists, assaying by means of spectrum analysis is, for the present, impracticable for the purposes of Mint operations.

Although these experiments have resulted negatively from the utilitarian standpoint from which they were undertaken, it is hoped that they may prove not altogether without value in a more general point of view. The fact that quantitative proportions of composite substances may be recognized at all, even to a rough degree, cannot but be regarded as a first step. All observations bearing upon the action of the spectral lines in indicating such proportions are at least worthy of being recorded. Not the least curious of these incidental observations is the fact that, while the spectroscope is sensitive to the minutest fraction of a grain of gold in the pure state or in solution, it fails to reveal the presence of a much larger proportion in a base alloy. Another is the fact that while the spark appears to select for its vehicle of transmission the more volatile metal in an alloy, and would thus seem to vaporize a greater quantity of the volatile than of the non volatile component, yet in point of fact the loss of weight by such volatilization is in some instances much less in the former case than in the latter.

The rationale of these apparent paradoxes is not at present evident; but if we may judge by former experiences, in which problems even more mysterious have been resolved by study, we are warranted in anticipating that, when a large number of observations, to be made perhaps by many experimenters groping in the dark, shall be collated, the true scent may of a sudden be struck, which shall discover the desideratum of quantitative spectrum analysis.

A red hot iron passed over old putty will soften it so that it is easily removed.

Barytes Green or Manganate of Baryta.

This salt has been introduced into commerce under the names of Cassel green or Rosenstiehl's green. It has generally been prepared by calcining nitrate of baryta with oxide or peroxide of manganese, or by fusing caustic baryta with manganese and chlorate of potash. The author gives a new method for its preparation. On precipitating a green boiling solution of manganate of potash with chloride of barium, there is formed a deposit, strongly granular but not crystalline. This precipitate is of a violet color, bordering on blue. It is well washed by decantation, and then filtered. When dried, its color becomes paler as the temperature rises. At a dark red heat it is white, with a grayish blue tinge. If heated higher, with access of air, it becomes by degrees completely green, then of a fine blue, and at very elevated temperatures it is converted into a dirty brown gray. If a solution of permanganate of potash is precipitated with chloride of barium, and allowed to boil, there is slowly formed a reddish violet deposit (color of peach blossom), and the liquid retains an intense violet color. The precipitate may be washed by decantation, and filtered without decomposition. It can even be dried at 212° Fah. without losing its color. When gradually heated, the permanganate of baryta loses its color like the manganate, but at very high temperatures it behaves differently. When its color has once been destroyed by a moderate heat, it does not become either green or blue by further heating with access of air. The whole becomes at once of a grayish brown. The finest barytes green is formed by calcining the manganate of baryta. Rosenstiehl's process—the fusion of hydrate of baryta with chlorate of potash and peroxide of manganese—yields an inferior color.—*E. Fleischer, in Chemical News.*

Carbon Cells and Plates for Galvanic Batteries.

With a sirup made of equal quantities of lump sugar and water, mix wood charcoal in powder with about a sixth part of a light powder sold by colormen, called vegetable black. The mixture should hang thickly on any mold dipped into it, and yet be sufficiently fluid to form itself into a smooth surface. The vegetable black considerably helps in this respect.

Molds of the cells required are made of stiff paper, and secured by wax or shellac. A projection should be made on the top of the mold for a connecting piece. These molds are dipped into the carbon sirup, so as to cover the outside only, and then allowed to dry. This dipping and drying is repeated until the cells are sufficiently thick. When well dried they are then buried in sand, and baked in an oven sufficiently hot to destroy the paper mold. When cleared from the sand and burnt paper, the cells are soaked for some hours in dilute hydrochloric acid, and again well dried, then soaked in sugar sirup. When dry, they are then packed with sand in an iron box, gradually raised to a white heat, and left to cool. Should some of the cells be cracked, they need not be rejected, but covered with paper or plaster and dipped in melted paraffin.

Rods or plates of carbon can be rolled or pressed out of a similar composition, but made thicker. Carbon thus made will be found to have a good metallic ring and a brilliant fracture.—*W. Symons, in Nature.*

Ingenuity of a Spider.

A correspondent writes to *Nature* that a spider constructed its web in an angle of his garden, the sides of which were attached by long threads to shrubs at the hight of nearly three feet from the gravel path beneath. Being much exposed to the wind, the equinoctial gales of this autumn destroyed the web several times.

The ingenious spider now adopted a new contrivance. It secured a conical fragment of gravel, with its larger end upwards, by two cords, one attached to each of its opposite sides, to the apex of its wedge-shaped web, and left it suspended as a movable weight to be opposed to the effect of such gusts of air as had destroyed the webs previously occupying the same situation.

The spider must have descended to the gravel path for this special object, and, having attached threads to a stone suited to its purpose, must have afterwards raised this by fixing itself upon the web, and pulling the weight up to a hight of more than two feet from the ground, where it hung suspended by elastic cords.

New Compound from Urine.

The substance in question, $C_3H_4N_2O$, has a strong resemblance to hippuric acid. It forms white columns of several millimeters in length. Freely soluble in boiling water; sparingly in cold water and spirit of wine; insoluble in absolute alcohol and ether. If heated to 250° Fah. the crystals experience no change. If more strongly heated, they decrepitate, evolve dense white vapors of a peculiar odor, fuse, and finally burn with the odor of horn. It is neutral to test paper, does not combine with bases, but forms with acids salts which do not readily crystallize, and deliquesce on exposure to the air.—*F. Baumstark.*

ACID IN THE GASTRIC JUICE.—R. Maly finds that the pure gastric juice in dogs contains no lactic acid. The decomposition of chlorides by lactic acid cannot, therefore, be the source of the hydrochloric acid in the stomach. Lactic acid seems to play no part in the chemistry of the normal formation of acids. The source of the free hydrochloric acid in the stomach is a process of dissociation of the chlorides without the action of an acid.

[International Review.]

THE CONSTITUTION OF THE SUN.

BY PROFESSOR C. A. YOUNG.

Number I.

THE CENTRAL CORE.

Probably no subjects of scientific research have ever attracted more attention than those relating to the sun. His preëminence in our system, as the controller of all planetary motions, and the origin and mainspring of all material energy in the earth and her sister worlds, invests with supreme interest every problem concerning his nature and modes of action.

As to the sun's central core, the opinion which now generally prevails, though not without some dissent, is that it is gaseous. The reasons which almost compel this conclusion are easily stated. In the first place, knowing the sun's distance, we readily compute its diameter, which turns out to be nearly 108 times that of the earth, or in round numbers 860,000 miles.* Now, since the bulks of different spheres are proportional to the cubes of their diameters, it follows that the volume of the sun, to use the technical term, is 108x108x108 times greater than that of the earth; in other words, it would require about 1,250,000 of the earth to make a globe as large in volume as the sun.

