THE POLYTECHNIC ASSOCIATION OF THE AMERICAN INSTITUTE.

[Reported expressly for the Scientific American.]

On account of a general meeting of the Institute occupying Thursday, the usual weekly meeting of the Association was held on Wednesday, 31st ult—Professor C. Mason presiding.

No miscellaneous matter being ready for the meeting, the regular subject, "Caloric Engines," was called up for

DISCUSSION.

The President—As we wish to arrive at the whole truth regarding the utility of caloric engines, we should consider their disadvantages and inconveniences as well as their virtues. I suggest as the most important of the objections urged against them: 1st. The liability of burning out the heaters, thus, in effect, increasing their cost and bringing interruptions in their use; 2d, their small amount of initial force; 3d, the small amount of force relative to the size of the engine. Water in the steam boiler expands to nearly 1,700 times its original bulk, while it is doubtful if air has practically been doubled in volume in any of the air heaters.

Mr. Babcock—Air engines have been a very prolific subject among inventors. In the United States, thirty-five patents pertaining to the caloric engine have been issued, and in England, the number is two hundred; possibly in other countries there are two hundred more. Caloric engines may be arranged into four classes: 1st, Those having a reservoir of heated air, corresponding to the steam boiler. This is a very obvious method of employing air; the class is represented by Paine's engine and by some of Ericsson's inventions. 2d. Such as make use of air mingled with the products of combustion. Of this class are Lord Cayley's, Drake's, and those described by Mr. Seely. 3d. Such as make use constantly of a confined quantity of air, alternately heating and cooling it. Of this class are Stirling's, Hazeltine's, and others. 4th. Such as take in cold air and exhaust it into the atmosphere. To this class belong Ericsson's latest engine, Wilcox's, and others, which are the only engines much in use at the present time.

The President—Why are not engines of the other varieties in use?

Mr. Babcock—I do not know why engines of the first class are not used. The excessive heat and ashes of those of the second class are reasons enough against them. The only engines which have actually been put to use are Stirling's, Ericsson's, and Wilcox's.

The President—How small powers are used?

Mr. Babcock—It would perhaps be easier to say, how large engines are in use? Wheeler & Wilson's sewing machine requires about 1-60th of a horse power. Most, or all of the air engines in use will drive several of these machines. Very few caloric engines have been thoroughly tested to determine their power. Yet it is certain that they work economically as to consumption of fuel.

Mr. Babcock here gave a detailed description of the Wilcox engine, making use of large and cleverly executed drawings. The engine is single acting, and its supply cylinder is of the same size as the working cylinder. The cylinders stand upright and side by side. The pistons are both solid. The supply cylinder has a closely fitting top through which its piston rod passes; the piston of the working cylinder is uncovered. Between the cylinders is a three-way valve which regulates the entrance and exit of the air. Finally, the engine is provided with a regenerator, which Mr. Wilcox prefers to call an economizer. The cold air enters first the space between the cover and piston of the supply cylinder, entering by the pressure of the atmosphere on the descent of the piston. When the supply piston rises, this cold air is forced through the regenerator down to the bottoms of both cylinders, which are in contact with the fire. The air thus heated expands and drives upwards the working piston. While the supply cylinder is receiving cold air, the working cylinder is exhausting through the regenerator; the pistons of course have an unequal motion.

Mr. Churchill.—Is there any novelty with respect to lubrication?

Mr. Babcock—Yes; the working cylinder has a top perforated with a line of holes, so as to direct the incoming air, as the piston descends, against the inner surface of the cylinder. The supply cylinder is always cool. Above the metallic packing, there is a ring of cotton always saturated with oil; the oil is supplied twice a day. The economizer, in capacity $\frac{1}{4}$ of the cylinder, prevents the valve from overheating. There is now no difficulty with the lubrication. Wilcox's engines have run at the rate of $2\frac{1}{2}$ pounds of coal per horse power per hour. These engines work very smoothly, and with little noise. The working temperature is supposed to be 600° Fah.

Mr. Stetson—Give the temperature of the exhaust.

Mr. Babcock—It is about 300°. The balance of the 600° is taken up by the economizer.

The President—Was the name "regenerator" dropped on account of its sectarian sound? [Laughter.]

