ASTRONOMICAL NOTES.

BY BERLIN H. WRIGHT.

PENN YAN, N. Y., Saturday, March 23, 1878.

The following calculations are adapted to the latitude of New York city, and are expressed in true or clock time, being for the date given in the caption when not otherwise stated.

PLANETS.

	H.M.		H.M.
Mercury sets	6 23 eve.	Saturn rises	5 52 mo.
Venus rises	4 12 mo.	Uranus in meridian	9 48 eve.
Mars sets	11 16 eve.	Uranus sets	4 40 mo.
Jupiter rises	3 25 mo.	Neptune sets	8 54 eve.

FIRST MAGNITUDE STARS.

	H.M.		H.M.
Antares rises	11 56 eve.	7 stars (cluster) set	11 03 eve.
Spica rises	7 50 eve.	Rigel sets	10 33 eve.
Altair rises	1 13 mo.	Capella sets	3 14 mo.
Vega rises	9 33 eve.	Betelgeuse sets	0 12 mo.
Deneb rises	10 36 eve.	Sirius in meridian	6 34 eve.
Algol (2d-4th mag.var.) sets	0 07 mo.	Regulus in meridian	9 56 eve.
Aldebaran sets	11 21 eve.	Procyon in meridian	7 27 eve.
Alpheratz sets	7 47 eve.	Arcturus in meridian	2 07 mo.

REMARKS.

Mercury sets 7m. after, and Saturn rises 7m. before the sun, hence both are invisible. Venus is brightest March 28, her phase at that time being in form that of a crescent. The moon will pass within 2½ times her apparent diameter of Jupiter March 27, in the morning. Jupiter's first satellite passes into an eclipse March 21, 4h. 46m. morning. The third issues from behind the planet March 23, 4h. 37m. morning. The first begins a transit across the planet's disk March 29, 5h. 9m. morning.

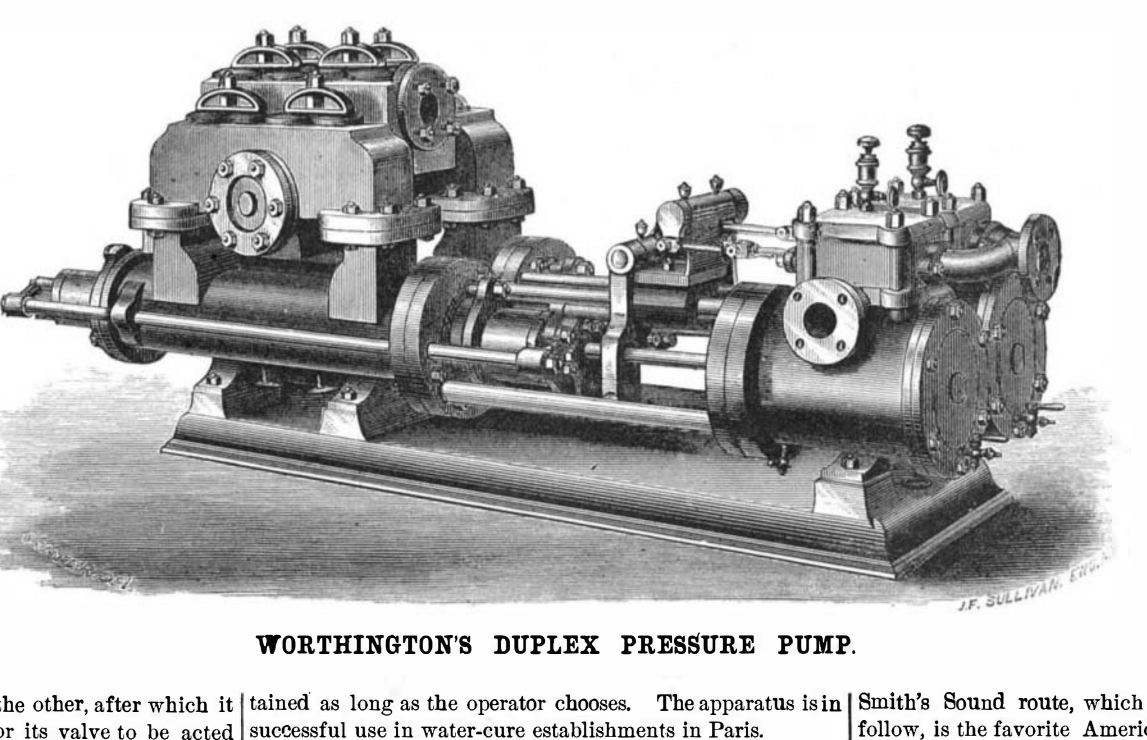
LARGE STEAM PUMPING ENGINES—A DUPLEX PRESSURE PUMP.

Among the pumps of largest capacity in this country are those constructed for water works by Henry R. Worthington, the inventor and patentee of a remarkably efficient type of pumping engines, known as Worthington's duplex steam pumps. At the Centennial Exhibition, Philadelphia, the largest and most expensive hydraulic exhibit was the pumping engine for supplying the entire Exhibition grounds with water, designed and constructed by this engineer. The capacity of this pumping engine was six million gallons daily. At Jersey City, N.J., there are two pumps, having together a capacity of sixteen million gallons; at Baltimore, Md., Toledo, Ohio, Toronto and Montreal, Canada, pumps with a capacity of ten million gallons; in Syracuse, N.Y., pumps of the same capacity were erected last year, and also in the same year were erected pumps for the Boston High Service, having a capacity of three million gallons daily. These are but a few of the many large pumps in successful operation, varying in capacity from half a million to sixteen million gallons daily.