According to the best determinations, we find that the sun is about 320,000 times as heavy as the earth; and since, as we have seen, it is a million and a quarter times as bulky, it follows that its average density is less than that of the earth nearly in the proportion of one to four; and this, although we know by means of the spectroscope that conspicuous among the materials of which the sun is composed are metals, whose density, even when not under pressure and in the liquid form, far exceeds that which has been mentioned. For since the earth has a mean specific gravity of about 5·5, it follows that that of the sun is only about 1·4, while the densities of iron, titanium, manganese, chromium, copper, zinc, magnesium, etc., range from 1·75 to 9. Of the substances known to exist in the sun, only sodium and hydrogen are lighter than the sun's mean density. It is to be remembered, also, that since the force of gravity at the sun's surface is twenty-eight times as great as on the earth, the effect of the weight of the strata near the surface, in compressing and increasing the density of the central parts must be correspondingly powerful. As things stand, then, there seems to be no possibility of admitting that the substances which compose the sun are mainly in the solid or liquid state, for in that case the mean density must almost necessarily far exceed that of the earth. This conclusion is strengthened by what we know of the intensity of the heat at the solar surface, where, although exposed to the cold of outer space, we find a temperature sufficient to keep the solar atmosphere charged with the vapors of the metals we have mentioned. We can hardly doubt, therefore, that in the interior of the sun the temperature must be such as to make the existence of the metals in the solid or even the liquid state quite impossible. And yet the theory that they are in a gaseous state is not without difficulties. A few years ago it would have been urged with great plausibility that, under such a pressure as must obtain at the center of the sun, every gas would necessarily be liquefied; and it would have been impossible to meet the objection by any knowledge then in our possession. The recent researches of Andrews have, however, shown that a vapor or gas, if above a certain critical temperature, refuses to be liquefied by any pressure whatever, but, growing denser and denser under the pressure, still maintains its gaseous characteristics, which are continuous expansibility under diminishing pressure without the formation of a free surface of equilibrium, continuous expansion under increasing temperature without the attainment of a boiling point, and, in the case of a mixture of different substances, a uniform diffusion of each through the whole space occupied, according to the law of Dalton and without regard to specific gravity.

These essential distinctions between liquids and condensed gases are often misunderstood; but it is the more necessary to keep sight of them, as in many most important respects the mechanical properties of gaseous matter, condensed by pressure to the specific gravity of water, are identical with those of liquids; especially if at the same time intensely heated—for then, as Maxwell has shown, the viscosity, or power of resisting motions, is greatly increased; so that a mass of hydrogen at the sun's center may very possibly in its mechanical behavior much more resemble pitch than what we are familiar with as gas and vapor.

It must be noted further, and is urged as an objection by many, though we fail to appreciate its force, that if the sun's central core is gaseous, then the temperature at the sun's center must be enormous—to be reckoned in millions of degrees, perhaps millions of millions. If it were not so, even the lightest gas, as hydrogen, at the temperature of the sun's surface, would, by the inconceivable (but not incalculable) pressure, be condensed so as to be hundreds of times heavier than platinum itself. We speak somewhat vaguely, because the numerical conditions of the problem are not very accurately known, though the general correctness of the result is certain. Heat, of enormous intensity, can alone counteract this effect, and give us the small density observed. For our own part, considering what we know of the amount, constancy, and permanence of the sun's radiation, we find no difficulty in conceding any internal temperature which may be necessary to account for the facts.

* Very few, we imagine, get from this bare statement any adequate conception of the vastness of the solar orb. Conceive the earth placed at its center so that the inner surface of the photospheric shell should be our sky; then the moon, which is distant nearly 240,000 miles, would pursue her accustomed orbit far within the bounding sphere; and indeed, if the earth had a second satellite at almost twice the moon's distance, this also would come within our firmament.

[The Telegraphic Journal.]

ELECTRO-DEPOSITION OF METALS.

BY J. T. SPRAGUE.

Number I.—PREPARATION OF THE ARTICLES.

The depositing of metals in the various forms required in the arts depends upon the practical application of the theoretical principles which have been frequently explained. The processes divide themselves into two general groups: 1. Electrotyping, the forming of a mass of metal intended to have a distinct existence of its own, and requiring therefore to possess a certain amount of strength or coherence. 2. Electroplating, in which a mere film of metal is to be employed as a covering to another metal, to beautify it or to protect it from atmospheric influences.

The essential distinction between the two processes is that in electroplating the two metals are desired to be brought into absolute molecular contact, so that they shall form one body, mechanically considered; this depends entirely upon the absence of any intervening substance, that is to say, upon the absolute cleanness of the surface to be coated. Under ordinary circumstances, every surface is coated with a very strongly adhering film of air, which appears to condense among the superficial molecules, and cling, as we see liquids do, to those surfaces which they can wet. This coating of air will prevent adherence unless it is very carefully removed; most metallic surfaces form either oxides or sulphides, and of course all collect a greasy film from the air, and the first and most essential operation is the removal of all these impurities, so as to present a pure metallic surface to the new metal to be incorporated with it.

In electrotyping, on the other hand, it is necessary to ensure the presence of an intervening film, which, while not resisting ordinary contact, will prevent true chemical or molecular contact. To effect this, after the surface to be deposited on (if metallic) is properly cleaned from everything which would deface the deposit, it should be lightly rubbed over with a leather or cloth moistened with turpentine in which a little beeswax has been dissolved—a piece the size of a pea to a quarter of a pint of turpentine will suffice—to prevent adhesion without filling up fine lines, etc.

The process of cleaning varies according to the nature of the objects and the solutions they are to be used with; these processes are mechanical and chemical. In mechanical cleaning, it is desirable, if the objects will permit, to expose them first to a red heat, and then to rub and polish them thoroughly by means of suitable brushes and polishing substances. The best apparatus for the purpose consists of circular brushes mounted on a spindle, driven by machinery or by a lathe. Circular pieces of wood, faced with leather, are also useful, as also the blocks of solid emery now so much used for grinding and polishing metals. A substitute for the latter may be usefully made by soaking a leather facing with glue, and coating well with emery, turning the wheel when nearly set against a roller, so as to consolidate the surface.

Most articles, however, are more rapidly and conveniently cleaned by chemical means. The first of these is the removal of grease by boiling in a solution of caustic soda, made by boiling 2 lbs. of common washing soda and ½ lb. quicklime in a gallon of water; after this they should be well brushed under water. The further processes will depend upon the nature of the objects.

1. Silver is washed in dilute nitric acid, then dipped for a moment in strong nitric acid, and well washed. Care must be taken that the water does not contain chlorine salts; if the ordinary supply does so, the first rinsing after acids must be made in water prepared for the purpose by removing the chlorine by adding to it a few drops of nitrate of silver, and allowing the chloride to settle.

2. Copper, brass and German silver are washed in a pickle of water 100 parts, oil of vitriol 100 parts, nitric acid (sp. gr. 1·3) 50 parts, hydrochloric acid 2 parts. Spots of verdigris should be first removed by rubbing with a piece of wood dipped in hydrochloric acid; they are then rinsed in water.

3. Britannia metal, pewter, tin, and lead cannot be well cleaned in acids, but are to be well rubbed in a fresh solution of caustic soda, and passed at once, without washing, into the depositing solution, which must be alkaline.

