SCIENTIFIC AMERICAN

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A NEW LIGHT DRAFT PROPELLER.

The principal demand which ship constructors find themselves called upon to meet at the present time is for small swift screw propellers. Pleasure vessels of this description have been constructed in large numbers both in Europe and in this country; and the speed obtained, through the progress made both in modeling the hull and in fitting thereto engines of maximum power yet of most compact form, is certainly remarkable when the small size of the craft is considered. The success thus attained has suggested the possibility of securing like qualities in the medium-sized vessels used for commercial purposes, thus bridging over the gap between the light and fast screw steamer and the small steam yacht, which hitherto has formed the stronghold of the now fast disappearing paddle wheel. The vessels occupying this intermediary position include ferry boats, river steamers, coasters, and the like, the first necessity in which is light draft of water, a cardinal requirement which, when the large carrying capacity and other requisites are considered, at once militates against the use of the screw. It will be seen, therefore, that the problem of a light draft screw steamer is by no means an easy one to solve; but on the other hand, the advantages to be gained by its solution are amply sufficient to warrant thorough study and investigation. That such a course will in the end lead to the desired result is clear from the fact that we are now enabled to lay before our readers one interesting instance of a vessel constructed under the required conditions and meeting all the requirements of actual usage in a thoroughly satisfactory manner.

The Geneva—represented in the engraving—has recently been built for the Kingston and Cape Vincent (Canada) Ferry Company, by Messrs. George Chaffey & Brother, of Portsmouth, Ontario. The depth of water of Lake Ontario, between the above named points, is such as to necessitate a light draft vessel; and at the same time a craft sufficiently fast to beat the best boat in the Company's service was demanded. The general dimensions laid down were as follows: Length over all 103 feet, beam on deck 20 feet, draft forward 3 feet 6 inches, aft 4 feet 4 inches. The vessel accommodates on her forward deck fifty head of cattle, and in her cabins and on the upper deck four hundred passengers. The high pressure engine, also built by the same firm, is of the ordinary type of inverted single cylinder, 14x13 stroke, constructed in the lightest manner consistent with strength: the rods, crosshead, and shaft being of steel. There is a return tubular boiler entirely of Lowmoor iron, 9 feet 3 inches long by 9 feet in hight and 5 feet in diameter, containing 157 return tubes, each $2\frac{1}{2}$ inches by 7 feet long. One and a half tuns of anthracite coal is consumed per 100 miles run. This is the average consumption for the season, and is very small considering that the fires are kept in night and day, and that the cabins are heated by steam from the boiler. The propeller is a Chaffey wheel, 4 feet 4 inches in diameter, with 7 feet 6 inches pitch.

On the trial trip over a measured distance of $2\frac{1}{4}$ miles, the Geneva ran at the rate of 14·2 miles per hour, the engine making 208 revolutions with 100 lbs. of steam. She is now capable of running 15 miles per hour, and has beaten, we are informed, the fastest boats in the vicinity by over two miles per hour, despite the fact that, for the latter, speeds varying from 16 to 18 knots are claimed.

The lines of the Geneva's model are of great beauty. A noticeable fact is that, while running at the hight of her speed, the vessel does not change the water line to any appreciable extent, but maintains the same trim as when at rest. This is remarkable, inasmuch as screw steamers ordinarily, when running at high speeds, settle aft, while many present the appearance of moving up hill.

The builders above named have already achieved considerable reputation for their steam yachts and pleasure vessels, all of which are notable for speed and beauty of model. Parties interested in the improved construction illustrated in the case of the Geneva may obtain further particulars by addressing Messrs. Chaffey & Brother, as above.

English Fire Engines.

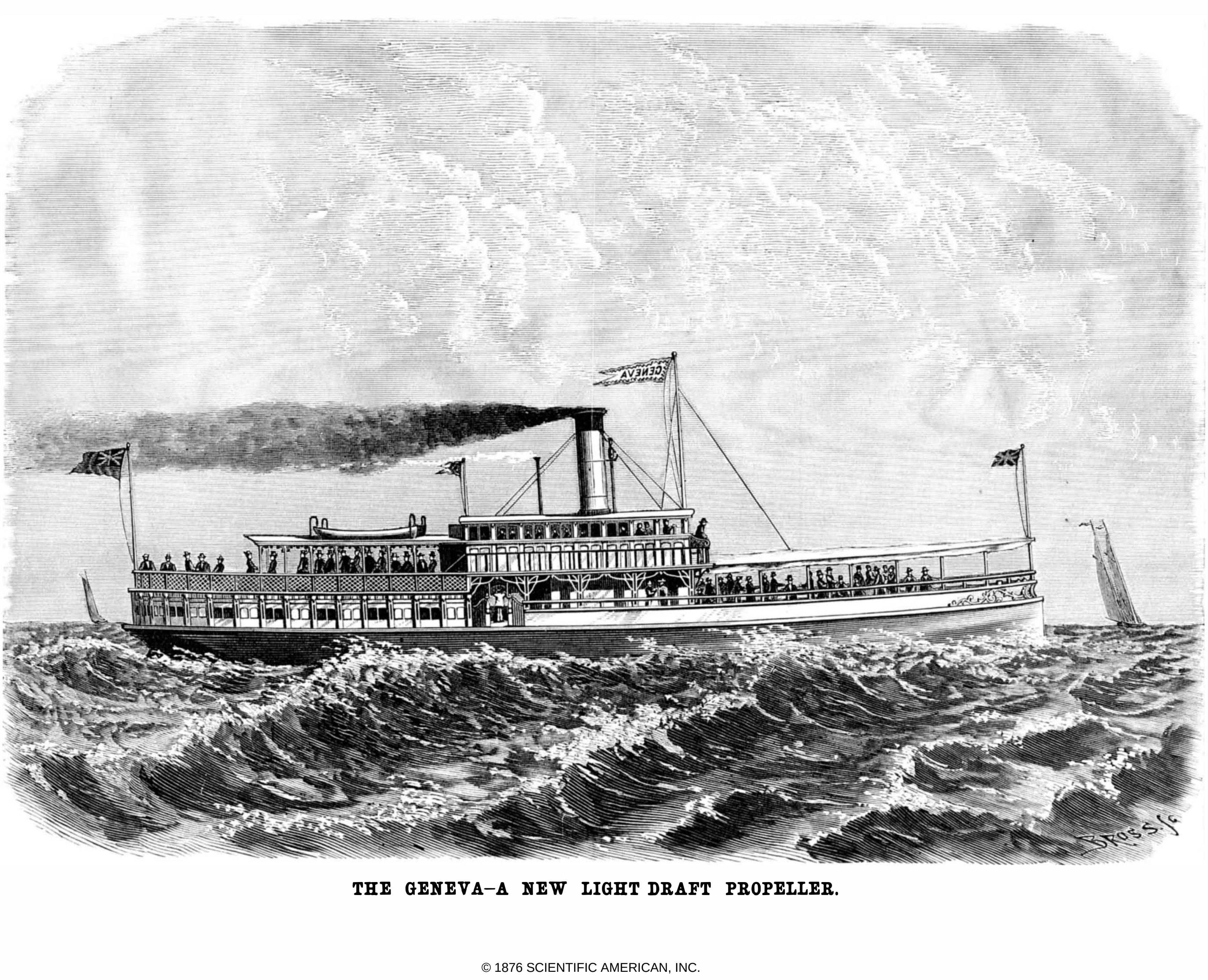
A series of trials of Messrs. Merryweather & Sons' new steam fire engine lately took place at Devonport Dockyard, the Admiral, Superintendent, and several heads of the various departments being present. The engine being placed along side the basin, and four lengths of suction pipe connected, a most severe test of raising the water through this vertical lift (32 feet) was satisfactorily accomplished. Steam was raised to 40 lbs. pressure in $5\frac{1}{4}$ minutes, and to 120 lbs in 11 minutes. Two jets of water, $1\frac{3}{4}$ inch in diameter, were thrown through 200 feet of hose to a vertical hight, estimated at 170 feet, with a mean water pressure of 100 lbs. on the square inch. After pumping sea water, the engine was then removed to take its supply from the dockyard fresh water service. Several interesting tests took place, one notably being that a 2 inch solid jet of water was projected over the various buildings.

Mr. Thomas Fearn.

The Birmingham (England) *Gazette*, announcing the death of Mr. Thomas Fearn, says: "Mr. Fearn may be said to have been the inventor of the process known as electro-metallurgy, the patent for which he disposed of to the Messrs. Elkington, and which he was instrumental in introducing to every part of the Continent. He studied at the Queen's College, Birmingham, afterwards at Paris, and for some time was a distinguished pupil of the well known German chemist, Dr. Liebig, with whom he formed a lasting friendship He was well known to the leading electro-metallurgists of Paris, Vienna, Berlin, and Cologne, and in Birmingham his society was courted, not only for his bright and far-reaching intelligence, but for his kindly and unostentatious geniality."

San Fernando Tunnel.

The tunnel through the San Fernando mountains has just been completed, and is worthy of notice, as it is by far the largest on the Pacific coast. Its length is 6,966 feet, while the longest tunnel on the Central Pacific Railroad, in crossing the Sierra, is not over 1,200 feet. It is not two years since the first borings were made, and since then many unforeseen difficulties have had to be encountered. From the character of the rock and the enormous pressure upon the timbers placed as supports, the tunnel will have to be lined with strong masonry throughout.



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(Illustrated articles are marked with an asterisk.)

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With 43 Figures.

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PROFESSOR HUXLEY'S MISTAKE.

It now appears that Professor Huxley made a grave mistake in giving such prominence to the Miltonic hypothesis of creation in his Chickering Hall lectures.

To say the least, it was a sheer waste of time and effort, and many aver that it was something a good deal worse: indeed, that he might just as appropriately have spent the time arguing that the moon is not made of green cheese, or that the world is not flat, or in discussing any other childish or antiquated notion, since not one of his audience ever dreamed of entertaining Milton's absurd six-day theory, which every American school boy knows to be inconsistent with the commonest facts of geology. More than one of our thoughtful journalists and clergymen have resented, as almost an insult to the intelligence of our people, the idea that a man of Professor Huxley's reputation should presume to discuss a topic like evolution, before such an audience as was gathered in Chickering Hall, in so trifling and elementary a manner—shirking, or at least shunning, the grand philosophical and moral questions involved in the evolution of protoplasm, apiarian politics, the missing link, monkey's ears, the human soul, and such things. It was altogether an insult, they make no bones of asserting, for Professor Huxley to insinuate, as he did, that Milton's purely imaginative description is commonly accepted in any literal sense as a true account of the manner in which plants and animals came into being.

It looks that way, we must confess; still we cannot bring ourselves to believe that Professor Huxley really intended to insult us. At the worst, it was a mistake, grievous, to be sure, but unintentional: a result, doubtless, of what certain of the daily papers have so pertinently described as "Professor Huxley's habit of generalizing from insufficient data." He had heard of Bishop Coxe, and, so he said, had conversed with some one who insisted that fossils were put into the rocks by the Creator to test our faith; and with characteristic haste, he jumped to the conclusion that all American Christians, or at least the greater part of them, were equally ignorant of right views of geology, the origin of species, and such matters. Had he remained to see and hear the outburst of indignation from pulpit and press which his blunder provoked, he would have returned to his native land, we fancy, much less satisfied with the course he had adopted.

We have just been looking over a considerable pile of the religious papers of last week, to see their comments on the lectures, and we are sure that Professor Huxley would be surprised to witness how generally and how vigorously they repudiate the Miltonic hypothesis. Now and then a belated sheet stands up for it, figuratively speaking; but the majority stoutly put it aside with scorn, and profess that evolution—or, as the favorite phrase runs, "a modified form of evolution"—is not only perfectly reasonable and scriptural, but a theory which they have cherished for years and years! And we sincerely trust that the publishers of all those papers have taken pains to send copies of them to Professor Huxley, that he may be speedily apprised of the grossness of his misapprehension of the intellectual attitude of the American people.

For example, the broadly undenominational *Christian Union*, speaking of the present order of Nature, remarks: "If Mr. Huxley's object was to illustrate the truth that evolution has performed an important part in producing that order, he has admirably succeeded. But that is a truth which no well informed person in America doubts. The mythical Pennsylvania Dutchman, who still votes for Andrew Jackson and believes that the sun goes round the world, probably supposes that the Universe was created in a week beginning on a Monday morning, January 1, 6,000 B. C. . . . . But no one of the exceptionally intelligent audience which listened to Professor Huxley's arguments, and few, if any, who read them, entertain the Miltonian theory of creation."

Here we have not only a positive rebuttal of Professor Huxley's insinuation, but one carrying beautiful internal evidence of its truth. The writer—doubtless one of the younger members of the *Christian Union* staff—so far from holding that anciently exploded theory, has never learned (or has forgotten) that, according to it, the proper date of creation is, or used to be, not the year 6,000 B. C., but B. C. 4,004!

But, it may be objected, the *Christian Union* is Mr. Beecher's paper; and Mr. Beecher has always been regarded by the strictly orthodox as a trifle unsound on some points. Well, then, take the intensely evangelical *Christian at Work*, whose vivacious editor, the Rev. T. De Witt Talmage, as everybody knows, is nothing if not sound. The *Christian at Work* reprovingly assures Professor Huxley that "it was not at all necessary for him to cross the ocean to demolish a poet's fancies about creation—theories largely imaginative and not consistent with the record in Genesis, and which neither are nor have been held for a century."

That is certainly decisive, though, like most of Mr. Talmage's utterances, it is a little loose in the joints and a trifle extravagant. Our recollection does not cover nearly a century, yet we distinctly remember having been taught precisely that account of creation, order, time, and all, while at school: and to make sure, we have taken pains to hunt up the remains of our old school geographies and histories, wherein we find the Miltonian story set down with great explicitness. We would not presume to say, however, that such absurdities have been imposed upon credulous children of late years.

One more witness against Professor Huxley is all we have space for, and one will suffice. As the evangelical side of the Protestant community has been fully represented, we will take this time a representative of the other, or non-evangelical, side, the *Church Journal and Gospel Messenger*. This excellent paper grieves bitterly over Professor Huxley's unfairness in giving his hearers to understand that the Miltonian theory is generally received among Christians at the present day. On the contrary, "the position he attacks is not the educated Christian's position at all. And Dr. Huxley very well knows it."

It may be so: yet charity to the absent compels us to presume that Professor Huxley was ignorant rather than malicious or purposely unfair. Evidently he did not know how rapid has been the progress of sound knowledge on this point among our people. It is truly humiliating, none the less, to think that he could have spent so many weeks among us, and go away at last laboring under such a grave misjudgment of our intelligence. We fear his associations here were hardly what they ought to have been.

Since writing the foregoing, we have been thinking the matter over, and it has occurred to us that, may be, this mistake of Professor Huxley's—annoying as it has been for the moment to us, and must be sooner or later to him—may after all be useful in calling out a general expression of opinion, and so serving to emphasize, as nothing else could, the progress we have been making toward juster views of the origin of things. We believe it was Agassiz who first observed that all great truths have to go through the same course of treatment on the way to popular acceptance. First, they are denounced as false and subversive of religion. Next, they are admitted to be probable, but not proved, and of little account either way. Finally, they are just what everybody has always believed. Evolution, it would seem, has pretty nearly arrived at the final stage.

THE ADVANTAGES OF CHEAP PATENTS.

After paying a high tribute to American Science and Art in his address, as President of the Mathematical and Physical Section of the British Association, Sir William Thomson said, speaking of the Centennial:

"I was much struck with the prevalence of patented inventions in the Exhibition; it seemed to me that every good thing deserving a patent was patented. I asked one inventor of a very good invention: "Why don't you patent it in England?' He answered: 'The conditions in England are too onerous.'

"We are certainly far behind America's wisdom in this respect," Sir William continued. "If Europe does not amend its patent laws (England in the opposite direction to that proposed in the bills before the last two sessions of Parliament), America will speedily become the nursery of useful inventions for the world."

Sir William Thomson is a clever inventor as well as an able mathematician and scientist. His apparatus for deep sea sounding with pianoforte wire, for example, has given immense help to that sort of investigation, and promises to be of not less advantage to commerce generally. And it was his galvanometer, we believe, which enabled the electricians to demonstrate, at Hallett's Point, the perfection of the battery connections intended for the instantaneous firing of the enormous mass of explosives distributed throughout the great mine: an experiment even more impressive, when rightly understood, than the final blast. As an inventor, he appreciates the importance of encouraging inventors; as a patentee, he knows that the protection which a patent gives an inventor is at once the cheapest and the most effective encouragement that his country can offer him.

America is, or is rapidly becoming, the nursery of useful inventions for the world, not because we are by nature more inventive than other men—every nationality becomes inventive the moment it comes under our laws—but simply because the poorest man here can patent his devices. And it does not matter how simple the contrivance may be, provided it is new.

In the aggregate the little things—which in England or on the continent either could not be or would not be patented, owingto the excessive cost of the papers or other onerous conditions—probably add more to the wealth and wellbeing of the community, and more to the personal income of the inventors, than the great things do. And very frequently the profit derived from some simple contrivance gives an inventor the independent time and the money required for the development of inventions which he could not otherwise dream of undertaking.

A striking illustration is furnished by the experience of the inventor of what is generally admitted to be the greatest advance made for many years in the art of weaving, the Lyall loom. During the war he invented and patented a simple compound for waterproofing textile fabrics. It was largely used, and brought him a generous revenue. We would not say that his valuable loom would not have been invented except for the fortune which the previous invention brought him; but it is very doubtful if he would otherwise have had the means for completing the work, even if he had had the will to do it. Without the encouragement of low patent fees in the first place, it is altogether likely that he would never have become a practical inventor at all.

Another illustration of the very great importance of some little inventions is found in the galvanometer already alluded to. It saved the first Atlantic cable from being a complete and utter failure, and so demonstrated to the world the grand fact that submarine telegraphy through long distances was not chimerical: yet it consisted essentially of nothing more than a slender magnetic needle, three eighths of an inch long, carrying a circular mirror about a quarter of an inch in diameter, the whole—weighing a grain and a half—being suspended by a film of silk. Without this prompt and acutely sensitive little indicator of electric disturbance, telegraphing through great lengths of submerged wire would have been practically impossible, owing to the length of time required for each signal wave: and it is not at all unlikely that, had Sir William's invention not been on hand in the nick of time, the Atlantic cable would not only have been abandoned as a hopeless failure, financially considered, but capitalists would have declined to sink any more money in that sort of enterprise. But its usefulness did not end there; it has since been and must ever continue to be of the utmost importance in ocean cabling, and in all important electrical operations on land, whether practical or purely investigative.

THE SPIRITUAL SLATE.

These are sorry days for spiritualists. Scarcely a week passes but some shining light in their troubled world is shattered, some "unimpeachable" instrument of the spirits and mediator between poor humanity and the angelic hosts is detected in vulgar trickery. And what is more discouraging, disaster seems ever to press hard upon delusive triumphs.

The latest misadventure is one of the saddest. Just when, by a clever trick, the subject had been sprung upon the British Association, and the champion performer and wonder worker of the sect, Dr. Slade, had been advertised beyond precedent, a mousing zoölogist plots with a friend of like character, and the result is

"One more triumph for devils and sorrow for angels,"

one more opportunity for the unbelieving to wag their heads, and cry—Next!

The story of Dr. Slade's experience in this country and in England is an interesting one; and as the English papers have lately been much occupied with his exploits, his downfall is more than ordinarily significant. Most of our readers have doubtless heard of his method, which is specially his own. He takes a slate—that is, he used to take a slate, and very likely still does the same, exposure being no bar to confidence on the part of the faithful—he takes a slate, wipes it clean, puts a bit of pencil on it, then places it under a table, on the questioner's head, behind his back, or elsewhere, and straightway a scratching sound is heard, and in due time a more or less clearly written message is produced: fee five dollars.

Everything appears to be frank, honest, and above-board, also very mysterious and altogether inexplicable, most observers declared, except on the hypothesis of "spirit" intervention. But there was one circumstance that the sceptical did not like the look of. It was a common thing for spiritualists to claim that they had known the spirits to write for Dr. Slade on the inside of a double slate when the two leaves were securely fastened together. But when an unbeliever offered such a test, the honest Doctor would candidly express his doubts of success; the conditions of the ordinary *séance* were exacting enough, he would say, and the intelligences which governed him would have nothing to do with locked slates, or the chemically prepared or otherwise doctored slates which too particular Yankees frequently brought him. Wary intelligences! and eke with tender sensibilities!

Nevertheless they have come to grief. One object of the paper read before the biological section of the British Association was to secure the appointment of a committee to investigate spiritualism with the hope to bring its vagaries under the protecting wings of Science. Particularly, the "phenomena" developed in the presence and through the ministration of Dr. Slade were to be enquired into. The motion failed on account of the intolerance of certain bigoted scientists of the ungodly sort.

But the examination was made scientifically for all that—by Dr. E. Ray Lankester, F. R. S., and Professor of Zoölogy in University College, London, a gentleman well known to the reading public. Dr. Lankester visited Slade several times, and, like the venerable Dr. Carpenter, was "very much shaken" by what he saw. In fact he simulated considerable agitation and an ardent belief in the mysterious nature of what he saw and heard. All the time he studied Dr. Slade's performances closely, and at last he thought he saw through them. So he appointed another interview, and went for his friend Dr. Horatio B. Donkin, of Queen's College, Oxford, one of the physicians of Westminster Hospital, to whom he explained his hypothesis, and arranged for a demonstration of it next day.

The hypothesis was simply that Dr. Slade himself wrote the messages, which were of two sorts, one short and sprawling, the other long and with the characters well formed: the first Dr. Lankester believed were written with the finger of one hand as the slate was being held under the table, the second while the slate was resting on Dr. Slade's knee, concealed by the table, the operator being ostensibly engaged meantime in preparing the pencil for the "spirits" to write with, and so on. The test proposed was simply to seize the slate after it was cleaned and before it was put under the table—that is, at a time previous to its submission to the "spirits."