Since 1844, the year when this engineer patented his first invention in steam pumps, he has taken out eleven patents in this country for inventions in this department of engineering.

The annexed engraving represents one of the smaller Worthington duplex "pressure" pumps, designed originally for driving hydraulic machinery, but also admirably adapted for mining, boiler feeding, severe and constant work generally. The form of the water end is peculiar, and intended for continuous pumping against heavy pressure, at moderate speed. Each piston drives two single-acting plungers, which have external adjustable packing.

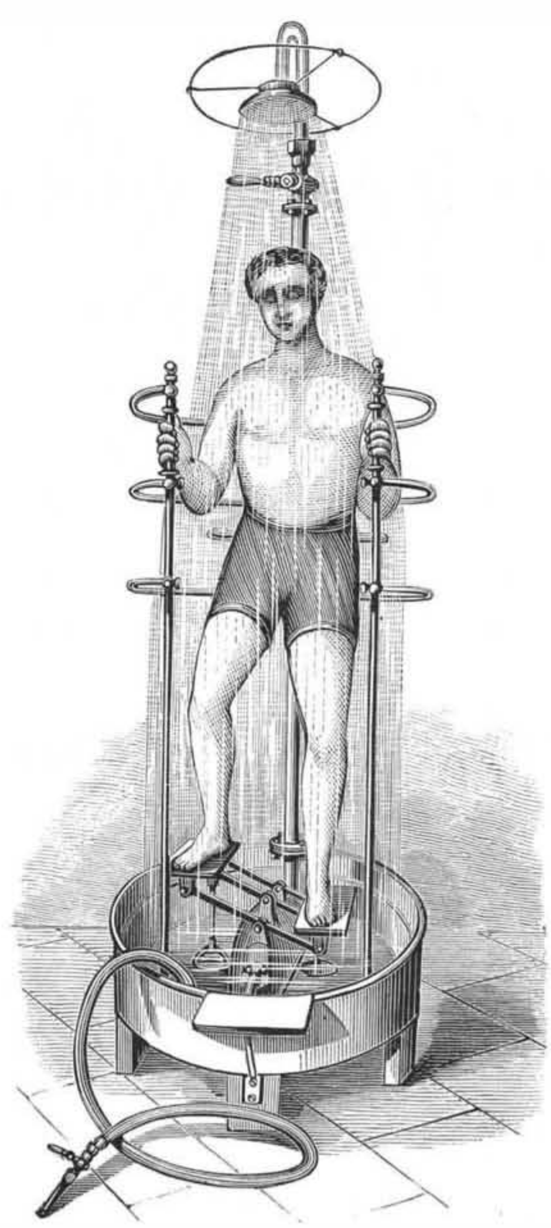
Reference being made to the engraving, it will be seen that the construction of this type of duplex pump varies materially from all others. The arrangement, which is very ingenious and gives great strength and compactness, is peculiarly the inventor's own, and original with him many years ago, is highly approved, and has been extensively copied by other pump manufacturers. All the parts are easily accessible for examination or adjustment. The moving pieces are made to gauge, and consequently can be readily renewed. Pumps of this description are constructed for special purposes and of various sizes. Special attention is called to the valve motion, which is the prominent and important peculiarity of this pump, as being that to which it owes its exemption from noise or concussive action. Two steam pumps are placed side by side, and so combined as to act reciprocally upon the steam valves of each other. The one piston acts to give steam to the other, after which it finishes its own stroke, and waits for its valve to be acted upon before it can renew its motion. This pause allows all the water valves to seat quietly, and removes everything like harshness of motion. As one or the other of the steam valves must be always open, there can be no center or dead point. The pump is therefore always ready to start when steam is admitted, and is managed by the simple opening and shutting of a valve. The office of Henry R. Worthington is at 239 Broadway, New York. The manufactory is at the Hydraulic Works, South Brooklyn, N. Y.



WORTHINGTON'S DUPLEX PRESSURE PUMP.

BOZERIAN'S NEW SHOWER BATH.

M. Gaston Bozerian, whose improved foot power engine we recently illustrated, has combined his apparatus with a pump, so as to produce a convenient shower bath, operated by the bather himself. In the tub shown in the annexed en-



BOZERIAN'S SHOWER BATH.

graving, which we take from *La Nature*, is a cast iron air chamber, which also serves as a support for the pedal levers. Each lever operates a pump, which forces the water in the basin into the air chamber, so that the operator has only to move the weight of his body alternately first on one pedal and then on the other to work the pumps. The water is thus driven up a pipe connecting with this air chamber, and escapes in a shower from the perforated receptacle above. The same water is used over and over again, and the shower is maintained as long as the operator chooses. The apparatus is in successful use in water-cure establishments in Paris.

Down in the Lower Levels.