Mr. Roosevelt—Perhaps Stirling was a Calvinist minister. [Laughter.]

Mr. Babcock—Mr. Wilcox simply considers the word "economizer" more expressive of its use. The word does not imply any theory, but indicates a fact.

Mr. Seely—At the last meeting I gave some details of methods of using the products of combustion, and also proposing to cool the air which might be overheated by causing it to pass in contact with water. When I commenced calculations and experiments in this direction, it was with the supposition that none of the practical expansion would be lost. I assumed, for example, that if a cubic foot of air at a pressure of 50 lbs., and at a temperature of 2,000°, be brought in contact with boiling water, the temperature would be at once reduced to less than 300°, and the tension of 50 lbs. would be maintained; that although the air would be lessened in bulk, sufficient steam would be formed to exactly compensate such loss. This proposition was submitted to various scientific friends, and was fully endorsed. But a little consideration of the laws of specific heat shows clearly that it is not rigidly true. The specific heat of water being 1, the specific heat of air is .25, or, in other words, the same amount of heat will have four times the effect on air as on water. A quantity of heat which will raise 1 lb. of water 10°, will raise 1 lb. of air 40°, and if air at a high temperature be mixed with water at a low temperature, the air will lose in temperature 4°, when it raises the water only 1°. If there was a doubt of the universality of this relation of air and heat, it would be in the case where water is converted into steam. But a very simple calculation shows that in this case also the same relation exists. I use round numbers, which are near enough to the truth for my purpose. One pound of water at 212° occupies 27 cubic inches. By the addition of 1,000 units of heat, these 27 cubic inches of water will become 27 cubic feet of steam; 27 cubic feet may therefore be taken as the measure of the expansion of water by 1,000 units of heat. Now what is the case with air? One pound of air occupies 13 cubic feet; 1,000 units of heat will raise the temperature to 4,000°, and as the original volume of air is doubled for each 500°, the resulting volume will be $8\times13=104$; 104 cubic feet, therefore, is the measure of the expansion in air of 1,000 units of heat, and as 104 is 4 times 27, the relation of water and air to heat, in the case supposed, is found to be no exception to the general rule. Although this calculation very much weakens the plan of using water and air together, it is by no means fatal, as I am prepared to show. But it is plain that the products of combustion may be used at as high a temperature as air alone, and when the hydrocarbons are used there can be no difficulty of ashes. There is another special reason why hydrocarbons will prove useful. The hydrogen which they contain combines with oxygen and forms steam, which carries the heat into the latent state, and thus will give a higher pressure than the same weight of air alone, at the same temperature. When coal burns, carbonic acid is formed, which occupies, when cooled, the same space as did the air and coal before combination, and the expansion due to the heat is precisely the same as would be given to air by the same heat. But with the hydrocarbons the case is quite different, for the steam formed occupies a far greater space than did the hydrogen and oxygen before the union; the hydrogen in the hydrocarbon is in a condensed form. The composition of the coal oils and other hydrocarbons plainly show the value of these considerations. The lightest of the coal oils is benzole ($C_{12}H_6$), and the illuminating and heavier oils have a gradually increasing proportion of hydrogen. Add C_2H_2 to the formula of a coal oil, and you will have the formula of the next one heavier in order. Thus toluol is $C_{14}H_8$, and cumenol, $C_{18}H_{12}$; in benzole, carbon is to hydrogen as 2 to 1, but in cumenol, as 3 to 2. The composition of alcohol is $C_4H^6O^2$, and in alcohol the carbon in effect is combined with the oxygen and hydrogen, so that it it may be viewed as condensed matter which expands on burning, taking much of the heat into the latent state. From the fact that alcohol gives no light, I think it certain that the carbon is not separated as an element on burning. Moreover, alcohol with 20 per cent, or more, of water, readily burns, giving up the heat of combustion to the conversion of this water into steam. I have seen it stated that the coke produced from a tun of bituminous coal was as effective in producing steam as a tun of the original coal. The products of combustion go away from hydrogen or a hydrocarbon comparatively cool.

Mr. Stetson addressed the meeting at considerable length on the peculiar uses and advantages of the caloric engine. His endorsement of air engines appeared to meet the general approval of the society.