The thing was done, after two or three messages had been regularly received. With Dr. Slade's permission Dr. Lankester was to hold the slate under the table; instead, he accused Slade of having already written the expected reply, and on turning the slate over, found the charge sustained.

"To any one not predisposed to believe in spirit agency at all hazards," writes Dr. Donkin to the London *Times*, "this *séance* is sufficient." We have not the slightest notion, however, that Dr. Slade's standing among the mass of spiritualists will be affected in the least. It is said that, when the exposure was made, he simply remarked: "You see that you have been paid in your own coin: the spirits will not come to people without faith:" and all true believers will accept the saying as not only satisfactory but grandly heroic.

Verily Faith, even more than Charity, hopeth all things, believeth all things, endureth all things!

THE INTER-MERCURIAL PLANET.

Quite a stir has recently occurred in the astronomical world, owing to the famous French astronomer M. Leverrier having telegraphed to the various observatories in Europe and America that it was probable that the supposed inter-Mercurial planet Vulcan would traverse the sun's disk disk in October. M. Leverrier at the same time requested that astronomers would watch most carefully for the phenomenon, and this, it is hardly necessary to add, has been done. The result, however, is disappointing, as the planet failed to appear, and the doubt as to its existence remains as strong as ever, although, on the other hand, the possibility of there being such another world is by no means unreasonable. It will be interesting, therefore, in the present connection, briefly to review the magnificent labors of M. Leverrier, as an incidental portion of which the hypothesis of a planet, nearer the sun than Mercury, suggested itself to his mind. And these labors have earned for the distinguished scientist the title of the "weigher of worlds," for all the great orbs which circle about the sun have been gaged by him as accurately as if they had been placed in the scale pan of some stupendous balance.

The vast work which we are about to sketch began on September 16, 1839; it was substantially completed on December 21, 1875; and the fact was announced by M. Leverrier in person, at the session of the French Academy at the last mentioned date. Every schoolboy knows that the sun is the central ruler of our planetary system, and that his mass is so enormously in excess of that of all the planets taken together that he is capable of swaying their motion without being himself disturbed. So colossal is the sun's attractive force that the like force which the planets exercise upon one another becomes extremely small. The sun's power over Saturn is 250 times that of Jupiter, even when the planets are nearest together; and as there is no disturbance in the whole solar system greater than that resulting from the mutual influence of Jupiter and Saturn, it is unnecessary to proceed further to show the paramount rule of sun. But small as these influences are, we cannot neglect them, for were the planets ruled absolutely by the sun they would go on circling in the same orbits, changelessly and for ever. Now if we consider that the more massive the planet is, the more potently it will disturb its neighbors, it follows that, even if we cannot tell exactly how much this disturbance amounts to, we can tell how large the planet's mass is, compared, say, with the earth's. Thus we can consider how much Venus disturbs Mercury, and thus infer her mass, and a chance comet may be affected by Venus, enough to afford us means for another determination. If our results over several observations failed to agree, we should search why; we should assume an error, which must be hunted down: and thus we should be led to one of two things, either to find our mistake, or else to discover some fact, before unsuspected, which has, unknown to us, become a factor in our problem.

This is Leverrier's method of dealing with planets, in a nutshell. Seven planets were known when he began his work; and finding that the tables of their motions in common use failed to rigorously accord with results of observation, he began the gigantic and complicated task of unraveling all the forces which produce the planetary movements. We can no more than summarize his results. Beginning with the earth, he reviewed nine thousand distinct observations of the sun; and by carefully estimating the sun's apparent monthly displacement, he reduced the accepted estimates of the distance of our luminary by between three and four million miles. Then he analyzed the observed motions of Uranus, and here he made the grand discovery of the unknown factor above referred to, which in this case could be none other than another great planet, producing the unaccountable Uranian perturbations. Concerning a hypothetical planet, he calculated its position; and aided by the lucky circumstance that but a very short time had elapsed since Uranus and the new planet were in conjunction, on pointing his telescope to the supposed position, he found Neptune. This magnificent result, shedding of itself enough glory on the astronomer to render him famous for ever, was, as we have seen, but incidental to the whole work, which has likewise included analyses of the motions of Mars, influenced by the great asteroid ring, and of Mercury, which has resulted in the noting of the remarkable perturbations, which are only to be accounted for by the existence of some inter-Mercurial matter, or probably by the existence of the supposed Vulcan. To the latter view, M. Leverrier, arguing very justly from the analogies of the discovery of Neptune, inclines, and therefore he is constantly on the alert for any visible indication of the hypothetical planet.

In 1859 M. Lescarbault, a physician in Paris, announced that he had witnessed the black disk of an unknown planet cross the sun. Leverrier at once investigated the details of the observations, and, despite the fact that the instruments used were of the roughest description, deemed the proof adduced conclusive that the planet had been seen: but Liais, an eminent Brazilian astronomer, subsequently reported that, at the reported time of transit, he likewise was examining the sun's face, with a very superior instrument, and that no black spot was visible.

There are few other recorded instances up to the present time where Vulcan is claimed to have been seen. On August 28 last, M. Leverrier communicated to the French Academy of Sciences, a letter from M Wolf, a well known Swiss astronomer, in which Wolf said that Weber in Prussia had seen a black spot crossing the sun on April 4, last. On the following day, Wolf, Schmidt (an astronomer in Athens, Greece), and Weber had all examined the solar disk, and no spot was then visible. Weber, unfortunately, did not note the rate of progression of the spot, nor has any one yet been able to find a solar photograph made at any observatory on April 4, so that there is no primary and positive evidence that the phenomenon was Vulcanian. On the other hand, there is secondary evidence to the effect that the spot disappeared within twenty-four hours, and that the period when it was seen would be that of the 148th transit, dating from the observation of Lescarbault, the Vulcanian year being 42·2 days. This, M. Leverrier deemed sufficiently important to warrant his making the general request noted in the first paragraph of this article. The result being as stated, the question still remains open, with the probabilities in favor of the halo of meteoric matter which is constantly about the sun being the cause of the Mercurial vagaries.

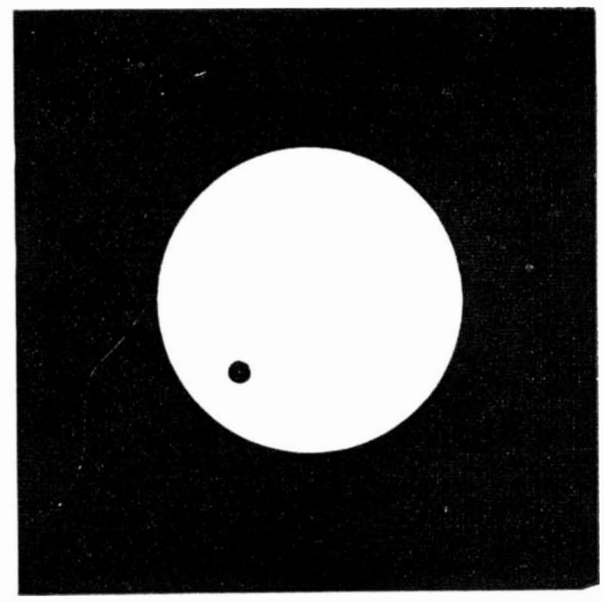
In this connection, however, the annexed letter of a correspondent details a phenomenon which is certainly worth considering.

To the Editor of the Scientific American:

The interest excited by the recent searches of the astronomers, for the supposed planet Vulcan, leads me to report to you the following observations made at Montclair, N. J.

On Sunday, July 23, 1876, at 3 P. M., I directed my telescope ($2\frac{1}{4}$ inch) towards the sun's disk in search of spots. As none had been seen for a considerable time previous, I rather congratulated myself on having at last found one, and on getting my instrument carefully focussed, was surprised to notice that, instead of the irregular, jagged form of common sun spots, this one was round.

It stood out on the lower left portion of the bright luminary, clear and sharp, as seen in the accompanying drawing.



Thinking that what I saw might be due to a defect in the lenses, I first rotated them in their tubes; but the round spot still kept the same place on the sun's disk. I then removed my object glasses, examined and cleaned them carefully. I did the same with my eyepiece lenses. On restoring them to their places in the tube, the same round body was still in view on the sun's disk. I called a friend to examine it with me. We studied it for some little time, until the clouds put an end to further observations. We concluded that we had chanced to hit upon a new kind of sun spot, perfectly round and black. We made no attempt to determine the motion of the spot.

A few days thereafter, on renewing my examination of the luminary, no spots were visible. B. B.

New York, October 4, 1876.

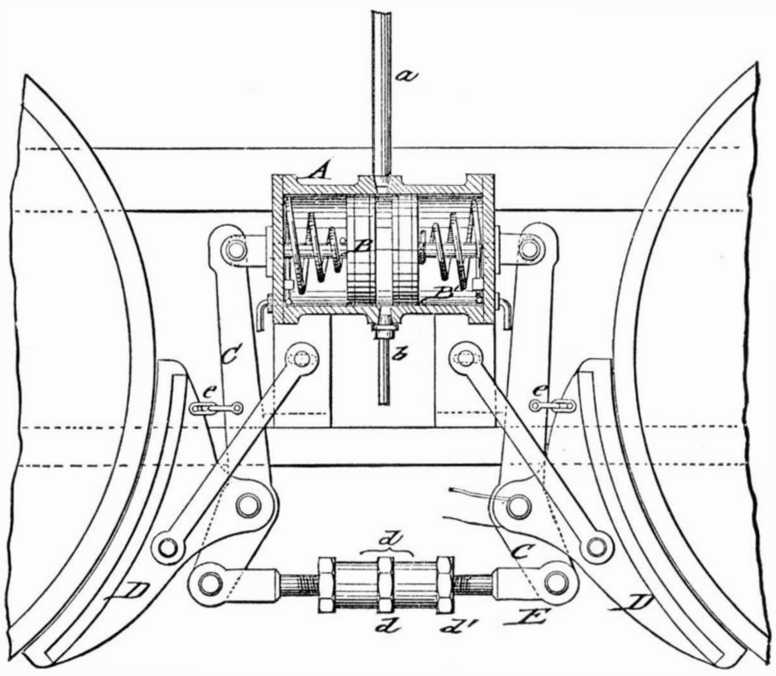
It will be perceived that the date of this observation is prior to the time when Weber's report was first brought to M. Leverrier's knowledge; and hence our correspondent had none of the present excitement to influence his imagination. Nor could the phenomenon have been due to a spot, for, as is well known, this is the minimum period of solar eruptions, and the sun's face has been spotless for many months; besides, spots never appear as black dots, but have clearly marked and unmistakable characteristics.

It appears further that M. Leverrier did not definitely designate October 2 and 3 as the epoch when the transit might occur. In his communication to Professor Watson of Ann Arbor, he specified October 9 and 10. Now M. Leverrier cites with details some thirty observations made by astronomers since 1750, and he selects data obtained in 1820 and 1856, and combines them with the recent results of Weber's observation. This leads him to conclude that the Vulcanian year is not 42·2 days, but 28·00774 days, and the motion of the planet is expressed thus: $V = 15{\cdot}2^{\circ} + 12{\cdot}85359^{\circ}\ (j - 1750)$ in which the first term is the longitude and j represents the number of days elapsed since 1750. The orbit is circular, the ascending node being at $+12^{\circ}$, and the descending node at 195. M. Leverrier now thinks that the transit will be visible on October 30. This date does not coincide with an even number of Vulcanian years of 28 days since our correspondent's observation. There is a discrepancy of two weeks; but on the other hand, there is an equal failure of coincidence with Weber's date, April 4.

Since writing the above, we have learned that still another astronomer is to be added to the list of those who have seen Vulcan. Rev. E. R. Craven, of Newark, states that the late Professor Joseph S. Hubbard repeatedly assured him that he had observed the transit of an inter-Mercurial planet. He was at New Haven at the time, and was using the Yale College telescope. The transit was an entire surprise, and hence no notes were taken.

IMPROVED LOCOMOTIVE AND CAR STEAM BRAKE.

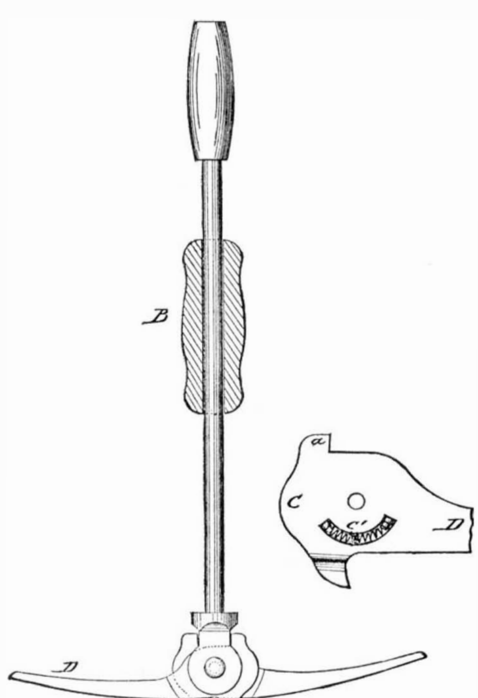
An ingenious brake mechanism has been devised by Mr. T. J. Shellhorn, of Marquette, Mich., and patented through the Scientific American Patent Agency, September 5, 1876. The steam cylinder, A, as shown in the illustration, is placed midway between the driving wheels of a locomotive or the wheels of a car truck. The steam is admitted to the cylinder by a pipe, *a*, entering midway between the cylinder heads, and acting simultaneously upon two pistons, B, that are arranged symmetrically in the cylinder, and acted upon by volute springs, B′, of considerable power. The steam pipe, *a*, is carried up the boiler head to the steam dome, and the admission and exhaust of steam is controlled by a three-way cock. A drip valve, *b*, is arranged at the bottom of the cylinder, A. The piston rods are pivoted at their outer ends to brake levers, C, which force the brake heads and shoes, D, against the driving wheels, the leverage being obtained by the fulcrum rods, E; said rods are pivoted to the lower ends of the brake levers, and connected by a sleeve or nut, *d*, with interior right and left hand screw threads, for the purpose of adjusting the levers, C, from time to time, as required by the gradual wear of the shoes, and also for providing for the distances between the driving and other wheels in different locomotives and cars. The right and left hand sleeve or nut, *d*, is held in stationary position by jam nuts, *d′*. The brake heads, D, are fulcrumed at some distance above the fulcrum rods to the brake levers, and further connected to the same at their upper ends by pivoted clearance links, *e e*. The links, *e e*, are intended for the purpose of carrying back the brake heads or shoes, with the brake levers, out of the line of friction with the wheels when the brakes are released. The release of the brakes is effected jointly by the exhaustion of the pressure in the cylinder, the action of the volute springs upon the pistons, and the gravitation of the brake heads. The brake levers, C, are not made straight, but with an obtuse angle, and formed by the heel or part below the fulcrum of the brake head with the upper part. By this means the strain of the wheels is thrown upon the top of the axle boxes instead of upon the sides.



SHELLHORN'S LOCOMOTIVE AND CAR STEAM BRAKE.

IMPROVED NAIL EXTRACTOR.

Mr. William H. Tinker, of Springfield, Mo., has patented through the Scientific American Patent Agency, August 22, 1876, an improved nail extractor, by which the nail is drawn with great facility without being bent, and which is illustrated in the accompanying engraving. B is a sliding handle weight, by which the jaws, C, are driven in the ordinary manner into the wood below the nail, to be then applied to the same by the double foot or leverage of the jaws. The jaws are fulcrumed to the lower part of the handle, and provided with symmetrically extending levers, D. that are opened by spiral springs, C′. The jaws, C, have shoulders, *a*, in the upper part, that come in contact with the handle or stock, A, and define the position of the levers. The double



leverage admits the pulling of the nail in two different directions without removing the instrument. This allows the withdrawing of nails from hard or soft wood in an easier manner without bending the nail, as the same may be first loosened and afterward extracted.

Capital and Labor.

Ask any economist, and he will tell you that capital is the accumulation of past labor, intended to move or assist labor, and that it is either a transient or a permanent assistance, the former requiring constant renovation, the latter being of an enduring character. Ask him what labor is, and he will tell you that it is the power which intelligence gives man over the properties of matter and life by which muscular effort can make matter useful. It will be added that this power which the laborer is able to exercise over matter may be either the direct action of the man, or may be indirectly exhibited upon certain inorganic and organic powers: in other words, that the workman may be plying his own muscles, or may be guiding animal power, or be using steam, wind, or any other natural motion which man is able to control and direct for his own ends. In technical language, economists speak of fixed and circulating capital, of muscular and nervous labor. All these definitions and distinctions, however, are not fundamental, but only denote tendencies under which the same facts appear in different forms, or in which one of the circumstances which accompanies the fact is exhibited in different degrees of intensity. Thus the labor of a manager is said to be nervous, that of a workman muscular. But unintelligent effort is of no avail, even for the commonest acts, nor can the sharpest intelligence give effect to its thoughts, except by means of muscular effort. No labor appears to be more characteristic of the brain than the thoughts of a poet or musician are, but both these personages must at least exercise the mechanical function of writing or speaking. Again, it is true that capital is the accumulation of past labor, embodied or condensed in material objects. With one exception, namely, land available for occupation or cultivation in densely peopled countries, there is no object whatever, which possesses value, that has not obtained its value by reason that labor has been expended on it. A sack of wheat, a bale of cotton, a barrel of wine,a wedge of gold, a house, or a spinning machine, possesses whatever value the market assigns to it by reason that labor has been expended on its production. It signifies nothing, from this point of view, whether the article is movable or has been gifted with qualities which cannot be recovered or resumed in their original form. In every case it is labor, and labor only, which confers on these objects those properties which economists recognise and comment on.—*Professor Thorold Rogers.*

The Electric-Harmonic Telegraphic System.

Although there has not been much said of late in regard to the electric-harmonic telegraph invention of Mr. Elisha Gray, constant progress has been made towards developing and perfecting it. Within the past year very important improvements have been made, which materially increase its value and reliability. Mr. Gray has been for several weeks past engaged in demonstrating the system on the wires of the Western Union Telegraph Company, and has certainly shown some remarkable results. On September 21, by invitation of that gentleman, we were present at an exhibition of it in the Western Union building, which was very successful. But one wire was employed,yet it required sixteen operators, eight at each end, to work this single wire. The wire employed was one of the Wes ern Union wires between this city and Philadelphia.

The most important improvement effec ed by Mr. Gray, since we last noticed his invention, is the successful duplexing of his apparatus, so that messages can be sent simultaneously from each end of the line. With the apparatus manufactured at the present time, four messages can be sent simultaneously from each end of the wire. Upon the occasion mentioned, four operators were engaged in sending and four in receiving, and the same number were similarly employed in the Philadelphia office at the same time on the one wire. Thus eight messages were being simultaneously transmitted and received, at a speed equal to that obtained in ordinary working of a single circuit on one wire, without the slightest interference with each other. The principle upon which this system is based is that of the number of vibrations required to give a musical tone. By very ingenious and simple apparatus, this principle is utilized for the transmission of telegraphic signals simultaneously on a number of circuits over a single wire. The receiving instrument, for instance, which is adjusted to receive the vibrations required to constitute the musical note represented by A, will pick up the signals sent by the corresponding transmitter, but it is not affected by those transmitted at any other pitch.

It is impossible to give a very satisfactory description of the system, apparatus, and connections, without diagrams. We propose, before long, to give a full and accurate description, with the latest improvements, properly illustrated of this system, which will doubtless be of great interest to all telegraphers. The importance of this invention can scarcely be overestimated. Although eight circuits only have been actually operated by it as yet, there seems to be no reason to doubt but that these may be increased, even to as many as thirty-two: that is, to as many as there are tones and semi-tones in the musical scale. It in fact already duplexes the quadruplex in actual operation, and is more reliable and less difficult to operate than the quadruplex. Mr. Gray has spent several years in developing and perfecting his invention, and there can be no doubt but that it is destined to play an important part in the telegraphy in the future.—*The Telegrapher.*

Our Silk Industry.

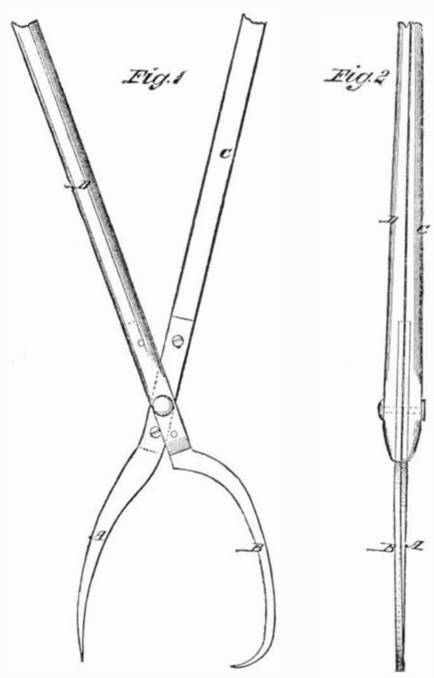
The English *Textile Manufacturer*, reviewing the progress of the silk industry in the United States, says that our manufactures of ribbons, etc., for 1875, were double those of 1874; and while other branches of industry were in a crippled state, the silk trade could offer occupation to a greater quantity of able regular workmen than usual, besides being able to afford higher prices. As characteristic of the increased activity of the manufacture in Paterson, N. J., last year, the immigration of English and French workmen is noted. The latter possess their own looms, which they take with them to work on their own account. The import of raw silk, in 1875, was 50 per cent greater than in 1874, and exceeded by 38,807 lbs. the corresponding exports of 1871: the amount in the latter year being the largest yet attained, except that in 1875.

Utilizing Unmarketable Cocoons.