Not many men who see the miners of the Savage lifted out at the top of the shaft at change of shift have the courage to descend into the lower regions of that mine. Very few even of the old residents of the Comstock would care to descend into the steaming regions below, and not one Eastern man in a thousand could be induced to make the trip after seeing the men popped out at the top of the shaft, steaming as though just lifted from out of a caldron of boiling water. Though they are shirtless—naked as at birth from the waist up—and wear only cotton overalls, they are dripping as if but a moment out of a pond of water; yet this is all from steam and perspiration. In all this great heat men must work. The wonder is that they are able to do anything but gasp and pant. It is a place better fitted for salamanders than for men. At the head of the main incline, where they have so long been engaged in putting in the V-bob, it is as hot as in the hottest vapor baths at Steamboat Springs.

One would think that men much in such a place would be quite secure against the rheumatism. On making inquiries in this regard of an underground foreman, he said that he never knew of any of the men working below to have the rheumatism. Some of our sufferers from the disease might try this cure—might have themselves lowered into the depths of the mine, there to sit and steam through one shift per day. But for the immense quantities of ice water they drink, the men could not endure the great heat in which they are placed or the floods of perspiration pumped from their pores. They swallow gallons on gallons of it, and it never hurts them in the least.—*Virginia Enterprise.*

Curious Habits of the Japanese.

The Japanese habit of reversing everything, if we may regard our own way of doing as the proper way, is very curious, and in some of its details very interesting. Mr. Griffiths, in his work on Japan, discusses it thus: "Another man is planing. He pulls the plane towards him. I notice a blacksmith at work. He pulls the bellows with his feet, while he is holding and hammering with both hands. He has several irons in the fire, and keeps his dinner pot boiling with the waste flame. His whole family, like the generations before them, seem to get their living in the hardware line. The cooper holds his tubs with his toes. All of them sit down while they work. Perhaps that is an important difference between a European and an Asiatic. One sits down to his work, the other stands up to it. Why is it that we do things contrariwise to the Japanese? Are we upside down, or they? The Japanese say that we are reversed. They call our penmanship 'crab writing,' because, say they, 'it goes backward.' The lines in our books cross the page like a crawfish, instead of going downward properly. In a Japanese stable we find the horse's flank where we look for his head. Japanese screws screw the other way. Their locks thrust to the left, our to the right. The baby toys of the Aryan race squeak when they are squeezed; the Turnonian gimcracks emit noise when pulled apart. A Caucasian, to injure his enemy, kills him; a Japanese kills himself to spite his foe. Which race is left-handed? Which has the negative, which the positive of truth? What is truth? What is down? What is up?"

Mr. Bennett's Polar Expedition.

A petition has been presented in the Senate by Mr. Conkling, from Mr. James Gordon Bennett, asking that an American register be granted to the Pandora, an English steamer which he proposes to man and equip at his own expense for a voyage of discovery toward the North Pole, taking the Spitzbergen or European route, simultaneously with the Howgate expedition *via* Greenland. It is thought that probably there will be more or less opposition on the part of the advocates of American shipbuilding; but if an American register be given to a foreign vessel for the Woodruff scheme, it is hard to see why one should not be given to another one for Mr. Bennett's expedition.

It is not known who is to be at the head of the expedition, but it is supposed that the adventurous Stanley, just returned from the burning sands of Africa, wishes to try his luck and endurance against the rigors of the Arctic winter which has conquered so many adventurous spirits.

Captain Howgate expresses much gratification at the proposed expedition of Mr. Bennett, because, when taken in connection with the proposed government expedition from the United States this year, it will test the practicability of the two most prominent routes to the North Pole. The Smith's Sound route, which Captain Howgate proposes to follow, is the favorite American route; while the Spitzbergen one is and has been advocated by foreign geographers, in the face of the many failures in that direction hitherto made. The two expeditions will probably differ widely in other respects, as the Howgate plan proposes an exhaustive study of the various scientific subjects upon which light can only be thrown by steady researches made within the polar area, and is not limited in its object to the mere discovery of the North Pole, that being only one of the items of the Howgate scheme.

Proposed Changes in the Patent Law.

The Committee on Patents of the United States Senate have lately reported a bill amendatory of the patent laws, which, according to an analysis prepared by the committee, has the following aims:

SEC. 1. Limitations. The period fixed is four years, to apply to all suits at law or in equity hereafter commenced, with a proviso allowing two years in which to bring suits on existing causes of action before the bar applies to them. If many suits are brought to preserve a right, the courts may stay proceedings in all except one.

SEC. 2. Profits and damages. This preserves the existing rule of damages. It changes the accounting in equity from the present rule of "savings" alone by providing that the amounts allowed as "profits" shall not exceed the profits actually realized in that part of the defendant's business connected with the use of the invention. The rule for apportionment of the actual profit among the different elements employed, excluding capital and personal services, remains unchanged. The court is allowed a discretion in all cases, both to increase and diminish the amount found, whereas it is now allowed only to increase, and that merely in an action at law. The court is also empowered to allow counsel fees and expenses in case of vexatious claims or willful infringement.

SEC. 3. Appeals. This is new, and gives to the Circuit Court the power to allow an appeal to determine the capital questions of validity or infringement before putting the parties to the delay and expense of an accounting which will become useless if the decision below is reversed.

