one extremity of it, in order to see whether it is true. We further verify it in a surer manner by drawing a line at one side, and turning it over upon the other surface in order to see whether the second line coincides with the first. For the more than forty centuries that geometry has been studied, no one has perceived that we are ignorant of the method of drawing a straight line. Meanwhile the professor of geometry has been teaching only exact constructions! Even at the present day, although the Peaucellier apparatus and its congeners have replaced the Watt parallelogram, our elementary works are silent in regard to this discovery—this mechanism—which is explained with the square of the hypothenuse by a clear demonstration given by Colonel Mannheim, professor at the Polytechnic School.

But to return to our subject. We must not abuse theoretical solutions beyond measure, since they are data and guides for the professional man; but it is necessary to take account of the operation of the machine, of the friction, and of the performance. By means of a new kind of calculation, due to Mr. Tchebichef and founded upon arithmetical methods whose germ is found in the work of Euler, the learned professor set out to find dimensions such that one of the points of the movable side (opposite the fixed side) should describe a straight line as accurately as possible.

Fig. 1 represents the new parallelogram. The points B and C, which are fixed, are the centers of rotation. The opposite side A D is of constant length, and its extremities describe the two circles shown by dotted lines. If the line A D be prolonged an equal length, that is to say, if D M = A M, the point M will describe a curve, which is here not the *curve of long inflexion* of Watt, but one of which a certain part very nearly approaches a straight line—as nearly as possible with the conditions imposed—provided the dimensions of the parallelogram be as follows, in taking the side A B as a unit of length:

$$CD = AD = AM = \frac{3+\sqrt{7}}{2}, \text{ and } BC = \frac{4+\sqrt{7}}{3}$$

In this case, as may be easily proved by constructing such a parallelogram with four wooden rulers, the point M will describe a trajectory that is sensibly rectilinear, when the apex A is describing its semicircle to the right. After passing over this part of the trajectory, the point M will rise, and effect its return in gradually mounting as far as to the center of its travel, and in descending according to the same law after getting beyond the said center.

Let us now suppose (Fig. 2) that such systems are applied to two cranks soldered to an axle, and directly opposite. In this case we obtain a mechanism in which the revolution of the axle is converted into a motion of two points, which, in turn, run over the same straight line, and one of which rises successively above such line after having passed over it when the other was descending upon it in order to do the same. Let us place at the side, as a balance, an apparatus that is symmetrical with respect to a central point (the navel, so to speak) of the machine, and let us connect it with the first by a fixed bar; and let us support the extremities of the four levers M by four feet, like those of an elephant. Now, if we pull towards the right with a cord, all this apparatus will begin to move, and will walk like a quadruped (Figs. 3 to 6).

If we cover this wooden apparatus with cardboard to imitate skin, and give it the form of an elephant, with tusks of ivory, we shall have, according to the dimensions, a plaything for the child or an object for use in spectacular dramas in theaters. If a clock or spring be placed inside of it, the apparatus may be made to walk automatically. With the leg of a giraffe, it might be utilized as a velocipede in the department of Landes; but the addition of so long legs would very naturally increase the cost. It would be more interesting to experiment with the apparatus on locomotives.

In conclusion, we may say that Mr. Tchebichef's apparatus gives the solution of a very important problem in mechanics. In considering only the rectilinear parts of the trajectory of the points M, we find that they produce with sufficient approximation the same effect as the equal arcs of the circumference of a revolving wheel, when the radius of the latter is very great. In other words, this mechanism performs the role of an infinitely large wheel.—*Science et Nature.*

The Gas Engine.

A gas engine, rated at 2 horse power, developing about 1·5 horse power, and running ten hours per day, will cost 10 cents per hour, including all items of expense of operation. These are: For interest, 5 per cent on first cost, credited to ten hours of actual running per day, 0·80 cent per hour; for repairs and depreciation, 5 per cent on first cost, similarly credited, 0·80 cent per hour; for oil, 0·40 cent per hour, and for gas 8 cents per hour. The current expense of operating such a gas engine will be about 6·7 cents per horse power per hour. Its first cost approximates $475. No charge for attendance need be allowed. Additional advantages are the cleanliness of the machines, the ease with which they are started, and the absence of risk from fire.