4. Iron and steel are soaked in water containing 1 lb. oil of vitriol to the gallon, with a little nitric and hydrochloric acids added. Cast iron requires a stronger solution, and careful rubbing with sand, &c., to remove scale and the carbon left by the acids. It is an advantage at times to connect them to a piece of zinc while cleaning. These metals should be cleaned just before placing in the depositing cell; and if they are placed in an alkaline solution, they should be rinsed and dipped in a solution of caustic soda, to remove all trace of acids.

5. Zinc may be cleaned like iron, with a dip into stronger acids before the final washing.

6. Solder requires special care, as the acids used with the objects produce upon it an insoluble coating, and an obstinate resistance to deposit is set up at the edge of the solder. The same remark applies to soft metal edgings and mounts. These should be rubbed with a strong caustic soda solution, rinsed, and then treated as follows:—Make a weak solution of nitrate of copper by dissolving copper in dilute nitric acid; to a camel hair or other soft brush, tie three or four fine iron wires to form part of the brush; dip this in the nitrate of copper, and draw over the solder, taking care that some of the iron wires touch it; a thin adherent of copper will form, and upon this a good deposit will take place.

7. Old work for replating must have the silver and gold carefully removed; if this is not done, there is apt to be a failure of contact at the edges of the old coatings, which causes blisters and stripping under the burnisher. The best mode of stripping is with the scratch brush, etc., as described for mechanical cleaning, but chemical means may be used. Gold is dissolved by strong nitric acid, to which common salt is gradually added; it may be collected afterwards by drying and fusing with soda or potash. Silver is similarly dissolved by strong sulphuric acid and crystals of saltpeter, and recovered by diluting and precipitating with hydrochloric acid, then reducing the chloride either by fusion with carbonate of soda, or by acid and zinc cuttings. Copper can be removed from silver by boiling with dilute hydrochloric acid, and tin and lead by a hot solution of perchloride of iron.

In preparing articles for silvering and gilding, a process of amalgamation is very commonly employed, by which a very thin film of mercury is formed over the surface, which makes a perfect connection between the two metals; this is effected by a solution of one ounce of mercury in dilute nitric acid, and then diluted to one gallon; there must always be a little free nitric acid present; articles dipped in this solution take a grayish color, which on brushing under water becomes a brilliant mercury surface. They must be at once transferred to the solution for coating, without exposure to the air. In the case of iron or steel articles, a similar process may be used, but in this case it is best to add to the solution an ounce of silver also dissolved in nitric acid. It requires great care to obtain a perfect mercury surface upon iron; occasionally sodium amalgam is rubbed over iron for this purpose; the iron must be very perfectly cleaned first.

Street Cars Propelled by Springs.

The winding-up of the spring barrels, which are carried under the car, is effected by engine power, located at suitable intervals along the track, as may be convenient for the run. The stationary engine drives by belt the horizontal shaft, carried in bearings, enclosed in a metallic tube or casing, beneath the roadway, and extending across the track; close alongside whereof a covered box is sunk in the roadway, enclosing a wheel, so shaped as to connect with the winding axle of the tramway car, and thus give the requisite motion thereto. On the arrival of a car at any station, the spring barrels are quickly wound up by the engine.

It has been computed that the actual tractive force, requisite to overcome the resistance of a street car weighing gross 5 tuns, is 60 lbs. on the driving wheels, corresponding to 720 lbs. on the periphery of the spring barrel; 24 lbs. and 288 lbs. respectively correspond to a gross weight of 2 tuns; and in like proportions for intermediate weights. So far as previous experience goes, a spring 6 lbs. in weight, exerting a direct pressure of 105 lbs., may be taken to represent the maximum in size and power of such steel springs. Under the stimulus applied by M. Leveaux's researches, the steel manufacturers of Sheffield, by special and improved plant, annealing ovens, and appliances, have turned out springs 30 to 60 feet long, capable when duly coiled of exerting a pressure of 800 lbs. to 900 lbs., without permanent set. In France, also, steel driving bands, with great elasticity, are made 100 yards in length, so that the question of the possibility of obtaining springs of the requisite size and power is practically solved.

M. Leveaux has had all the necessary mechanism and appliances made by a well known firm of engineers, so as to fit up a tramway car or cars for actual trial upon some of the lines of metropolitan tramways in London; for which indeed, the arrangements are now nearly complete, so that the practical working of the system will speedily receive a thorough public demonstration. We have ourselves had opportunities of seeing the potentialities of the principle, both in the model and full working size; and even in view of the sweeping change in the tramway system which is involved in its complete success and adoption, we cannot withhold the conviction that all the important practical difficulties have been effectually surmounted, reducing its practical realization to mere matters of detail. The working of the springs is entirely free from noise, perfectly smooth, easy, and effective, and completely under control, for application, cessation, and reversal.—*Iron.*

Wood Cutting by Electricity.

Professor Barnard, of Columbia College, writing to the New York *Times*, as an item of recent scientific news, says that the Abbé Moigno, in a recent number of his periodical, entitled *Les Mondes*, describes an invention which, he says, has recently been patented by Mr. George Robinson, of New York, for sawing wood by an entirely new, and what seems a sufficiently odd, process. The process consists in substituting instead of the saw a platinum wire, heated white hot by means of an electric current, etc.

The original account of this invention was published in the SCIENTIFIC AMERICAN, June 22, 1872. It was patented here in May of the same year.

Machinists in the Navy.

A regulation circular has just been issued from the Navy Department, defining more clearly the qualifications requisite for the position of machinist in the navy, as well as the pay and duties. There are three ratings established, namely, machinist, boiler maker, and coppersmith. The last two are on a level, so far as pay is concerned, and promotion lies from these grades to that of machinist, when sufficient proficiency is shown. Candidates for any position must be between the ages of twenty and forty years, and must successfully pass an examination in the presence of the commanding officer of any rendezvous or recruiting station, as to qualifications. There is also a medical examination, touching physical fitness, to be undergone.

Boiler makers and coppersmiths are examined solely as to their suitability for such special ratings. A machinist must be able to read and to write with sufficient correctness to keep a steam log of his watch. He must know the names of the various parts of a marine engine; understand the uses and management of the various gages, cocks, and valves, the mode of raising steam and starting and regulating the action of the engine. He must also know how to ascertain the hight and density of water in the boilers; how to check foaming, regulate the quantity of injection water, to guard against water in the cylinder, and against all dangers to the generators; understand what measures are to be taken in cases of hot journals; and, in short, know how to act upon the occurrence of any of the ordinary casualties of the engine room. In matters of repairs, the candidate is to be examined on the ordinary overhauling and repairing of machinery, the packing of the various joints and rods, grinding of valves, putting on hard and soft patches, putting in and plugging tubes, and all other work required in the management of marine engines.

The regular pay of a machinist is $75 per month; of a boiler maker, $40; and of a coppersmith, $40. To this is added $109 per year rations, and $18 extra per President's order; so that the aggregate annual salary of a machinist is $1,027, and of a boiler maker or coppersmith is $607.