SEC. 4. Appeals. This also is new, and enables the Circuit Court, subject to the direction of the Supreme Court, to exercise a control over the parties by injunction pending an appeal. In the present state of the Supreme Court docket a cause is not reached until three or four years after the appeal is taken.

SEC. 5. Reissues. This replaces Revised Statute 4,916, and changes it in these respects: First, it does not allow any evidence of what the invention is, except such as the papers filed in the office before the original patent issued afford, whereas the present law in certain cases allows evidence *aliunde* by *ex parte* affidavits. Second, it does not allow the model to be resorted to at all for purposes of reissue. This change has been introduced by the committee. Third, it directly makes it the duty of the court to inquire in suits on a reissued patent whether it is for anything except the same invention shown, contained, or substantially indicated in the specification or drawings of the original application or its amendments, and which the inventor would then have been entitled to patent.

SEC. 6. (New.) Provides that reissues shall not have a retroactive effect.

SEC. 7. Provides that if a patent be issued to two on the invention of one, or to one on the invention of two, this mistake may be corrected, as a clerical error, by the consent of all inventors and owners.

SEC. 8. Taking testimony *in perpetuam*. The existing law adopting the English chancery practice was intended for questions of titles relating to real estate, and does not meet the exigencies of patent litigation. The scheme of this section is that anybody may take testimony upon leave of court first obtained, and notice to the opposing party in interest that any person, whether a party to that proceeding or not, may use the evidence, but only as against those who were parties to the original proceeding, and actually served with notice or those claiming under them; that when a petitioner in such a proceeding perpetuates testimony upon any particular topic the opponent may, by leave of the court, introduce evidence in rebuttal or avoidance, and if any stranger avails himself of one part of this record he thereby makes the whole as competent against him as if he had been a party to the proceeding. This section is entirely new, and has been considerably amended by the committee.

SEC. 9. (New.) Allows suits to be brought by special leave of court to repeal and annul patents which are void. Existing laws afford no adequate remedy.

SEC. 10. (New.) Supplies a remedy for cases where a person injures the business of another by advertising that it infringes a patent, and yet refuses to bring a suit in which the validity of the patent or the question of infringement can be tried.

SEC. 11. Periodical fees. This is new, and has been already explained.

SEC. 12. The change introduced by this requires exclusive licenses to be recorded in the same manner as technical grants, because practically the two are equivalent. It shortens the time allowed for recording assignments from three months to one month. Improvements in the mail service since 1836 justify this. It allows all agreements about patents to be recorded, and makes certified copies from the records to be legal evidence.

SEC. 13. The law now is that each joint owner of a patent may grant licenses without the consent of the other. The object of this amendment is to give full effect to an agreement between them as to which shall exercise the power, if the agreement be in writing, signed by all the parties and recorded.

SEC. 14. (New.) This punishes, by not exceeding one year's imprisonment or $1,000 fine, whosoever "with intent to defraud" sells, as unincumbered, a patent which he actually knows he has no power to sell and convey.

SEC. 18. This proviso is new, and provides that the delay of the office after the patentee has completed all that he has to do shall not prejudice his rights.

SEC. 19. The law about granting patents in this country to those who have patented their inventions abroad has been changed several times, particularly by the act of March 2, 1861, in a manner which has caused considerable confusion. This section establishes what is believed to be a just and reasonable rule. It retains the provision that a foreign patent does not prevent a patent here to the same inventor, but that he cannot come here to get a patent for an invention that has been in use here for two years. It adds a new requirement that if he makes it known by patenting abroad he must apply here within two years or it can be used by the public. The old law provided that if the inventor patented abroad his United States patent must expire as soon as the foreign patent, but if he leaves it unpatented so that foreigners can use the invention freely, he is allowed the whole seventeen years here. This discrimination against our patentees is abolished.

SEC. 21. Applications. No change as to original applications. Applications for reissues may be signed and sworn to by the owner of the patent or his legal representatives. At one time the surrender of a patent and the application for a reissue were required to be sworn to by the owner; and at another time by the inventor. This amendment leaves it to be sworn to by the owner. The oath is of no importance, because the action of the Commissioner is to be based solely on the sworn statements filed by the inventor on his original application. To require his oath to the new application is to enable him to extort money from the person who has already bought and paid him for the invention.

SEC. 23. The law has always required the patentee to mark on the article the date of the patent. About 300 patents a week are now issued, all bearing the same date. This amendment requires him to add the number of his patent in order that it may be identified.

Several sections, particularly section 1 (limitations) and section 2 (damages and profits) apply not merely to existing patents, but to some extent to existing rights of action. After hearing elaborate arguments upon both sides of the question, the committee are satisfied that a patent right is "property" within the protection of the Constitution, and cannot be taken away or impaired by any legislative action. That right is under the terms of the law, and under the Constitution probably must be exclusive. This was declared by Mr. Chief Justice Marshall and by the Senate. But while Congress is bound to provide a remedy efficient and adequate to cause that right to be respected, and protected from invasion, it clearly has the right to select the precise remedy for that purpose. Though the patentee has a right to some sufficient remedy, because without it his right would be merely nominal and illusory, and therefore virtually be taken from him under the doctrines laid down in Bronson against Kinzie (1 How., 311), without due process of law, yet he has no right to any particular remedy. His right is to such efficient remedy as exists at the time of trial, and not necessarily to such as existed at the time the cause of action arose. The committee cannot doubt, therefore, that Congress can make some changes in the remedy for existing causes of action, and that the changes made by this bill leave them fully adequate and efficient to secure to the inventor the exclusive right which the Constitution contemplates that Congress shall secure to him.

