IMPROVED POWER FEED SANDPAPERING MACHINE.

It is now common to finish irregular objects, such as wheels, parts of carriages, and the stocks of firearms, by machinery, so that they compare favorably with similar work done by skilled operators; and, in many cases, the machine work is really more excellent. The production of plane wooden surfaces is not so easily accomplished by machinery, and it is one of the things which has not been done until quite recently; one reason for this is that little skill is required and the labor is inexpensive; but when a business of a certain character grows, so that a great number of workmen are required to perform a particular branch of labor, there arises a demand for labor-saving machinery.

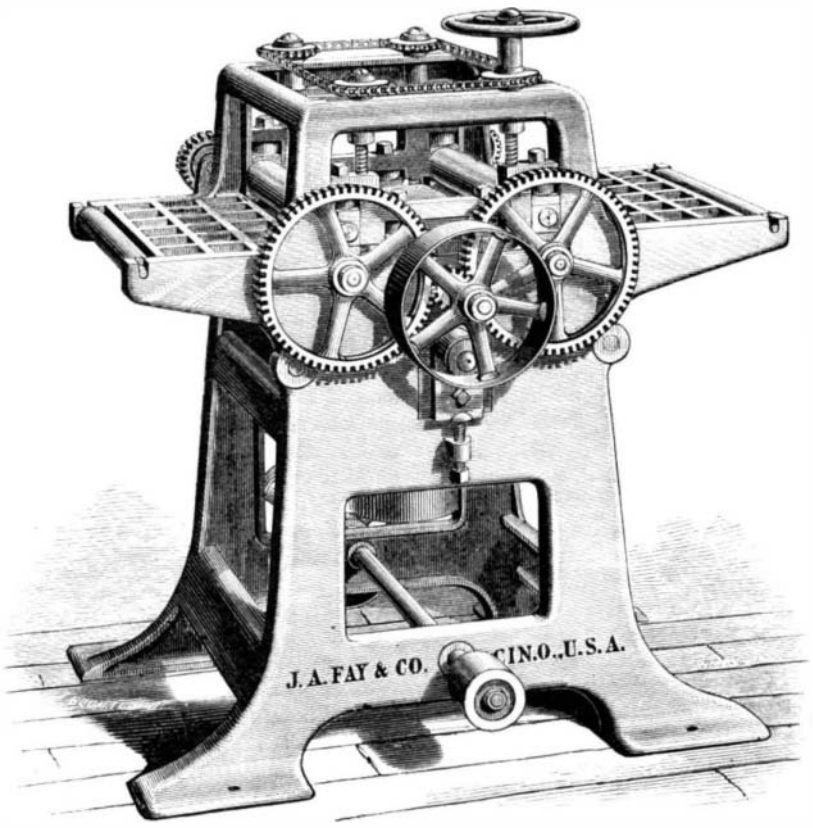
Several methods of smoothing plane woodwork with sandpaper have been tried. Some of them are adapted to special purposes and answer well for preparing surfaces for receiving paint, but where greater perfection is essential, as in the case of pianos and some classes of furniture, something better is required.

The cylinder sandpapering machines, with or without power-feeding apparatus, seem to be adapted to fine work, and are coming into use, performing excellent service when properly constructed.

We present to our readers an engraving of a power feed sandpapering machine for producing perfectly smoothed surfaces, constructed by the eminent woodworking machinery manufacturers, Messrs. J. A. Fay & Co., Cincinnati, Ohio. This machine has some peculiarities in its construction worthy of notice as tending to insure convenience in operation and perfection of product. The feeding arrangement is geared to drive from the cylinder shaft, and consists of four driven rollers, two in the table, and two supported to be raised and lowered by screws operated simultaneously by one hand-wheel. The lower and upper rollers are connected by expansion gearing to graduate for different thicknesses of stuff, one pair of rollers being on either side of the cylinder, and the upper roller having springs to give the required pressure on the material being fed through. The lumber is passed between the rollers. The sandpapering cylinder projects through the table sufficiently to give the required cut. The cylinder is adjustable vertically for more or less cut, as may be desired, and is covered by an elastic substance which gives its surface a peculiar flexibility, and keeps a comparatively large surface of sandpaper constantly in contact with the material being smoothed. This flexibility of the cylinder, in combination with the vibratory motion endwise, are elements peculiar to this machine, and seem indispensable for the work to be accomplished. All parts of the machine are easy of access, the entire feed works being hinged to the column, so that the cylinder can be reached without difficulty. As the cylinder is inclosed in a case, the dust can be conveyed by an exhaust pipe to any desired point.