Mrs. Bladen Neill, of London, England, has invented a new utilization of cocoons which are adjudged unfit for use in silk making, and has philanthropically turned her invention to such account as to make it the basis of remunerative labor for women. A certain proportion of every crop of cocoons is rejected, because, the chrysalis having become matured, the moth has made its escape, and thus the filaments at one end of the cocoons are cut through. The continuity of the thread being broken, it loses its value and is useless for reeling. Mrs. Neill sends to various parts of the world and gathers these faulty cocoons, boils them, and reels off the fragmentary filaments. These are sent to the spinners and made into a handsome silk yarn, which is dyed as required, and the material is sued to poor women who convert it into knit goods. The fabric thus produced is of such excellent quality that the demand already has far exceeded the supply.

A NEW FODDER FORK.

Mr. William M. Scotten, of Hall, Ind., is the inventor of an improved fodder fork, patented through the Scientific American Patent Agency, August 8, 1876. The object is to enable the substance to be firmly grasped and securely held while being handled. A and B are the two prongs or tines of the fork, which are pivoted to each other at their bases.



The prong, A, is slightly bent; and the prong, B, is made longer, and its point is bent inward into hook form, so that when brought together the points of the two prongs may meet. To the shanks or bases of the prongs, A B, are attached the handles, C D, which are made half round, so that when brought together they may form a round handle, as shown in Fig. 2, and so that the gripe upon the said handles may hold the prongs together. In using the fork, the prongs are opened, as shown in Fig. 1; the prong, A, is then thrust into the load, the hook prong, B, is closed upon it, and the load is taken to the desired place.

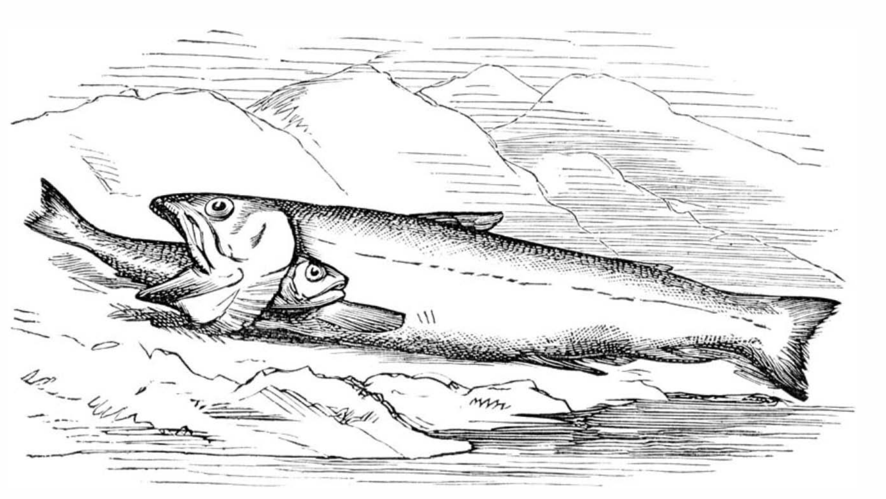
THE American Fish Commission recently held a convention in the Maryland State building in the Centennial grounds, at which Professor Baird stated that 8,000,000 young shad and 8,000,000 young salmon have been distributed in this country in the past year, and 600,000 eggs sent abroad. Mr. Livingstone Slone has just brought 4,000,000 salmon eggs from California.

SINGULAR ACCIDENT TO A TROUT.

The trout shown in the accompanying engraving was recently captured in England, having come to an untimely death. Mr. Frank Buckland, the indefatigable naturalist who edits *Land and Water*, states that the trout was found lying dead, on its back, with a dace fixed tight in its gills, and further says:

"The only interpretation that I can give of this accident is that the trout had rushed at the dace to eat him, and, seizing him by the head, had attempted to swallow him; the dace, objecting to this process, and possibly knowing by instinct that if he got into the trout's stomach he would never return therefrom alive, fought hard for his life; and seeing a possible way of escape through the aperture of the gills, he used his best efforts to pass through: fate, however, was against him, and the unfortunate dace became wedged among the gills of the trout, and both fish thus perished.

"When we consider the delicate structure of the swallowing apparatus in all animals, ourselves included, it is really wonderful that more accidents by choking do not take place. In our own persons the apparatus for preventing accidents of this kind are, indeed, most marvellous. The trachea or windpipe is situated immediately in front of the œsophagus, and every morsel of food and fluid we swallow has to pass over the opening of the trachea, which is in fact not unlike the slit of a money box, before it can get into the œsophagus or gullet. The pain and irritation caused by even a crumb or a drop of water getting by accident into the trachea is very great. We cannot, therefore, sufficiently admire the wonderful valve which the Creator has placed upon the top of the trachea. The valve is self-acting, and luckily for us does not depend upon any volition of our own. If it were not so, a person's whole time might be taken up in watching every morsel of food he put into his mouth. By a beneficent arrangement, the act of swallowing is quite as independent of the volition of ourselves as is the action of the heart, the power of thought, and the machinery of the human system in general. The same state of things that is found in the structure of the inhabitants of the land prevails also in the structure of the creatures which live in the water, and among them, as among land animals, an accident is very rare; the above drawing is therefore the more interesting, inasmuch as it shows that even fish are sometimes choked by the living prey on which they subsist."



A TROUT CHOKED BY A DACE.

Correspondence.

The Tripartition of an Angle.

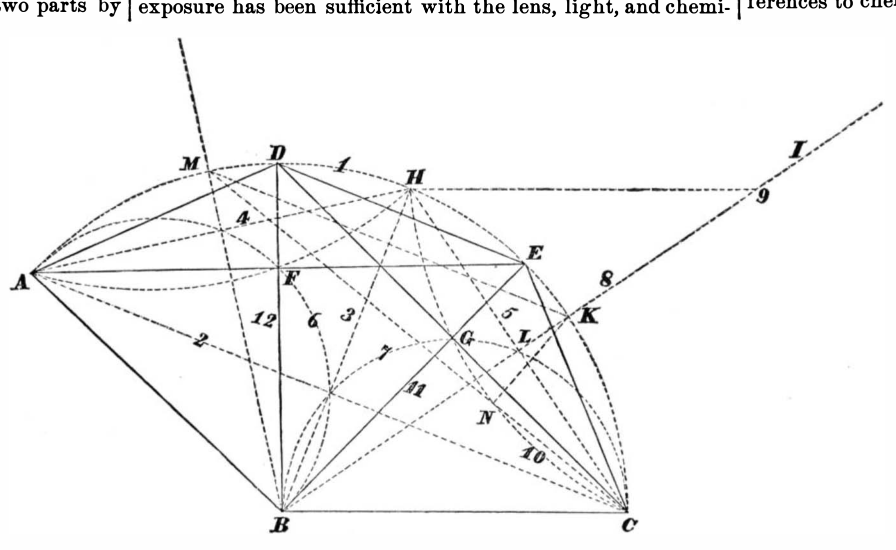
To the Editor of the Scientific American:

Dividing an angle in two parts is one of the easiest operations in geometry; but the division of an angle into three equal parts is considered a difficult and an impossible one.

Let it be supposed that the angle, A B C, is divided into three equal parts by the lines, B D and B E; then draw the arc, A C, and its chord; next draw the lines, A D, A E, D E, D C, E C, resulting in two isosceles triangles, A E D and D C E. Studying the properties of these triangles, we find that their altitudes are the division lines. These lines, therefore, must divide the base lines in two halves, and stand rectangular upon them. Therefore, if A D is really equal to D E, then A F must = F E, and D F be perpendicular to A E; and if D E = E C, then D G = G C, and G E is perpendicular to D C.

The following is the construction and solution of the problem: The angle, A B C, is to be divided into three equal parts: 1. Draw the arc, A C, with any radius. 2. Draw the chord, A C. 3. Divide the angle, A B C, in two parts by the line, B H. 4, 5. Draw the lines A H and H C. 6, 7. Draw semicircles, A F B and B G C, over each side of the given angle. These semicircles have the property of dividing all lines (chords) drawn from A or C to the periphery, A H C, into two equal parts, because each of their radii is half that of A B C. 8. Draw B I perpendicular to H C in its middle, and B M perpendicular to A H. 9. Make L I = B K. 10. Draw, with radius H I, the arc, H G C. 11. Draw B E through the point, G, where the arc, H G C, intersects the semicircle, B G C, and the same on the other side of B H, where B D is drawn through the intersecting point, F.

If the arc, A H C, is divided into a convenient number of equal parts, 8, 16, or so, of which M and K are two, draw M C, and K N perpendicular to M C; then N is the nadir of the altitude of the triangle, M C K. In the same way more points are found, all lying in the circle, H G C, with the radius, H I = B K + L K.



Both conditions are really complied with; C G = G D and E G is perpendicular to D C; the triangle, D C E, is isosceles, and D E = E C; and further, A D = D E. Therefore we have A D = D E = E C, and angle A B D = D B E = E B C.

It remains to show that triangle D C E is the only isosceles triangle that answers both of these conditions.

M K C cannot be an isosceles triangle, because we made C K = H K = H M = A D, and therefore C K is not equal to K M. In every triangle in consideration, one side must be parallel with the chord of the given angle, as M K, A C, D E. Only one isosceles triangle fulfils this and the other conditions, and this is the one sought for.

In a similar way I tried to find the law for dividing an angle into n equal parts, when n is a prime number; but I am obliged to confess that I did not succeed. Nevertheless there is some law in these divisions. I found that the semicircle, A F B, is intersected in $\frac{n-1}{2}$ points by as many circles, the positions of which I cannot find, and there are as many parallel lines connecting the points of division. So 3 parts has 1, 5 parts 2, 7 parts 3, 11 parts 5, 31 parts 15. If n is an even number, for instance 6, then the problem is to be reduced to tripartitions, which must be made in each half. The semicircle is intersected in 2½ points, that means that one of the dividing radii goes through the points where the two semicircles cut each other, thus dividing the angle in two parts.

W. THIESE.

Rochester, N. Y.

A New Photographic Test Plate.

Mr. William A. Brice, of London, England, the inventor of the improved portable photographic apparatus illustrated in these columns not long ago, has patented through the Scientific American Patent Agency, September 12, 1876, a novel testing plate, which will enable photographers to determine with considerable certainty the quality of the chemicals employed, the quick or slow working of the lens, and to define whether the presence of "fog" or want of clearness in the picture is attributable to impurities of the chemicals, alkalinity of the bath, diffused light, over-exposure to light, or to other causes.

The invention consists of a frame with a sliding glass plate, to which are applied fixed pieces of transparent material superposed in layers of one, two, three, and more, in regular succession, to produce a greater or less obstacle to the passage of the light. This is set up between the lens and the sensitized plate, and the picture is then taken in the usual manner. The result is a picture which produces the the light shade or shadow of the object to be photographed with the chemicals and lens, and with light of more or less the same actinic quality, intended to be used for the picture to be taken. When the picture is developed on this plate, it is, while visible, wholly divided into sections of unequal intensity, being more or less distinct according as the light has passed through one or more layers. The absence of fog where the light has been transmitted through several sheets of transparent material indicates that the chemicals are pure, that there is no diffused light, and that the nitrate bath is of proper acidity. If at that section details of the picture are clearly developed, it may be concluded that the exposure has been sufficient with the lens, light, and chemicals used. The second section of the testing plate, where the light passes through a less number of layers, gives more or less the same information, but indicates more clearly whether the exposure has been adapted to existing conditions or not. The next section indicates, if properly developed, what time, chemicals, etc., are to be used for the picture to be taken; while the middle or uncovered section indicates by the evident over-exposure that the lens is good and rapid in action, that the chemicals are in good condition, and that the light is sufficient in actinic power to produce good pictures with rapid exposure. The device is one which photographers will doubtless find labor-saving and of much general assistance.

The Preparation of Salicylic Acid.

Cahours obtained salicylic acid in 1844, from methyl-salicylate, or oil of wintergreen (*gaultheria procumbens*). Professors Kolbe and Lautermann in 1860 brought out their method of obtaining the acid from carbolic acid; but it was not until within the last year that Kolbe discovered its peculiar preserving and disinfecting properties. The manner of obtaining the acid from carbolic acid is as follows: The saturating capacity of a carbolic and also that of a soda lye is determined, and both are then mixed according to equivalents, so as to form sodic carbolate. The solution thus obtained is carefully evaporated to dryness, taking care that the dry mass sticking to the bottom of the vessel is constantly removed by scrapers, and that the mass itself is also constantly crushed, with a pestle or other tool, to facilitate its drying out, until at length the carbolate remains as a perfectly dry powder of a rose-red tint. Excess of carbolic acid gives always an inferior dark-looking residue, which, when it undergoes the final process of treatment with carbonic acid gas, gives far less salicylic acid than is in accordance with the amount of carbolate calculated in the mass. The dry carbolate is then either put into the retorts at once, or it may be kept for further treatment by putting it, while hot, into vessels which may be hermetically sealed. The fact that sodic carbolate is very hygroscopic explains the necessity of this manipulation.

After the carbolate is put into the retorts, the contents are slowly heated to 212° Fah., and when this temperature is reached, a slow current of perfectly dry carbonic acid gas is allowed to enter the retort. The temperature is then slowly increased to 356° Fah., and may, towards the end of the operation, reach to 428° or 482° Fah. About an hour after the beginning of the operation, carbolic acid will begin to distil, and the process may be considered finished, if, at the latter mentioned temperature, no more carbolic acid distils. It will be found that the distilled carbolic acid amounts to just one half of the original quantity employed. The residue in the retort is basic salicylate of soda, which is dissolved, and which, on acidifying with an acid, yields a brownish-colored crystalline precipitate of salicylic acid.

With regard to the purifying of the crude acid as obtained by the process given above, Rautert's method is usually employed; it is as follows: The crude acid is placed in a retort and strongly heated to 338° Fah., when a current of steam at a like temperature is injected into the retort. In the presence of the superheated steam, the acid distils at once; and after a short time, nothing remains in the retort but a trace of a black resinous mass. The apparatus must be arranged in such a manner that the neck of the retort may be kept free from crystals, as, for instance, by an inserted movable wire.

The Literature of Manganese.

Dr. H. C. Bolton of this city has been ransacking the literature of the past and present to learn what has been said and written about manganese, its ores and its compounds. In a communication to the Lyceum of Natural History, in November last, he detailed all the sources of information on this subject. The results of his patient labors have recently been published in the *Annals* of that society, and also reprinted in pamphlet form under the title of "Index to the Literature of Manganese." In this little pamphlet of 44 pages are contained 400 distinct references to manganese minerals, extending from 1596 down to 1873, and 1,700 references to chemical papers beginning with Pott's "*Examen chymicum magnesiæ vitriariorum, Germanis Braunstein,*" published in Berlin, in 1740. The value of an index of this kind, to a person wishing to examine the literature of or study any of the compounds of manganese, can scarcely be over-estimated. The references are arranged in chronological order, and give the name of the investigator, subject of the paper, and list of all the journals into which it has been copied with number of volume and page.

Nor is this the first work of the sort done by this chemical antiquarian. In 1870, Dr. Bolton published a similar index to the literature of uranium, from its discovery by Klaproth in 1789 to 1869.

We hope that other chemists, who have prepared extensive lists of reference on subjects that they were investigating, will be induced to put them in print for the benefit of others that may come after, in a style uniform with those above described.

Electrical Dust Figures in Space.

A brass rod pointed at one end, and with a ball at the other, is laid horizontally on an ebonite plate supported on wood; receives sparks from an electric machine; is discharged by touching, and removed; and the plate is then sprinkled with a fine powder. The author gives drawings of the negative and positive figures obtained. Conceive these turned about their axes, and we have the electrical dust figures in space, of which the ordinary Lichtenberg figures are merely sections.

M. Lommel fixed the brass rod in a certain position, and moved the ebonite plate up and down under it, taking figures at each position. He also used an ebonite plate with an aperture, allowing the brass rod to pass through it. He shows how the various figures are related to the original two. The cause of the Lichtenberg figures is to be found (he thinks) in a peculiar state of motion of the air about the conducting body, and this is simply imaged on the ebonite plate.

TURBINE WATER WHEELS.

BY S. W. ROBINSON.

A look at the numerous turbines on exhibition in Machinery Hall, and their elaborate catalogues, giving lists of the thousands which have been introduced in this country, gives evidence of a thriving and extensive business; and one can hardly realize that thirty years ago the turbine was scarcely recognized as a motor.

The first wheel of this kind was made in France by a Frenchman named Burdin, in 1827 or 1828, but the real merits of the wheel were not generally accepted till some five years after. Soon after this it began to receive the attention of American engineers; and the first of these wheels of importance was constructed by Uriah A. Boyden, in 1844, and introduced into the Appleton Company's cotton mills at Lowell, Mass. Tests of these wheels gave remarkable results, the maximum being 92, and the mean maximum 88, per cent of useful effect from the power of the water.

This extraordinary figure is supposed to be due to the engineer's extreme precaution in polishing the surfaces of the apparatus, using Russian iron guides and floats, and in giving such form to the flume as to impart to the water, as it approached the guides, such a spiral-like rotation as to cause it to enter the guides without resistance. The trials which gave the above percentages decided the great superiority of the turbine over the old breast wheel, and engineers at once saw that, for perfecting water motors, their attention must be turned into a new channel.

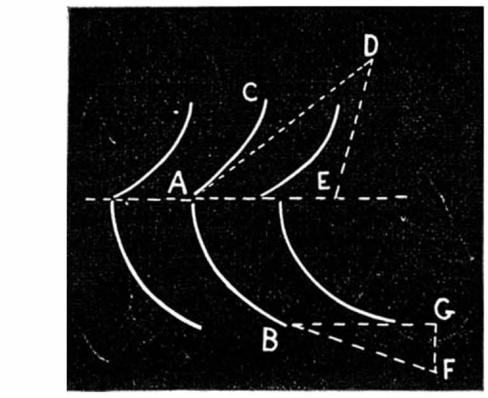
The breast wheel was at once summarily dismissed, and the turbine adopted for reasons unmistakably in its favor, some of which are the following: 1. Increase of percentage from five to fifteen. 2. Greater compactness. 3. Perfect freedom from back-water annoyance. 4. Perfect adaptation of given wheel to all heads. 5. More convenient speed of running. 6. Much less subject to fluctuations of speed. 7. Convenience of installment, and for shipment ready made. Advantages of breast wheel, none.

Some of these point are self-evident, but others, such as Nos. 1, 3, 4, and 6, may not be. To help this, and also for the reason that the correct theory of the turbine wheel is but poorly comprehended, as evinced by the forms given the parts in existing ones, the following descriptive exposition of the main theory is given with the hope that practical builders may thereby receive a benefit.

First of all, water wheels must receive power from the water by reducing its velocity, and water engines by action of its pressure. These points are believed to be sufficiently evident from observation. It is therefore obvious that, for a maximum of effect, the water should have the greatest possible velocity due to head in approaching the wheel; and in leaving, the motion should be entirely destroyed. To illustrate, suppose a flat disk be placed square against an isolated jet of water. If stationary, the water will be thrown in all directions without much change in velocity, and no power is developed because standing still. If it moves with the water the stream is not disturbed, and also no power developed. At half the water velocity, the vane receives its greatest power, but the water is projected laterally, and for this reason the motion of water is not destroyed, and the maximum of effect is known by hydraulic engineers to be only half the power stored in the moving jet. But this is what may be styled a fair example of percussion, and hence builders of wheels who operate on this principle must expect low returns.

Next, suppose the vane be in the form of a hollow half cylinder, and placed so that the jet strikes it tangentially at one side. While stationary, the water is sent around the smooth surface, and escapes, with velocity unchanged, in a direction differing by 180°: and of course we have no power. Giving the vane the velocity of the jet, we get no power again, but with half the velocity of the stream it receives the water with a relative velocity, one half its absolute, and passes it to issue at 180° unchanged, at which the absolute velocity of the water is zero. Now multiplying the motion of vane by the pressure against it, the result is found to be equal to the whole power of the water. In this example we see that the water is delivered upon the float without shock or percussion, and leaves it without velocity, which principle has long been known in theory as the ne^essary condition for high percentages. As this has regard to the power of the jet only, the latter should, of course, be made the maximum, by giving the water the highest possible velocity of projection. Of the forms of orifice of projection, the one known, from experiment, to give the greatest velocity is that formed in a thin wall, whose coefficient, or realizable percentage of the theoretic velocity, is about 97. Rapidly converging adjutages give very nearly this, say upwards of 92, while prismatic adjutages give only 82 per cent. Hence a turbine, whose chutes have parallel sides, can only return a percentage of 82, provided the wheel otherwise be absolutely perfect. It is therefore evident that the form of chute is of no whit less importance than the wheel.

Again, in turbines there should be a certain adaptation of chutes and floats to each other, and certain forms of wheel passages and exits. The forms most consistent with theory are best explained by aid of the accompanying diagram, which may be regarded as a side view of a Jonval turbine. Let A B represent a float of the wheel, and A C a guide. Let D A represent the direction and velocity of the affluent water, and B F the same for the issuing water.



Take A E or B G for the velocity of wheel, which must be equal, from the nature of the case. The point, D, should be found by making D E equal to A E, and the direction of D E the same as the first elements of the floats. Then we have D E=A E=B G.

Now if a particle of water moves from D to A, while a point on the wheel moves from E to A, the direction and velocity of the water, relatively to the wheel, will be D E, and hence will enter tangentially upon the float with entire freedom from shock. Compared with the cylindrical vane above, the water will move along the curved float, A B, without change of velocity, and issue with a velocity, B F, equal to D E. But as D E=B G, then B G=B F, and the absolute velocity of the water will only be G F. If the water could be made to issue tangentially, G F would be zero, as required for a percentage of 100. Though in practice G F must have a magnitude, it should be reduced to the minimum. The water has also been regarded as having uniform velocity from A to B. That this be possible, the transverse sections through the inter-float passages should be the same at all points. Hence, that the exits be thin, requires them to be long from crown to crown. And again, in order to deliver the water on wheel in direction, D A, the last elements of the guides should have the direction, D A; otherwise the form should be favorable for high velocity of projection.

