The American Spiral Spring Butt Hinge Manufacturing Co. of Mamaroneck. Capital, $100,000.

National Coal Gas Co. Capital, $1,000,000.

National Asphalte Composite Co. Capital, 1,000,000.

The United States Metalline Co. Capital, $1,000,000.

The Colwells, Shaw & Willard Manufacturing Co. Capital stock, $300,000.

National Ice Co. Capital stock, $250,000.

Kraffert Ice Machine Co. Capital, $500,000.

This enumeration has been made in just theorder in which the reports of the several companies appeared. Those familiar with the objects and business of these companies will see at once that by far the larger portion of them have more or less to do with patents and patented processes, while many are organized for the avowed purpose of manufacturing some patented machine or article. The inference cannot be avoided that our patent system has become a powerful modifying and directly beneficial influence upon the business of the country. We might extend this article by remarks upon the indirect way in which manufactures, arts and commerce are stimulated by the patent system, but will defer this until a future occasion.

FACTS AND FIGURES--IMPORTANCE OF THE LATTER TO SUBSTANTIATE THE FORMER.

In a recent article advocating the introduction of drawing as a branch of instruction in public schools, we asserted that the statement of facts in figures is the most important element in business, study, and science. Of course, we used the word figures in a figurative sense, meaning thereby the expression of the general relation of quantity in mathematical notation, of whatever kind it may be.

To make the proposition more plain, we propose to enlarge somewhat upon it in the present article. That there is need of the lesson which such a discussion will convey, is evident from the fact that a very large share of the blunders, committed in business, study, and science, arise from the neglect of habitually reducing facts to figures.

In nothing are these blunders more apparent than in the invention and construction of machinery. It is this neglect, either through incapacity or indisposition to make the proper calculations, that allows men's minds to get befuddled with ideas of perpetual motion, the indefinite multiplication of force and power, and other mechanical absurdities. The same neglect admits elements of weakness into structural designs of all kinds, which disappoint their projectors, and involve endless repairs and serious expense.

There are those who scoff at algebra. The senior editor of the New York *Tribune* once fulminated a protest against it as useless, yet its language, as all know who are acquainted with it, gives a much freer scope for the accurate and easy expression of mechanical principles than is possible to ordinary written or spoken language. In it and the higher mathematics are found the means of expressing not only abstract quantity, but of coupling, with such expression, qualifying and directing ideas. Thus, to use one of the simplest illustrations, we may express not only a given number of miles, but give the direction, from a certain fixed point at which the measurement begins, by the use of a single sign. We may, in expressing degrees of a thermometer also, by the use of a single sign indicate whether the temperature is above or below zero. In accounts, we may show whether the balance is debit or credit in the same manner. This illustration shows how the expression of facts in figures may be shortened by algebraic notation, and this is one of the first things the learner discovers in his algebraic studies. But this is only the merest beginning. By the use of mathematical notation, many ideas and conceptions of the relations of quantities are expressed, that cannot be uttered or written in any other language. Any one who has advanced far in mathematical knowledge has discovered this truth, and has, moreover, found that the notation employed has in many cases been invented solely for the purpose of conveying ideas that common language is incapable of expressing.

To the expert mathematician a simple formula, like $x^3 + y^3 - axy$ may express a beautiful curve called the foliate curve, which he may construct geometrically to correspond with the equation.

We have said enough to serve the purpose of a denial to the assertion of the inutility of mathematics. No one makes this charge except such as are ignorant of what they speak. Without the higher mathematics, the theories that have given the present status to mechanical, astronomical, and even chemical science could never have existed. It is very doubtful whether there would have been railroads or telegraphs, and it is quite certain that the modern locomotive and ocean steamer would have had no existence.

History would be nothing without dates. Chemistry would be nothing without weights. Engineering science must deal with measurements, strength, weights, motion, momentum, inertia, etc., correct ideas of which are only attainable by the aid of higher mathematics. Even the processes in use in common arithmetic are many of them derived from, and capable of demonstration only through the use of, algebraic and geometric notation; of these may be mentioned the extraction of roots, certain operations in alligation, mensuration, etc.

In conclusion, it may be said that only as the various sciences attain to the expression of facts in their definite relation to quantity are they sciences at all. Chemistry was no science till the law of combination in definite proportions was discovered. Till astronomy was aided by geometry, it had no existence, save in a few crude observations of shepherds and navigators that had become traditional. As soon as mathematics became the handmaid of observation, the most important knowledge was given to mankind, by the aid of which ships now traverse by night and day vast wastes of water, on which there is to be found no guide whatever save that which mathematics has charted down from the light of the stars, and the magnetic needle, whose vagaries and variations are only compensated for by mathematical calculations.