Mr. Dibben doubted the statements of the economy of fuel in the caloric engine. Yet, from the fact that a dozen or two of Wilcox's and 500 or 600 of Ericsson's engines are in use and satisfy their owners, it is evident that they have genuine merit.

Mr. Roosevelt—Fifty thousand dollars spent on bread pills will bring a fortune, and the pills will cure and give satisfaction. I have never seen a caloric engine which could'nt be stopped in grinding an ax.

The President—One large boiler may drive many steam engines.

An engineer—When the steam engine is not in use, the steam may be employed for warming and other purposes.

Mr. Stetson—At present there seems to be a necessity for making the caloric engine single-acting. Ericsson's engines are very much over-rated in their power. I have tested one carefully by the friction brake. It was an 18-inch engine employed in driving printing presses at Dodge & Grattan's, in this city. It was rated by some at 4 horse power. I found that when diligently fired, it performed with exactly two-thirds of one horse power. But the extravagance of some estimates should not lead us to underrate its actual performance. The caloric engine, both of Ericsson and Wilcox, is a success. It is difficult to compare strictly with steam engines. The performance of an engine depends much upon its construction; so that a steam engine of two horse power may do the work of only one man, or of six or eight horses. The expense and trouble of replacing the heaters are very small. The Ericsson heaters are much more exposed than the Wilcox heaters, but even in the Ericsson engine, the most exposed parts endure a year or more with moderately hard firing, and are replaced at an expense of only $15. The great economy of the caloric engine, however, arises from the ease with which it may be kept in operation without a professional engineer.

Mr. Fisher—There is no doubt of the superior durability of the steam engine. Boilers well made and properly used will last fifty years. Watt, for safety, used steam at 5 or 10 lbs. We can make boilers which are perfectly safe for steam at 60 lbs. If the caloric engine should take the place of all the steam engines now in use, we should probably discover chances of accident and danger of which we now know nothing.

Lieut. Bartlett—There should be no contest between steam and air engines. Each has its place, and each is admirable. The caloric engine is only proposed for circumstances where steam is impracticable. There is a wide enough field for both; both deserve our praises. [Applause.]

Subject for next week: "Preservation of Timber Exposed to the Weather."

After the adjournment, a large number of the audience passed to another part of the building and examined a Wilcox engine in operation. Mr. Roosevelt, who had proclaimed himself a doubter of the power of caloric engines, was called upon to stop the engine. This feat he at once accomplished by pressing his hands on the fly wheel. The engine however performed hand somely, and seemed to be generally approved. The experiment of closing the ports was tried, and the engine kept in motion till all were satisfied and tired.

ENLARGED FIELDS FOR INVENTION.

Now, that the excitement of the presidential election is over, we presume the several industrial operations of the country will resume their usual steady character, less subject to interruptions than they have been for some months past ; and, in harmony with this resumption of work, we look for renewed activity among the hosts of inventors. This most valuable class of the community is steadily becoming larger, from the constantly widening field for improvement. Railroad traveling, telegraphing, machine sewing, every new art that is introduced opens a broad field for the exercise of inventive genius. Again, as wealth and population increase, and labor becomes more subdivided, small improvements in the details of mechanism become of greater value, and they are consequently invented and patented in constantly increasing numbers. Thus we have a large number of patents for coupling belts, for stepping millstone spindles, for journal boxes, for shafting hangers, and for other small improvements in the arrangement of machinery.

But the most powerful agency in enlarging the field for invention is the increasing knowledge of the properties of matter. Every new substance that is discovered opens up the possibility of an indefinite series of combinations with other substances already known. For instance, who can foretell the number of inventions which will result from the discovery of aluminum? In the first place is the problem of reducing it from the clay of which it forms a part—one of the most inviting of all the fields which are now open for the exploration of the man of science. Every bank of clay is the ore of a precious metal, and the man who discovers the most economical process of separating the metal from the ore is sure of a very large reward. Then, the introduction of this new metal, with its peculiar properties, into the arts, renders possible a vast variety of new and improved combinations of mechanism by its means. Still farther the new machines will probably require modified tools for their construction; and thus the consequences of the introduction of this one substance into the arts are ramified in so many ways that the mind is bewildered in the effort to follow them.