In furniture, cabinet, coffin, and piano making, as well as many other branches of woodworking, this machine will prove of great utility. It is stated that one machine will do better and more perfect work than can possibly be accomplished in the old way by hand, and will save the labor of twenty men.

Further particulars may be obtained by addressing the patentees and manufacturers.



J. A. FAY & CO.'S POWER FEED SANDPAPERING MACHINE.

New Inventions.

Mr. Conrad H. Matthiessen, of Odell, Ill., has patented a Wagon Track, each rail of which is formed of three perpendicular wooden pieces, the intermediate one being sunk below the other two.

Mr. Michael E. Toomey, of Rathbone Place, England, has devised an improved Dental Tray to be used in taking wax or other impressions of the teeth, gums, and palate for dental purposes. It consists in a tray so constructed as to enable a complete impression of the mouth—that is to say, of the upper and lower jaws, the palate, and also of the "bite"—to be obtained at one operation and by the patient himself.

Mr. Ambrose P. Miller, of Hoboken, N. J., has patented an improved Handle Socket for picks, cold chisels, tamping bars, adzes, and other tools, which is so constructed as to enable the tools to be made easier and cheaper than in the usual way.

An improvement in Brushes has been patented by Mr. Frederick Sprower, of Brooklyn (E. D.), N. Y. The object of this invention is to secure the ends of the bristles, so that when the brush is bent or the point is struck against an object they will be held in place and prevented from slipping up and becoming loosened on the handle.

Mr. Charles O. G. Kennel, of New York city, has patented a Chimney Cowl or Ventilator designed to deflect the natural currents of air so that a draught in the chimney or ventilating shaft is continually maintained; also, to protect the chimney or ventilating shaft from downward currents and from rain or snow.

Teredo-Proof Trees.

Dr. Kellogg, in the Proceedings of the California Academy of Sciences, states that there are but two trees known to him which are perfectly proof against the teredo, or pile borer (*Teredo navalis*) of tidal water. These are the palettmo and the Australian *Eucalyptus rostrata*. The teredo will attack the wood of *Eucalyptus globulus*, as well as other species.

Archæology.

From our late foreign exchanges we learn that renewed interest is awakened in the East for prosecuting excavations in various parts for archæological treasures. Favored by the authorities at Constantinople, Dr. Schliemann is again busily excavating at Troy; and Mr. Rassam has permission to dig anywhere in Mesopotamia. With such a comprehensive grant, districts will be opened that have not hitherto been searched, and we shall hear of fresh discoveries at Nineveh, of explorations in the long hidden ancient city of Assur, and of endeavors to find the famous royal "record office," or "Babylonian Bank," as some Assyriologists call it, in which were stored a large collection of mercantile tablets, representing the monetary transactions of a firm trading in the name of Egibi & Sons. It is curious to have bills for corn and fruits, and woven goods, and invoices and vouchers from the days of Nabupalassar and Artaxerxes in the form of baked clay; but they are to be seen at the British Museum. The Arabs and Jews from whom they were obtained have kept the secret so well that the place in which they were discovered is not yet known to Europeans.

Kutha, now a group of great mounds, was the sacred university city of Babylonia, and had an extensive library, which is frequently referred to in mythological tablets discovered in other parts of the kingdom. It was from that storehouse of learning that the tablets giving an account of the creation were originally taken; and it is hoped that discoveries of other documents not less interesting will there be made.

In the mound of Nebbi-Yunus, search will be made for the palace of Sennacherib, in the expectation that some records of the latter years of that monarch may be found, "and possibly some accounts, however meager, of the second campaign against Hezekiah."