THE NEW YORK TRADE SCHOOLS.

Sir William Siemens, in describing the apprenticeship system which controlled the principal trades in German cities half a century ago, says that "every journeyman, in commencing, had to be bound as an apprentice for three or four years—the master engaging to teach him the trade; before the young man could leave his apprenticeship, he had to pass an examination as journeyman; he had then to travel four years, working in different places, and remaining not longer than four months under one master, but could not settle as a master in his trade until he had produced a master piece of work which would pass examination by the guild masters' committee: he was then pronounced a master, and allowed to marry."

The guild system in Germany was abolished in 1869, but the apprenticeship system, under which boys are regularly indentured to trades, still furnishes most of the skilled artisans yearly added to the ranks of industrial workers throughout the Continent of Europe and in the British Isles. This European apprenticeship system is also largely supplying the demand for skilled labor in our own workshops, for our trades unions do not encourage the employment of apprentices, although they are ever ready to admit to membership, as quick as he reaches our shores, the carpenter, bricklayer, plasterer, or stonecutter who has served his time under a foreign master. The old system of apprenticeship has, in fact, almost ceased to exist in America, and there is nothing yet to take its place. The demand for skilled workmen is only to be supplied by these foreign accessions, by the fast thinning out ranks of those who learned their trades in a former generation, and by those who have picked up only a "smattering" of a trade.

To partially take the place of the old apprenticeship system, trade schools have been recommended, where instruction and actual practice in the handling of tools could be obtained, and an institution of this kind forms the subject of our first page illustrations this week. It is situated on First Avenue, between Sixty-seventh and Sixty-eighth Streets, occupying a plat of land 200 by 114 feet, the buildings being of brick, one story high, with a large percentage of glass surface. Three of the workshops are 30 by 72 feet each, and 18 feet high, one being used for a plumbing shop, one for the plasterers, and another divided into three parts for the fresco painters, pattern makers, and wood carvers. In the rear is a building 40 by 120 feet used for the bricklayers and stonecutters, and adjoining this is a structure 30 by 50 feet used as a carpenters' shop. The bricklaying room has an earthen floor, the plastering room floor is concreted, with a Portland cement top, and the other shops have wooden floors, every part being thoroughly lighted at night with gas.

These schools were first opened in November, 1881, by Colonel R. T. Auchmuty, an architect, only plumbing and fresco painting being taught the first season, to a total of 33 students. In the season of 1882-83, bricklaying, and pattern making for moulders and machinists, were added, and the pupils numbered 88. In the season of 1883-84, instruction was also given in wood carving, stone cutting, and plastering, the classes then numbering over 200, and during the present season (1884-85) carpentering has been added.

Although it is a part of the scheme on which these schools are organized to give day instruction in the several trades, there has not yet been sufficient demand for such lessons to justify the organization of day classes, and the instruction now given is confined to a course of three evenings a week—Monday, Wednesday, and Friday—for the five months from October to April. The institution is not intended to be either a charitable or a money-making one, a charge being made for instruction based on what it is expected will ultimately cover the outlay, but the receipts for tuition have not thus far met the cost of running expenses. The charges for the different courses, five months each, are as follows: Bricklaying, $17; plastering, $15; plumbing, $12; and all the other branches $10 each, these figures covering also the use of tools and materials.

In the school for plastering, shown in one of our views, one side of the room is partitioned off to form a number of alcoves, nearly all of which are now plastered and hard finished by this season's class. The course includes scratch coating, brown coating, and hard finishing, and running cornices and mouldings, and the work now on the walls is such as would do no discredit to many of our city journeymen.