The relative position of men enlisted for the above grades is that of petty officer—about the same as non-commissioned officer in the army. The duties are regular watch in the engine and fire room, managing the engines and boilers (of course, under the direction of the regular engineer officers of the ship). The pay is higher for machinist than that of any other petty officer; and, when it is considered that quarters are found, the recipient having only to supply his mess and uniform (which may be done at a very moderate sum), it will be seen that every opportunity is afforded for saving.

Cruising vessels on regular squadrons are at sea for a large proportion of their time, when no chance exists for spending money. In port, a moderate amount of liberty is granted to those whose duties do not interfere with the privilege. There is an excellent system of allotment in the service, whereby a man, before he leaves home, may authorize the paymaster of the station nearest his domicile to pay, to his wife or friends, a certain proportion of his pay. This amount is then out of his control, and will be deducted from his salary by the paymaster of his vessel.

DECISIONS OF THE COURTS.

United States Circuit Court.---Southern District of New York.

PATENT REFRIGERATOR.—THE LYMAN VENTILATING AND REFRIGERATOR COMPANY *vs.* WILLIAM LALOR.

[Decided September 10, 1874.]

BLATCHFORD, *J.*:

This suit and several others are brought on reissued letters patent granted to Stephen Cutter, March 10, 1874, for an "improvement in methods of cooling and ventilating rooms." The title to this patent is vested in the plaintiffs for the whole of the United States, except the eastern district of New York, and that part of the city of New York lying westerly of Broadway and Fifth avenue, and a few counties in New Jersey, the title for such excepted territory being vested in the Lyman Patent Refrigerator Company. The original letters patent were granted to Azel S. Lyman, as inventor, March 25, 1856, and were extended for seven years from March 25, 1870, and were reissued to Lyman, December 26, 1871, and were then assigned to said Cutter, and reissued to him, as above stated, March 10, 1874.

The first claim of the reissue sued on is in these words: The combination of a descending conduit or cold air flue, or either, with a reservoir for containing cooling materials, substantially in the manner and for the purposes described. This claim differs only in the addition of the words "or either" from the first claim of the reissue of 1871. The first claim of the reissue of 1871 was sustained in two suits in equity, on final hearing: one before Judge Hall, in the northern district of New York, in March, 1872 (Lyman *vs.* Myers), and the other before Judge Benedict, in the eastern district of New York, in January, 1874 (The Lyman Patent Refrigerator Company *vs.* Oswald.) In both of those suits it was sustained against the alleged prior invention of Thaddeus Fairbanks, a patent for which was applied for September 5, 1846, and rejected February 6, 1847, and withdrawn July 27, 1847. Long after such withdrawal, John C. Schooley obtained from Fairbanks, for the sum of five dollars, an assignment of Fairbanks' alleged invention, and an application was again made for a patent for it, and a patent was granted to Schooley, as assignee of Fairbanks, August 12, 1856. Judge Benedict, in the case against Oswald, says: The proofs show that Fairbanks abandoned his invention long prior to the issue of the patent upon it. His application for a patent, made in 1846, was rejected on the 27th of July, 1847, and he then withdrew his application. No subsequent effort to obtain a patent or preserve his invention or to put it in use appears ever to have been made by him. The patent for the invention, subsequently issued August 12, 1856, was obtained by one Schooley, as assignee of Fairbanks, who obtained an assignment of the invention from Fairbanks for the sum of five dollars, nearly ten years after the withdrawal of the application and abandonment of the invention by Fairbanks, the inventor.

To this it may be added that, on the present motion, nothing is shown in reference to the invention of Fairbanks, except the papers from the Patent Office and an affidavit by Schooley, showing the foregoing facts. It is not shown that, prior to the date of the original patent to Lyman, much less prior to the date of Lyman's invention, a refrigerator was actually constructed embodying what was set forth in the application of Fairbanks. The alleged invention of Fairbanks, as anticipating Lyman, must, therefore, be laid out of view. As regards anything shown in the original application of Fairbanks, made in 1846 and rejected and withdrawn in 1847, it is well settled that a written description of a machine, although illustrated by drawings, which has not been given to the public, does not constitute an invention within the meaning of the patent laws. Evidence that such a description was made does not show, of itself, a prior invention. Such a description has not the same effect as a printed publication. It lacks the essential quality of such publication; for, even though deposited in the Patent Office, it is not designed for general circulation, nor is it made accessible to the public generally, being so deposited for the special purpose of being examined and passed upon by the Patent Office, and not that it may thereby become known to the public. Although it may incidentally become known, the deposit of it is not a publication of it, within the meaning of the statute or the law. Moreover, although the description may be so full and precise as to enable any one skilled in the art to which it appertains to construct what it describes, it does not attain the proportions or the character of a complete invention until it is embodied in a form capable of useful operation (The Northwestern Fire Extinguisher Company *vs.* The Philadelphia Fire Extinguisher Company, 6 *Official Gazette* of Patent Office, 34.)

In answer to the present motion for injunction, various other alleged prior inventions are set up.

I have carefully considered all the matters presented in these cases, and am of opinion that the injunction asked for must be granted as to the first claim of the patent.

[*John J. Allen* and *Edward J. Cramer*, for the plaintiffs.
Edward N. Dickerson and *Charles C. Beaman, Jr.*, for the defendants.]

United States Circuit Court, District of Maryland.

PATENT GLASS FURNACE.—FREDERICK G. SCHAUM, ADMINISTRATOR OF FREDERICK SCHAUM, DECEASED, *vs.* CHARLES J. BAKER, *et al.*, TRADING AS BAKER, BROS. & CO.

An assignment by a bankrupt carries with it all patent rights which the insolvent owns at the time of making the assignment; but does not include his inchoate right to an extension of a patent under the law of 1836.

The plaintiff proved that his intestate, Frederick Schaum, was the first and original inventor of certain new and useful improvements in the construction of glass furnaces, for which letters patent were granted to his said intestate on the 25th of April, 1854, application therefor having been made on the 7th of June, 1853. That said letters patent were extended to plaintiff, under the act of 1836, section 15, on the 23d day of April, 1868.

The improvement claimed was the making of the external and internal configuration of the breastwork of the furnace wall with re-entering portion, so as to partly embrace the pots, and furnace room for additional or extra teaze or ring holes. That the defendants had, during a period of fourteen months, constructed and used furnaces embodying the configuration of the breast wall, as described in said letters patent, was not denied.

Plaintiff offered evidence to prove that, by the use of the said improvement, one third more wall could be made at the same expense, which was denied by defendants. Plaintiff further proved that the said improvement was extensively used by the defendants and others.

Defendants proved that, in 1856, plaintiff's intestate applied for the benefit of the insolvent laws of the State of Maryland, and executed an assignment of all his property, estate, rights, and claims to William Geo. Read, his permanent trustee, for the benefit of his creditors.

Defendants further proved that the said firm of Baker, Brothers & Co. was formed in July, 1872, the suit having been instituted in November, 1873.