Some of these proposed changes are good, and others are quite objectionable, as we shall show in a future discussion of the subject.

Muscular Power.

Fick and Wislicenus proved, in 1865, that muscular power is to a great extent produced by the oxidation of non-nitrogenous substances, such as fat. Frankland determined to put the matter beyond dispute by determining the amount of potential energy locked up in muscle, and its chief products of oxidation—urea, uric acid, and hippuric acid. A number of tables are given in the memoir, showing the amount of actual energy developed by 1 grain of various articles of food when oxidized in the body. These tables show that 0·55 lb. of fat will perform the work of 1·15 lb. of cheese, 5 lbs. of potatoes, 1·3 lb. of flour or pea-meal, or of 3½ lbs. of lean beef. The following conclusions were drawn from the author's results, coupled with those of Fick and Wislicenus:

1. "A muscle is a machine for the conversion of potential energy into mechanical force.

2. "The mechanical force of the muscles is derived chiefly, if not entirely, from the oxidation of matters either contained in the blood or deposited around the muscular fibers, and not from the oxidation of the muscles themselves.

3. "In man the chief materials used for the production of muscular power are non-nitrogenous; but nitrogenous matters can also be employed for the same purpose, and hence the greatly increased evolution of nitrogen, under the influence of a flesh diet, even with no increase of muscular exertion.

4. "Like every other part of the body, the muscles are constantly being renewed; but this renewal is scarcely perceptibly more rapid during great muscular activity than during comparative quiescence.

5. "After the supply of sufficient albuminoid matters in the food of man to provide for the necessary renewal of the tissues, the best materials for the production both of internal and external work are non-nitrogenous matters, such as oil, fat, sugars, starch, gum, etc.

6. "The non-nitrogenous matters of food which find their way into the blood yield up all their potential energy as actual energy; the nitrogenous matters, on the other hand, leave the body with a portion at least one seventh) of their potential energy unexpended.

7. "The transformation of potential energy into muscular power is necessarily accompanied by the production of heat within the body, even when the muscular power is exerted externally. This is doubtless the chief, and probably the only, source of natural heat."

Transatlantic Steamers.

We are indebted to Mr. Arthur J. Maginnis for a manuscript copy of a valuable paper on the subject of "Transatlantic Lines and Steamships," recently read by him before the Liverpool Engineering Society. It is quite lengthy, and hence we are debarred from publishing it *in extenso;* but it contains much useful information not easily obtainable and not, we believe, before made public. This is mainly found in the tables, which form an appendix to the essay proper, which deals chiefly with the history of the different lines and the progress made in introducing improvements in ocean steamers. In table No. 1 are given the names of the various Atlantic lines, with their aggregate tonnages brought up to the present year. Of these, the Allan line shows the largest total, having 18 vessels and a total gross registered tonnage of 52,650 tons. The other lines succeed in the following order: Hamburgh-American, National, Cunard, North German Lloyd, Inman, French, Anchor, White Star, Dominion, Netherlands, Leyland, Guion, State, American, Warren, Wilson, Netherlands-American, Beaver, and Great Western. The total number of steamers is 182, of which 125 (377,905 tons) are British; 5 (15,798 tons) American; 10 (39,325 tons) French; 32 (97,395 tons) German; and 10 (26,427 tons) Dutch. Total tonnage of all, 556,850 tons.

In table No. 2 the dimensions of a dozen famous steamers are given, beginning with the old side-wheeler Britannia of the Cunard line, built in 1840, the dimensions, etc., of which were: Length, 230 feet; beam, 34 feet 5 inches; depth, 22 feet 5 inches; tonnage, 1,150; and horse power, 440; and ending with the Inman screw steamer City of Berlin, built in 1875, the data concerning which are: Length, 520 feet; beam, 44 feet; depth, 37 feet; tonnage, 5,491; and horse power, 1,000. Examination of the figures shows the constant increase of length and nearly as steady diminution of beam. From the two succeeding tables of quick passages, it appears that in July, 1840, the Britannia steamed from Liverpool to Boston, 2,755 miles, in 14 days and 8 hours; in August, 1877, the Britannic made the passage from Queenstown to New York, 2,802 miles, in 7 days 10 hours and 53 minutes, or a little over half the time, a remarkable instance of the progress in steam navigation in 40 years. Two valuable tables are given showing the average passages of Atlantic steamers. For the first nine months of 1877 the figures are as follows: Trips outward from the United States—Cunard, 9 days 7 hours 7 minutes; Inman, 8 days 20 hours 36 minutes; Guion, 9 days 13 hours 51 minutes; National, 10 days 5 hours 31 minutes; and White Star, 8 days 10 hours 30 minutes. In 1850 the average run of the Cunard line was 12 days 16 hours.