If we enter the laboratories of the chemists, we find that there are innumerable substances, possessed of almost every conceivable property, which now merely serve for the idle amusement of abstract students, but which are doubtless destined to be appropriated by practical men to useful purposes, and made to contribute their share to human comfort.

People, in looking about and seeing every department of art full of patent inventions, are apt to imagine that the field is all explored and the work all done; but as Newton, after all his studies, declared himself but as a child wandering on the sea shore and picking up a few grains of knowledge, while the great ocean of truth lay unexplored before him, so is it with the mechanic arts; even now they are but in their infancy. As long as human knowledge is limited, as long as man is imperfect, so long will the opportunities for improvement remain unexhausted.

NEW STEAM FIRE-ENGINE.

On the 6th inst., a new steam fire-engine, built by the Amoskeag Manufacturing Company, of Manchester, N. H., was tested in this city. Its boiler is a vertical tubular, having 243 1-inch tubes with 155 feet of heating surface. Its steam cylinder is 12 by 8 inches, placed vertically near the top of the boiler. The pump is $4\frac{3}{4}$ inches in diameter, situated directly under the steam cylinder. The piston rod of the engine is connected to a yoke placed midway between the stroke of the two cylinders, and this is connected to two cranks which rotate a shaft having a small balance wheel at each side of the engine. The piston rod of the pump and that of the steam cylinder being connected to the yoke, they almost directly reciprocate; the arrangement is simple, so as to connect the reciprocating motion of the piston, with the rotary motion of the balance wheel shaft, to equalize the action and overcome the dead points. The feed pump is a common locomotive one, worked from the yoke described. It is quite a light engine, intended to be drawn to fires by hand, and its mountings are quite elaborate. It was tried at the famous test pole in West Broadway, and we paid particular attention to the time required to raise the steam to the working point—a most important consideration in all such engines. From the instant the fire was lighted with wood until the machine was working with steam at 20 lbs. pressure, the time was $5\frac{1}{4}$ minutes ; in 10 minutes, it was up to 40 lbs., and in $15\frac{1}{2}$ minutes, it was 100 lbs. on the inch. The day was very windy and unfavorable for playing high, but it occasionally sent a stream 160 feet up the pole, out of a $1\frac{1}{4}$ inch nozzle. The pole is 187 feet to the very top, and we think that it would have played to this hight had the day been more propitious. There appeared to be no difficulty experienced in working steadily and keeping up a steam pressure of 100 lbs., with cannel coal, Sometimes the pump made no less than 280 strokes per minute ; on the whole, the working of this engine produced a favorable impression on the mechanics present. All the steam fire-engines which we have lately seen have vertical boilers ; these are more favorable for raising steam, but a locomotive horizontal boiler would afford a superior arrangement for the framing, and would be more solid for running over rough streets ; there is still room for several improvements in steam fire engines.

A fire broke out in the rear part of the Astor House, on the morning of the 8th inst., but did not do much damage, as two steam engines of the Lee & Larned class were soon on hand and performed admirably. One large hand engine (No. 14) was also in operation, but, though a first-class engine, it appeared very inefficient beside the conquering power of steam. The firemen manned the brakes, and, in their red shirts, tugged and sweat like heroes, but they could not compete with iron muscles and lungs of steel.

On the subsequent morning (9th), a fire broke out in the large drug store of Penfield, Parker & Mower, in Beekman-street, at which the above Amoskeag engine (*Champion*, by name) was brought out and did admirable volunteer duty, along with two of Lee & Larned's engines.

Typographical Error.—Perhaps some of our readers have noticed a paragraph that recently went the rounds of the press, which originated in a typographical error in the *Springfield Republican.* Two accounts got mixed up together, one of a runaway dog, and the other of the inauguration of a minister, which resulted in the publication of the statement that the respectable clergyman was last seen running down the street with a tin kettle tied to his tail! We have had our share of annoyance from these typographical errors, but we believe the most annoying one that we ever endured occurred in last week's issue, in Mr. Charles Seely's report on water gas. Two queries were asked which got transposed, and to make sense our readers will please understand that the former should be, "What is the effect when you shut off the *steam?*" and the latter, "What is the effect when you shut off the rosin?"