Now this diagram may be greatly varied, and still these principles hold equally well. It is only necessary that D E =A E=B G=B F; last element of guide have direction D A; first element of float have direction D E; and inter-float passages be uniformly large from beginning to exit. The velocity of wheel will be to that of the water as A E is to A D. When the first elements of float, for instance, are perpendicular to A E, the guide direction, A D, should be 45°. For float direction, A D, 60° to the right, guide direction will be 60° to the left, and A D E will be an equilateral triangle. Indeed A D E is always an isoceles triangle.

In designing a wheel it is very important that there be no interference to free passage of water in the curbing or penstock, or in the vent from wheel; and hence these should be large and unobstructed.—*Polytechnic Review.*

THE BLACK KNOT.

There are many things in Nature seemingly so insignificant that we consider them unworthy of our notice; yet they have the power of doing us great benefit or harm according to their habit. The mold, upon bread, cheese, and on most other neglected vegetable matter, is well known to be a plant growth of a low order. It is a fungus, and of the same nature as our common mushrooms. The potato disease, which is causing so much anxiety in England and on the continent of Europe, is also the result of a fungous growth. These plants are now receiving considerable study from botanists on account of both their practical and their scientific interest.

In this country, and peculiar to it, the black knot, as it is called, on plum and cherry trees has recently been proven to be another fungus. Dr. W. S. Farlow, of Harvard University, has presented, in the *Bulletin of the Bussey Institution*, a most important paper as the result of his researches on this subject. The black, warty excrescences on plum trees and on all kinds of wild and cultivated cherries have been noticed by every one from early time, and have long been the bane of fruit growers. For the most part, these have been attributed to the work of insects; and this has not been without considerable shadow of reason. Insects are not unfrequently found there, and in old knots insects or their remains are generally found. The curculio often pierces the knot in its young state, and deposits within it its eggs, which soon hatch out. The young live in the knot, and may be found there in the various stages of their development. Insects also of different species have been found within these knots.

But it is now conclusively demonstrated that the unsightly knots are not of insect origin. Though, till very recently, the subject has been almost entirely neglected by botanists, it now seems certain that they have determined its true character. The knots are not like galls, made by a known insect; and when young, they are most frequently entirely devoid of insects. Again, the fact that the insects are not all of one species, and the very same are also found on trees which are never afflicted with knot, would be quite conclusive against this assumption. On the other hand, the knot has never been found without the presence of the specific fungus (*sphæria morbosa*), which is now accepted as its origin; and this fungus is not known to exist except in connection with the knot. The mycelial threads, however, of the fungus are found in the slightly swollen stem long before any real semblance to a knot has appeared; but the growth of these may be traced till the knot has attained its full size, and the fungus has shown all its phases of life.

Dr. Farlow has considered the life history of the fungus, whether the disease is the same on plum and cherry trees, and the means of preventing its ravages.

The knots vary in size from a few lines to several inches in length, and average about two inches in circumference. They seldom entirely surround the branch, and often cause it to bend or twist into unsightly shapes. The vegetative portion first appears in the form of very minute threads (mycelium), twisted together and extending from the cambium—or inner—layer of the bark towards the outer portion of the stem. "The fungus first reaches the cambium either by the germination of spores on the surface of the branch, or by the mycelium proceeding from a neighboring knot." Hence the Professor concludes that the growing layer of tissue is where the fungus commences its work of destruction. During the growing stages of the knot—which continue to the flowering time of its victim—it is of a greenish color and solid or pulpy throughout. When it has attained its maturity. it turns black; and in the winter it often becomes cracked, broken, worm-eaten, and hollow. The outer shell contains the perithecia, which are small pits or sacs containing the sexual spores. These, always eight in number, are borne in *asci* or cells. These cells grow slowly during the winter, and the spores in them ripen from the middle of January to the end of February. Those ripening in February germinate in from three to five days, if sufficiently moist.

Microscopic investigation proves that the knots on plums of all sorts, and on cultivated, wild, and choke cherries, are identical: though, to the naked eye, they differ slightly in general appearance, owing probably to the more favorable circumstances for their growth in some species of the genus *prunus* than in others.

The remedy against this contagious disease is a very obvious one: simply to cut off and burn the knots and swollen branches when and wherever found. This should be done in autumn as soon as they become plainly seen by the falling of the leaves. It is not sufficient to cut them off, for some of the spores which do not ripen till late in the winter have been carefully observed to ripen after the branches were cut from the tree and not afterwards burnt. Professor Farlow recommends the complete destruction of choke cherry, bird cherry, and wild plum trees, since they furnish means for the rapid propagation of the knot, and are themselves of little value in comparison with the cultivated cherries and plums. "Concert of action is what is needed in this matter, and not only by attending to one's cultivated trees, but to the wild plums and cherries that frequent our fence rows and woodlands as well: as in very many instances the latter prove to be pest houses where the contagion is propagated and sent forth to carry desolation over many a thriving tree, dear to the eye of its owner." The wild plums are the most abundant in the Western States, and the wild and choke cherries in the Eastern. These, in their habitats therefore, require special attention.

This is a matter of vast importance to fruit growers; and to institute vigorous measures, against this destructive fungus, will be a great source of profit to fruit producers and merchants, as well as an equally great source of comfort and enjoyment to the consumer. S. H. T.

The American Reports on the Vienna Exposition.

We have received the four volumes of reports of the United States Commissioners to the Vienna Exhibition of 1873, which have just been published, under authority of Congress, at the Government Printing Office, at Washington, D. C. The work possesses a double interest: first, in that it is a tangible result of the expenditure of $200,000 of the people's money, and of the labors of certain paid scientific commissioners and eight practical artizans: second, in that it is a valuable record of the Vienna show, edited with much ability and discriminating judgment.

Professor Thurston devotes volume first to an introductory description of previous world's fairs, following which is a complete account of the organization of the Vienna Exposition. Copious extracts from the reports of the commissioners from other nations upon the United States exhibit are given; and a report on forests and foresting, by J. A. Warder, M. D., and one on sheep and wool, by J. R. Dodge, close the volume. In volume second are collected all the reports on scientific and educational subjects. Volume third is mainly occupied by the editor's own report on machinery and manufactures, to which are added Mr. William Watson's paper on "Engineering and Architecture," that of Mr. Fairfield on "Sewing Machines," and that of Mr. Charles Davis on "Hydraulic Engineering." Volume fourth contains reports on buildings, wood and stone industries, metallurgy, and a copious general index, which greatly adds to the value of the work as a book of reference. There is a lavish profusion of maps and engravings, and the general appearance of the book is superior to the usual official productions of the government printer. We shall, as opportunity offers, lay before our readers such abstracts from the work as appear interesting. Meanwhile, and in advance of the public verdict, we can warmly commend Professor Thurston's labors. He has accomplished a task of great magnitude, with a thoroughness which will secure wide and favorable recognition, and he has given us probably the best set of reports ever based upon a world's fair.

Science in America.

The following passage taken from the opening address of Professor Sir William Thomson, on assuming the chair of the section of physical science at the Glasgow meeting of the British Association, will be read with interest as showing the impression made upon an English student of Science by our progress in discovery and practical science:

"Six weeks ago, when I landed in England after a most interesting trip to America and back, and I became painfully conscious that I must have the honor to address you here today, I wished to write an address, of which Science in America should be the subject. I came home indeed vividly impressed with much that I had seen, both in the great exhibition at Philadelphia and out of it, showing the truest scientific spirit and devotion and originality, the inventiveness, the patient, persevering thoughtfulness of work, the appreciativeness, and the generous open-mindedness and sympathy from which the great things of Science come.

"I wish I could speak to you of the veteran Henry, generous rival of Faraday in electromagnetic discovery; of Peirce, the founder of high mathematics in America; of Bache, and of the splendid heritage he has left to America and to the world, in the United States coast survey; of the great school of astronomers which followed—Newton, Newcomb, Watson, Young, Alvan Clarke, Rutherford, Draper, father and son; of Commander Belknap, and his great exploration of the Pacific depths by pianoforte wire, with imperfect apparatus supplied from Glasgow, out of which he forced a success in his own way; and of Captain Sigsbee, who followed with the like fervor and resolution, and made further improvements in the apparatus, by which he has done marvels of easy, quick, and sure deep sea soundings in his little surveying ship Blake; and of the admirable official spirit which makes such men and such doings possible in the United States naval service.

"I would like to tell you, too, of my reasons for confidently expecting that American hydrography will soon supply the data from tidal observations, long ago asked of our government in vain by a committee of the British Association, by which the amount of the earth's elastic yielding to the distorting influence of sun and moon will be measured; and of my strong hope that the compass department of the American navy will repay the debt to France, England, and Germany, so appreciatively acknowledged in their reprint of the works of Poisson, Airy, Archibald Smith, Evans, and the Liverpool compass committee, by giving in return a fresh marine survey of terrestrial magnetism to supply the navigator with data for correcting his compass without sight of sun or stars. I should also tell you of 'Old Prob.'s' weather warnings, which cost the nation $250,000 a year, money well spent, say the western farmers, and not they alone; in this the whole people of the United States are agreed, and though Democrats or Republicans playing the "economical ticket" may, for half a session, stop the appropriations for even the United States coast survey, no one would for a moment think of starving 'Old Prob.'; and now that 80 per cent of his probabilities have proved true, and General Myer has, for a month back, ceased to call his daily forecasts probabilities, and has begun to call them indications, what will the western farmers call him this time next year? The United States naval observatory is full of the very highest Science, under the command of Admiral Davis.

If, to get on to precession and nutation, I had resolved to omit telling you that I had there, in an instrument for measuring photographs of the transit of Venus shown me by Professor Harkness (a young Scotchman attracted into the United States naval service), seen, for the first time in an astronomical instrument, a geometrical slide, the verdict on the disaster on board the Thunderer, published while I am writing this address, forbids me to keep any such resolution, and compels me to put the question: Is there in the British navy, or in a British steamer, or in a British land boiler, another safety valve so constructed that, by any possibility, at any temperature, or under any stress, it can jam? and to say that if there is, it must be instantly corrected or removed. Can I go on to precession and nutation without a word of what I saw in the great Exhibition of Philadelphia? In the United States government part of it, Professor Hilgard showed me the measuring rods of the United States coast survey, with their beautiful mechanical appliances for end measurement, by which the three great base lines of Maine, Long Island, and Georgia were measured with about the same accuracy as the most accurate scientific measures, whether of Europe or America, have attained in comparing two meter or yard measures. In the United States telegraphic department I saw and heard Elisha Gray's splendidly worked-out electric telephone, actually sounding four messages simultaneously on the Morse code, and clearly capable of doing yet four times as many with very moderate improvements of detail; and I saw Edison's automatic telegraph delivering 1,015 words in 57 seconds—this done by the long-neglected electro-chemical method of Bain, long ago condemned in England to the helot work of recording from a relay, and then turned adrift as needlessly delicate for that.

"In the Canadian department I heard 'To be or not to be'—'there's the rub,' through an electric telegraph wire; but, scorning monosyllables, the electric articulation rose to higher flights, and gave me passages taken at random from the New York newspapers: 'S. S. Cox has arrived' (I failed to make out the S. S. Cox), 'The city of New York,' 'Senator Morton,' 'The senate has resolved to print a thousand extra copies," "The Americans in London have resolved to celebrate the coming Fourth of July.' All this my own ears heard spoken to me with unmistakable distinctness by the thin, circular disk armature of just such another little electromagnet as this which I hold in my hand. The words were shouted with a clear and loud voice by my colleague judge, Professor Watson, at the far end of the line, holding his mouth close to a stretched membrane, such as you see before you here, carrying a little piece of soft iron, which was thus made to perform in the neighborhood of an electromagnet in circuit with the line motions proportional to the sonorific motions of the air. This, the greatest by far of all the marvels of the electric telegraph, is due to a young countryman of our own, Mr. Graham Bell, of Edinburgh and Montreal and Boston, now becoming a naturalized citizen of the United States. Who can but admire the hardihood of invention which devised such very slight means to realize the mathematical conception that, if electricity is to convey all the delicacies of quality which distinguish articulate speech, the strength of its current must vary continuously, and, as nearly as may be, in simple proportion to the velocity of a particle of air engaged in constituting the sound?

"The Patent Museum of Washington, an institution of which the nation is justly proud, and the beneficent working of the United States patent laws deserve notice in the section of the British Association concerned with branches of Science to which nine tenths of all the useful patents of the world owe their foundations. I was much struck with the prevalence of patented inventions in the Exhibition; it seemed to me that every good thing deserving a patent was patented. I asked one inventor, of a very good invention: 'Why don't you patent it in England?' He answered: 'The conditions of England are too onerous.' We certainly are far behind America's wisdom in this respect. If Europe does not amend its laws (England in the opposite direction to that proposed in the bills before the last two sessions of Parliament), America will speedily become the nursery of useful inventions for the world. I ought to speak to you too of the already venerable Harvard University, and of the Technological Institute of Boston, created by William Rogers, brother of my Glasgow University colleague, Henry Rogers, the Cambridge of America, and of the Johns Hopkins University of Baltimore, which with its youthful vigor has torn Sylvester from us, has utilized the genius and working power of Roland for experimental research, and, three days after my arrival in America, sent for the young Porter Poinier to make him a Fellow. But he was on his death bed in New York, 'begging his physicians to keep him alive just long enough to finish his book, and then he would be willing to go.' Of his book, 'Thermodynamics,' we may hope to see at least a part, as much of the manuscript and kind and able friends to edit it are left; but the appointment of a fellowship in the Johns Hopkins University came a day too late to gratify his noble ambition. But the stimulus of intercourse with American scientific men left no place in my mind for framing or attempting to frame a report on American Science."

THE LATEST NEWS FROM THE SUN.

There are not many persons living who, with the reverend Director of the Observatory of the Roman College, can lay claim to have minutely examined the face of the sun every day for the past ten years. Father Secchi, moreover, as an astronomer is the peer of Lockyer, Huggins, or Young, and as such his conclusions are worthy of the highest respect. The new edition of his work on the sun, which has lately been published in Paris, embodies the results of his most recent investigations, as well as of those which have extended over long periods of time, and hence it may be regarded as one of the latest dicta of Science regarding the physical constitution of our luminary.

Father Secchi's theory of the sun spots is that they are phenomena of eruption. They result from the upheavals which take place in the solar mass, and form, in the photosphere or luminous envelope, cavities more or less regular, surrounded by brilliant projecting ridges. The depth of these cavities rarely exceeds 3,600 miles—generally it is less—and the hollows themselves are filled with dark vapors which absorb and so cut off the luminous rays emitted by the strata beneath. The physical constitution of the solar mass, and the true nature of the incessant motion of which it is the seat, have been little understood. Now, however, we are in possession of a spectroscopic method of distinguishing the different currents which cross and mingle, of discerning the jets of hydrogen and of incandescent metallic vapors, and observing the rose-colored protuberances which formerly could not be studied, except during a total eclipse, when the bright light of the radiant disk was intercepted. Father Secchi has determined the closest relations between the spots and the protuberances seen on the solar edge.

If the results of a series of observations of solar rotations be considered, it appears that the spots, the most brilliant faculæ, and the eruptive protuberances (those which contain metallic vapors) appear as a rule in similar regions on the the solar disk, that is to say, in the two zones near the equator and comprised between the 10th and 30th parallels of latitude, and that the majority of these phenomena occur at the same epochs. When a number of individual observations of spots and protuberances are thus compared, this conclusion is often at fault; but this is to be expected, because the protuberances can be seen only on the edge, while the spots and faculæ are visible on the face, of the sun. On the other hand, the parallelism of the three orders of phenomena becomes manifest when the results are considered in the aggregate. Moreover, whenever a considerable protuberance rises on the oriental side, it is almost certain that a spot will appear next day in the same place.

Father Secchi therefore considers that without doubt the spots and protuberances are correlated phenomena, and that the spots are a secondary effect of the eruptions which are revealed to us by the protuberances. It is necessary, however, to note that the latter do not always appear to be true eruptions, as they are often simple jets of incandescent hydrogen which rise from the photosphere like fires from a forge. Such flames cannot produce the absorbent vapors which form the spots. Hence a distinction must be made between eruptive protuberances characterized by the presence of metallic vapors, and hydrogen protuberances where such vapors are not manifest; but, the author adds, traces of the metallic spectroscopic lines are almost always discernible at the base of the hydrogen jets. The difference between the two kinds of protuberances, therefore, while existing, is not clearly defined. Often the metallic lines of the protuberances are visible on the solar disk, and are prolonged as far as the nucleus of a spot near the edge, affording irrefutable evidence that the metallic vapors have their origin near the nucleus. Beyond the 40° parallels, true spots and eruptions are rarely encountered.

The eruptions are probably violent crises produced by chemical combinations which occur at a certain depth below the solar surface. The cooled products of the reactions unite in thick clouds, like those clouds arising from sulphur volcanoes, which fall by virtue of their weight when condensed, and bury themselves in the luminous envelope, while they in turn are quickly invaded by the ambient matter of the photosphere. From all sides tongues of fire penetrate the interior of the spot, and, joining it together in places, divide it into segments. These luminous filaments give to the penumbra its radial structure, and then, becoming as it were dissolved in the obscure mass, lose their brilliancy by cooling. The spot then assumes quite a regular rounded form; a period of calm succeeds the fierce effervescence and the tumultuous and discordant movements which characterize the formative processes. Above the dark nucleus, less intense emanations occur of short and slightly luminous flames, in which the spectroscope is no longer able to recognize the lines of metals. Then, little by little, the spot diminishes and finally totally disappears.

This theory is believed to account for all the phenomena hitherto observed; and it will be seen that Father Secchi is no adherent of the whirlwind theory, which he somewhat brusquely dismisses as a "fiction destitute of all reality." Out of several hundred spots which he has closely observed he says that but seven or eight show a spiriform structure. This even disappears in a day or two, and often the rotary movement, after becoming slower, is rendered in the opposite direction. The motion, he affirms, is no essential property of the spots.

The physical constitution of the sun, our author sums up as follows: The sun is formed of a fluid incandescent mass, enveloped in a highly luminous photosphere, above which there is yet an atmosphere of less density. The photosphere is a fiery mist, probably of gases which have become luminous through the effect of high temperature and high pressure. Immediately above this, a very thin envelope of metallic vapors mixed with those of hydrogen is encountered. This is the chromosphere, and its thickness is from 10 to 15 seconds of arc. Beyond the chromosphere again there is a vast envelope composed of hydrogen and of two unknown substances which produce the yellow spectrum line D_3, and the line 1,474, and to one of which the name "helium" has provisionally been given. During total eclipses of the sun, the outer envelope becomes visible and produces the phenomenon of the corona. Finally the vast eruptions throw forth jets of hydrogen to hights equal to one fourth the solar diameter, 224,400 miles, and with such tremendous velocity that it is believed that the hydrogen may at times leave the sun and pass into the interstellar space.

Look Out for Him.

A correspondent from Springfield, Mo., sends us a receipt signed R. Allen, for one year's subscription to the SCIENTIFIC AMERICAN.

The writer states that the person to whom he paid his $3.20 was a modest, retiring sort of an individual, and represented himself to be a special correspondent of the paper. It is likely that the same party has swindled others out of their money, in Springfield and other places in the vicinity.

We warn our friends in all parts of the country against subscribing and paying money to any one unknown to them, on our account. No traveling agents are employed; and if any stranger claims to be an authorized agent for soliciting subscriptions, denounce him as a swindler wherever you find him, and keep your hand on your pocket so long as the person remains.

Naval Engineer Corps Gazette.

September 29. Chief Engineer John B. Carpenter and Assistant Engineer C. P. Howell were detached from the United States steamship Alaska, and placed on waiting orders.

Passed Assistant Engineer Julien S. Ogden has been ordered to duty at the Navy Yard, New York.

October 4. Chief Engineer O. H. Lackey was ordered to duty as member of the board at Annapolis, Md., for the examination of midshipmen for promotion to the grade of ensign.

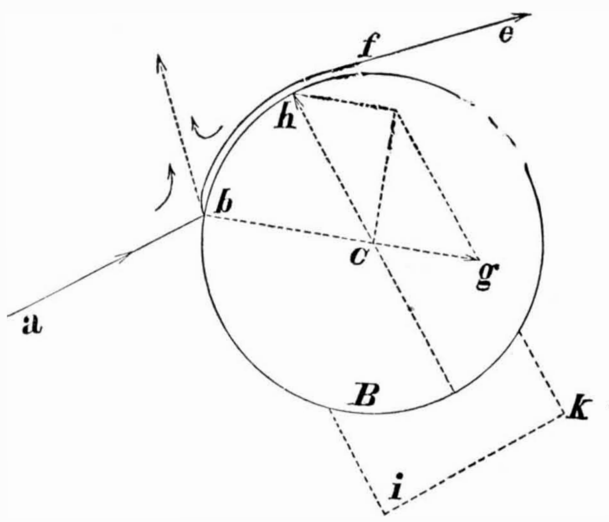
Passed Assistant Engineer Robert Crawford has been ordered to temporary duty at the Naval Academy, Annapolis, as an instructor in the department of steam engineering.

FOR the protection of workmen handling lead and mercury compounds, M. Melsens, of Paris, France, recommends small daily doses of iodide of potassium. This salt, he says, dissolves the lead or mercurial compounds, and effects their removal.

A THEORY OF THE BALL PUZZLE.

Mr. Hugo Bilgram, of Philadelphia, has written the following explanation of the ball puzzle described in the SCIENTIFIC AMERICAN SUPPLEMENT, page 576, volume II.:

A current of air, *a b*, striking the ball, B, will not, as might be expected, be reflected in the line from *b*, nearly at right angles to *a b*, but will follow the course, *b f e*. The reason can be explained as follows: Any current of air has a tendency to carry along with itself the surrounding air; but the current, *b d*, can be supplied from one side only, while on the other side, in the angle, *d b f*, a rarefaction of air takes place. The current will therefore be deflected by the pressure of the atmosphere, and take the course as shown. The impact of the air, at *b*, produces the force, *c g*, while the surplus pressure of the column of air, *i k*, over the rarefied conditions under the current, *b f*, exerts the pressure, *c h*. These two forces united produce a vertical force equal to the weight of the ball. The rarefaction of



air, between *b* and *f*, as well as the deflection of the current, can easily be demonstrated by experiment.