The Court, Hon. Wm. Fell Giles, Judge, gave, among others, the following instructions:

1. That the patent of Frederick Schaum was for two purposes. The construction of glass furnaces, by making the external and internal configuration of the breastwork of the furnace wall with the re-entering portions, so as, first, to partly embrace the pots; and, secondly, to furnish room for additional or extra teaze or ring holes, more than were to be found in the glass furnaces known and constructed at or before the date of the patent.

2. That the plaintiff was entitled to recover, if the jury should believe that the plaintiff's intestate was the first and original inventor of a new and useful improvement in glass furnaces, for which he received letters patent, and that said letters patent were extended to the plaintiff, the administrator of the original patentee, then deceased; and should further find that the defendants had, since the granting of said extension, and since July 1st, 1872, constructed and used a glass furnace or furnaces, substantially embracing the improvement described in said letters patent.

3. That in considering the question of utility in the preceding instruction, the jury are instructed that the fact of extensive use by defendants and others is evidence of such utility.

4. That if the jury believe that plaintiff's intestate, Frederick Schaum, in 1856, applied for the benefit of the insolvent laws, and made an assignment to his permanent trustee, the plaintiff is not entitled to recover for breaches of the original patent.

The defendants also offered the following prayer, which the Court rejected: That if the jury find that the said Frederick Schaum applied for the benefit of the insolvent laws of the State of Maryland in 1856, and that William Geo. Read was duly appointed his trustee, then all the interest of said insolvent in said patent, and his right to an extension, passed to said trustee, and the plaintiff is not entitled to recover.

Verdict for plaintiff.

T. Alex. Seth and *Harry E. Mann*, for plaintiff.
Fred. W. Brune and *Fred. J. Brown*, for defendants.

Recent American and Foreign Patents.

Improved Trap and Cesspool Cover.

John Peter Schmitz, San Francisco, Cal.—The object of this invention is to provide a combined trap and cover for cesspools, to prevent foul air or odors escaping from the sewers. The frame or trap case is arranged to be on a level with the sidewalk, resting with its rim on the wall of the cesspool, its lower end sloping, and having a solid rim whereon the smooth flap, with its elastic lining, forms a tight joint when held up by a weight which is detachably connected with it.

Improved Wheel.

Henry Gwynn, Baltimore, Md.—This invention relates to certain improvements in wheels, and it consists in a socket plate cast in one piece with the shell or hub, and having triangular sections, forming sockets which are deepest and widest at the point where the spokes are introduced, in combination with an annular plate and nut, and the spokes having inclined ends and sides.

Improved Cultivator.

James M. Holladay, Twyman's Store, Spottsylvania county, Va.—This invention relates to certain improvements in cultivators, and it consists in the peculiar construction of right angular standards in combination with a metallic frame of double bars and break pins for fastening the said standards therein. It consists further in the peculiar construction of an adjustable bifurcated draft hook, and a brace on draft bar, in combination with the frame and standards.

Improved Stove.

Alexander Hamilton, Cresco, Iowa, assignor of one half his right to Aug. Beadle and Benj. Huntting, same place.—In this stove, straw, hay, or grass may be packed or compressed so as to burn slowly, and thus be profitably utilized as a fuel. Inside is a press follower adapted to be raised up to the top of the fire chamber, and receive fuel under it from a tubular feeder, and then be forced down on the fuel to press it into a dense mass. Shafts are provided for raising and lowering both the follower and the grate, and have a ratchet and pawl upon the outside of the stove to hold them at any required point.

Improved Child's Carriage.

Charles F. Lauer, Pittsburgh, Pa.—This invention consists of a front bolster for a carriage for children, having a vertical socket in the center with a coiled spring in it, contrived for affording the necessary elasticity for the easy working of the carriage, and also for allowing the necessary oscillation of the front axle for running over uneven surfaces. The sockets, together with the clips, embrace the axle and the arms for bolting the bolster to the frame pieces, and are all cast in one piece. The socket is so contrived that a single spring serves for affording the elasticity and for laterally supporting the body.

Improved Hod Elevator.

William Mullen, New York city.—This is a sliding elevator frame with top cross bar and lateral side arms, supporting, at suitable hight above the lower end of the sliding side bars, longitudinal connecting bars with forked and inclined hod-supporting pieces or carriers. The last are suitably concaved along the recessed parts for bearing the collars attached to the hod shanks, and admitting the ready swinging of the hods away from or on to the elevator frame.

Improved Heating Stove.

Edward E. Gold, Brooklyn, N. Y.—This is a fireplace heater adapted for use as an ordinary stove. The fire pot is surrounded by large vertical tubes extending through the top and bottom plate for heating air. A curtain extends from the top plate nearly to the bottom plate, between the tubes and the outside plate, for causing the heat to pass from the upper part of the fire space and the heating tubes, to which it first rises, down along said tubes to the bottom before escaping from them, so as to heat the tubes and the air passing through them. Said heater also has a wide open front, with sliding illuminated doors, whereby it can be used for an open or closed fire.

Improved Glass Furnace.

Samuel Richardson, Brooklyn, N. Y.—The two compartments of a double glass melting furnace are made in a single stack by separating the ordinary furnace with a double partition, with an air space for keeping one side cool while the other is hot. There is a passage through the floor of the oven to a pit below, for receiving the glass which escapes from the pots, and a passage in the floor leading to the pit. By making the furnace double, it enables the temperature in one part to be lowered greatly for tempering the melted glass suitably for working properly, while a higher heat is maintained in the other for melting the glass, thus enabling the melting to be carried on in one part while the working of the glass is going on in the other part.

Improved Whip Socket.

Henry A. Matthews, Waterbury, Conn.—This invention consists of spring hooks, combined with the socket, and contrived to hook it to the dash-rail detachably. The said hooks are made of double springs of flat metal attached to side of the socket.

Improved Watchman's Time Check.

Theodore Hahn, Stuttgart, Germany.—This invention consists of the arrangement of a dial in connection with a disk, rotated by the action of the keys at the various stations on a ratchet wheel at the underside of the same, to produce the forward motion simultaneously with the action of the keys on the spring-marking devices.

Improved Mechanical Movement.

Robert E. Brand, of Plainfield, N. J.—This is a mechanical movement by which rotary motion may be readily transmitted from the driving wheel of a machine to an upright shaft placed in position under any angle of the quadrant, for the purpose of being used in hat ironing, polishing, and similar machines.

Improved Apparatus for Loading Cars and Vessels.

George Barclay, Fayette, Mich.—In carrying the freight up an inclined plane, the forward wheels run from the machine on to a platform, while a raised or curved portion of the track prevents the rear wheels from following. When the truck reaches the top of the incline, the rope ceases to draw it forward, and after it is discharged the rope will tip down the back end to allow the forward wheels to regain the track.

Improved Machine for Rounding Leather.

Laken D. Williams, Bethel, Ky, assignor to himself and James E. Letton, same place.—One of the two standards is made low, and to it is hinged a bar, the ends of which are bent downward nearly at right angles to meet the ends of the posts. The other end of the bar is rabbeted upon both sides to form a tenon, which enters a vertical slot formed in a higher post, where it is secured by a key. The journals of an upper roller revolve in half bearings in slots in the bent-down ends of the bar.