In the carpenter shop, door and window framing, and general carpenters' and joiners' work, is being carried on by a class of young men, the most of whom handle their tools so deftly that one has to look for some minutes to determine who are the instructors and who the pupils. There are some samples of work here ready for exhibition at the next fair of the American Institute. The manual of "How to use Wood-working Tools," prepared under the direction of Mr. George L. Cheney, President of the Industrial School Association of Boston, Mass., is used in this class with marked success.

In the department of wood carving, and in that devoted to pattern making, the work is all done from drawings. Some very elaborate work in wood carving is now to be seen well advanced on the young workmen's benches, and patterns which present considerable difficulty to experienced pattern makers are shown as part of the work of this season's class. The patterns made are always tested in actual practice, to explain the management and setting of the cores, a four-blade propeller, two feet in diameter, being cast last week from a pattern made in this shop.

The instruction in bricklaying covers the laying of eight, twelve, and sixteen inch walls, the building of piers, arches, flues, fire-places, setting sills and lintels, etc. In this, as in all the other departments, the instructors are practical workmen of exceptional skill, who go around among the young beginners, correcting faults and explaining how the work should be done, occasionally taking the trowel themselves to illustrate their comments. The work done evenings is torn down by laborers in the day time, the mortar made and the brick cleaned for relaying, so that there will be no unnecessary waste of material and no frittering away of time by the evening classes. Besides this manual instruction, the properties of mortar and cement, the principles governing the stability of walls and the thrust of arches, as well as the construction of flues, are explained.

Stone cutting is taught on plain and ornamental work in brown stone, and the specimens of work already done by members of this season's class, who never before had a stone cutter's tool in their hands, would do credit to many an old hand.

In the fresco painting department, a view of which takes up the center of our first page, are shown some fine oil and water color designs of the students, for ceilings of rooms, which are to be exhibited at the next Fair of the American Institute.

The instruction in plumbing is both practical and scientific. The practical part includes dressing pipe, making lead joints, wipe joints, sand bends, lead safes, etc.; and the scientific instruction covers lectures and verbal directions upon the proper arrangement of service and water pipes, and upon drainage and ventilation. Three teachers are employed in this room, which is fitted up with all the appliances of a first-class shop. Work done in this class has received two medals at the American Institute Fair, and at the request of the U. S. Commissioner of Education, an exhibit of work done here has been forwarded for display at New Orleans.

Col. Auchmuty states that although none but first-class mechanics have, from the first, been employed as instructors, he has found it of great importance to have a clearly defined course of instruction laid out for each class, showing the ground that it is most necessary to cover during each season, otherwise the sufficient consideration of many essential points would be too much a matter of accident. His ideas in this respect have been admirably worked out in a series of seven question papers for the guidance of the class in plumbing. They cover, respectively, the following subjects: "Soil pipes," "Trapping and ventilation of soil pipes," "Cold water supply pipes," "Boilers," "Tanks," "Fixtures," and "Trapping or Fixtures." Accompanying the first one of these papers is a direction which it would be better for society if every plumber would scrupulously heed, viz.: "Do not use inferior material to secure a job, or even to oblige the owner; a leak in a soil pipe may cause death, or the ruin of a life through sickness."

At the lectures the students are given the printed questions on the subject to be discussed, and under each question is a blank space in which the student is expected to write his answer, as the matter is being explained by the lecturer. The following are among the questions on soil pipes, which is the subject of the first lecture in the plumbing course:

Of what materials are the different kinds of soil pipe made?

Why is cast iron used exclusively in New York city?

Why is cast iron considered the best?

What material is used for soil pipes in England?

Why is lead objected to in this country?

What should be the thickness of 2, 3, and 4 inch cast iron pipe?

Give the weight per foot of 2, 3, 4, 5, and 6 inch cast iron pipe, in 5 foot lengths, with hub and spigot?

Is there any way of testing the uniform thickness of soil pipe?