But besides all this, Mr. Rassam will make explorations in the country of that ancient people, often mentioned in Scripture—the Hittites. The existence of mounds along the bank of the Euphrates has long been known; and under a certain group known as the mounds of Jerabolus, it is supposed that Carchemish, the Hittite capital, lies hidden. Inscriptions in an unknown character were found in that neighborhood a few years ago; and it is hoped that some key thereto may be met with in the course of the excavations now to be undertaken, and furnish to scholars the link wanting to connect Assyria with Western Asia. As the firman granted to Mr. Rassam extends over a number of years, we may trust that the interesting enterprise will be carried to a successful issue.

HARD ROLLED IRON AND STEEL RIM PULLEYS.

In every branch of constructive art, from the simplest implement to the most powerful and complicated engine, American workmanship is specially characterized by a skillful adaptation of material, in kind, quality, and weight, to the duty it is to perform. The aim is to employ, in every part of every implement or machine, just so much material of the most suitable sort as may be needed, and not an ounce more. Thus intelligent design is visible in every part of every truly American product, and, as a rule, the lightness of American machinery is not less noticeable than its strength and durability. This appears in the accessory parts as well as in the more essential; and very frequently the lightening of the accessories makes possible a corresponding reduction in the weight of the parts which have the main portion of the work to do.

An illustration of this tendency of American workmanship, and the advantages of it, is seen in the recently patented pulley shown in the engraving. By its structure and the allotment of its material, this pulley is designed to give the greatest strength with the least weight consistent with the duty which a pulley has to perform. Its advantages over any cast pulley are found in its superior strength, due to the absence of shrinkage strains in the arms; to its more perfect balancing, the metal in the rim being uniform in section, and every part equidistant from the center; to the fibrous character of the steel rim, the fibers running in the direction of the strains; also to its diminished weight, allowing it to be safely run at much higher speeds than the common cast iron pulley, and on lighter castings, with a greatly diminished weight of metal in hangers, framings, and so on.

The weights of these pulleys range as follows: 48x9 inches, 110 lbs.; 36x8 inches, 75 lbs.; 36x6 inches, 62 lbs.; 24x6 inches, 36 lbs.; 18x4½ inches, 20 lbs.; 15x4½ inches, 17 lbs.; 12x4 inches, 10 lbs.; 9x2½ inches, 4 lbs.

For driving cotton and woolen machinery, blowers, and in the construction of milling and agricultural machines, this combination of strength with lightness is a manifest advantage. Economy in freightage, when shipped to a distance, is another item worth noticing. These pulleys can be made in any good establishment at a cost, the patentee claims, not exceeding half that of an all cast pulley. The patent is for sale. For particulars inquire of Geo. W. Fisher, Superintendent Fulton Iron Works, St. Louis, Mo., or of Philip Medart, 107 Market street, the same city.

HARD ROLLED IRON AND STEEL RIM PULLEYS.

Mr. Lockyer's Solar Studies.

The popular enthusiasm awakened by the first revelations of the spectroscope promises to be surpassed by the interest resulting from its latest teachings. Whether Mr. Lockyer's solar hypotheses are verifiable or not by existing facts or future observations, the boldness of his assertions, and the evident sincerity of his convictions with regard to the correctness of his interpretation of solar phenomena, cannot fail to challenge the attention of spectroscopists and chemists as well as the imagination of the public at large.

The most trustworthy as well as the fullest statement of his observations and inferences is to be found in the following summary, which the London *Times* has given of the paper read by Mr. Lockyer before the last meeting of the Royal Society in London:

In order that the line of argument followed by Mr. Lockyer may be understood, it will be necessary briefly to refer to the results of previous researches. As a rule, in observing spectra, the substance to be examined is volatilized in a gas flame or by means of sparks from an induction coil, and the light is allowed to fall on the slit of the spectroscope; the spectrum is then generally one in which the lines run across the entire field, but by interposing a lens between the spark apparatus and the slit of the spectroscope, Mr. Lockyer was enabled to study the various regions of the heated vapor, and thus to establish the fact, already noted by some previous observers, but to which little attention had been paid, that all the lines in the spectrum of the substance volatilized did not extend to equal distances from the poles. He then showed, by the aid of this method, that in the case of alloys containing different proportions of two metals, if one constituent were present in very small quantity its spectrum was reduced to its simplest form, the line or lines longest in the spectrum of the pure substance alone appearing, but that on increasing the amount of this constituent its other lines gradually appeared in the order of their lengths in the spectrum of the pure substance. Similar observations were made with compound bodies. It was also noticed that the lines furnished by a particular substance varied not only in length and number, but also in brightness and thickness, according to the relative amount present. Armed with these facts, and with the object of ultimately ascertaining more definitely than has hitherto been possible which of the elements are present in the sun, Mr. Lockyer, about four years ago, commenced the preparation of a map of a particular region of the spectra of the metallic elements for comparison with the map of the same region of the solar spectrum. For this purpose about 2,000 photographs of spectra of all the various metallic elements have been taken, and in addition more than 100,000 eye observations have been made. As it is almost impossible to obtain pure substances, the photographs have been carefully compared, in order to eliminate the lines due to impurities; the absence of a particular element as impurity being regarded as proved if its longest and strongest line was absent from the photograph of the element under examination. The result of all this labor, Mr. Lockyer states, is to show that the hypothesis that identical lines in different spectra are due to impurities is not sufficient, for he finds short line coincidences between the spectra of many metals in which the freedom from mutual impurity has been demonstrated by the absence of the longest lines. He then adds that, five years ago, he pointed out that there are many facts and many trains of thought suggested by solar and stellar physics which point to another hypothesis—namely, that the elements themselves, or, at all events, some of them, are compound bodies. Thus it would appear that the hotter a star the more simple is its spectrum; for the brightest, and therefore probably the hottest stars, such as Sirius, furnish spectra showing only very thick hydrogen lines and a few very thin metallic lines, characteristic of elements of low atomic weight; while the cooler stars, such as our sun, are shown by their spectra to contain a much larger number of metallic elements than stars such as Sirius, but no non-metallic elements; and the coolest stars furnish fluted band spectra characteristic of compounds of metallic with non-metallic elements and of non-metallic elements. These facts appear to meet with a simple explanation if it be supposed that as the temperature increases the compounds are first broken up into their constituent "elements," and that these "elements" then undergo dissociation or decomposition into "elements" of lower atomic weight. Mr. Lockyer next considers what will be the difference in the spectroscopic phenomena, supposing that A contains B as an impurity and as a constituent. In both cases A will have a spectrum of its own. B, however, if present as an impurity, will merely add its lines according to the amount present, as we have above explained; whereas, if a constituent of A, it will add its lines according to the extent to which A is decomposed and B is set at liberty. So that as the temperature increases the spectrum of A will fade if A be a compound body, whereas it will not fade if A be a true element. Moreover, if A be a compound body, the longest lines at one temperature will not be the longest at another. The paper chiefly deals with a discussion from this point of view of the spectra of calcium, iron, hydrogen, and lithium as observed at various temperatures; and it is shown that precisely the kind of change which is to be expected on the hypothesis of the non-elementary character of the elements has been found to take place. Thus each of the salts of calcium, so long as the temperature is below a certain point, has a definite spectrum of its own, but as the temperature is raised the spectrum of the salt gradually dies out and very fine lines, due to the metal, appear in the blue and violet portions of the spectrum.

At the temperature of the electric arc the line in the blue is of great intensity, the violet H and K lines, as they are called, being still thin; in the sun the H and K lines are very thick, and the line in the blue is of less intensity than either, and much thinner than in the arc. Lastly, Dr. Huggins' magnificent star photographs show that both the H and K lines are present in the spectrum of *a Aquilæ*, the latter being, however, only about half the breadth of the former; but that in the spectrum of *a Lyræ* and Sirius only the H line of calcium is present. Similar evidence that these different lines may represent different substances appears to be afforded by Professor Young's spectroscopic observations of solar storms, he having seen the H line injected into the chromosphere seventy-five times, the K line fifty times; but the blue line, which is the all important line of the calcium at the arc temperature, was only injected thrice. In the spectrum of iron, two sets of these lines occur in the region between H and G which are highly characteristic of this metal. On comparing photographs of the solar spectrum and of the spark taken between poles of iron, the relative intensity of these triplets was seen to be absolutely reversed, the lines barely visible in the spark photograph being among the most prominent in that of the solar spectrum, while the triplet, which is prominent in the spark photograph, is represented by lines not half so thick in the solar spectrum. Professor Young has observed, during solar storms, two very faint lines in the iron spectrum near G, injected thirty times into the chromosphere, while one of the lines of the triplet was only injected twice. These facts, Mr. Lockyer contends, at once meet with a simple explanation if it be admitted that the lines are produced by the vibration of several distinct molecules. The lithium spectrum exhibits a series of changes with a rise of temperature precisely analogous to those observed in the case of calcium.