It is stated that in April, 1877, the Germania (White Star line), coming westward, logged 410 knots in a day of 24 hours and 55 minutes. This is at the rate of 19¼ statute miles per hour. The same vessel, going eastward in October, 1877, made a day's run averaging 19⅜ statute miles per hour. This performance can hardly be surpassed until the existing mode of propelling vessels has undergone a complete change, which shall reduce the costly wear and tear of machinery and still heavy consumption of fuel.

The Tide of Lake Superior.

A correspondent, Mr. John Smith, who has studied the eccentric fluctuations in level of Lake Superior, writes that he has come to the conclusion that it is unnecessary to resort to the hypothesis of unequal atmospheric pressure upon different portions of the lake, or any similarly remote cause, to account for the phenomena. His observations lead him to believe that these movements are entirely analogous to the oceanic tides, and that they are purely the effects of lunar and solar attraction; the repetition, or return waves, being explained as merely the rebound of the original tidal wave from the opposite shore.

THE United States Supervising Inspector-General of Steamboats gives notice to supervising and local inspectors of steam vessels, that their whole time must be devoted to their official duties, and that they will not, under any circumstances, be allowed to superintend the repairs on any steam vessels or draw the plans for the construction of boilers or machinery, or act as experts in any such matters for the agents or owners of steam vessels, either with or without pay, under the penalty of dismissal from office: *Provided, however,* That officers whose salaries are less than one thousand dollars ($1,000) per annum, may, when not officially employed, engage in other occupations that do not approximate their official duties, when the same can be done without detriment to the public service.

THE Belgian Government has appointed a commission consisting of twenty civil and mining engineers, iron manufacturers, architects, and railroad officers, to inquire into the best means of enlarging the field for the consumption of iron, so as to increase the demand for the products of the Belgian works, which have long suffered from a depressed state of trade.

The Objects of the Howgate Polar Expedition.

Favorable reports relative to Captain Howgate's plan for exploring the Arctic regions have been made in both Houses of Congress, and a bill providing for a suitable appropriation will shortly be considered. Captain Howgate has pointed out the cardinal objects of his plan with much clearness, and in a way which must go far to satisfy those who can see no national benefit to accrue from Polar expeditions, the ostensible end of which is the empty glory of showing the flag at the pole, annexing new territories of ice fields, and bringing polar bears and Esquimaux under the blessings of a Republican government. The fact is, however, that the benefits to be gained by Captain Howgate's scheme are really of great importance; and perhaps most especially so in the additions to our knowledge of the laws of meteorology which will be secured. In reducing meteorology to an exact science, an experienced German student and explorer has shown the necessity of a comprehension of the conditions existing in the Polar zones. The general movements of the atmosphere arise from the exchange of cold and warm, of dry and humid air, between the poles and the equator. How enormous must be the influence of the huge masses of polar ice upon the distribution of the earth's heat is obvious. Greenland and Iceland afford proofs how the movements of ice, driven by winds and oceanic currents, may affect the climate of a country, but our knowledge of these movements is very defective. Now it is possible that the ice of the Polar zones may be the regular cause of our own climatic conditions, the origin of many of the furious storms which sweep destructively along our coasts and over our own land. It is probably not saying too much, adds the same authority, when we assert that the Polar regions are the most important portions of our globe for the study of the natural sciences.

The extreme conditions under which the forces of nature act in the vicinity of the poles produce phenomena which offer us the best means of investigating the nature of the forces themselves. As in meteorology, so, also, in terrestrial magnetism and electricity, these have to do with forces of the most tremendous magnitude, often exhibited in destructive energy, but never yet subdued to the service of man. So, too, if it is desired to investigate the ocean currents, and the laws of the tides upon which depend the safety and success of ocean commerce, influences are found centering in the North which must be traced to their source. Probably there is not one of the laws which govern the elements in their movements, a better knowledge of which will not result in material benefit to the race in cheapening the means of supporting life, in increasing the sources of human happiness, or in averting the perils to which we are now subject.

Captain Howgate's plan is simply that the explorers shall go as far north as they can and settle there, building themselves a suitable habitation. As soon as fixed good weather or other conditions indicate the possibility of an advance, they are again to push forward and again settle when stopped, and thus it is believed, by slow, gradual progression, the adventurers, who meanwhile will become acclimated to the cold and other abnormal phenomena, will be enabled in time to reach the pole.

The Astor Library, New York.

The Astor Free Library in this city is rich in valuable scientific and technical books and works of reference in all departments of science. It is a student's library; and as doubtless many of our readers avail themselves of the facilities here presented, we intend to offer from time to time a list of the recent additions.