What is meant by sand holes and flaws?

Describe how cast iron pipes should be calked at the joints.

What is the least depth the ring of lead formed by calking should have?

What is a rust joint?

Is there any objection to its use?

Why are putty, mortar, and cement joints objectionable?

What is the usual size of a soil pipe in New York?

Is it usual to make the horizontal soil pipe in the cellar larger than the vertical soil pipes?

How large should the soil pipe be from the highest fixture to the roof?

Should any allowance be made for the expansion and contraction of soil pipes?

What is the regulation of the Board of Health in regard to soil pipes in cellars?

What fall per foot should a horizontal soil pipe have?

How can a soil pipe be cut after it is put into a building, to allow the insertion of a branch pipe?

What is meant by the peppermint test, and how is it applied?

In a building over seventy feet high, how is the water test applied?

It is not expected that the course of lessons given at these schools will make the recipients complete masters of their trades, and able at once to cope with regular journeymen therein; but, from the experience thus far gained, it is proved that the knowledge here imparted forms the very best groundwork for the quick making of a first-class workman. There have been several instances where workmen have gone from these schools and at once earned journeymen's wages as plasterers and bricklayers, but these cases have been considered exceptional, as, although the student may have gained a better theoretical knowledge of the business in one term than is possessed by ordinary journeymen, it generally requires a longer time and more practice to gain the manual dexterity; that is, the skillful journeyman will lay about 1,500 bricks in the time it will take the average student from these schools to lay 500 or 600, the increased speed being acquired by practice, and so it is comparatively in other trades. The walls of the building in which bricklaying is taught, and also those of the plasterers' room, were built by the students, who were paid for their work in proportion to the number of brick laid. The founder of these schools, also, last year, in order mainly to give employment to a number of the young bricklayers, built the foundations and heavy lower story walls of what will eventually be some tall buildings, and says the work of his graduates on this job will compare well with any other bricklaying in the city; it is, in fact, so satisfactory that he will employ some of the members of this year's class in putting up the walls of some five-story buildings to be erected during the coming summer.

Although, by the terms of admission to the various classes, instruction at these schools is intended to be limited to those between 16 and 25 years of age, there has been no earnest effort, until the past season, to enforce this regulation. Experience has proved, so far as the history of these schools goes, that men who have failed at various occupations, and who have not settled down to the learning of a trade until they are over 25 years old, do not take hold and stick to their work with that spirit and resolution necessary to become a skillful workman, and so it is the intention hereafter to confine the membership to those within the specified ages. Other men who desired admittance, although most of them would come under the preceding provision, were the janitors of various flats and office buildings, who simply wished to learn enough to enable them to do their own jobs; as such students did not intend to completely learn the trade, and their work was not likely to be particularly creditable, it was decided not to admit them to the privileges of the trade schools.

When these schools were first started, some difficulty was experienced in engaging competent teachers, the best mechanics being afraid that they might be expelled from their trade-unions if engaging in such work, but this trouble is now over, and many union men bring their sons to the school, and come in the evening to help the instructors teach them. The Master Freestone Cutters' Association and the Journeymen Stonecutters' Association have both passed resolutions indorsing the trade schools.