Ourselves as Others See Us.

We all like to know what others think of us, even if their opinion makes us wince; and recognizing this fact, a bright newspaper man has been chatting with the representatives of the foreign nations at the Centennial show to learn their notions of our country and ourselves. The phlegmatic Turk is astounded at our inquisitiveness. "They come up to your stand, handle your goods, ask you all sorts of impertinent questions, never apologize for troubling you, but address you invariably with the inevitable 'how much.'" We fear the Turk makes a fair criticism. The Frenchman thinks our mode of life, so far as eating is concerned, is detestable. "Your mode of living," said one of the commissioners, "is the cause of illness among your women, which must affect the whole race. The undue use of ice water, ice cream, iced drinks of all kinds, the abuse of pepper and salt, are all injurious. You need a public school to teach the art of proper feeding." The Belgian also detests our mode of living and our cooking. He thinks our national stomach must be out of order—not far out of the way—and we eat too much meat. While we are exceedingly sociable, we have no *cafés*, and drink too often and too quickly; this is also the Belgian's criticism. The Frenchman, so far as our character is concerned, thinks "the high appreciation of number one does much to stunt the development of morality." The Spaniard declares us to be "the most cordial and hospitable people in the world." The Italian thinks we lack sentiment and principles. "To achieve what you have done," said one of the Italian Commission, "you have had to make a god—the dollar—and a machine of your country, a money-making apparatus." But the American women puzzle the Italian the most. Says this same commissioner:

"I ask myself concerning them: Is it innocence, virtue, ingenuousness, or what? They are the most impertinent creatures I ever saw. They go up to a foreigner with the most perfect *sang froid*, stare him out of countenance, ask him if he is married, how many children he has, where he comes from, and I know not what. Their excessive freedom of manner to our hot-blooded people seems what I hope it is not. But they take the most extraordinary liberties. Fancy a pretty girl of eighteen laying her little dimpled hand on your arm and asking you, naively or boldly, I know not which, how you like the American ladies? What the deuce can one think?"

Like the Frenchman and Belgian, the Italian is disgusted at our cooking. "You need a thorough reformation of your *cuisine*," said one. "You have little or no variety of food, and oh! you lack good wines! If you only had our wines, you would have less public drunkenness." The German laments the absence of domestic life; but he seems to regard America as a sort of promised land, and thinks it especially a paradise for working men. The Austrian, like the Turk, is disgusted with the national impoliteness. Said one: "The people are pleasant enough, but they do not know the use of the words 'please' and 'thank you,' and seem to imagine that for the admission price of fifty cents they purchase the services, as guides, instructors, and playthings, of all the exhibitors." And then we are woefully ignorant. "Most of the American visitors here," said the same Austrian, "don't know the difference between Austria and Australia, and ask me how I like living in the bush. One old lady asked me, just now, where is the Belgian and Brazilian stands? You know, the place where they make bug jewelry, jewelry out of bugs,' and that is only one instance from many hundreds." The Dane thinks our middle classes not so well educated as those of his own country. The Mexican is particularly struck by the abuses of our street car travel and our hacks. He would have stringent laws to prevent the overcrowding of the street cars, and, to stop the extortion of the hackmen, capital punishment. The Dutchman doesn't like our women, thinks they are weak and puny, compared with their buxom girls. And the opinion of the Chinaman is compressed into the following expressive sentences: "Much likee Melica. Costee muchee money livee in Melica, costee little money livee Chilee. Chilee man make muchee money in Melica; Melican man makee d—n little money in Chilee."—*Boston Weekly Globe.*

THE "MODEL" SCROLL SAW.

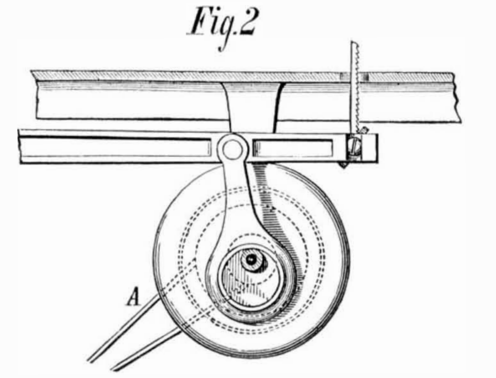
We illustrate herewith a new scroll saw, excellently suited for amateur use. It is capable of cutting wood up to one and a half inches in thickness, of holding blades of all sizes, from one fourth inch down to the finest made, without adjustment, and it works rapidly and smoothly. It offers beside the advantage of not being driven by a crank motion from the treadle, but by devices which have no dead centers, and which therefore maintain the machine in continuous movement. By pressing down the treadle, the strap attached thereto is caused to rotate a noiseless clutch, Fig. 2, by which the balance wheel is driven. The latter, by means of an eccentric, moves the arms to which the saw is attached. The clutch merely touches the balance wheel when driven forward, but becomes entirely disconnected therefrom when it is stopped, so that the wheel is thus left to run free. When the motion of the balance wheel slackens, the treadle, which has been drawn up by the reverse

Fig. 1

rotation of the clutch shaft, by the spring arm and strap, A, Fig. 1, into its normal position, is again pressed down and the wheel receives fresh impulse. The saw starts at once in the right direction; and the thinner the material cut, the less frequently is it necessary to work the treadle.

The upper saw arm is jointed at B, so that it can be raised entirely out of the way of the work when changing the blade from one hole to another in sawing inside portions. To hold the saw, the elasticity only of the upper arm is used; and in fastening the upper end of the blade, it is therefore merely necessary to push down the arm until the desired strain is obtained. This of course can be varied to suit the

Fig. 2



size of saw and the kind of work. The machine, we are informed, is made in quantities on special apparatus and to standard gages. It is entirely of metal, and has no adjuncts beyond the six saws which are supplied with it. The arm holding the saw works on steel points, and is jointed to the connecting rod by an adjustable bearing which takes up the wear. The main shaft is of Stubs' steel. The space under the arm is fifteen inches in the clear, and thus allows of sawing to the center of a piece thirty inches in diameter The balance wheel is so adjusted that there is scarcely any vibration even when the machine runs at from 1,000 to 1,200 revolutions per minute. The finish is ornamental, and the workmanship is neat and good.

For further information address the manufacturers, Messrs. Bush & Smith, West New Brighton, Staten Island, N. Y.

RUBBER OVERSHOE MAKING AT THE CENTENNIAL.

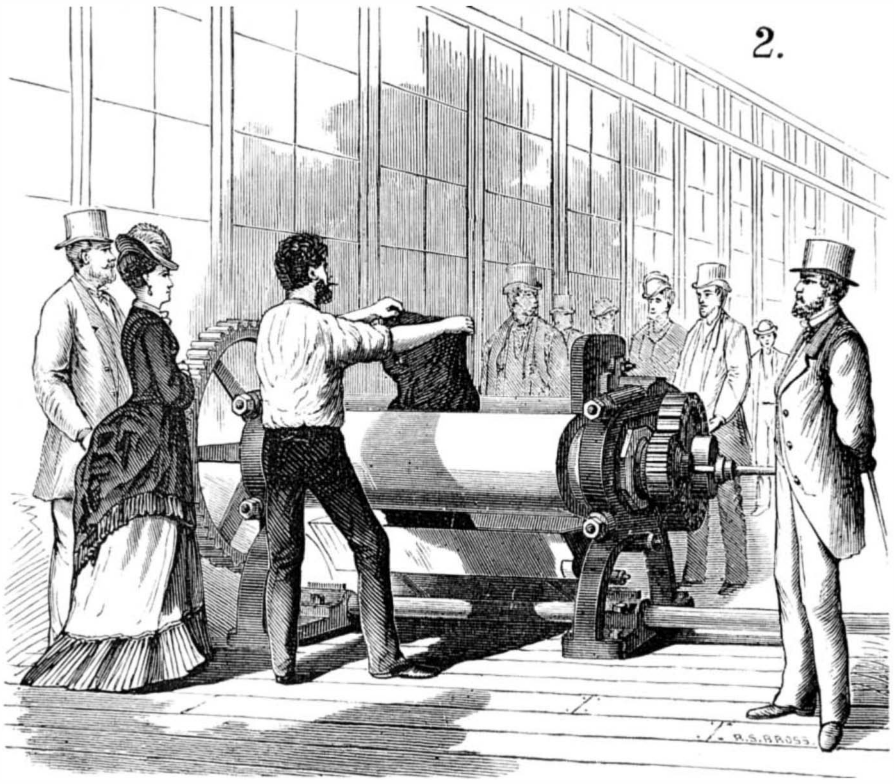
The inventors of the rubber overshoe were the Indians

RAW RUBBER. THE VULCANIZING OVEN. VARNISHING THE SHOES.

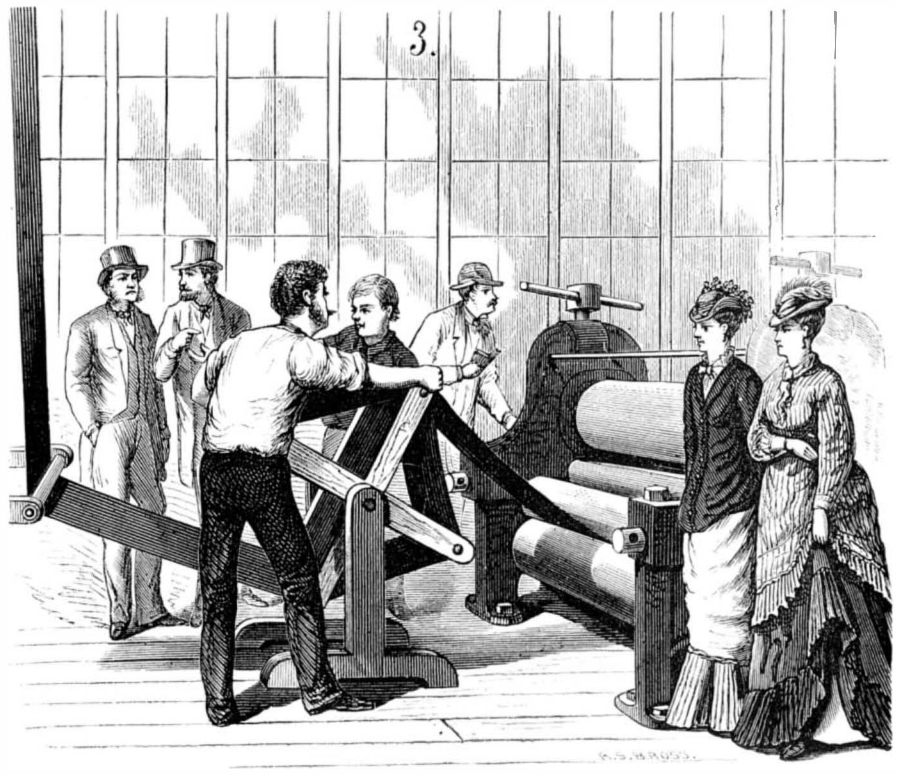
who inhabited those portions of Brazil where the caoutchouc tree most abounded. Their method of manufacture consisted in making a rude last of clay, which was covered repeatedly with layers of the juice, each coating being allowed to dry before the next was applied. When a proper thickness was attained, the mold, with its elastic covering, was held over the smoke of a wood fire for a time, and the clay was then broken out. It was not until 1825 that the rubber shoe made its appearance in the United States; and then Thomas C. Wales, a Boston merchant, imported a few of the crude Indian productions from Brazil. Rough and ungainly as these feet coverings were, their superiority over goloshes, which were nothing more than wooden shoes or clogs, and which furnished the only means, beyond extra thick leather boots, of protecting the feet during wet weather, was soon perceived. Mr. Wales thereupon sent to Brazil a large number of American lasts of better shape than those used by the native makers; and such a trade in the shoes speedily arose that, at the end of three years, no less than half a million pairs were exported from Brazil to Europe and America.

Several years before this time both English and American inventors had been seeking for means of utilizing the caoutchouc gum. In 1797, one Johnson obtained a patent in England for waterproofing cloth by covering it with rubber in solution. Hummel, of Philadelphia, followed in 1819, with a gum elastic varnish. Then Macintosh, in England, made in the same year waterproof garments which still bear his name. These efforts were, of course, known in the United States; and the rubber overshoe had no sooner become almost an article of necessity when the results of the cogitations of American inventors over the subject began to appear, in the shape of attempts to make the shoes cheaply by the processes already understood. In 1832 Wait Webster, of New York, patented a process for attaching soles to gum elastic shoes; in the following year the first American factory for the making of rubber shoes, hose, etc., was established in Roxbury, Mass.; but the mode of manufacture in those days differed greatly from that now in vogue, a fact proved by an exhibition of leather boots at the Fair of the American Institute of 1833, which had previously been sent by J. M. Hood, of New York, to South America, to be varnished with the fresh juice from the tree. The Roxbury factory created a wonderful impetus in the trade, shares of its stock sold for many times their original value, and at once six more companies embarked in the manufacture. In 1835 Charles Goodyear invented his nitric acid process for depriving rubber of its adhesiveness, and this was at once applied to the fabrication of the shoe, effectually supplanting other modes of production. It was itself, in turn, supplanted by Goodyear's great invention of the vulcanizing process; and this last, although it has been greatly modified since its origination, is now employed. Such is the briefly told history of the rubber overshoe, an article of apparel now almost indispensable, and one that is manufactured in this country at the rate of some six million pairs per year.

It was an excellent idea on the part of the National Rubber Company, of Providence, R. I., to exhibit not merely their goods at the Centennial Exposition, but also to transport thither a set of machinery, and to show to the visitor the manner in which rubber shoes are made. The annexed engravings represent the different operations, now in progress in Machinery Hall, by means of which the rough lumps of crude rubber are converted into the handsomely finished shoe. A mass of raw rubber is represented in Fig. 1. This, cut into suitable pieces by hand knives almost as large as swords, is thrown between a pair of fluted cylinders, Fig. 2, between which it is masticated and washed by streams of hot water, emerging in the mat-like form also represented in Fig. 1. Next follows grinding, for from fifteen to twenty minutes, between hot, smooth cylinders; and while the rubber is undergoing this process, the sulphur, tar, and other compounds to be mixed with it are added. The material now begins to form itself into a sheet; and after going through a pair of cylinders which stamp upon it the patterns of the shapes in which it is to be cut, besides ornamentation, etc., it is led to a reel, as shown in Fig. 3. Meanwhile the black cloth, which is to form the backing, is led to the same reel, and as the latter is turned, alternate layers of rubber and cloth become wound about it. It remains now to consolidate the two materials, and this is done by passing the double sheet through heavy calender rollers under great pressure. From the sheets, thus prepared and of varying



CRUSHING AND WASHING THE RUBBER.



MAKING THE RUBBER INTO SHEETS.

thickness, according to the parts which they are destined to form, the various portions of the shoe are cut (Fig. 4), the workman following the stamped pattern with his curved knife. There are nine portions which go to make up the anatomy of the overshoe: the lining, the filling sole, the outsole, the insole, the forming strip up the heel, the strip around the shoe, the heel piece, the heel stuffing piece, and the junior or auxiliary heel piece; the respective uses of all these are sufficiently indicated by their names. As fast as they are cut out, they are passed to girls who sit beside a high table, perched on elevated stools. Running midway of the table are iron racks, and on pins thereon rest the asts upon which the shoes are formed. The operation of

4.

CUTTING OUT THE RUBBER SHOES.

putting the shoes together, which we illustrate in Fig. 5, is by no means a difficult one, although it requires some skill The lining and inside are attached to the last, and then the various pieces follow in succession, being secured in place by india rubber cement. Varnishing (Fig. 6) is next in order, and then it might be supposed that the shoe was complete—that is, to all appearances; but to feel the rubber is soon to be undeceived. It is soft and literally flabby; and although it has the shape of a shoe now, there is no reason to doubt but that, after a week's wear, the owner would find it half a dozen or so sizes too large, and more resembling a bag than a shoe. But here the vulcanizing process steps in to render the material hard and firm, yet elastic, and in a condition that, while the shoe may wear out, the shape will remain to the end. In Fig. 7, in rear of the varnisher, a pyramidal iron carriage is shown, which a workman appears to be pushing into an open doorway. Across the framework of this carriage are tiers of bars, and on these bars are fastened the lasts with the varnished shoes upon them. When the carriage is filled it is pushed into the vulcanizing oven, a small brick chamber beneath which are large coils of steam pipes. The steam heat is gradually brought to about 270° Fah., causing, in about seven hours, the complete vulcanization or union of the rubber with the sulphur and other ingredients, and leaving the shoes in fit condition for wear.

Mr. James Lick.

M. James Lick, the California millionaire, through whose munificence the construction of the million dollar telescope was some time ago provided for, died in San F rancisco a few days ago. Mr. Lick was born in Fredericksburg, Pa., in 1796, and was taught the cabinet maker's trade. About twenty-four years of his life were spent in South America, working as a mechanic at piano and furniture manufacture. He was an excellent workman and fortune favored him. so that he amassed some $40,000. With this capital he went to California before the acquisition of that State by the United States, and, foreseeing the rise in value of real estate which followed the settlement of the country, invested his money in land. Meanwhile he started a flour mill, where it is stated he made the best flour offered in the California markets, and which always commanded a dollar or so a barrel above ruling rates. During his successful milling business, however, he never lost sight of his land investments, and he was constantly on the alert to buy up government titles given to soldiers and other tenures of property which the owners at that time believed would never become very valuable. In this way he acquired the ground on which the Lick House in San Francisco now stands, for $40. That building Mr. Lick had built under his personal supervision, his mechanical knowledge standing him in good stead in constructing the elegant fittings of rare wood which embellish the halls and parlors. He likewise erected other large buildings on his land, most of which is in the heart of San Francisco, the city having grown round and upon it.

Not long ago, as we explained at the time, Mr. Lick set aside some $5,000,000 from his immense fortune for various charitable purposes, and for the construction of an immense telescope, vesting the funds in trustees. Subsequently he reconsidered his project, and sought to change the conditions of certain portions of the gift, and in this way became involved in dissensions with his trustees which gave rise to the report that he had abandoned the project. It is hoped that no legal controversy may arise to prevent a construction of the magnificent telescope, to cost one million dollars, as provided for originally by the deceased. Mr. Lick leaves one son only, a man about 50 years of age, who was attending the Centennial Exhibition when his father died.

How to Lay Shingles.

Not one half the persons who lay shingles when making a roof on a building have any correct ideas in regard to making a roof that will be absolutely rain-tight during a driving storm of rain. We have frequently seen men shingling, who, when they would meet with a worthless shingle, say once in laying two or three courses, would lay this poor shingle among the good ones, saying: "It is only one poor shingle, one shingle cannot make a poor roof." But one poor shingle will make a leaky one. If firstrate shingles are employed, and one poor one is worked in among every 100, that roof might about as well have been without any shingles. If any poor shingles are to be used, let them all be laid together near the upper part of the roof. The best of shingles will not make a tight roof if they are not properly laid, while the same shingles would make an excellent roof if laid as shingles should be laid.

The correct rule for laying shingles of any length, in order to form a roof leak-tight, is to lay the courses less than one third the length of the shortest shingles. For example, when shingles are 18 inches long, many of them will not be more than 17 inches in length. Therefore five inches is all that the courses will bear to be laid to the weather with surety of forming a good roof. The shingles must be three thicknesses over the entire roof. If they are not three thicknesses—if now and then a shingle lacks a quarter or half an inch of being long enough to make three thicknesses—there will in all probability be a leaky place in the roof at such a point. Moreover, when the lower courses lack half an inch of extending up far enough to receive the rain from the outermost course, in case the middle course were removed, it would be just as well to lay them seven or eight inches to the weather as to lay them only five, or five and a half, inches. Many shingles are only 16 inches long, and many that are sold for 16 inches long will hardly measure 15 inches. In this case—if the roof be rather flat, say about one quarter pitch—four and a half inches is as far as they should be laid to the weather. In case a roof were quite steep it might answer to lay the courses four and three quarter inches to the weather.

When buildings are erected by the job, proprietors should give their personal attention to this subject, and see that jobbers do not lay the courses a half inch too far to the weather.

There is another important consideration which is too frequently overlooked in shingling, which is breaking joints. Careless workmen will often break joints within half an inch of each other. When the joints of the different courses come so close together, the roof will most certainly leak. Why should it not? There is nothing to prevent it during a heavy rain. Unless a roof is steeper than a quarter pitch,

5.

MAKING THE RUBBER SHOES.

much care should be taken to break joints not less than one and a quarter inches. Let all workmen and helpers be taught the vast importance of rejecting every poor shingle, except when the upper courses are being laid.—*Canadian Mechanic's Magazine.*

An Effort to Preserve the Main Exhibition Building.

The Philadelphia *Ledger* says that preliminary steps have been taken toward the permanent preservation of as much as possible of the utility and beauty of the Centennial Exhibition buildings and grounds. The suggestion has taken strong hold of a number of energetic and influential men, who have expressed their readiness to give the undertaking both moral support and material aid.

[For the Scientific American.]

SEASONAL BEHAVIOR OF PLANTS.

It has for some time been supposed that the heat of spring acts more powerfully or promptly upon plants in higher than in lower latitudes. De Candolle attempted to test this by planting, in some intermediate locality, seeds of several common annuals, taken from different latitudes. With the exception of one species of seeds, which one confirmed his opinions, he had in this way but indifferent success, owing probably to the fact that most of the seeds from the different latitudes represented unlike forms of variable species. It then occurred to him to make the trial with trees instead of seeds. Accordingly, in the early part of 1875, he sent for branches of four species of trees from Montpellier, and paired them with similar branches from Geneva. After subjecting them to the same degree of heat till all acquired the same temperature, he placed the pairs in glasses of wet sand in a warm room under exactly the same conditions. When these developed buds and leaves in the spring, he found that all the slips from the northern locality arrived at the same stage of vernation earlier by from 18 to 23 days than those in the southern locality.