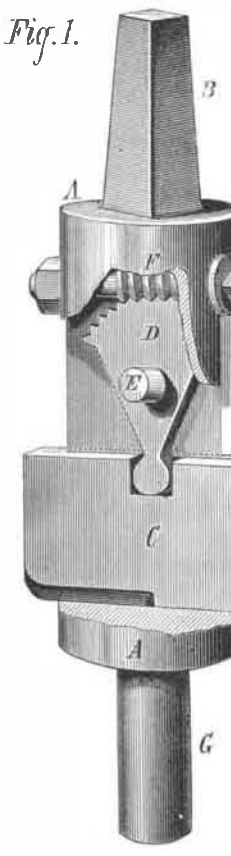
The following is a list of recent additions in the department of mechanics and engineering, which has been prepared by the courteous assistance of the librarian:

Shreve, Samuel H., Treatise on Strength of Bridges and Roofs, New York, 1873, 8vo. Matheson, Ewing, Works in Iron, London and New York, 1873, 8vo. Fanning, J. P., Practical Treatise on Water Supply Engineering, New York, 1877, 8vo. Krepp, Frederick Charles, The Sewage Question, London, 1867, 8vo. Spon's Dictionary of Engineering, 8 vols., New York, 1874, 8vo. Whipple, S., Elementary and Practical Treatise on Bridge Building, New York, 1873, 8vo. Auchincloss, Wm. S., Slide Valve and Link Motion, New York, 1875, 8vo. Burgh, N. P., Treatise on Boilers and Boiler Making, London, 1873, 4to. Francis, J. B., Lowell Hydraulic Experiments, New York, 1871, 4to. Burgh, N. P., Modern Marine Compound Engines, London and New York, 1874, 4to. Burgh, N. P., Treatise on Condensation of Steam, London, 1871, 8vo. Burgh, N. P., Link Motion and Expansion Gear, London, 1872, 8vo. McCord, C. W., Treatise on Movement of Slide Valves, New York, 1873, 4to. Spon, Ernest, Present Practice of Sinking and Boring Wells, London and New York, 1875, 8vo. Neville, John, Hydraulic Tables, etc., London, 1875, 8vo. Jackson, L. D'A., Hydraulic Manual, London, 1875, 8vo. Downing, Samuel, Elements of Practical Hydraulics, London, 1875, 8vo. Stevenson, Thomas, Design and Construction of Harbors, Edinburgh, 1874, 8vo. Clark, Daniel Kinnear, A Manual of Rules, Tables, etc., London, 1877, 8vo. Weissenborn, G., American Locomotive Engineering, 2 vols., 1 text, 1 plates. Humber, Wm., Treatise on Water Supply of Cities and Towns, London, 1876, folio. Merrill, Col. W. E., Iron Truss Bridges—Railroads, New York, 1875, 4to. Stevenson, David, Principles and Practice of Canal and River Engineering, Edinburgh, 1872, 8vo. Debauve, A., Manuel de l'Ingénieur, 8 vols., 6 text, 2 plates, Paris, 1871-3, 8vo.

A NEW TOOL.

A new and very useful tool has of late been introduced into the marine engine manufactories of Glasgow, Scotland, and it is likely to find an extended field of usefulness, because it is capable of performing a class of work which is somewhat troublesome to manipulate and usually requires a great deal of hand finishing. With this new tool, however, most, if not all the hand manipulation can be dispensed with.

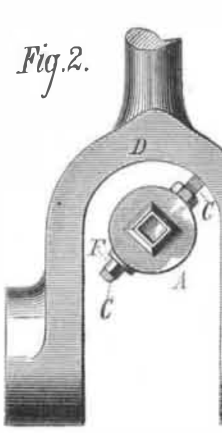
Fig. 1.



In our engravings, Fig. 1 shows the construction of the tool, which consists of the stock, A A, with the shank, B, made tapering to fit the socket of a boring or drilling machine. Through the body of the stock is a keyway or slot, in which is placed the cutter, C, provided in the center of the upper edge with a notch or recess. Into this slot fits the end of the piece, D, which is pivoted upon the pin, E. The radial edge of D has female worm teeth upon it. F is a worm screw in gear with the radial edge of D. Upon the outer end of F is a square projection to receive a handle, and it is obvious that by revolving the screw, F, the cutter, C, will be moved through the slot in the stock, and hence the size of the circle which the cutter will describe in a revolution of the stock, A, may be determined by operating the screw, F. Thus the tool is adjustable for different sizes of work, while it is rigidly held to any size without any tendency whatever either to slip or alter its form. The pin, G, is not an absolutely necessary part of the tool, but it is a valuable addition, as it steadies the tool. This is necessary when the spindle of the machine in which it is used has play in the bearings, which is very often the case with boring and drilling machines. The use of G is to act as a guide fixed in the table upon which the work is held, to prevent the tool from springing away from the cut, and hence enabling it to do much smoother work. It is usual to make the width of the cutter, C, to suit some piece of work of which there is a large quantity to do, because when the cutter is in the center of the stock both edges may perform cutting duty; in which case the tool can be fed to the cut twice as fast as when the cutter is used for an increased diameter, and one cutting edge only is operative. The tool may be put between the lathe centers and revolved, the work being fastened to the lathe saddle. In this way it is exceedingly useful in cutting out plain cores in half core boxes.

In addition to its value as an adjustable boring tool this device may be used to cut out sweeps and curves, and is especially adapted to cutting those of double eyes. This operation is shown in Fig. 2, in which D is the double eye, A is the tool stock, F is the adjusting screw, and C is the cutter. The circular ends of connecting rod strips and other similar work also fall within the province of this tool, and in the case of such work upon rods too long to be revolved this is an important item, as such work has now to be relegated to that slowest and most unhandy of all machine tools, the slotting machine. The tool was invented by one of the engineers of the transatlantic steamships, who unfortunately neglected to patent it.