Improved Windlass Water Elevator.

George G. Howe and Silas L. Heywood, Faribault, Minn.—The invention consists in a chain wheel, formed with a double rim, connected by cross bars, and having alternate high and low ribs or lugs formed upon its sides, and arranged in pairs, to give a zigzag direction to the chain. There is also a double pawl, arranged with a ratchet wheel attached to the shaft that carries the chain wheel, to cause the said pawl to be shifted by the tilting buckets. To the upper edge of the buckets is attached a metallic ring cap, to prevent the mouths of the buckets from being worn by the wire, and to cause said buckets to move more readily when being tilted.

Improved Railway Car Brake.

Moses P. Kimball, Randolph, Mass.—Two sleeves work loosely upon the axle. Upon one end of the sleeves is formed a part of a friction clutch, the other part of which is attached to and revolves with the axles. By this construction, when the sleeves are moved up to the clutch, they will be revolved by friction, and will wind up chains applying both brakes.

Improved Lock Spindle.

Albert Kirks, Canton, Ohio.—This invention is a combination of a spindle having a double conical form at or about the center, and recessed laminæ of the safe door with elastic packing rings, applied to said spindle on opposite sides of the point of largest diameter. This prevents breaking open the safe by introducing gunpowder in the door.

Improved Horse Hay Rake.

Samuel G. Hurlbut, South Union, Ky.—The heads, to which the spring tines are applied, are pivoted to a rock shaft, operated by a lever mechanism, so that the tines may be raised and the hay dumped by the driver. The rock shaft is provided with guide plates, so that the heads may be thrown to either side of the shaft. A stop flange, at the rear end of each guide plate, defines the angle of greatest inclination of heads and rock shaft, while a spring pin and hand lever, operated by the driver, locks in perforations of the guide plates and secures thereby the heads and tines at any suitable angle to the rock shaft.

Improved Nut Lock.

Finis L. Bates, Carrollton, Miss.—This nut has a screw thread which does not extend through the nut, but acts as a smoother to cut the outer threads from the bolt and bind the nut.

Improved Device for Multiplying Motion.

Francois Marie Eugene Heimer, Nancy, France.—This invention consists in a means for multiplying motion by utilizing the increased velocity of a secondary rotation produced in a sliding connection moving on one side in a guide attached to an actuating axis, and on the other in a guide at right angles to the first, upon an axis placed in a different plane from the first. The sliding connection is of such construction as to keep the two guides at the same angle to each other, by means of which the two guides revolve in the same direction with the same velocity. The connection also runs a circumference, the diameter of which is the distance between the axis of the two guides, and with a velocity twice that of the said guides and actuating shaft.

Improved Heel-Polishing Machine.

Charles H. Helms, Poughkeepsie, N. Y.—Upon vibrating a bar back and forth, arms are moved over the surface of an arch, which gives the polishers a corresponding motion on the heel. The heel is raised up to the polishers, when the shoe has been affixed to the slide, by means of a foot lever. The arch and arms are heated to a high temperature, and the polishers are raised to the desired temperature by heat conductors therefrom. The heel is held rigid while receiving the polish.

Improved Rock Drill.

William Hoar, Floyd, Iowa.—The main portion of the drill is attached to the shank by means of a socket and screw. A section has a long mortise and a wing on each side, secured by a tenon, which extends half way through the mortise, and fills it in length and width. Through each of the wings are two mortises, which receive each a gib and key. The outer ends of these mortises are made angular, and the gibs are made to fit, so that they cannot work longitudinally when the keys are driven, while angular portions serve to hold the two wings together. The wings as well as the main part have each a cutting edge with right-angled lips.

Improved Ironing Machine.

George Francis Perrenet, Rockport, Tex.—The ironing board is arranged to reciprocate in ways, said board having one end connected by a chain to a drum, and the other end similarly connected to another drum. The chains pass over a guide plate, which keeps them from interfering with the driving shaft. These drums are mounted on a tilting frame. Stops alternately strike a lever on opposite sides, tilt the frame so as to bring first one pinion and then the other into connection with a spur wheel. The iron is connected to arms mounted on a post, so as to move up and down to some extent, and has a spring and a lever to pull it down and press it on the board, and also a cam lever, to raise it up and hold it by a button.

Improved Sewing Machine.

Chaim Groubman, Odessa, Russia.—The needle bars are connected with an actuating rock shaft by means of a wrist pin and vibrating arm, the latter having a slot in its free end in which the pin works. The object of the invention is to distribute the wear or friction incident to such connection of the needle bar and rock shaft arm over a larger surface, and to furnish a guide for the needle bar in its reciprocating movement. Two rectangular blocks are pivoted on the pin of the needle bar, one of which slides vertically in a groove of the head of the machine, and the other in the slot of the arm of the rock shaft.

Business and Personal.

The Charge for Insertion under this head is $1 a Line.

Answers to Correspondents

(1) C. C. asks: Is there any way to render silicate of soda insoluble, so as to resist the action of rain water? A. There is no known method for this.

(2) C. L. W. asks: What will neutralize the effect of nitric acid upon clothing? A. Aqua ammonia, if promptly applied.

Will two electro-magnets (the two unlike poles being opposite) attract each other with more force than one electro-magnet will attract a piece of iron with? A. No, if the other conditions are the same.

(3) C. D. asks: How am I to proceed to electroplate in iron? A. Use the protosulphate or neutral chloride of iron, with an iron electrode.

(4) T. B. C. asks: 1. Has a steam boiler ever been constructed so as to be heated by electricity? A. No. 2. My idea is to have coils of platinum wire traversing the boiler and attached to batteries of sufficient power to generate the heat. Is this practicable? Can sufficient heat be generated? A. Your idea is totally impracticable.

(5) W. M. asks: Can you tell me why the English telegraphs are run on the open circuit and the American on the closed circuit, and which is the most economical? A. The original telegraph in England was the Cooke and Wheatstone's needle telegraph, which was worked by reversals of the poles and necessitated the use of the open circuit, with batteries at each station. When the Morse came into use, they still adhered to the open circuit feature. In this country, the open circuit plan has been used quite extensively, and is still employed to work the duplex and quadruplex systems. The open circuit plan is the most economical.

(6) W. E. W. asks: How can I become a good practical architect? A. The best way is to serve a regular novitiate in the office of an architect of good standing, in which you will become acquainted with the requirements of the profession, and have access to his library.

(7) M. B. asks: 1. What would be the width of the torrid zone if the axis of the earth were inclined 30° instead of 23·5°? A. Sixty degrees. The sun's greatest declination is 23° 27′ 25″, and is diminishing ½ second annually. 2. We are situated at about 40° north latitude. As the sun never gets farther north than the Tropic of Cancer, why is it that the sun appears to rise north of us in the summer? A. At the summer solstice, in latitude 40°, the ecliptic meets the N. E. by E. horizon.