Two interesting considerations grow out of these facts, one of them practical and the other scientific in character. If these are facts, universal in their application, it will become a matter of considerable practical value in preparing vegetable products for market at the earliest possible moment. The great profits on many products of the soil depend largely upon their early introduction into market, when the demand is great and the supply small. If, by introducing seeds or plants from a northern locality, the gardener or fruit grower can make his crop ready for the market two or three weeks earlier, the advantages of such a course will not long remain unimproved. It is only necessary, by actual and sufficiently exhaustive experiment, to establish the truth of this theory in its application to all our seeds and plants, to gain for it universal acceptance.

In point of scientific interest appears the question why the same temperature acts more effectually upon the plant from the more northerly locality. De Candolle gives two answers to this query. First, that it may be due to natural selection of the buds. The earliest or most precocious have the advantage in the struggle for existence, while the latter ones are stifled. "In this way comes a selection and a successive adaptation of the tree to the climate." In connection with this, he furnishes incidental information respecting reversion. To illustrate the theory that the above result is accomplished because "every peculiarity of a bud is ordinarily reproduced year after year in the succeeding growth," he cites the case of a horse chestnut tree near Geneva, which, about the year 1822, first produced a single branch that bore double flowers, and has ever since borne nothing but double flowers, showing no tendency to revert to the single-flowered condition. This branch is supposed to be the origin of all the double-flowered horse chestnuts in the world, all others having been propagated from it by grafts.

The second reason why the northern plant develops, with the same temperature, more rapidly than the southern, is that the winter repose of the former is more complete than the latter; which, opines De Candolle, in some unaccountable way renders it more susceptible to the heat of spring. De Candolle attributes most importance to the latter explanation, while Dr. Asa Gray, in his comments, seems to incline to the former rather than to the latter.

The average time of the flowering of spring plants has been of late attracting considerable attention in Scotland. The Scottish Meteorological Society and the Botanical Society of Edinburgh have both been collecting data upon this subject. Both collections of facts have in view the advancement of meteorological science. The former society has given attention, for the past twenty years, to facts relating to the budding, leafing, flowering, and defoliation of trees and plants, and to the migrations of birds, in connection with the periodical return of the seasons. The material here brought together on this interesting subject has not yet been worked up so as to exhibit results; and before this is undertaken, it was decided to discuss the observations of Mr. McNab on the flowering of 32 spring plants in the open air in the Royal Botanical Garden of Edinburgh, during the past twenty-six years. These observations have been published in the "Transactions of the Edinburgh Botanical Society."

Mr. McNab's observations resulted in finding that the average time of flowering of the 32 plants taken had, during the twenty-six years, ranged in different species from January 25 to April 1, and later. He finds that the spring of different years varies considerably in the time of opening, it being sometimes thirty days later than the average, and again twenty-three days earlier: thus making a difference of fifty-three days between the earliest and latest springs during the twenty-six years. This average is obtained from observations on all the 32 plants; but when particular flowers are taken, the deviations from the mean are still greater. The greater deviations occur before the time of the equinox, when the time of flowering is often from five to seven weeks earlier or later than the mean. Unusually mild or severe weather before the time of flowering, as would be expected, greatly disturbs the plant in its season of æstivation, yet it affects some plants more than others. For example, in 1864, when the preceding December was remarkably mild, and the following January and February colder than usual, one species of blue-eyed grass (*sisyrinchium*), whose mean time of flowering was eleven days earlier than that of *daphne*, flowered eighty-six days before the latter. When such disturbances occur, of course no computed mean can be relied on, unless it be from data gained by observations recorded through a long series of years.

In Edinburgh, the mean temperature falls till January 11, and then slowly rises. Before the end of February, nearly half the 32 plants have flowered; and the very gradual rise in temperature to that time "suggests that it is not so much absolute temperature as the accumulated amounts of the preceding daily temperature, in the extent to which these rise above freezing."

If interest in this work can be sufficiently excited to prompt to the taking of observations similar to the above in other sections of the globe outside of Edinburgh and Scotland, we may expect results, in the science of meteorology, which will be not only most interesting but most profitable. We shall doubtless learn how closely the science of botany is related to that of meteorology, and how much insight we may gain into the intricacies of temperature and climatic influences by knowing the mean time of the flowering of plants in widely separated localities.

Another interesting matter, closely connected with the above, is the relation of color to the time of flowering of plants otherwise similar. Of the 32 plants observed by Mr. McNab, three were the blue, white, and red varieties of the species *scilla bifolia*. Of these, he found that the blue flowered first, and on the average ten days before the white, and the latter, four days before the red: making the difference of two weeks between the flowering time of two varieties of the same species, differing from each other only in color. The British wild flowers, to the number of 909 species, have been grouped according to their color and the month in which the flowers open. The results are very similar to those obtained by Mr. McNab. The order of colors in their average time of flowering is found to be, from earliest to latest, blue, white, purple, yellow, red, etc.

That the order of colors in spring flowers is from the outer colors of the spectrum to the inner has been several times observed by parties independent of each other; but others, in making like observations, have failed to see this order. Of course, to reach satisfactory conclusions on this point, an exhaustive study must be made upon all the colors of all the flowers, and the general average taken. Such exhaustive observations, continued from year to year for a long time, can hardly fail to result in very valuable knowledge as to the relative vitalizing power of the sun's rays in different seasons of the year, which will probably be available as well in the study of animal as of vegetable life. This also has a practical application in the rearing of early and late varieties of flowers and fruits.

It has been suggested that experiments be tried by excluding from the flower those colors of the sun's rays which the flower itself presents, in order to see what effect it would have upon the color and locality of the flower. In reply, it has been suggested that the reflected light would probably have less effect upon the plant than the absorbed light, and hence the object might possibly be best attained by excluding the colors complementary to those reflected.

Askenasy and others have experimented with flowers provided with sufficient food, but excluded entirely from light, and found that some changed their color and others did not. Mr. J. C. Costems suggests that the color may become almost constant by continued inheritance during a long lapse of time, and, consequently, be unaffected by the change of a few weeks or months. H. C. Sorby obtained results similar to Askenasy's, and concluded that "growing flowers in the dark seems to stop the normal development, to a greater or less extent, according to the nature of the coloring matters, the effect being greatest in the case of those substances which are the most easily decomposed."

An intimate connection has been observed between the seasonal order of color in flowers and the seeming "erratic behavior of certain radiometers." These eccentricities, observed in things so dissimilar as the color of flowers and the movements of radiometers, both affected by light, may lead us still further onward toward the eventual discovery of some new, or rather hitherto unknown, property or form of force existing in light. S. H. T.

[For the Scientific American.]

THE BLESSINGS OF GUNPOWDER.

All inventions, of whatever kind, belonging to any period of man's existence on the earth, have proceeded from his wants; or as it is stated in the characteristic proverb: "Necessity is the mother of invention." It is indeed a fact that history, ancient as well as modern, proves the truth, first forcibly brought out by Darwin, that the mightiest cause of progress has always been, with man as well as with the whole vegetable and animal kingdom, the struggle for existence and the survival of the fittest. This struggle has not only improved individual man from his originally savage condition to that of civilization and finally to enlighten ment, but, on a larger scale, has also served to promote the progress of nationalities, which has extinguished the weaker and less intellectual races of mankind, and exalted the stronger and more intellectual. This struggle for national superiority, which in its final result proves which are the really superior races, institutes, in its widest sense, war. In ancient barbarous and semi-barbarous times, bodily strength was the only superiority recognized, because it conferred on the possessor the means of compelling from others recognition and obedience; and hence in olden time the foremost leaders were always men of powerful frames, who could enforce obedience. This state of things lasted until the world was blessed with the invention of gunpowder, which equalized the power of individual men, as the bullet fired by a small man is as mortal as the bullet fired by a giant. It made an end to oppression of the weak by the strong, and even gave the weak and small some advantage, as the chance of being hit by a ball is larger in proportion to the size of the individual, and *vice versâ*.

The general introduction of gunpowder for purposes of defence was the most powerful cause of the downfall of feudalism, that curse of the middle ages, when the weak and poor had not only to work for the strong and rich, but to submit to the most glaring injustice. It was gunpowder which changed all that, because physical strength no longer gave entire superiority to its possessor, and the powerful soon found that he had to practise justice, even to the lowest and feeblest of his neighbors and dependants. Gunpowder, then, has wrought the great social change which resulted in the lawful protection of the weak; and as necessity is the mother of invention, it is no wonder that this valuable invention was due to that state of society in which the most urgent wants are created, namely, a general war or struggle for superiority. This is a grand subject of contemplation for the deepest philosophical minds.

The saying that "gunpowder is the greatest civilizer" is therefore a profound truth. It is certain that that wonderful ancient nation, the Chinese, who knew it many centuries before the European peoples, had some degree of civilization at a period when Europe was still plunged into barbarism. At that time the Chinese had a perfect right to consider other nations as outside barbarians; and these nations made no considerable progress until gunpowder came into extensive use in warfare. Gunpowder at once put an end to the barbarous and demoralizing hand-to-hand fights, and has thus made wars less ferocious and less destructive, as it decides battles with far less destruction of life than was formerly the case. Even the improved appliances of the present day, the cannon of enormous size, the *mitrailleuses*, Gatling guns, needle guns, breech-loading rifles, etc., murderous as they look, and able to kill many men in a shorter time before, have, strange to say, an effect contrary to the theory, by which they would naturally be supposed to have the result of augmenting the list of victims in battles. Statistics of all the recent battles in which these appliances were used have indeed shown a much reduced slaughter of human beings, in proportion to the number engaged, than was the case in battles fought before these apparently very destructive and murderous inventions were adopted.

The greatest enemy in war is, at the present day, sickness, as was shown in the Crimean war, our Southern war, etc. Disease, indeed, has carried off or disabled more men than lead. But since chemical and mechanical ingenuity has conferred the blessings of gunpowder and improved firearms upon the world, it is now the business of physiological and medical science to apply knowledge and skill, and devise means of introducing sanitary measures to preserve the health of the soldier, and to reform the treatment of the sick so as to reduce mortality in the hospitals to a minimum: for as we have stated, the mortality by battles is, on an average, notwithstanding that appearances point the other way, less than that by disease in the hospitals.

It is a subject of just national pride that many of the measures taken by the staff of our military health officers has been so proper and effective that they have excited the admiration of all the world, and been imitated and introduced by several European nations. The principal cause of this, we should state, is that, according to the acknowledgment of the heads of this department, their plans were not thwarted by interference by non-medical superiors, as is the case in European armies. Our medical staff has an independent existence, enjoying the direct support of the United States government, which gives it *carte blanche* to carry out its own views on the important functions it is called upon to perform. How effectively and honestly this has been done, and the confidence placed in the medical officers been justified, the history of our war fully and conclusively proves. *

A New Dye Stuff.

Ch. Lauth has succeeded in producing another new class of dyes by the introduction of sulphur into aromatic diamines, and then oxidizing the new sulphur compound. On heating phenylen-diamine (made from nitro-acetic anilide) with sulphur, to 150° or 180° C. (300° or 356° Fah.), sulphuretted hydrogen gas is evolved, and a new base containing sulphur is formed. This base is converted by oxidizing agents into a beautiful violet dye.

The same substance can be obtained in a more simple manner by dissolving the muriate of phenyl-diamine in a large quantity of sulphuretted hydrogen water, and slowly adding sesquichloride of iron. The precipitate formed is washed with a weak salt solution and recrystallized from hot water. In the dry state this dye consists of very fine curved and intricate needles of dark green luster. It is soluble in pure water, but foreign substances change its solubility; with caustic soda it yields a brown precipitate, probably the free base. Reducing agents destroy the color of the violet substance; oxidizing agents destroy it quite quickly. Like the ordinary aniline dyes, it may be modified by substitution; with aniline it produces a blue dye insoluble in water; with aldehyde or iodide of methyl it gives a green, which attaches itself directly to the fibers. Cresylen-diamide from nitrated ortho-acetoluidin gives, under similar conditions, more of a reddish violet; cresylen-diamine, corresponding to paratoluidin, gives a violet red. These new dyes contain sulphur.

CEMENT FOR WOOD VESSELS REQUIRED TO BE WATER-TIGHT.—A mixture of lime clay and oxide of iron separately calcined and reduced to powder, intimately mixed, kept in a close vessel, and mixed with water when used.

THE PROCESSES OF STEEL MANUFACTURE.

The manufacture of steel by a process as simple as possible, at the lowest cost and of the best quality, has called forth, especially of late years, the exercise of much inventive ability on the part of both chemists and engineers, both at home and abroad. There has resulted such a variety of differing methods that some systematic classification of the processes has become very necessary. In the *Mittheilungen des Hannoverischen Gewerbe-Vereines*, Professor Heeren publishes the complete classification, a translation of which is given below, and which will be found both instructive and of value for purposes of reference. As steel occupies nearly the middle place between cast and wrought iron in its proportion of carbon, it may be prepared either by decarburizing pig iron, or, on the contrary, by causing wrought iron to absorb carbon. The processes to accomplish these ends may be arranged under five principal heads: A, Fabrication of steel by decarburization of crude or pig iron; B, by carburization of wrought iron; C, by mixing a wrought iron poor in carbon with a pig iron rich in same; D, by mixing pig iron with ore (the pig yields carbon which reduces the ore and transforms the reduced iron into steel); E, directly by means of ore; F, cast steel. Subdividing these systems, we have the following methods under each heading.

A.—METHODS BY DECARBURIZING THE CRUDE IRON.

1. Steel obtained by a long heating of the crude iron in an oxidizing atmosphere, the metal not being brought to fusion. (*a*) Tunner's method in sand, where the deoxidation is produced by means of the oxygen in the air. (*b*) Jullien's method, in forge scales or spathic ore. This produces malleable iron. (*c*) Herzeeles' method in steam; (*d*) Thomas' method in carbonic acid. The last two processes have not been employed to any great extent.

2. Natural steel: In this method, employed since the earliest times, the crude iron is melted in a refining furnace with wood charcoal, and decarburized by the ferrous oxide of the scoria. The product is purified by a repeated refining.

3. Puddling: This process is the same as the preceding, from a chemical point of view, but is practised in a reverberatory furnace heated with coal. It is necessary to purify the product by repeated refining or by transforming it into cast steel.

The construction of puddling furnaces has undergone many changes. We may distinguish (*a*) the ordinary puddling furnace with fixed hearth and heated by coal, (*b*) the same heated by lignite or peat, (*c*) the puddling furnaces of Schafhäutl and others, with mechanical rabbles designed to diminish the labor so fatiguing to the workman. These, however, have been entirely superseded by new systems. (*d*) The Danks furnace, the hearth of which is formed of a hollow cylinder placed horizontally, and turning about its axis. It gives a product of excellent quality, and is economical. The interior lining, however, is difficult to maintain. (*e*) The Ehrenwerth furnace has a horizontal circular hearth turning about a vertical axis. (*f*) The Pernot furnace also has a circular sole, which, however, is not horizontal, but slightly inclined, so that during its rotation the iron and scoria run to the lowest point and are thus in a state of continual motion; while the elevated parts of the hearth, together with the iron and scoriæ thereto adherent, are submitted to the oxidizing action of the air. Professor Heeren thinks this furnace to be the best, because it realizes the advantages of mechanical puddling without needing any special lining.

4. The Bessemer process: A current of air, finely divided, is passed through the liquid crude iron. The carbon, silicon, and a part of the iron burn, and the temperature is so highly elevated that the iron, decarburized in part or transformed into steel, remains molten. It is then run into molds.

5. Bérard's modification of the above: Air and gases are alternately introduced into the retort with different advantages.

6. Peters' process: The liquefied crude iron in a reverberatory furnace falls in the form of rain in a vertical chamber in which the furnace gases also pass, and in which air is blown so as to decarburize the metal to the desired degree.

B.—METHODS BY CARBURIZATION OF WROUGHT IRON.

1. Indian or Wootz steel: Wrought iron of extraordinary purity, obtained by treating a very pure ore in small chamber furnaces by the direct method, is hammered, made into bars, cut into short pieces, and placed in small crucibles with a few green leaves. The crucibles are hermetically sealed and heated for a long time at a high temperature. The iron is transformed into steel by uniting with it this carbon contained in the leaves, and the steel even partially melts. These half melted masses furnish the famous sword blades and plates of Persia and Damascus.

2. There are several other processes resembling the Indian, which, however, are not carried on on a large scale. There are (*a*) the Mushet process, in which wrought iron obtained by the ordinary refining method is melted with powdered wood charcoal. (*b*) The Vickers' process, analogous to the preceding, with the addition of oxide of manganese. (*c*) The Stourbridge, Brooman, Thomas, and Binks processes, based on identical principles.

3. English cemented steel: Wrought iron of the best possible quality is, in the shape of bars, packed in clay boxes, together with wood charcoal coarsely pulverized. The heating continues for two or three weeks. Without melting, the iron is changed into steel, which by remelting is transformed into cast steel.

4. Parry's cupola steel: Fragments of wrought iron, melted in the cupola with a large consumption of coke or wood charcoal, may be transformed into steel or even into cast iron according to the length of the operation. This system offers an advantageous method of utilizing scrap, and requires no special apparatus.

5. Chenot's process: In this the ore is reduced by heating it progressively with coal. A non-melted iron sponge is obtained, which is ground and separated as well as possible from the gangues by the aid of a magnet. Lastly, it is mixed with carboniferous substances, and melted under pressure. The principal disadvantage of this process is the difficulty of separating the gangues without losing the steel.

6. Casehardening has for its object the transformation of the surfaces of wrought iron objects into steel. It is done in two ways. (*a*) The pieces are placed in small sheet iron boxes and surrounded with chips of wood. The boxes are hermetically closed and heated in a forge fire, for 15 or 30 minutes, to an intense red heat. They are then removed quickly, opened, and their contents thrown into cold water, whereby the exterior steel shell is rendered as hard as glass. (*b*) The pieces are heated to a whitish red and moistened with ferrocyanide of potassium, which acts, by its cyanogen, on the iron, and transforms the surface into steel.

C.—METHODS BY FUSION OF A MIXTURE OF CAST AND WROUGHT IRON.

The two materials may be, both or only one of them, used in a melted state.

1. Bessemer steel, prepared by the ordinary method. The crude and wrought iron here are both liquid, while, as we have previously said, cast iron may be directly transformed into steel. The method most followed, and which leads most surely to the end in view, consists in completely decarburizing the crude iron in the converter, and in adding to the melted metallic iron a rigorously determined quantity of liquid crude iron. The carbon of the latter affects the previously decarburized iron, and makes a steel containing a given proportion of carbon.

2. Crucible steel is obtained by melting in crucibles a mixture of crude and wrought iron. The former liquefies first, and slowly melts the latter.

3. Martin's steel is similarly made, by replacing the crucible with a reverberatory furnace. The crude iron is liquefied under a thin layer of scoria on the concave hearth of a reverberatory furnace, heated to an intense red-white heat by a Siemens regenerator. Scraps of steel and wrought iron of all kinds in desired quantity are added, and the steel is run into molds of cast iron.

D.—METHODS BY A MIXTURE OF CAST IRON AND ORE.

Uchatius steel: The cast iron is granulated by running it into water while molten, and the grains are melted with spathic ore, peroxide of manganese, and wrought iron in crucibles. The ferrous oxide of the spathic ore is reduced by the carbon of the cast iron, and the surplus of carbon unites with the wrought iron to make steel.

E.—METHODS BY PREPARATION DIRECT FROM THE ORE.

The Siemens direct process: The ore is melted alone, without addition of reducing material, at a very elevated temperature; then the iron is reduced and transformed into wrought iron or into steel by adding coal.

F.—CAST STEEL.

For the purification of steel by fusion, cemented, forged, and puddled steel are employed. To improve the qualities of the steel, and notably to augment its hardness, diverse substances are added. Thus we have: 1, silver steel, 2, nickel steel, and 3, wolfram or Mushet special steel.

THE RUSSIAN SYSTEM OF TRADE EDUCATION.

Our correspondents at the Centennial Exposition have already briefly described the courses of study in many of the institutions of learning there represented. There is one great school, however, which is worthy of something more than passing notice; and for many reasons its exhibit may be profitably studied by all interested in the important question of how best to impart practically valuable technical education. While, with all mechanical schools, the cardinal object of the Imperial Technical School of Moscow, Russia, is to eliminate all useless or routine labor in the acquisition of a trade, and to require the student to perform only such as is best adapted, in connection with proper advice, to give the necessary knowledge, it adopts to this end a different method from any hitherto practised; and for the first time it has successfully proved the value of absolutely systematic instruction applied to the acquirement of industrial skill. The method of teaching the mechanical arts here initiated has gradually spread itself into all the Russian technical schools; and it is not unsafe to believe that, judging from the reported results, the same must eventually supersede other modes of instruction elsewhere. It is our purpose in the following to exhibit briefly the practical way in which the system is carried on.

The auxiliaries of education appointed for the teaching of any mechanical work whatever—for example, fitting—are divided into three categories. Taking fitter's work as an example, under the first division belong collections of tools used in the various operations, with which the beginner must make himself perfectly familiar before entering upon practical labor. Some of these collections are exhibited at the Centennial. There are collections of instruments for measuring, for drilling, and for finishing, models of files increased to 24 times ordinary size for the purpose of exhibiting the shape of teeth, etc., models of taps and dies magnified 6 times for the study of the direction of the angles of incision, and models of drills similarly magnified for the practical study of cutting angles; and there is also a collection of instruments and apparatus for teaching the tracing of yet unworked metal articles. Similarly in turning both in metal and wood, and in joinery, there are like collections, in which every tool is represented either in actual or in largely magnified form, so that the most accurate knowledge is thus imparted relative to every characteristic of the implements.