The business exigencies of the world have for a long time enforced the importance of arithmetical knowledge. Scientific and mechanical exigencies now urge the importance of more extended mathematical knowledge. Steam, as a motor, is now so generally used that the chances are nine in ten that every boy in our public schools will have, at some period, more or less to do with it. The boy, may grow up into a mere stoker, or may become a finished and accomplished engineer, but he will never be the latter if he is limited in mathematics to a common knowledge of arithmetic.

But we are extending our remarks further than was intended. What we have written has been to supplement what we said in the article above referred to, lest it should be thought we underrated those branches of study to which arithmetic is only the fitting introduction.

RUSSIAN INTERNATIONAL EXHIBITION.

We alluded, a few weeks ago, to the international exhibition now in preparation in Austria. Russia is now in the field for a similar show, and, like Austria, invites the inventors and manufacturers of the United States to send over their choicest productions and their latest inventions. If our people comply, it will, of course, be a very fine thing for Russia, as it will put her in possession, gratis, of useful information and the best industrial examples; but precisely how our countrymen are to be benefitted by the operation does not appear. In the matter of new improvements, Russia offers but little encouragement to American inventors. The charges incident to the obtaining of a Russian patent are heavier than in almost any other country, while the term of the patent, if the invention is wholly new, is only ten years, with no extension. If the invention has been previously patented in any other country, the Russian patent only runs six years. The ten years patent is void, unless worked within 2½ years from its date; the six year patent is void, unless worked within 1½ years. The owner of the patent cannot form a joint stock company or sell to a company. Military improvements are not patentable at all. It will thus be seen that Americans have little to gain by going to Russia with their good things.

But in England and France, a more liberal policy prevails. In England especially, Americans may obtain full protection for their inventions, may sell to whoever they choose. and are not obliged to work them except at their own convenience.

THE SOLAR ECLIPSE, DECEMBER, 1871.

In our number of December 23, 1871, we were able to report the success of the endeavors of the European astronomers, who travelled to India and Australia, in obtaining definite and important results as to the phenomenon referred to. The central line of the occultation commenced in the Arabian sea, and passed through Ceylon, Java, Sumatra, and part of Australia. The British astronomers were divided into three sections, devoting their attention respectively to photography, polariscopy, and spectroscopy, the latter observations being naturally regarded with the most interest. Professor Young's asseveration that, at the moment of total obscuration, the dark lines in the spectrum change suddenly into bright ones was confirmed, although a defined cause for the phenomenon is still being sought for. Mr. J. Norman Lockyer, not content with the aid of his Government, and the instruments placed at his disposal by the Royal Society and the Royal Astronomical Society, had an instrument especially constructed for the observation of the corona, and went to Ceylon, whence he has not yet returned. The intensity of the sun's flames necessitates the use of a battery of prisms to ensure dispersion of the light, which would otherwise be too brilliant for the eye. But as the light from the corona is feebler, and the congregated prisms would further weaken it by dispersion, a special instrument for the purpose is necessary. It was, in fact, a telescope with a focal length of only six feet, and a reflector of 9½ inches diameter, so arranged as to concentrate the light, in the slit of the spectroscope, of a very bright and small image of the sun.

Mr. Lockyer also took out, some glass vacuum tubes for the ignition of attenuated hydrogen, iron vapor, and other gases, under various pressures, the ignition of course being produced by electrical discharges from an induction coil. The object of this was to throw the lines produced by the ignited gases into the same field of view as the lines expected to be thrown by the corona, so that the two might be directly compared, and all mistakes as to their absolute coincidence in position or otherwise avoided.

Although telegrams have been received from other observers, no news has yet come to hand from Mr. Lockyer, says the *Engineer*, he having been stationed too far from any telegraph station. By the time these lines are printed, the results he has obtained may or may not be known in England, but all must wish him success in his anxious and responsible two minutes of work. When he went to the Mediterranean last year, the weather prevented him from seeing the eclipse, and it would be hard indeed if the same fate awaited him in Ceylon. His report will be given to our readers as soon as it arrives, and will doubtless add to our information on the subject of the elements of the sun.

HOW TO BUILD AN ICE BOAT.

Of all manly sports, we can conceive of nothing so exhilarating and so full of all that pertains to a noble recreation as ice boating. On sound ice, such boats are even more safe than pleasure yachts. They sail very close to the wind, can beat to windward, and perform all the maneuvres of water craft. We never heard of one capsizing. They make no lee way, and are easy to steer.