(8) C. H. A. asks: 1. How is the sphericity of the earth proved by the appearance of clouds on the horizon? A. Lines of true level are curved, and differ from straight sight lines of apparent level one eighth of an inch in a sight of one eighth of a mile. 2. How can it be shown by canal level? A. The dip of the horizon at sea when the hight of the eye is three feet is 1′ 42″; when the eye is elevated 17 feet, it is 4′ 3″.

(9) B. D. R. asks: 1. How many times does the strongest magnifying glass now known magnify? A. 100,000 diameters. 2. Could such a glass be used as ordinary eye glasses or spectacles? A. You can wear a pair of magnifying spectacles of about 3 inches focus. The microscope brings the object nearer to the eye than ten inches, its normal focal distance. A pin hole in a card, or a larger aperture holding a drop of Canada balsam, or a sphercule melted from glass thread, illustrates this.

(10) H. M. asks: When the air is perfectly dry and clear, is sound propagated farther than when moisture exists in the air? A. Yes.

(11) A. B. asks: 1. Is there any difference in the kind of electricity obtained from an electrical shocking machine, operated by a battery, and one composed of magnets which are turned by a crank? A. None. 2. Do they use a common glass plate or cylinder electrical machine for medical purposes? A. No. 3. Is a galvanic battery without any machine for shocking ever employed? I never could feel anything by simply using a battery. A. Yes; in some hospitals it is exclusively used. A battery of 100 Daniell's cells is employed. You would have got a shock if you had used a battery of a sufficient number of cells. 3. How is it that I feel a shock when I put the wires on the shocking machine, but not when I simply hold the wires from the battery without connecting with the machine? A. Because the passing of the current of low tension through the primary coil induces electricity of high tension in the secondary coil, from which you obtain the shock.

(12) S. E. S. asks: If I start from the equator and travel in a northeasterly direction, shall I finally arrive at the point from which I started? I think that if I kept any course except due east or west, I should finally reach one of the poles. A. You are right. In shaping a course, the middle latitude between two places is used to look for the difference of longitude, departure, course, and distance in the tables.

Where is the Puerco River? A. In New Mexico. It flows into the Rio Grande.

(13) E. W. asks: If I make a mark, at 1 o'clock by a correct watch, on a floor, where the shadow of the corner of a house falls, shall I have a standard to keep the watch correct by? A. The sun is right April 15, June 14, September 1, and December 24. Make a noon mark in the meridian and apply the equation of time from the *Nautical Almanac*.

(14) C. D. asks: How is asphalt pavement made? A. It is composed of broken stones, sand, and gravel, cemented together by tar, pitch, or bitumen.

How much pressure per inch is it safe to use in a boiler of two feet diameter, and 1-16 inch thick? A. About 25 lbs.

(15) B. F. asks: What is the highest temperature at which water will readily condense steam? A. At any temperature less than that of the steam, if enough water be circulated through the condenser.

(16) S. H. D. says: If you put a thermometer in an open vessel of water heated to the boiling point, it will indicate 212°. If it is in a boiler or other closed vessel, will it indicate more than 212°, provided you have heating surface enough, as in a boiler furnace? A. It can be made to give much higher indications, if the water is confined so that it can be converted into steam of greater pressure than that of the atmosphere.

MINERALS, ETC.—Specimens have been received from the following correspondents, and examined, with the results stated:

D. W. D.—It is impure brown sesquioxide of iron.—E. M. M.—Your specimen is graphite.—J. N.—It is iron pyrites.—M. S. W.—It is sulphuret of zinc, traversed by a thin seam of pyrites.—C. L.—It is gypsum.—J. W.—It is clay, with a small percentage of oxide of iron. It would make an inferior paint.—V. W. S.—It is a very difficult thing to answer such questions as yours, when a piece of something looking like dirt and of hardly the size of a three cent piece is sent. A piece of reasonable size should be sent, with some suitable explanations. The present so-called specimen is black and green sealing wax, mixed up with nitrate of baryta.—A reader sends two specimens, in an unlabeled pasteboard box. No. 1 is a silvery looking mineral, in fan-like needles, with a greasy feeling like soapstone. It is pyrophyllite, so called because when heated it swells out to many times its original bulk, forming small leaves. It is a silicate of alumina containing water. No. 2 is quartz sand mixed up with pebbles of brown oxide of iron. Some of the latter, of a cubical shape, have arisen from the alteration of the yellow sulphide of iron to the brown oxide.

J. A. C. says, in reference to an article on spontaneous combustion in hay: Some persons distribute salt plentifully throughout their hay when they pack it away, in order to make it more palatable to the stock. Cannot the salt be also suggested as a preventive of spontaneous combustion?—S. W. asks: Is the wood of the *bois d'arc* or Osage orange tree ever used in ornamental work?—T. McI. asks: Are there any wire swing bridges?—H. R. E. asks: How are dies, for making type, cut?—G. E. asks: How do pocketbook makers make the creases in the leather of pocket books and what kind of tool is used?

COMMUNICATIONS RECEIVED.

The Editor of the SCIENTIFIC AMERICAN acknowledges, with much pleasure, the receipt of original papers and contributions upon the following subjects:

On Ventilation. By C. A. W.
On Hydraulic Brakes. By W. M. H.
On the Phylloxera. By L. W. G.
On Dynamite. By H. C. R.
On Life Insurance. By B. F. R.
On a Hole through the Earth. By B. C.
On a Flying Machine. By L. M.
On the SCIENTIFIC AMERICAN. By E. G. F.
On Sun Spots and Comets. By J. W. F.
On Strange Forces in Nature. By G. W. R.
On Lacing Belts. By J. W. S.
On Cribbing in Horses. By B.
On Tempering Steel Tools. By T. D. L.
On a Cut Worm. By A. G. C.
On Phosphor Bronze. By J. A. B.

Also enquiries and answers from the following:

W. P. F.—C. E. M.—H. M. H.—S. D. G. N.—B.—B. H. F.—L. L. B.—G. E. W.—C. J. B.—W. H. H.

HINTS TO CORRESPONDENTS.

Correspondents whose inquiries fail to appear should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them. The address of the writer should always be given.

Enquiries relating to patents, or to the patentability of inventions, assignments, etc., will not be published here. All such questions, when initials only are given, are thrown into the waste basket, as it would fill half of our paper to print them all but we generally take pleasure in answering briefly by mail, if the writer's address is given.

Hundreds of enquiries analogous to the following are sent: "Where can the three cylinder engine be obtained? Whose is the best book-paging machine? Where can bookbinders' finishing tools be bought?" All such personal enquiries are printed, as will be observed, in the column of "Business and Personal," which is specially set apart for that purpose, subject to the charge mentioned at the head of that column. Almost any desired information can in this way be expeditiously obtained.

[OFFICIAL.]

INDEX OF INVENTIONS

FOR WHICH

Letters Patent of the United States were Granted in the Week ending

November 17, 1874,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

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Alarm signal, electric, Z. P. Hotchkiss	156,002
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Alphabet case, Baade & Sangster	156,868
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Bale tie, J. N. Smith	157,032
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Bed, bureau or dressing case, M. Crosby	156,986
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Shoe, gum, D. P. Dieterich	156,841
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Window frame, cellar, J. E. Gaylord	156,995

SCHEDULE OF PATENT FEES.