Having learned what he is to work with, the student is next taught practical manipulations. These are included in the second category, and it is worth while to review them. In wood turning, the pupil begins by following exercise models of various channelings, then he learns to turn a cylinder, a cone, a bullet, and so on, through thirteen articles, up to a vase and cover. In model and pattern making, the first lesson is to saw straight and along fiber, then to saw in a curved line, then to plane wood of different sections, to make joints, and the last of 25 operations is cross scarring by a skew abutting. At the forge, the student begins by forging square out of round iron, then round out of square. Nuts are next made, then screw heads of all shapes, then bolts of various kinds, then welding and steeling; and the last operation is to make welded ears to square bar iron. Metal turning starts with a simple cylinder and ends with right and left worms of a screw. Fitting begins with cleaning castings, which is followed by chiseling of various surfaces. There are 29 filing operations, beginning with the filing of thin edges according to marked lines, and ending with the filing of cast conical apertures. Then come punching and boring, drilling, and finally screw cutting.

These are merely general operations. Models are followed and the work is accurately graded, so that the beginner overcomes by degrees the difficulties presented. The teacher sees that each number of the programme is satisfactorily executed, and keeps the learner on that particular piece of work until it is mastered. Then the next operation in the series is undertaken, the instructor giving all the requisite explanations. Hence it is impossible for a student to become a good chiseler and a poor filer at once, or skillful at the drill and bungling with saw and plane. In every course the order is inflexibly followed, and the acquirement of each integral advance is the only road to progress.

Lastly comes the third category, or the practical application of all that has been learned. And here another series of lists meets us. But instead of the objects being, as it were, merely abstract, they are parts of machines, etc., selected so that in their execution all the practical resources of the art which the pupil has been studying are brought into play. The wood turner begins by producing a stuffing box cover. Then follows the shell for a step, a valve with a bullet seat, oil cups, rollers, star and bevel wheels, cylinder cover, same with stuffing box, pulley, and so on through a list of 43 pieces, ending with the chamber of a bullet valve. The model maker following models of wood joinings starts with a tongue joint, and, after producing 25 kinds of joints, scarrings, etc., begins on patterns. The list includes a grate bar, crank, puppet, wall box, sheave drum, and eccentric bevel wheels; and the eighteenth and last requirement is a set of patterns for a horizontal feed pump. The metal turner makes a steam cylinder, piston, cylinder cover, and lastly a crank shaft. The last five operations required of the fitter are the fitting of a toothed coupling, of a clutch coupling, of brasses to a plummer block by five planes, of a parallelopiped to an aperture, and the fitting of sliding plates.

That the pupil who has gone through this course becomes a skilled workman, it is hardly necessary to point out. He must be so if he succeeds in graduating at all. But all this is merely preliminary. The student has yet to learn to be an engineer, and to this end he has been taught theory for a portion of his time. He now advances to a new school of practice, namely, the mechanical works. There, while he may not labor at the bench himself, he sees others do it, and he is taught construction. There is a large force of hired workmen carrying out orders on a commercial footing, for engines and machines of all kinds. There are iron and brass founderies, engineers' shops, builders' shop, forge, joiners' and painters' shops, drawing office, and counting room. The student is obliged to study everything, from iron smelting to book keeping, and thus his course is completed.

It is the fortune of a large number of graduates of the scientific courses of our colleges, when thrown for the first time upon their own resources, to take positions as draftsmen; some few enter works to learn the practical part of a trade. The latter are neither apprentices nor skilled hands. Those who become draftsmen, not possessing as a rule the practical groundwork for an industrial career, nor from their position having opportunities for acquiring the same, too often remain draftsmen for their best years, if not for all their lives. The trade learners, meaning some day to follow their profession, perhaps learn the truth that, while the professions are overcrowded (except at the top), the trades are not, and, concluding to adhere to the trade, become educated to a certain branch, and, under the principle of the division of labor (in these times constantly expanding), find in the end that their knowledge is confined within the limits of a narrow specialization.

With such an education as we have outlined, it is difficult to imagine either of the above results; for even should professional opportunities fail, the shop is ever open to a workman whose skill is as broad as a trade itself and not confined to any one branch thereof. Such acquirements, moreover, could not be of the greatest value to any person in any walk of life. The Emperor of Germany, should he lose his crown, can earn a good living by setting type, for he is an excellent practical compositor and printer. The Queen of England is a skilled seamstress, a successful authoress, an artist of ability, and a mistress of the spinning wheel and loom. These are but well known instances, out of the scores of examples, of the highest of dignitaries protecting themselves against reverses of fortune by acquiring trades.

THE PROFITABLENESS OF IRRIGATION.

During recent years the British Government has invested something like seventy millions of dollars in irrigation works in India, and it is proposed to spend thirty millions more for such purposes during the next five years. In almost every instance, the works have proved immediately remunerative, while in some cases the profit has been enormous.

On a few of the larger complete works, the expenditure has been as follows:

Ganges Canal	$13,223,225
Eastern Jumna Canal	1,038,615
Western Jumna Canal	1,671,085
Godavery Delta Works	3,221,405
Kistnah Delta Works	2,164,470
Cauvery Delta Works	211,020
Sind Inundation Canals	2,980,000

For all India the net annual revenue from irrigation works now amounts to upwards of five million dollars, or 7·7 per cent of the capital invested. From Oude and the Central Provinces, the returns have been *nil*. In Rajapootana there has been an annual loss of 19 per cent of the capital. Elsewhere the profits were very encouraging. In the Northwestern Provinces, the revenue shows a profit on the outlay of 4·6 per cent, in the Punjaub 5·6 per cent; in Madras 27·6, in Bombay, including Sind, 16·9, in British Burmah 3·27 per cent. The Ganges canal yields 4·88 per cent, the Eastern Jumna 25 2, the Western Jumna 30, the Godavery delta works 42·16, the Kistnah works, 19·73, the Cauvery works 273·31, the Sind canals 33·3 per cent annually.

Charging against the capital outlay of these works the interest lost on the money invested before the works became productive, compensation paid to landowners, money spent on unfinished and impractical schemes, etc., in addition to the direct outlay, the revenue still shows a considerable balance of profit. The corrected capital, and the percentage of annual revenue thereon, appear in the following table:

	Capital invested.	Percentage of revenue on capital.
Northwestern Provinces	$17,827,225	5·2
Punjaub	15,671,010	4·8
Madras	9,467,200	22·72
Bombay (with Sind)	11,113,940	11·9
Gauges Canal	14,400,890	4·5
Eastern Jumna Canal	2,349,890	11·2
Western " "	6,531,965	7·6
Godavery Delta Works	3,418,525	39·7
Kistnah " "	2,337,135	13·2
Cauvery " "	1,467,890	36·6
Sind Inundation Canal	5,930,000	18·6

But the revenue returns from these great undertakings are not the only source of profit. In a country like India, where rains are irregular and transportation difficult—and often in the wet season impossible—a failure of seasonable rain is apt to be followed by loss of harvests and consequent famine, entailing great loss of life, loss of revenue to the government, and sometimes the abandonment of thousands of square miles of fertile soil to the jungle, for lack of cultivators. All this is prevented by irrigation.

In 1860, when a large part of the Northwest Provinces was baked as in an oven, the Ganges canal preserved grain crops enough to feed a million of people who must otherwise have perished unless kept alive at the cost of the Government. And again in 1874 a great multitude were saved from the horrors of starvation; and the enormous outlay consequent upon the famine in the low provinces was kept from being still more enormous by the Soave canal, which even in its unfinished condition enabled luxuriant harvests to come to maturity when otherwise every green thing would have been destroyed by the drouth. In other parts, the seats of some of the worst famines of history have been thoroughly watered and placed beyond the reach of such disasters.

COMPARATIVE COST OF ILLUMINATION.

A number of experiments have been made lately in London to test the comparative cost of illumination with the various materials used for that purpose. Below is the result, the first column containing a description of the materials tested; the second, the price of the material in London, reckoning twenty-four cents to the shilling; the third column shows the duration of the light furnished for one cent, the light being reduced to equal one sperm candle. With tho exception of the last named material, common gas, the prices do not vary sufficiently from those which prevail here to effect the value of the comparison. London gas is reputedly of inferior illuminating power, so that the economy of its use can scarcely be so much greater than ours as its cheapness would seem to indicate.

Standard sperm candles, per lb.	$ 48	1h. 7m.
Best wax candle per lb.	48	1:6
Sperm oil in moderator, per gallon	2.28	1:12
Belmont sperm candle, per lb.	30	1:27
Stella, or Burmese wax, per lb.	30	1:37
Petroline candle, per lb.	36	2:15
Composite candle, No. 1, per lb.	22	2:5
" " " 3 "	16	2:45
Common dip candles, per lb.	12	2:52
Almond oil, in moderator, per gallon	2.22	3
Colza, per gallon	1.20	4:37
Paraffin oil, in lamp, per gallon	72	9:35
Common gas, per 1,000 feet	90	26

The price of gas being about three times as great here as in London, no such marked advantage as appears in the table can accrue from its use on the score of cost. Still it must rank among the most economical of artificial illuminations, at least three or four times as economical as common candles, for a given amount of light.

A British Steam Tramway.

The Wantage line was only opened for public traffic in October last, and lies in a somewhat remote district. Perhaps it may be well to state, for the information of those who are unacquainted with its formation, that it is about 2½ miles in length, laid down along the side of the turnpike road leading from the town to the station of the Great Western Railway at Wantage Road. It consists of a single line of 4 feet 8½ inches gage, with four turnouts or passing places, with movable facing points at intermediate distances. The rails are of the ordinary bridge section, 40 lbs. per yard, bolted to longitudinal timbers of the dimensions 10 inches by 6 inches, with transoms 5 inches by 4 inches, 10 feet apart. The line crosses the turnpike road once only in the distance, and passes over the Wilts and Berks canal by an iron bridge of 38 feet span; its sharpest curves are of 70 feet radius, and its steepest gradient is 1 in 47, the length of the longest being 330 yards. The machine in use on the line is Mr. Grantham's patent combined steam car. The car has from the commencement continued to run daily with satisfaction, and without in any way obstructing the traffic on the road; and from its freedom from noise, steam, and smoke—the two latter being scarcely observable—horses traveling on the road appear to take no more notice of it than of an ordinary horse car. It may be stated also that on the occasion of the Berks volunteer review, which was held on August 7 last, on ground adjoining the Great Western Railway station, when it was computed that not less than 5,000 persons traveled on the road in vehicles of all descriptions during the day, and the car was running backwards and forwards the whole time, no inconvenience or difficulty with the horses was experienced. The car, which is 27 feet 3 inches in length, 11 feet 1 inch high, and 6 feet 6 inches wide, is divided into first and second passenger compartments, with the boiler and machinery fixed in the center, and runs on four wheels, one pair for driving, the other pair fixed to a radial axle for easing the curves; it is propelled backwards and forwards without turning at either end of the line, and only requires to be replenished with water after a double journey; it is driven from either end by removable levers, the driver having complete control of the machine as regards turning on, shutting off, or reversing steam, as well as applying the brake power, which is so perfect that the car can be brought to an almost immediate standstill. It is constructed to carry, both inside and outside, 60 passengers, and the full complement has often been conveyed by it; it appears highly popular with the public, and the traveling is much prefered to that of the horse cars; and judging from the silence with which it glides along on the rails, the absence of clatter and noise, as well as the ease with which the machine can be worked, it is considered, by those competent to form an opinion of its action, that the time is not far distant when the expensive system of working our street traffic on tramways by means of horse power will be succeeded by the use of steam under proper restrictions, especially as it must be apparent to all acquainted with the subject that the cost of working must be greatly in favor of steam. For the information of those interested, the cost of working the Wantage line, per day of twelve hours, as nearly as can be ascertained, is submitted:

DISTANCE TRAVELED PER DAY, 40 MILES.

Weight of gas coke, 240 lbs.		
Weight of steam coal, 56 lbs.		
—296 lbs. cost	67	cents.
Fuel for lighting	3	"
Oil and light for car	6	"
Driver's wages	$1.20	"
Stoker's wages	72	"
Conductor's wages	56	"
Estimated wear and tear	96	"
COST OF WORKING PER MILE, 11 CENTS FOR STEAM CAR.	$4.20	
Cost of horse cars—Four horses, at 72 cents	$2.88	cents.
Two drivers.	1.44	"
Conductor	56	"
Oil and light	4	"
Estimated wear and tear	1.44	"
Rent of stables, etc	24	"
COST OF WORKING PER MILE, 16·5 CENTS FOR HORSE CAR.	$6.60	

It will be seen by the above table that the cost of working the Wantage line by horse power is greatly in excess of the cost of working it by steam power; but the time occupied, owing to the restrictions laid down by the Board of Trade, confining the speed to eight miles per hour, is the same.

The Lowe Gas Process.

The long effort to obtain the gases of water upon a practical scale, that is, in unlimited quantity and at an economical cost, is too old and familiar a story to need repetition here. It has covered so many unsuccessful attempts and so many misrepresentations that the very name has been a synonym for failure and fraud. Nevertheless it is to-day an accomplished fact, as real as the systems of steam power and telegraphy; and it is peculiarly gratifying that, after sixty-five years of unsuccessful experiments, in which the most enlightened nations have participated, our Centennial year should witness the complete demonstration by our own countrymen, of a method, the value and influence of which, on the industries of this industrious age, can hardly be estimated. This journal has heretofore directed attention to the earliest performances of the new method, which has now accepted and accomplished a test upon so large a working scale as to entitle it to a marked recognition. It has recently gone into operation at the Manayunk Station of the Philadelphia Gas Trust, with such excellent results as would seem to justify all that has been claimed for it.

Indeed, each successive trial appears to develop stronger points in the system. For example, in the able report of Professor Henry Wurtz upon its workings in Utica, where it distributed satisfactorily some 24,000,000 cubic feet, its facility was deemed remarkable at a yield of 3,000 cubic feet per single generator for a run of forty minutes. At Philadelphia, however, it has, in the first days of its operation, produced as high as 10,000 feet for thirty minutes, and it is believed that increasing familiarity with the apparatus will show a gain even on this. This advance is, in part, attributable to the delivery of steam at a temperature never before attained, and by a plan at once economical and efficient, the heat being derived from the products of combustion previously burned in a stack of refractory material, through which, when at a white heat, the steam is conducted. This ingenious method also avoids the oxidation so troublesome in all other superheaters.

The high heats evolved by this simple apparatus are likely to reduce to a minimum the carbonic acid gas, already at a low proportion in this process. It would really seem that the question which has been so prominently before the public of late, as to the possibility of obtaining better and more economical methods of lighting, has been fully met and answered by this system.

It certainly furnishes a very brilliant illuminant at what is claimed to be an important reduction in cost, and it is to be hoped that those who control the gas-making interest will give prompt attention to the matter. Their business has grown to be one of the great industries of the period, and it should be conducted upon progressive principles.

But valuable as this process may be for illuminating purposes, it must be manifest that a demonstrated success in this department carries with it some great possibilities in the direction of fuel. There is scarcely a question of greater practical interest than that relating to improved methods of heating, as it affects so wide a range of manufactures in metallurgy, mechanics, and chemistry, to say nothing of the still wider realm of domestic uses. Our present systems are still grossly defective and wasteful, utilizing not more than one eighth of the heating power of coal, without reckoning the inconvenience and cost of handling so heavy a material.

It is hardly unsafe to predict that the coming fuel, for the next stage of swiftly developing civilization, will be in a gaseous form, the advantages of which are too apparent to need enumeration.

When this time comes, and we hope to see it, it is our belief that the gases employed will be the product of water by some such process as the one whereof we write. Air, which is similarly decomposed into gas, is employed to some extent now, principally in the case of the Siemens furnace for steel manufacture, but the excess of nitrogen and carbonic acid render it a very questionable economy. Certainly an element that would furnish hydrogen, in lieu of these two non-combustible gases, would possess great advantages.

The field of investigation presented by the Lowe process at Philadelphia is one of great interest, and should be improved. We shall watch its development and report upon it from time to time.

NEW BOOKS AND PUBLICATIONS.

NOTES ON BUILDING CONSTRUCTION. Part II. (Advanced Course). London, England: Rivingtons, Waterloo Place. For sale by J. B. Lippincott & Co., Philadelphia, Pa.

This is a continuation of a very admirable text book prepared for the use of students in the Government Science and Art Schools, South Kensington, London, and especially directed to the requirements of the examiners of that celebrated institution. If the architects and builders of the coming generation are educated up to the standard contemplated in this work, and are imbued with the thoroughly practical spirit it inculcates, an important improvement in our homes and public buildings, in regard to both the art and the science of architecture, may be looked for. Technical explanations are seldom given with such clearness as in this work; and it is a pity that the author's name is not given, as he has written a standard manual of the very highest excellence. Part I. of the book was published some time since, and reviewed by us at the time. Part III. is now in the press.

THE ELEMENTS OF GRAPHICAL STATICS. By Karl Von Ott, Professor of the Imperial and Royal German High School of Practical Science, etc. Translated by George Sydenham Clarke, Lieutenant Royal Engineers, etc. Price $2.00. New York city: E. & F. N. Spon, 446 Broome street.

The literature of the graphical method is rapidly extending, and its study now forms a large and important part of the education of properly trained engineers; but although Professor Clerk-Maxwell, and more notably the late Professor Rankine, have used this method in their many well known works, it has scarcely received the attention which it merits. Lieutenant Clarke has faithfully performed the translator's task, and has added some valuable notes to Professor Ott's book, which is an excellent introductory treatise on the whole subject.

ALGEBRA SELF-TAUGHT. By W. P. Higgs, M. A., etc., Author of "Scientific Notes for Unscientific People." Price $1.00. New York city: E. and F. N. Spon, 446 Broome street.

This is the book that we have been looking for for some time past, namely, a clear and practical introduction to the science of algebra, written in a way to interest the young and uneducated. The many correspondents who modestly inform us that they are "unacquainted with algebra and formulas" should read this little book carefully; and it will open before them a large field of knowledge of the highest practical value in all the mechanical arts.

ELECTRO-TELEGRAPHY. By Frederick S. Beechey, Telegraph Engineer. Price 60 cents. New York city: E. & F. N. Spon, 446 Broome street.

A very readable little text book, containing much information.

TABLES FOR SYSTEMATIC QUALITATIVE CHEMICAL ANALYSIS. By John H. Snively, Ph.Dr., Professor of Analytical Chemistry in the Tennessee College of Pharmacy, etc. Price $1.00, post paid. Nashville, Tenn.: C. W. Smith, 158 Church street.

This handy volume contains practical directions for the analytical processes used in the investigation of all common substances, which are ar ranged in tabular form, and are well adapted for the use of students, as an introduction to the voluminous literature on the subject. Much of the matter is new and original; and the author's explanatory notes give many details of manipulation, and point out the precautions to be observed by the operator. The book bears promise of much utility.

LIVER COMPLAINT, NERVOUS DYSPEPSIA, AND HEADACHE: Their Causes, Prevention, and Cure. By M. L. Holbrook, M.D., Editor of the "Herald of Health," etc. New York city: Wood and Holbrook, 13 and 15 Laight street.

The treatises on health and disease which have been published in great numbers of late years do not seem to have diminished the crowds of patients who flock to the doctors in search of remedies for dyspepsia, liver complaint, and other troubles, brought on, as Dr. Holbrook points out, mainly by gluttony, intemperance of all kinds, and laziness. This little book gives the only recommendation possible in such cases, namely, moderation in food and drink, care in the choice of food, exercise, and cleanliness. It is not much to the credit of the invalids and hypochondriacs of our day that these remedies have to be so frequently prescribed.

THE WOOL CARDER'S VADE MECUM, a Handbook of Woolen Industry. By W. C. Bramwell. Terre Haute, Ind.: Hebb and Wigley.

An excellent treatise on a little understood specialty. The tables and formulæ for calculating speeds, etc., are especially valuable.

A SONG OF AMERICA, AND MINOR LYRICS. By V. Voldo. New York city: Hanscom & Co.

The "Song of America" commences: "When Earth was but a fledgling, and her race first entertained the everlasting space," etc. The author does not explain where earth's race lived when earth's feathers began to grow, nor the nature of the entertainment to which everlasting space was invited: but he puzzles his readers with a wilderness of riddles of the same kind, and astonishes them with seventy pages of matter that defies the interpreter, and laughs him to scorn. Every line in the book has a sphinx-like impenetrability about it that would be exasperating if it were not perfectly easy to place the volume in the basket thereunto appointed.

MR. F. GUICHETEAU has recently patented a newspaper file of very convenient form. It consists of a paper box, made in the shape of a book and appropriately lettered on the back. Inside the box, where the backs of the papers are, are cross wires for filing the papers on, and a steel spring for holding them tightly in place. The files are made and sold by Mr. F. Clerget, 1,575 Broadway, Brooklyn, N. Y.

W. E. MARSHALL, artist, has made some fine steel plate portraits of the candidates, which are published by O. Marshall, 697 Broadway, New York.

Recent American and Foreign Patents.

NEW AGRICULTURAL INVENTIONS.

IMPROVED HAND CULTIVATOR.

James S. Lucas, Bowling Green, Ky.—This consists of a hand cultivator with V-shaped arms, having a suitable number of teeth and curved cutting knives at the front part. It is readily used between the rows of vegetables, and forms thus a convenient implement for field and garden use.

IMPROVED MOWING MACHINE.

Frank Pastorius, Quincy, Ill.—This is an improved device for giving motion to the sickle bar of reapers and mowers. To the journals of the gear wheels, which engage with the drive wheels, are rigidly attached two cams, set in opposite directions, so as to alternately push against the opposite sides of, and thus oscillate, a lever, which is connected with the sickle bar.

IMPROVED FEEDER FOR THRASHING MACHINES.

John Potterton Fison, Teversham, England.—This invention relates to a combined drum guard and feeder for thrashing machines. It is designed to prevent accidents by making it impossible for any person to fall upon or be drawn into the drum, and to act, also, as a feed regulator. Should any unusual weight come upon either the cylinder or the upper part of the feed board, the cylinder instantly descends upon the feed board, and the lower at the same time rises to meet the cylinder. The cylinder and feed board being thus brought together, the feed opening of the machine is entirely closed.

IMPROVED HARROW.