In discussing the hydrogen spectrum, Mr. Lockyer adduces a number of most important and interesting facts and speculations. It is pointed out that the most refrangible line of hydrogen in the solar spectrum, *h*, is only seen in laboratory experiments when a very high temperature is employed; and that it was absent from the solar protuberances during the eclipse of 1875, although the other lines of hydrogen were photographed. This line, also, is coincident with the strongest line of indium, as already recorded by Thalnè, and may be photographed by volatilizing indium in the electric arc, whereas palladium charged with hydrogen furnishes a photograph in which none of the hydrogen lines are visible. By employing a very feeble spark at a very low pressure the F line of hydrogen in the green is obtained without the blue and red lines which are seen when a stronger spark is used, so that alterations undoubtedly take place in the spectrum of hydrogen similar to those observed in the case of calcium.

In concluding this portion of his paper, Mr. Lockyer states that he has obtained evidence leading to the conclusion that the substance giving the non-reversed line in the chromosphere, which has been termed helium, and not previously identified with any known form of matter, and also the substance giving the 1,474 or coronal line, are really other forms of hydrogen, the one more simple than that which gives the H line alone, the other more complex than that which gives the F line alone.

The feeling of the leading English chemists and spectroscopists, who listened to the reading of Mr. Lockyer's paper, was that the observations described were open to other interpretations, and that very much more would have to be done in the way of observation and experiment before the matter could be decided.

This appears to be also the opinion of the majority of the more prominent scientists on this side the Atlantic. Dr. John C. Draper, however, is apparently inclined to accept Mr. Lockyer's conclusions; and, if not misreported, awaits further information with considerable confidence, that Mr. Lockyer has taken the necessary precaution to build his theory on the solid ground of nature. Mr. Lockyer's latest announcement, through the *Herald's* London correspondent (Jan. 13), is that he has obtained evidence—whether sufficient or not is not stated—that the bright lines of the solar chromosphere are chiefly lines due to the not yet isolated bases of fourteen of the so-called elements, and that the solar phenomena in their totality are, in all probability, due to dissociation at the photospheric level and association at higher levels.

The Solar Eclipse of 1880.

The central line in the total solar eclipse of January 11, 1880, ends soon after reaching the coast of California, where its totality may possibly be witnessed close upon sunset. The only lands in the course of the shadow through its long course across the Pacific are the Coquille, Bonham, and Elizabeth Islands, lying near together, between 169° and 170° E. longitude, and belonging to the Marshall Islands group. The eclipse passes centrally over the largest of the Coquilles, as laid down in the British Admiralty chart of this group, according to a calculation in which the moon's place has been made to accord very nearly with Hansen corrected to Newcomb, which gives the following track:

Long. E.	Lat. N. limit.	Lat. Cent. line.	Lat. S. limit.
°	° ′	° ′	° ′
168	+6 44·6	+6 28·0	+6 11·6
170	6 20·3	6 3·8	5 47·3
172	5 57·8	5 41·4	5 24·8

So that the breadth of the shadow in the direction of the meridian does not exceed 33′. Reading off from the chart it will be found that the center of the largest of the Coquille Islands is in about 169° 35·5′ E. and 6° 8·5′ N., and, calculating directly for this point, it appears that the total eclipse will commence at 8h. 41m. 25s. A.M. on January 12, local mean time, and continue 1m. 16s., and this represents the most favorable condition under which the eclipse can be observed on land. For any other point within the shadow in this vicinity the duration of totality may be determined by the following formulæ, where L is the east longitude from Greenwich, *l* the geocentric latitude, and *t* the Greenwich mean time of beginning or ending, according as the upper or lower sign is employed:

$$\text{Cos. } w = +\,109{\cdot}0051 - [2{\cdot}34285]\ \text{sin. } l + [1{\cdot}98006]\ \text{cos. } l \ \text{cos. } (L - 15^\circ\ 15{\cdot}9').$$

$$t = 11\text{h. } 10\text{m. } 48{\cdot}9\text{s.} \mp [1{\cdot}58154]\ \text{sin. } w + [3{\cdot}16228]\ \text{sin. } l. - [3{\cdot}95668]\ \text{cos. } l.\ \text{cos. } (L - 126^\circ\ 35{\cdot}7').$$

Spectroscopic Temperatures.