The question as to how the call for skilled labor in the United States is to be met, in the future, may possibly find its solution in the experiment now being worked out in the New York trade schools, or some plan on the same principle. In many of the old trades it would be difficult for an apprentice now to thoroughly learn a business, as it was learned a generation ago, even were it not for the opposition of trade societies. The introduction of machinery and the division of labor have greatly changed the conditions of industry. The carpenter finds that door and window frames, all kinds of mouldings, and in fact all the interior work of modern buildings, come ready-made from the factory; the blacksmith or machinist sees that the most difficult pieces of work in his line are now generally the product of the stamping or draw press, or that some other labor saving device shortens the old process; and so it is, in a greater or less degree, through all our modern industries. But notwithstanding all these changes, that facility in the use of tools, that knowledge of the working of materials, that judgment of design and fitness in an article, which come only as the result of practice and study together, are still most important requisites for the workman in any branch of industry. And yet the American employer now troubles himself but little on these points; the whole tendency is to engage boys in the same way as men, simply for what they are worth, which causes so many, taking only casual employment, or following unskilled pursuits for temporary gain, to grow up without any higher ability than that of laborers. It is easier for a young man to get an opportunity to learn a trade in the country than in the city, as there are not such rigid trade-union restrictions in the country, but the standard of workmanship is not as high as it is in the cities. In the city there are thousands of young men whose education and bringing up admirably adapt them for the mechanic arts, but their places are now largely filled by foreigners and mechanics from the country. For such young men, whose lives have in many cases been marred by the efforts of trade unions to limit the number of employes, these trade schools offer an opportunity hitherto unattainable to learn a trade, or to improve themselves therein should they be already so engaged; and to such extent as they are sustained, they promise to prove a not inefficient substitute for an apprentice system.

Pneumonia.

This disease has been very prevalent in this city, and in other northern places, the past winter.

The chilly winds of March have not been the means of lessening the fatality of the disease, and persons in middle life, as well as old people, are stricken down, and die within a few days after their attack. B. V. French tells in the *Boston Journal* what pneumonia is, and what to do in the first stages of the disease.

His mode of treatment seems rational; certainly, it is simple enough, and most of the remedies can be

BATZ'S HAND PROPELLER FOR BOATS.

found in out-of-the-way places, away from physicians. Pneumonia, says the writer, is inflammation of the lungs. When the inflammation is on the lining of the chest, it is pleurisy. The two may be combined. Pneumonia is a dangerous disease, and requires prompt action. It is preceded by a chill, from which it sometimes is difficult to restore the natural heat. This chill is followed by a high fever, in which the heart beats rapidly.

Chills may come from other causes than pneumonia, but unless sure of the cause and sure that it is not dangerous, it is safe to suspect a coming pneumonia, and to send at once for a physician. On no account attempt to manage the case without one. The disease is too serious to warrant such an attempt. Until he arrives, do what you can to equalize the circulation and temperature. Keep in bed between woolen blankets or sheets, increase the temperature of the room, apply to the affected parts old soft cotton (not linen) cloths wet in hot water, in which has been mixed one-half of a teaspoonful of mustard to a quart of water, and to this apply heat from tins or bottles of hot water or hot bricks. Rubber water bags are best; apply heat in the same way to the feet. Do not increase the quantity of mustard. The object is to excite action in the skin, but to avoid an irritation that would hinder or destroy action. As these cool, replace them at once with others, not allowing the temperature to reduce at all. On no account must the patient get out of bed.

For medicine give aconite, four globules, every half hour; this is homœopathic. When the perspiration returns and the patient can sleep, let him sleep; continue the heat for a time, and when it is reduced let it be done with great care. If the patient needs food, let it be of a plain, simple kind. Avoid cold drinks until the natural condition of the skin is restored.

MR. IVAN LEVINSTEIN, in conclusion of his defense of aniline dyes against the charges, in the London *Times*, of their poisonous effects upon human health, cautions against the use of chrome yellow and chrome orange in dyeing cotton articles which are to be worn next to the skin, because these dyes consist in a salt of lead, which may be absorbed by the skin and produce disease.

How to Make a Paper Pan.