James M. Flower, Traverse City, Mich.—The harrow frame is formed of four sections, each section consisting of three bars, arranged in the form of the letter N, connected at one end by a cross bar, and hinged together in pairs.

IMPROVED STRAW CUTTER.

Hugh G. Fladger, Lilesville, N. C.—The balance driving wheel has an eccentric groove in one side, in which a roller works to operate the cutter lever, the roller being mounted at one side of the free end of the lever on a pin.

NEW MECHANICAL AND ENGINEERING INVENTIONS.

IMPROVED CAR COUPLING.

John Slade, Bay City, Mich.—This invention relates particularly to the form of the shank of the hooks, and to the provision of beveled blocks, attached to the side of the hooks, whereby the latter are adapted to be uncoupled when raised to a slight angle.

IMPROVED COAL CHUTE.

Edmund R. Bulkley, Perth Amboy, N. J.—This consists in the combination, with an adjustable discharging chute section and the feeding bin of an adjustable and intermediate section having a sieve bottom for sifting out the fine coal as it passes from the bin, and for preventing a too violent fall of the coal into the hold of the vessel.

IMPROVED HAY AND COTTON PRESS.

Isaac N. Ward, Henryville, Tenn., and Hugh R. White, Lawrenceburg, Tenn.—This invention is an improvement in cotton presses of the modern type, in which the upper end of the box is left open for filling, and the follower is worked from beneath. The head and sides of the press box are made removable, and the ends travel with the follower, which is operated by pivoted levers. The said levers are connected by movable clamps or dogs, with vertical rods which are pivoted to the ends of the follower, and attached, at their upper ends, to the sliding or traveling ends of the press box; so that as the levers are vibrated, the clamps or dogs bite on said rods, thereby raising the follower and the ends of the press box and the rods simultaneously. The said ends are made in sections to facilitate the removal of the bale.

IMPROVED CAR COUPLING.

Alvin K. Mott, Atlantic, Iowa.—This consists of a drawhead, with sliding and spring-acted block, and a fork-shaped locking piece that slides in side grooves and top perforations of the drawhead, and couples the arrow-shaped head of the link. The forked lock piece is made wider at the lower parts of the legs to admit the forward motitn of the spring block and the seating of the lock piece on the forward projecting top flange of the same.

IMPROVED MANDREL OR CORE FOR CASTING.

James M. Rohrer, Shamokin, Pa., assignor to himself and William L. Follower, same place.—The flanges for holding the parts of the mandrel together are bored out tapering to fit the tapering ends of the shell, so as to be easily removed. The shell is cut longitudinally to receive a beveled key, which is cut beveling, so that it will give toward the center, as the shell contracts when the center plug is given from the shell to relieve the pressure caused by the shrinkage of the casting in cooling. This sectional mandrel is used in casting cylinders of any kind that require hard and smooth inner surfaces.

NEW WOODWORKING AND HOUSE AND CARRIAGE BUILDING INVENTIONS.

IMPROVED WHIFFLETREE COUPLING.

Asa T. Martin, Jr., Waverly, Iowa.—This is an improved coupling for connecting whiffletrees with the double tree, and the double tree with the tongue, so constructed as to prevent them from tipping or turning over. It also causes the end that moves forward to rise, so that it will return to its place. The coupling bolt, which is rigidly attached to a washer, is bent at an angle at its point of intersection with said washer. The washer is made thicker upon one side than at the other, to counterbalance the angle of the bolt and give the whiffletree a firm seat.

IMPROVED SAWMILL DOG.

Alfred Mepham, Fayette, Ohio.—This invention consists of a dog, mounted on a block, which slides up and down on the standard, with a crank pinion and toothed bar for working it, and a ratchet lever for applying great force to press the dog into the log. There is also a secondary plank dog detachably connected to the block carrying the principal log dog, and contrived with a cranked screw nut for drawing the plank up to the standard, in addition to the contrivance for pressing the dogs down into the timber.

IMPROVED SASH BALANCE.

W. Woodward, Nashville, Tenn.—The object of this invention is to provide a simple and efficient sash balance, in which the cords carrying the suspended weight shall be concealed from sight and yet arranged so as to permit the raising or lowering of each sash to its entire length. To this end the invention consists in grooving the sash upon its edges and attaching the cord to the same at the bottom, then passing it between two pulleys, arranged about the middle of the window frame, and thence around a third pulley, located about the center of the window.

IMPROVED COMPOSITION PAINT FOR COATING ROOFS.

Thomas Dana and Zechariah B. Stuart, Manchester, N. H.—This compound may be used as a waterproof coating for any purpose. It is not affected by heat or cold, and is light and durable. It is composed of gutta percha, isinglass, chloroform, and rosin, japan and asphalt varnish.

IMPROVED LOCOMOTIVE WHEEL.

Wilson Weathersbee, Spring Garden, Ill.—This is a new method of gearing one or both of the driving wheels of a locomotive, so that they can turn independently of each other in going around curves, and thus prevent sliding, as when both wheels are keyed fast to the axle.

IMPROVED PUMP.

David N. Green, Rockbridge, Ohio.—The novel feature consists in detachable plugs held over lateral apertures in the pump stock by sliding keys, by which plugs the water in cold weather is allowed to run out.

IMPROVED HORSESHOE BLANK.

James N. Whitman, Pembroke, Me.—This consists of a rolled bar of iron or steel, having formed on one side thereof, in process of rolling, calks for the heel and toe and a nick at the end of each blank. Upon the reverse side is a clip for the toe, and nicks corresponding to those on the calk side.

IMPROVED SIGNAL ATTACHMENT FOR ELEVATORS.

Charles Hoffman, New York city.—This consists of an elevator or dumb waiter, arranged with a number of separate pulls and catches for each story, that come in contact with a signaling or alarm device of the corresponding story when raised to the proper hight.

IMPROVED SAW SWAGE.

Asher Willey, Rochester, Mo.—This consists of a recessed stock, provided with shaping dies of different curvatures, that are set into the recesses of the stock, and locked by an inclosing sleeve. The swage is applied to the tooth and driven by a mallet on the same, so that a cutting edge corresponding to the curvature of the shaping die is formed, and thereby a tooth of greater or less cutting power obtained.

IMPROVED SUGAR MILL.

James Mallon, Baton Rouge, La.—This invention consists of a sugar mill, arranged with a perforated steam pipe in front of the receiving rollers, and one or more perforated steam pipes in the cane knife for forcing small jets of steam up through the cane as it passes over the knife or turn plate.

IMPROVED CAR REPLACER.

Homer G. Brooks, Greenville, S. C.—This consists of a casting that rises gradually on an inclined plane from the broader lower part to the narrower higher end, at a level with the rail, being fitted thereto by bottom recesses and rail head binding wings. Guide grooves and flanges lead the car wheel to a key, socketed at suitable angle at the highest end of the replacer, to transfer then the wheel to the rail.

IMPROVED COTTON PRESS.

William H. Horn, San Augustine, Tex.—This relates to the press on which a patent was granted May 5, 1875, to William B. Hollowell; and it consists of a duplicate master wheel on the drum for working the follower: also an improved contrivance for connecting the pitman to the lever and to its pivot, whereby the machine is rendered more efficient, and may be made lighter for a given strength.

NEW HOUSEHOLD INVENTIONS.

IMPROVED APPLE CORER.

Isaac Rogers, Sheridan, Oregon.—This invention consists in combining with a fork, coring tube, and cutter, a cross piece having top pins, whereby the pared and sliced apple is automatically removed. The forward stroke of tube and blade cores and cuts the fruit, while the return stroke carries the core back and drops the divided fruit.

IMPROVED CARPET SWEEPER.

Samuel F. Leach, Chelsea, Mass.—This invention consists in carpet sweeper gear wheels made of leather, treated with a hardening and waterproofing substance or substances. Leather is better than wood or metal because it is entirely noiseless and will not tear the carpet, and it is also superior to rubber or rubber compound, as it will always preserve its round or true shape, which is not the case with rubber wheels.

IMPROVED SUSPENSION BED SPRING.

James W. Wright, Washington, D. C.—This invention relates to an improved construction of suspension bed spring; and it consists in detachable wire springs bent so as to form seats in which the ends of the slats are suspended, the said pieces of wire having their middle parts bent into coils, through which passes a rod, and their ends extended upwardly in the form of arms terminating in hooks. The seats for the slats project laterally from the said rod, which latter, passing through the coils, operates as a pivot for the same, while the upwardly extending hooks are detachably fastened to the end frames of the bedstead and sustained in a suspended position.

IMPROVED AUTOMATIC FAN.

Morris Ruben and Herman K. Bradshaw, Alexandria, Va.—The object of this invention is to provide a cheap and available motive power for driving fans, with a force sufficient to produce a current of air over a dining room table, bed, or sick couch, thereby accomplishing the double result of supplying a cool current of air, and driving away flies, mosquitos, and other troublesome insects. To this end the invention consists in an overshot wheel, arranged to be operated by a stream of falling sand or water, and combined with peculiar mechanism for operating the fan.

IMPROVED FRUIT JAR RACK.

Stokley D. Dilts, Lawrenceville, Ill.—This rack consists of bars and frames, the latter being provided with opening to allow the top to be secured at a greater or less elevation above the bottom to suit jars of different hights.

IMPROVED FURNITURE CASTER.

Benjamin E. Flanders, Brooklyn, N. Y.—This consists of a caster, the socket of which is provided with an interior concavo-convex glass shell, which extends from the upper point of greatest pressure, and bears on a revolving ball that is retained by an outer metallic casing. The friction between shell and ball being reduced to a minimum, the wear is decreased.

IMPROVED CARPET FASTENER.

John H. Campbell, New York city.—This consists in a carpet fastener made of sheet metal, and having key holes, which allow it to be placed over and slid under the heads of rivets. When the fastening nails are placed in position, and the carpet cut, sewn, and stretched, the edge of the same is carried by the flat knife under the clamping top part, and the knife then withdrawn. The toothed part of the fastener takes firmly hold of the edge of the carpet, and prevents its escape, whatever be the strain thereon.

IMPROVED REFRIGERATOR.

Mahlon Moon, Morrisville, Pa.—Between a preserving chamber and the ice chamber, a fibrous or absorbent material is placed to collect and carry off the moisture condensed from the air. This furnishes a simple device for preventing injury to fruit, etc., by dampness.

NEW MISCELLANEOUS INVENTIONS.

IMPROVED FOUNTAIN PENHOLDER.

Almerrin P. Allen, Denmark, Iowa.—This is an improved fountain penholder that supplies the required quantity of ink to the pen during writing, while holding at the same time the main body of ink in check, and conveying it in regular and even manner to the point of the pen. The novel features are a cap extension and beveled point, connected by narrow side strips, that fit the shape of the pen.

IMPROVED FUNNEL.

John O. Barton, Chicago, Ill.—This is a convenient device for grocers and others dealing in sirups. The invention consists of a funnel, with an interior plug, to close the discharge spout, and cross wires to indicate the quantity to be measured. The funnel has a hermetically fitting screw cap with a central air tube, to which the pipe, connecting with a force pump applied to the barrel, is attached, so as to force the sirup quickly into the jug.

IMPROVED COMBINED ELECTRIC FIRE SIGNAL APPARATUS AND FIRE EXTINGUISHER.

Thomas F. Nevins and John W. Smith, Brooklyn, N. Y.—With the pipe through which the water is brought into the building and in the upper part of the room is connected a perforated pipe through which the water is discharged into the room, and in which, near the pipe, is placed a stopcock. To the handle of the stopcock is attached a weight. The stem of the weight is made with an eye to receive a pin, that is held back by a spring and is held forward by a cord which is led to different parts of the room, so that, should a fire occur, the flame may burn off the cord and cause the weight to drop, which opens the cock and causes a discharge of water into the room. In the pipe is placed a small water wheel, which, when the cock is thus opened, rotates thereby, sounding an alarm.

IMPROVED TOY CAMERA.

August Herzog, New York city.—This is a photographic apparatus, of simple construction, consisting of an upright frame, to which a camera, with sliding lens tube, is applied. Supports are also provided for a ground glass and plate holder.

IMPROVED ELECTRICAL APPARATUS.

Jerome Kidder, New York city.—This apparatus is designed for medical use, and includes several novel devices. A portion of a series of battery elements, arranged for transmitting a circuit through the body, are adapted to operate an induction coil. A new means is provided for substituting fresh fluid for that which has become spent in power, in the elements. There are new supports for the induction coil, and some novel arrangements for modifying the force of the induced currents.

IMPROVED PROCESS FOR THE MANUFACTURE OF RAWHIDE.

William Coupe, South Attleborough, Mass.—This improved process consists in submitting the hides or skins from which the hair has been removed to a succession of baths composed of a solution of lime, etc., and, when partially dry, coating them with a mixture of tallow, beeswax, and paraffin, and then submitting them to the action of a revolving drum or other suitable softening apparatus.

IMPROVED TOY PISTOL.

Otto C. Butterweck, St. Louis, Mo.—This invention consists of a pistol in which any projectile is impelled from the barrel by a concave-faced piston, around the rod of which is coiled a spiral spring. The piston rod is drawn back by means of a button or loop on its rear end, and is retained in position by a projection, on a spring trigger, which catches against the front surface of the piston; the spiral spring being compressed between the latter and the inner surface of the rear end of the pistol.

IMPROVED BUCKLE.

Charles W. Higinbotom and Frederick F. Smith, Vandalia, Ill.—This invention is an improvement in that class of buckles in which the tongue is made detachable and entirely separate from the frame. The tongue of this improved buckle is provided with a rib or lug in the center, and with claws or points on its ends, which pass through holes in the strap or straps, to which the buckle is applied. When the tongue is adjusted in place, the rib or lug prevents displacement of the end of the strap, and aids the claws in sustaining the strain to which the strap is subjected.

IMPROVED BARBED FENCE WIRE.

Rollin G. Brown, De Witt, Iowa.—This consists in an improved fence wire, formed by interlocking with each other sections, having loops and barbs formed upon their ends.

Business and Personal,

The Charge for Insertion under this head is One Dollar a Line for each insertion. If the Notice exceeds Four Lines, One Dollar and a Half per Line will be charged.

Notes & Queries

F. P. will find directions for writing on glass on p. 203, vol. 33.—S. B. will find directions for dissolving mica on p. 241, vol. 32.—J. A. L., J. O. M., and T. B. will find directions for ebonizing wood on p. 50, vol. 33.—C. R. can calculate the horse power of his engine by the formula given on p. 33, vol. 33. As to speeds of pulleys, etc., see p. 180, vol. 26.—T. S. should galvanize his castings. See p. 315, vol. 33.—B. B. will find a description of an incubator on p. 277, vol. 33.—A. C. G. should use Indian ink for architectural drawing.—C. P. R. R. will find directions for making rubber stamps on p. 156, vol. 31.—C. H. will find a recipe for a depilatory on p. 183, vol. 34.—M., G. C. M., C. H. L., W. B., H. H., J. I., T. B. C., and many others who ask us to recommend books on industrial and scientific subjects, should address the booksellers who advertise in our columns, all of whom are trustworthy firms, for catalogues.

(1) C. B. W. says: 1. Why is it that there are so many more square inches in the smoke arch of a locomotive than there are in the flues, when the steam exhaust and petticoat pipe are in their places? A. To give the cinders a chance to fall in the smoke box. 2. Would there be the same draft to the locomotive if the arch only had the same square inches in it as there are in the flues when the draft is made by the exhaust steam? A. We think not.

(2) C. W. J. says: 1. My house is in the cottage style, one story high; the main body is 32x14 feet. The roof is a hipped roof, with pediment in front of main roof. The roof is perforated by two terra cotta flues. Would you advise the use of lightning rods? A. Yes. 2. What kind and size rods would insure safety? A. Use iron rods half an inch in diameter, and terminate them in the earth where it is constantly wet. Connect all the rods together at the top of the house and in the earth. Also connect lateral rods at the earth to insure good contact with the ground. 3. The roof around the terra cotta leaks. What kind of cement or plaster would effectually stop the damage and annoyance? A. See p. 183, vol. 33.

(3) H. P. S. asks: 1. What is the hardest metal or composition for rollers, that will not rust or corrode by salt water or dampness? A. The new mixture of metals termed phosphor bronze. See p. 180, vol. 32. 2. What is the hardest and most durable metal to use for rollers, and what is the method of hardening? A. Steel, hardened as described on p. 51, vol. 30. 3. What is the cheapest method of turning or grinding chilled cast iron rollers or boxes? A. See p. 559, vol. II, SCIENTIFIC AMERICAN SUPPLEMENT.

(4) H. P. & S. say: We have one high pressure engine of 14 inches bore and 36 inches stroke, with the ordinary slide valve. It makes 48 revolutions per minute, driving our whole works with 45 lbs. of steam. Every time the engine exhausts, there is a drag to it, and a kind of a sucking noise which we cannot stop. The valve has got about $\frac{1}{32}$ inch lead, and takes her steam alike at both ends, and the crank passes her centers easily. The slide valve sets square on its face and perfectly tight; we have tried it, and it will not leak a drop of water. How can we stop this drag on our exhaust? A. There is probably not enough steam lap on the valve to give a free exhaust, in which case the lead may be made ⅛ inch.

(5) J. D. H. says: What is the cause of the long lines found cut in the piston of a steam engine as well as in the cylinder? A. Abrasion or cutting, from grit in the lubricant, bad fitting, or other cause.

(6) A. F. & Co. say: We are running an old fashioned 10x24 inches engine, with steam chest on top of cylinder. It cuts off the steam at 4 inches from the end of stroke, is making 112 revolutions per minute, and drives 2 runs of 4 feet stones, grinding 5 bushels wheat per hour, and driving the necessary machinery. We carry 60 lbs. of steam on a 4 x 12 feet tubular boiler. Intending some time to put in an extra run, can we increase the power of an engine by putting in a longer valve, so as to cut off the steam, say at ⅔ stroke? We have ample room in steam chest and can lengthen stroke of valve both by the eccentric and the rod shaft. A. You would not increase the power by cutting off earlier in the stroke.

(7) M. J. T. asks: What metal is susceptible of the highest polish? A. Steel.

(8) N. E. L. says: 1. What is Mr. Corliss' improvement on the steam engine? A. Corliss connected the governor to cut-off valves placed close to the bore of the cylinder, and thus governed the engine by cutting off the steam earlier or later in the stroke, according as the amount of the load diminished or increased, and by this means effected a saving in fuel. 2. Was he the first man to use steam expansively? A. No. 3. What percentage does the Corliss save by placing the valves near the ends of the cylinders? A. This depends upon the length and size of the ports of which comparison is made. 4. What percentage of fuel ought I to save by an expansion valve? A. It depends upon the degree of expansion used and other circumstances. 5. I am going to take off my plain slide valve, give my eccentric a longer throw, add more lap to the valve, and let steam follow about one third. The engine is a 4 horse portable. We run two lathes, emery wheel, etc. A. A plain slide valve will give a very distorted action if given lap sufficient to cut off the steam at one third of the stroke as you propose. See p. 373, vol. 31.

(9) J. W. D. E. asks: If 50 lbs. tractive force will be sufficient to draw a certain load along a level railway track at the rate of 5 miles per hour, what will be the increase of force necessary to draw the same load at an increased speed of 10 miles per hour? A. About 12 lbs. The power required will of course be more than twice as great, since there is an increased resistance to be overcome at a double rate of speed.

(10) H. A. H. says: 1. I have constructed a galvanic battery, but it will not work. I took a two gallon stone jar, and in the jar I put a zinc cylinder; inside of that I put a flowerpot (for a porous cup) and inside of the flowerpot I put a piece of copper. I then attached a copper wire to the zinc cylinder, and one to the copper in the flower pot; then I made a solution of sulphate of copper and put it into the flower pot next to the copper, and a solution of common table salt and put it into the jar next to the zinc cylinder; then I connected the two wires at their other extremities, but I get no sign of electricity. Please let me know what is wrong. A. The battery you describe would produce a current, although not a very strong one. 2. Can I make Leyden jars out of glass beer bottles if I cut the necks off? A. Yes, by covering the inside and outside with tinfoil.

(11) W. H. J. asks: Will you please explain how a pair of car wheels get around a curve? A. argues that the inside wheel slips and the outside wheel slides. B. argues that only the inside wheel slips. C. argues that only the outside slides. Who is right? A. It might be possible for either action to occur in certain cases. Generally, on moderate curves, we think C.'s view is the most correct.

C. W. J. asks: How can I preserve guava and citron?—C. H. T. asks: Can you tell me of some way (other than by grinding or filing) by which the black caused by hardening can be removed from the steel, leaving the steel gray?—C. H. L. asks: How can I make a good flavoring for cigars?—P. S. K. asks: How can I make Belfast ginger ale?

COMMUNICATIONS RECEIVED.

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

On Rambling Notes. By L.
On Disinfectants, etc. By H. J.
On a Point on a Connecting Rod. By W. H. P.
On a Solar Phenomenon. By S. J. W.
On a Soil Pipe. By J. D. S.
On Squeaking Boots. By P.
On Spiritualism. By B. J. L. M.
On Workmen and their Instructors. By S.
On Patents. By G. W. H.

Also inquiries and answers from the following:
V.—E. A. D.—A. J. C.—C. C. R.—C. C.—W. C. F.—J. R. N.—W. W.—J. B. O.

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 inquiries analogous to the following are sent: "Who makes rain gages? Who sells the improved hydraulic ram, described on p. 259, vol. 31? Who sells ice-making machinery? Who sells propellers suitable for boats 12 feet long? Who sells machines for bending, punching, and rounding band iron? Who sells oilstones? Who sells surface butt hinges, suitable for cupboard doors? Who sells small knife blades? Who sells matches for use in the open air? Who sells folding tents?" All such personal inquiries 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

September 19, 1876,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

A complete copy of any patent in the annexed list, including both the specifications and drawings, will be furnished from this office for one dollar. In ordering please state the number and date of the patent desired and remit to Munn & Co., 37 Park Row, New York city.

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