Hearing in large churches can be made comparatively easy by an arrangement of a sound reflector which has recently been applied in Trinity Church, this city. It consists of a paraboloidal reflector of sound placed at the back of the pulpit, of which the speaker's mouth is the focus. A beam of sound, about ten feet in diameter, is thus thrown to the most remote point of the church, and, by its side flow fills the whole body of the building.

All irons of commerce which have been examined contain sulphur; they also deposit silica and black matters when treated with diluted acids, and, consequently, are impure. Iron can be prepared in a pure state only by pharmaceutists, its preparation requiring the minutest care; industry can furnish iron only of a relative, not absolute, purity. It appears that chemically pure iron may be kept an indefinite time in distilled water without exhibiting the least trace of oxydation, and retaining all its metallic luster.

Pike's Peak Gold.—The average fineness of this gold is .832, valued at $17 20 per ounce. The loss in melting, cleaning and refining varies from four to twelve per cent, according to the specimens.

RECENT AMERICAN INVENTIONS.

The following inventions are among the most useful improvements lately patented:—

CAPSTAN WINDLASSES.

This invention consists in combining the capstan with the barrel of the windlass by means of a worm wheel on the barrel of the windless and an endless screw on a central shaft, which is so fitted to and combined with the capstan, and so furnished with the pawl rim and stops, that the capstan may either be employed to work the windlass—in which operation it gives a very powerful purchase—or may be employed independently of the windlass in those operations in which capstans are commonly used on board ships. The patentee of this invention is Samuel P. Patten, of New York City.

CLOTHES' SPRINKLER.

This invention is a useful device for sprinkling or wetting clothes previously to ironing them. It consists in combining with a cylindrical bellows, small enough to be conveniently used with one hand, a siphon-shaped tube, and a small barrel with a hole in one end, which hole is stopped by a simple valve when a pressure is put upon the bellows, the end of which barrel is finely perforated around the central hole, for allowing the water to issue from the barrel in fine jets or sprays. The credit of this contrivance is due to Sarah N. Davies, of Muskegon, Mich.

A Fan for an Empress.—During the recent visit of the emperor and empress of France to Algeria, a number of jewish ladies presented her majesty with a notable fan. This article is principally formed of white ostrich feathers fixed in a golden disk ornamented around the edge with pearls, rubies and emeralds, and in the center with arabesques in enamels on gold, of different colors, and with rubies, emeralds and diamonds. In the center is a Hebrew inscription mentioning the conquest of 1830—a date not agreeable to the Moors, since it was that at which their domination in Algeria ceased. The handle is in coral, fluted with gold and ornamented with fine pearls. The upper part is divided into two branches, ornamented with arabesques, and having the imperial crown in gold ; the other end terminates in a golden ball studded with stars in diamonds, and bearing a ring ornamented with rubies and emeralds. On one side of the handle is a large emerald surrounded with a double triangle, forming a star with six points, ornamented with arabesques, rubies and brilliants.

It seems that the early French settlers and the Indians in Western Pennsylvania were acquainted with the natural oil or petroleum wells, which are now thought by many persons to be a new discovery. At Franklin, Pa., old oil vats have been discovered, with trees a century old growing in them. An old well, supposed to have been sunk for obtaining the oil, has also been discovered, with the remains of an Indian ladder in it. The early settlers used to place a dam on the creek, then take off the oil which floated on the surface by absorption with blankets. This they used to sell in vials as a medicine for curing rheumatism.

Mr. Merriam on the Late Earthquake.—The following are Mr. Merriam's remarks on the shock of earthquake which was lately felt in the North and East. He says:—"A time cycle of twelve years has run its round since October 17, 1848, when the Islands of New Zealand, at the antipodes, were visited by a company of terrific earthquakes, numbering more than a thousand strong, which vibrated through the earth's body, and were felt on the sea coast of England. Then the aurora australis and the aurora borealis united their labors, and a bright band encircled the whole earth."

Foreign Iron.—A correspondent of the St. Louis *Evening News* directs the attention of the citizens to the very bad quality of foreign iron which has been imported for the railroads of the Great West. He asserts that it is mere *rubbish*, and that far superior rails can be manufactured in St. Louis for $60 per tun.

Deafening Floors.—A correspondent (L. A. D., of Dupre, La.) informs us that he has found dry sawdust a most convenient and excellent material for filling in between partitions in rooms and floors for the purpose of "deafening sound."