Fig. 2.



Improvement in Car Lighting.

Some of the Western railroads—among them the Lake Shore and Michigan Southern—have recently adopted an improvement in car lighting which bids fair to supersede the old method of lighting by candles. This is a 300° fire test illuminating oil, made by Corrigan & Company, at Cleveland, Ohio, from petroleum, and the light it gives is stated to be 8 times greater than that of candles, while it is cheaper to produce. By the use of this oil the railway coaches are said to be brilliantly lighted and passengers are enabled to read with ease. The old system has been the cause of much complaint from the traveling public, who will welcome an improvement that, it is thought, will be adopted by railroads generally.

[For the Scientific American.]

WHY NUTS COME LOOSE AND BOLTS DROP OUT.

A correspondent asks: "Can you explain why it is that nuts come off, which they will do when subject to rapid motion or vibration, though they may be a tight fit upon the bolts and screwed tightly home with the wrench? Why indeed should it take two nuts to lock one bolt?"

The tendency of a nut to unwind and recede from the pressure upon its radial face is proportionate to the pitch of the thread and the diameter of the bolt, and the finer the thread upon a given diameter of bolt, or the larger the diameter of bolt with a given pitch of thread, the less is the tendency of the nut to move back. In the case of ordinary bolts and nuts a given diameter of bolt is given a standard pitch of thread, and these pitches are not so fine as to prevent the nuts from unscrewing in many cases unless checknuts are used.

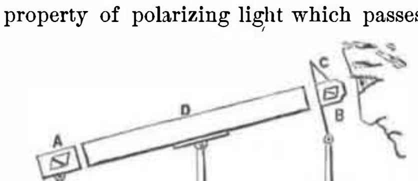
It would appear that if the nut thread fits reasonably tight upon the bolt and the nut is screwed well home, it should remain there, but there are palpable explanations why it does not do so. Of these the principal are the errors which ensue from the alteration of form which takes place in the screw cutting tools during the hardening process. As a rule all steel increases in dimensions from being hardened. What the amount of increase or expansion is we have at present no very definite knowledge, because it varies considerably; although it is probably equal under equal conditions. Suppose, then, that a tap is made of the correct diameter to a vernier gauge, and that it increases in diameter and in length (as it almost invariably does) during the hardening, the pitch, the thickness, the depth, and the diameter of the thread will be altered and "out of true."

Unless both the tap and the die are tempered to precisely the same shade of color, the amount of the contraction will vary. As a result of these at present irremediable errors taps are made to suit existing solid dies, or adjustable dies are set to suit the taps, and though the nut may fit closely to the bolt so as to be just movable by hand, or under a moderate pressure of a wrench, yet the sides of the thread do not fit properly, nor can they be made to do so under any ordinary conditions. The result is that under vibration the threads give way on the contact sides, for vibration is a number of minute blows. Under reciprocating motion the result is precisely similar, for the whole pressure upon the nut is supported by that part of the surface of the thread which is in contact, which compresses or recedes. Any machinist who desires to test this matter may do so by taking a nut that fits very tightly upon a bolt, and, striking upon the sides, he will find it will lose the fit to the bolt. J. R.

THE SACCHAROMETER.

BY SELIMO BOTTONE.

The action of the saccharometer depends on the fact that ordinary light, when transmitted through or reflected by certain bodies, acquires certain properties which it did not before possess. Among other properties conferred upon the light is that of displaying gorgeous prismatic colors when caused to traverse certain liquids and crystals. These colors, when brought into view by means of a solution of cane sugar, are the more vivid as the solution is more concentrated. In the best form of saccharometer, a tube about 10 in. long is closed at each end with a clear glass disk. An orifice, closed at will with a stopper, is left at about the center of the tube, so as to admit of the introduction of the sirup to be tested. This tube is placed between two prepared crystals of Iceland spar, called Nicol's prisms, which have the property of polarizing light which passes through



them. One, at which the eye of the observer is placed, is termed the analyzer; the other, through which the light enters, the polarizer. The analyzer is attached to the body of the instrument in such a manner that it can be made to rotate on its axis; and the amount of rotation can be measured by means of an index affixed to the analyzer, which points to divisions on a circle. To use the instrument, the analyzer is turned until the field of view (before the tube containing the sugar solution is interposed) appears dark by effect of polarization. At this point the index shows zero on the scale. The sugar solution is now introduced, when color immediately becomes visible, and the analyzer is rotated until a certain standard tint is produced. The angle of rotation is then compared with that required to produce the same given tint with a saturated solution of perfectly pure cane sugar. It is not absolutely necessary that the polarizing portion of the instrument should consist of prisms of Iceland spar, as the light reflected from a plate of glass may be made to answer, but the above arrangement is found more convenient in practice.

The illustration furnishes a rough sketch of the essential portions of a polarizing saccharometer, as seen in section. A, the polarizer, being a short piece of tube containing the Nicol's prism; B, the analyzer, a similar piece of tube containing also a Nicol's prism, free to rotate on its axis, the rotation being measured by the pointer, C; D, the tube in which the sirup is placed, closed at each end by plates of glass.