It may be interesting to some of our readers to give some practical details of the construction of these boats. Those shown in an engraving published on another page, are the kind used for racing, but a cheaper form, cat-rigged and more convenient for pleasure parties in which ladies are to share, can be made in the following manner:

Frame together, in the form of a triangle, two 8x4 oak scantlings 15 feet in length, with one of the same cross section 10 feet in length. At each of the corners, formed by the junction of the shorter with the longer scantlings, put a skate of good iron or steel, fastened in the most substantial manner by strong bolts. At the other angle, place the steering skate, on a strong pivot, to which the tiller is attached. All these parts must be made very strong, as they are those most likely to give way, especially if the ice be somewhat rough. Now, upon the frame thus made, put a strong plank floor, which braces the frame. Upon this platform, erect a box like a sleigh box with seats on the inside entirely around the boat. Step the mast through the middle of the front seat and into a stout socket spiked to the plank bottom, giving it a little rake toward the stern. Then rig it precisely like a cat-rigged water boat. You cannot sail quite so close to the wind with this as with the jib boats shown in our engraving, but with a party of laughing houris, smooth ice, a good wind, and plenty of fur robes, you can get your money's worth of fun in a shorter time than in any other way we can recommend.

The skates should have ample bearing surface so as not to cut the ice too deep. When sailing with the wind, the latter even if strong is scarcely felt, as the speed of the boat will come so near to that of the wind itself. These boats also sail before the wind better than yachts, the bows of which are depressed so that they draw more water.

In conclusion, there seems a possibility that the knowledge of ice boating acquired by the study of it as a sport may give rise to something very useful in traversing the frozen lakes and hard snow fields of the "Far North;" so that, both as a sport and as a matter of utility, the practice of ice boating is commendable.

THE HEATING OF BUILDINGS BY STEAM.

One of the most important applications of the latent heat of watery vapor or steam is the heating of buildings. The amount of heat thus readily transmitted through buildings, by comparatively very narrow tubing, is really surprising. While, in the system of heating buildings with hot air, every middle sized room requires a separate tube of some eight to ten inches diameter to carry to it a sufficient amount of hot air to keep its temperature comfortable in winter, a whole house, containing eight or ten such rooms, may be heated by the steam passing through a single tube of about one and a half inch diameter, which is connected in each room with a set of coils or disks into which the steam condenses, leaving its latent heat behind, and from which it returns in the condition of water to the boiler to be reconverted into steam.

It has been shown, on page 5 of this volume, that the evaporation of one pound or twenty-seven cubic inches of water produces twenty-seven cubic feet of steam; and that, in this transformation, 962 units of heat are made latent, which may be carried by the steam anywhere as long as it remains in the condition of steam. It has been shown, also, that these 962 units of heat are only set free or given out at the time and place where the steam is condensed or reconverted into water, that is, in every room of a building where there is a set of tubes accessible to this steam. As it does not take very long to discharge twenty-seven cubic feet of steam through a 1½ inch tube, it is readily seen that these 962 units may be quickly conveyed to any part of a building, and heat 962 lbs. of water one degree, or 96 lbs. 10°, or 24 lbs. 40°. But air has only one fourth of the specific heat of water, that means, it takes no more heat to raise the temperature of 4 lbs. of air than of 1 lb. of water, so that the 962 units of latent heat conveyed and set free by the condensing steam may heat 4 × 24 lbs. = 96 lbs. of air, 40°. As now one cubic foot of air weighs 1¼ ounces, 96 lbs. or 1,536 ounces of air have a capacity of 1,536 ÷ 1¼, or 1,229 cubic feet, corresponding nearly to a room of 11 feet square by 10 feet high. The temperature of the air in such a room then may, by the steam conveyed from the evaporation of one single pound of water, be raised 40°; and if this steam is conveyed in two minutes, it will, in that short period of time, have that addition of temperature. The necessity of a provision to regulate the heat is evident from this consideration; a simple stopcock is sufficient, and by this the steam may be turned off, or rather the coil, intended to heat the room, disconnected from the main steam pipe.

It must not be forgotten, however, that it is not only the air of a room which must be heated, but the walls, the furniture, and every thing in the room must be brought to the same temperature, say 68°, before the room is comfortable, and this takes more heat than the mere heating of the air. The amount of heating surface of the steam coils has been shown by experience to be most appropriate when taking one square foot for every 100 cubic feet of air in the room, but this proportion may vary according to climate, local circumstances, and the steam pressure used.