On each Caveat	$10
On each Trade mark	$25
On filing each application for a Patent (17 years)	$15
On issuing each original Patent	$20
On appeal to Examiners-in-Chief	$10
On appeal to Commissioner of Patents	$20
On application for Reissue	$30
On filing a Disclaimer	$10
On an application for Design (3½ years)	$10
On application for Design (7 years)	$15
On application for Design (14 years)	$30

CANADIAN PATENTS.

List of Patents Granted in Canada, November 18 to 25, 1874.

4,071.—S. H. Finch, New York city, U. S. Improvement in railroad switches, called "Finch's Railroad Switch." Nov. 19, 1874.

4,072.—E. Beard, Chicago, Ill., U. S. Improvement on a machine for nailing boxes, called "Beard's American Box Nailer." Nov. 19, 1874.

4,073.—R. M. Evans, Buffalo, Erie county, N. Y., U. S. Improvements on the consecutive number printer, called "Evans' Number Printer." Nov. 19, 1874.

4,074.—J. F. Collins and J. W. Cumming, Montreal, P. Q. Improvements in the process of separating animal from vegetable matter, called "Collins' Patent Process for Separation of Animal from Vegetable Matter." Nov. 19, 1874.

4,075.—E. T. Ducharme, Montreal, P. Q. Improvements on automatic oil cans, called "Ducharme's Automatic Oil Can." Nov. 19, 1874.

4,076.—F. Proudfoot, Toronto, Ont. Improvements on stovepipe drums, called "Proudfoot's Heating Drum." Nov. 19, 1874.

4,077.—C. P. Chisholm, Oakville, Halton county, Ont. Useful plant box, called "Chisholm's Improved Plant Box." Nov. 19, 1874.

4,078.—S. P. Littlefield, Lynn, Mass., U. S. Useful way meter for railway carriages, called "Littlefield's Railway Carriage Meter." Nov. 20, 1874.

4,079.—E. Leonard, London, Ont. Improvements in stills and on process of distilling petroleum and other fluids, called "Leonard's Perpetual Still." Nov. 20, 1874.

4,080.—G. S. Bruce, Cincinnati, O., U. S. A coal box, called "Bruce's Improved Coal Vase or Box." Nov. 20, 1874.

4,081.—R. T. Booth, Trumansburgh, Tompkins county, N. Y., U. S. Improvements on automatic gas light extinguishers, called "Booth's Automatic Gas Light Extinguisher." Nov. 20, 1874.

4,082.—A. Eames, Bridgeport, Fairfield county, Conn., U. S. Improvements on machines for molding patterns, called "Eames' Molding Machine." Nov. 25, 1874.

4,083.—L. Prentice, Montreal, P. Q. Improvements on cigar molds, called "The Dominion Cigar Mold." Nov. 25, 1874.

4,084.—J. Higginbotham, Toronto, Ont. Improvements on a machine for washing, called "The Eclipse Washing Machine." Nov. 25, 1874.

4,085.—N. W. Simons, Ashtabula, Ashtabula county, O., U. S. Improvements on harness holdbacks, called "Simons' Improved Harness Holdback." Nov. 25, 1874.

4,086.—E. Horton, Hartford, Hartford county, Conn., U. S. Improvements on machines for reaping and binding grain, called "Horton's Reaper and Binder." Nov. 25, 1874.

Advertisements.

Back Page - - - - - - - $1.00 a line.
Inside Page - - - - - - - 75 cents a line.

Engravings may head advertisements at the same rate per line, by measurement, as the letter press. Advertisements must be received at publication office as early as Friday morning to appear in next issue.

NOTICE.

TO THE BUILDERS OF HYDRAULIC POWER PUMPING MACHINERY.

Sealed Proposals for the construction and erection of Hydraulic Power Pumping Machinery will be received by the Board of Water Commissioners of the village of Peekskill, N. Y., at their office in said village, until the FIRST DAY OF JANUARY, 1875. The Commissioners reserve the right to reject any or all proposals.
Specifications and further information can be had upon application to C. E. FOWLER, C. E., Peekskill, N.Y.

R. R. Finch, Chas. F. Southard,
G. T. Sutton, Wm. S. Tompkins,
George W. Robertson,
Board of Water Commissioners.

Dated Peekskill, Nov. 19, 1874.

Advertisements.

Back Page . . . . $1.00 a line.
Inside Page . . . . 75 cents a line.

Engravings may head advertisements at the same rate per line, by measurement, as the letter press. Advertisements must be received at publication office as early as Friday morning to appear in next issue.

PROPOSALS FOR CONVICT LABOR.

Agents' and Wardens' Office, Sing-Sing Prison, November 18, 1874. Pursuant to a resolution of the Board of Inspectors, sealed proposals will be received by the undersigned, at his office, Sing Sing Prison, up to the 3rd day of December, 1874, at noon, for the labor and services of five hundred (500) male convicts confined in this prison, to be employed in the Laundry business, to commence on the 1st day of December, 1874, for the term of five years (5).

Also, proposals for the labor and services of Fifty Male Convicts confined in this Prison, to be employed in the manufacture of Brooms, for the term of 5 years.

Also, proposals for the labor and services of Fifty Male Convicts confined in this Prison, to be employed in the manufacture of Wooden Ware for the term of five years (5), to commence on the 1st day of December, 1874.

Also, proposals for the labor and services of Fifty Male Convicts confined in this Prison, to be employed in the manufacture of Machinery for the term of five (5) years, to commence on the 1st day of December, 1874.

Also, proposals for the labor and services of Fifty Male Convicts confined in this Prison, to be employed in the manufacture of Cigars for the term of five (5) years, to commence on the 1st day of December, 1874.

With such labor and services will be furnished shops and premises in the Prison Yard. No Hydraulic, no steam power or Machinery will be furnished with such labor and services. The use of the Croton Water will be allowed at a reasonable rate.

Proposals for the labor and services of Male Convicts to be employed in the Laundry Business must be addressed to the undersigned, marked: Proposals for the Labor and Services of Male Convicts to be Employed in the Laundry Business. And each of the other proposals must be addressed in like manner and specify what the services are required for.

Blanks for such proposals will be furnished by the Clerk of this Prison to any person applying therefor. They must be accompanied by the written consent of the persons to become sureties in the said Contract, and they must have annexed a justification of the sureties in a sum not less than five thousand dollars, as provided by Section 9, Chapter 451, Laws of 1874. No proposals will be entertained which offer more than one price per day; and the right is reserved to the Inspectors, with the assent of the undersigned, to reject all or any of the proposals made, if they shall deem it for the interest of the State so to do.

ALFRED WALKER, Agent and Warden.

THE "Scientific American" is printed with CHAS ENEU JOHNSON & CO.'S INK. Tenth and Lombard Sts., Philadelphia and 59 Gold St., New York