I recently required a dish to silver some paper on, and none could be obtained near where I live. I made a dish in the following manner: First cut out a block of wood the exact size and thickness of dish required. Then take a sheet of cartridge paper, paste it with flour paste and rub in the paste well, letting the paper be thoroughly soaked with it. Then place the paper evenly on the wooden block, turn down the edges smoothly and double the corners back, rubbing them down well. Be very particular with the first sheet, because if you get that smooth, the rest is easy. Follow with another sheet of cartridge paper, turning the surplus or slack paper at the corners, the opposite direction to the last. Follow with five or six sheets of old newspaper in the same way, and cap with another sheet of cartridge. Put the block with the paper on it into an oven, and bake till dry. Then take out the block and trim the edges. Paint the outside of the paper dish with varnish. Pour some varnish inside the dish and let it soak in, and then pour off the surplus. Bake in the oven again. After the varnish is hard and dry, warm the dish until it is hot enough to melt paraffine wax. Pour some melted paraffine into it, and tilt it about till the bottom and sides are evenly covered; pour off the surplus, and when dry you can use for toning, developing, or even silvering paper. Of course the above is only recommended as a substitute for glass or porcelain when the latter cannot be readily obtained. Paraffine alone may be used if you like.—*F. Whitehead, Photo. Times.*

HAND PROPELLER FOR BOATS.

The engraving herewith shows a device for propelling and steering a boat which is very simple in construction, easy to manage, and which will drive the boat at good speed with the expenditure of but little muscular power. Journaled transversely is a shaft carrying two beveled wheels, between which is a third beveled wheel mounted on the forward end of the propeller shaft. By means of a lever placed within easy reach of the foot of the operator, the transverse shaft may be shifted so as to make the third beveled wheel engage with either the right or left hand wheel on the transverse shaft, thereby turning the propeller shaft forward or backward. To hand levers pivoted to the bottom of the boat are secured the ends of straps, the opposite ends of which are attached to barrels mounted loosely on the transverse shaft, one at the side of each beveled wheel. When the levers are drawn toward the operator, the barrels revolve the shaft through pawls and ratchets. The levers are brought forward by coiled springs placed within the barrels. The boat is steered from the feet, which rest on a centrally pivoted cross bar, to the ends of which the tiller ropes are attached.

The boat is easily steered, and can be as easily reversed, the work to be done by the occupant being continuous and always in the same direction, and since he faces forward, he is enabled to keep a good lookout ahead. Power as well as speed can be changed by attaching the straps higher or lower on the hand lever. These levers can be worked together or independently, and when additional power is needed, a second pair may be placed just forward of the machine, as indicated by the dotted lines. This apparatus is applicable to life saving boats, as it takes up but little space and is always in position ready for use.

Further information concerning this hand propeller can be obtained from the inventor, Mr. Michael Batz, of 357 Flatbush Avenue, Brooklyn, N. Y.

Progress of the Tehuantepec Ship Railway.

The Government of Mexico has lately made important additions to the concessions heretofore granted to the Tehuantepec Ship Railway. Mexico guarantees the net revenue of the Company to the extent of $1,250,000 per annum for 15 years after the completion of the road, and gives the Company the right to ask for additional guarantees from other governments to the extent of $2,500,000 per annum, or a total of $3,750,000, being four per cent on $93,000,000.

Other guaranteeing governments may have a rebate of 25 per cent. on their commerce for 30 years, and a representation of two-ninths in the Board of Directors. The Company has the right to establish coaling stations and to import coal free of duty, to furnish ships in transit, and also the right to collect all tolls, except those from Mexican commerce, in gold, a difference in favor of the Company of about 18 per cent. There are several other minor concessions granted, such as the right to establish two tow-boat lines independent of taxation, and to collect harbor dues.