A. Crova has measured the calorific intensity of different portions of spectra, by means of a thermo-electric pile and a very sensitive galvanometer. Representing by 1,000 the calorific intensity which corresponds to a red ray with a wave length of 676 millionths of a millimeter, he gives the following table:

Wave lengths	676	605	560	523	486	459
Sunlight.....	1000	820	760	670	540	460
Electric light.....	1000	707	597	506	307	228
Drummond light...	1000	573	490	299	168	73
Standard lamp....	1000	442	296	166	80	27

The electric light was derived from 60 large Bunsen elements, with Carré's carbons, in the focus of a concave metallic mirror; the standard lamp was filled with colza oil. Crova concludes that temperatures can be rigidly determined by the spectrometric method, as soon as we have ascertained the exact law of emission for all the rays and the numerical constants for each wave length. He presents these results as a first essay toward the solution of this important question. —*Comptes Rendus.*

Fresh and Stale Bread.

The celebrated French chemist, M. Boussingault, has recently investigated the nature of the change which bread undergoes when it becomes stale. Up to the present time this has not been well understood.

A circular loaf, 12 inches in diameter and 6 inches thick, was taken from an oven heated to 240° Réaumur, and a thermometer immediately forced three inches into it. The thermometer indicated 78° R. (207·5° F.). The loaf was then taken to a room at a temperature of 15° R. (66° F.), and was found to weigh 7½ pounds. In 12 hours the temperature of the loaf sank to 19° R. (73° F.), in 24 hours to 15° (66° F.), and in 36 hours to 14° (63·5° F.). In the first 48 hours it lost only two ounces in weight. After six days the loaf was again put in the oven, and when the thermometer indicated that its temperature had risen to 55° R. (156° F.), it was cut, and was found to be as fresh, and to possess the same qualities, as if it had been taken out of the oven for the first time; but it had now lost twelve ounces in weight. Experiments were also made on slices of the loaf with similar results, proving that new bread differs from old, not by containing a larger proportion of water, but by a peculiar molecular condition. This commences and continues to change during cooling, but by again heating the bread to a certain temperature it is restored to its original state. It is this mechanical state which makes new bread less digestible than old. The former is so soft, elastic, and glutinous in all its parts that ordinary mastication fails to reduce it to a sufficiently divided condition. It forms itself into hard balls, which are almost unaffected by the gastric juice. These balls often remain in the stomach, and, like foreign bodies, irritate and discommode it, inducing all sorts of unpleasant feelings.

Life Without Air.

This doctrine, so ably advocated by Pasteur, still finds opponents. It is admitted that oxygen is essentially necessary for fermentation, but those who believe in the theory of "life without air," maintain that the yeast cells can under circumstances obtain a supply of that element from the surrounding organic substances, and therefore the process of fermentation can proceed without air. Gunning, however, has been continuing his experiments upon this subject, and as a result questions the fact that the total absence of oxygen from the receptacles used by Pasteur has been satisfactorily demonstrated.

Metal Exhibits.

At the late Paris Exhibition a Belgium exhibit showed rolled iron of various sections up to 60 feet long, and a double head rail about 180 feet long. Among the foreign exhibits was a wrought iron taper tube half inch diameter at one end, and 12 inches diameter at the other, 276 feet long, bent into a spiral; a wrought iron plate bent into a double arch about 3 feet 6 inches wide, one eighth inch thick, 57 feet long; a wrought iron plate bent to form an arch, and coiled at each end, 120 feet long; a galvanized plate half inch thick, 4 feet 6 inches wide, and 30 feet long; a steel plate three eighths inch thick, 6 feet 6 inches wide, 30 feet long, and a large variety of very fine specimens of rolled work. Among English exhibits was a piece of hoop iron 330 feet long, 3 inches wide, by 38 gauge, and a steel wire rod, 1,250 feet long, No. 2 gauge, weighing about 270 lbs.