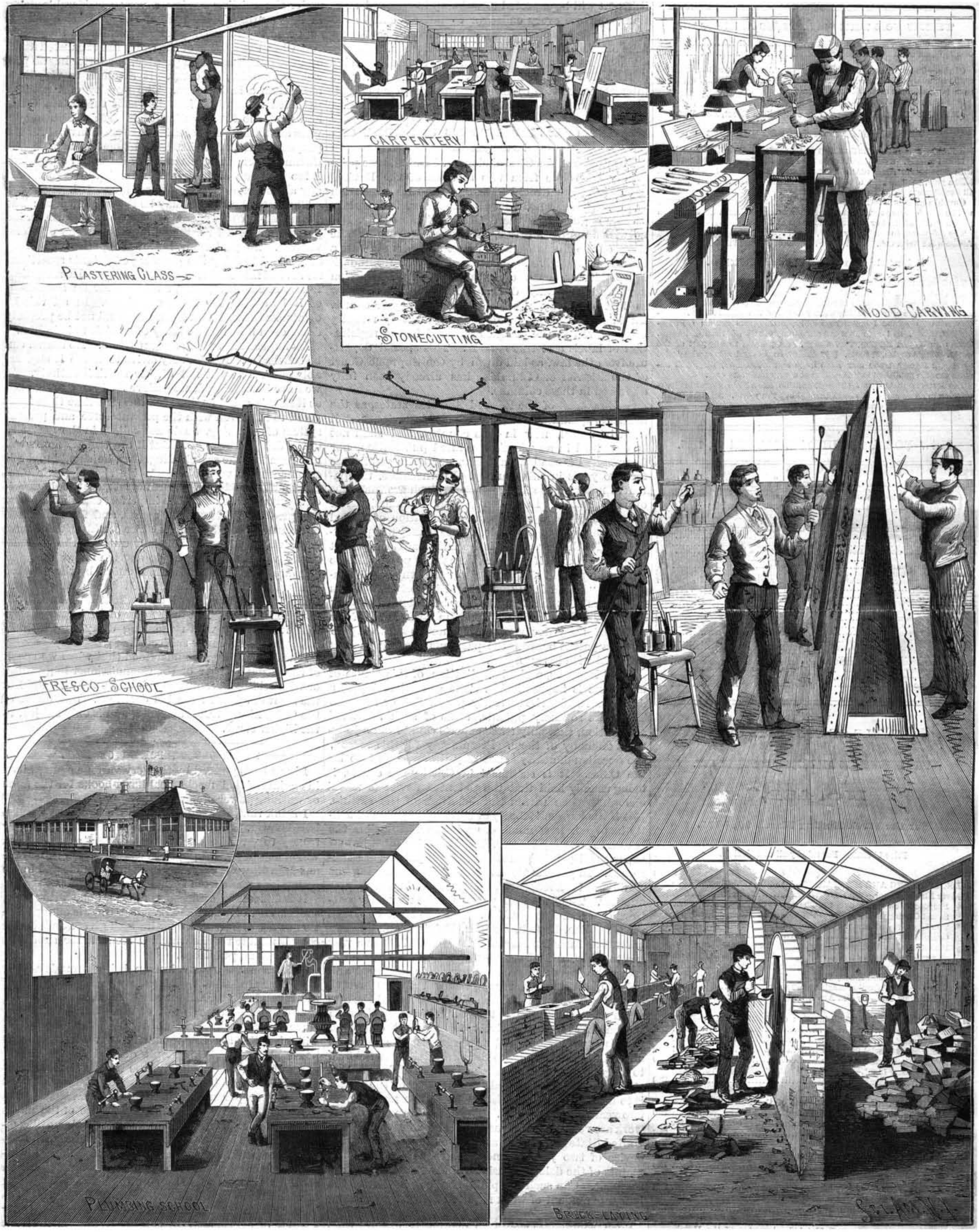
IN our last issue we omitted to give credit to London *Engineering* for the illustrations of twin screw engines of the Italian ram Etna. We herein acknowledge our indebtedness.

SCIENTIFIC AMERICAN

[Entered at the Post Office of New York, N. Y., as Second Class Matter.]

A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

Vol. LII.—No. 13.] [NEW SERIES.] NEW YORK, MARCH 28, 1885. [$3.20 per Annum. [POSTAGE PREPAID.]



THE NEW YORK TRADE SCHOOLS—TEACHING YOUNG MEN BRICKLAYING PLASTERING PLUMBING, CARPENTERING ETC.—[See p. 196.]