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SCIENTIFIC AMERICAN SUPPLEMENT

No. 668.

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AMERICAN INSTITUTE FAIR.

The visitor to New York, if in the neighborhood of 63d Street and 3d Avenue, might walk by a modest little Dorian entrance on the east side of the street and never suspect he was close upon a great hive of industry, where steam-driven shafting is flying among many curious machines, with stone breakers hammering away, electrical dynamos giving out that mysterious energy which here is setting a hundred lights aglow and there pumping water or pouring silently into a sleeping battery a potentiality that will awaken into light and power when fly wheels are at rest. It is the fifty-seventh annual exhibit of the American Institute, and whoever may have seen last year's will easily discover the progress made in a twelvemonth by a comparison of mechanical devices and the mode of applying them. What is most noteworthy is, perhaps, the silence of the electrical generators; the buzz that used to shake the floors and send bits of paper scooting through the air like Japanese butterflies is gone. So still they are, one stands among them tempted to ask if they are "going."

Then there is machinery for grinding grains and sowing broadcast, for working over the summer fallow land, and there are fruits and flowers—the stereotyped show of garden and house flowers one may see at any fair, or, saving the trouble, find in any florist's window; and wild flowers that are not shown at fairs and florists do not keep, the charming little plants that ornament the woods and paint the fields and hillsides, not so fresh, to be sure, nor so brilliant, as those the gardener shows, for they do not bear plucking so well, yet beautiful they are, and more familiar and interesting to those who love the country. Here is the golden rod that has long been turning the fields to gold, and its burning rival, the bitter-sweet, that climbs the hillsides and peeps up from under the rail fences with copper burnished blossomings; the woolly, long-leaved mullein, that biennial herb that springs from the stoniest pasture, bearing flowers in large terminal racemes; the evening primrose that blooms morning as well as evening despite its name, and with four petals of deepest yellow; the Jerusalem artichoke with its miniature sunflowers and enormous stalks; the wild carrot in white, the bog onion in scarlet with its single cup of fire, ruddier than the tulip and like a torch upon the roadside, and phlox, smart-weed, spiderwort, Jack-in-the-pulpit, sweet balsam, yarrow, butter-and-eggs, sweet barbary, bur-marigold, thistle, wild aster, and the rest of them.

There is a fine collection of foot and hand machinery, none the less interesting because not always new; though those familiar with its type will find instruction in novel devices seen here and there. Here is the circular rip-saw, by the aid of which one man can do the work of three working in the old way; the work as true and square as that by steam or water power, and as easily dressed with the plane. It will rip boards or planks of either hard or soft wood up to 3¾ inches, and of any width up to 19 inches. Then there is the improved combined machine, a scroll saw and a circular one, the scroll saw easily removed while on its mandrel while its mate is being used; the boring attachment for the combined machine with a sliding table for the work, moving on firm ways and carrying it precisely to the auger or bit; new cutter heads for making grooves, gains, dadoes, rabbets, etc.; the improved foot-power former having pedals like a bicycle, and used for moulding brackets, scroll and panel work—the speed of the knives being about 2,000 moves a minute.

There is not, of course, anything novel in the sight of a gas-engine driving a dynamo with the latter alternately working a pump, setting electric lights aglow, or charging a battery. Yet it is a very interesting spectacle, one not easily seen, and possessing a power for instructing the general public that volumes of electric lighting literature could not hope to accomplish. "Why not use the gas-engine directly with the pump?" is the question that naturally suggests itself to the observer. The amiable attendant explains to him that far more power can be got out of the coal when translated into gas and then into electrical energy than when used directly under the boilers of the engine driving the dynamo. He means by this that the residuents of gas making are so valuable that they almost off-set the cost of making the gas, which, because of greater intensity, is a more economical fuel than the coal it is made from. The secondary battery, too, placed as it is on a shelf in clear sight, is an enjoying study in itself. You can see how it is connected up to the dynamo, how cut off; the operation of the little incandescent lights, depending from the ceiling above, glowing when they are connected up with this battery, even when the gas-engine and the dynamo are at rest. Among the lamps overhead sixteen-candle-power lights are made to glow directly from the dynamo: the gas-engine working the latter being of 4 horse power—eight lights to the horse power. But, if the dynamo be connected up with the secondary battery for five hours, then, with all connection with the dynamo cut off, it will feed 52 of these little lamps for several hours, and if then the dynamo is coupled up with its own lamps, there will be 84 aglow, and all, as is obvious, coming indirectly from the energy given out by a 4 horse power gas-engine.

The system of arc lighting used to light up the building at night is wholly new, and in itself will well repay a visit to the exhibition. We are not in a position to verify the statements as to its economy made by its projectors, not having seen any tests, and so are content to give a simple description of the system, repeating what those most interested say for it. The lamp, even to the magnet, is new; the method of regulating quite different from others, and the generator as well. As will be remembered, in the early days of arc lighting the lights were unsteady as well as costly, requiring, most of them, 1½ H. P. per light, an extravagant expenditure of power, which later on was reduced to 1 H. P. and quite recently to a little less than that per lamp. It is easily calculated, this divergence between the 18 to 20 ampere types and the 9·6 to 10 ampere systems, by the well known equation $C^2 \times R = W$; that is, the square of the current multiplied by the resistance of a lamp equals the power in watts, and 746 watts equal one horse power. The 20 ampere systems burn, it is said, a short arc or with carbons close together. The 10 ampere systems burn a long arc or carbons separated from $\frac{3}{32}$ to $\frac{3}{16}$ of an inch. A greater resistance in the lamps is the result; the 20 ampere systems having 2 ohms and the 10 ampere systems 5 ohms resistance in each lamp, though there is a variation in this according to the conditions in which the work is done. One of the sponsors of the new system says: "Under this rule we find that the 20 ampere systems give $\frac{800}{746}$ horse power per light, the 10 ampere systems give $\frac{500}{746}$ horse power per light. But, in practice, they do not begin to attain 100 per cent efficiency [this is clearly manifest], and we find them taking one and one-half horse power and one horse power per light." At a recent test of a new eight-light dynamo worked by a gas-engine of seven indicated H. P., the eight full arc lights were kept running, it is said, with only 5·18 actual H. P., the engine having ample power to spare; consuming no more than 132 cubic feet of gas per hour. This consumption came down to 102 cubic feet when four lights were cut out. The machine was then short-circuited without sparks or injury to it, the expense of gas coming down to 42 feet per hour. If this statement is not exaggerated, the new machine made a fine showing, for five full arc lights is about all such a gas engine can get from the older types of dynamos.

Here are the figures of this test as given by the makers of a well known gas engine who conducted it:

	Number of lights.					Machine in short circuit.—No lights.	Engine alone.
	Eight.	Seven.	Six.	Five.	Four.		
Gas consumed per minute.	2·2	2 1	2	1·9	1·7	0·71	0·58
Revolutions of engine per minute..............	180	180	180	180	180	184	184
Revolutions of dynamo per minute....	1,300	1,300	1,300	1,300	1,300	1,320	1,320
Slip of belt..............	10 p. c.	10 p. c.	10 p. c.	10 p. c.	10 p. c.	10 p. c.	
Actual H. P., including friction........	5·18				3 58		
Gas taken per hour in cubic feet..............	132	126	120	114	102	42·6	34·8

The new dynamo has long bearings for the armature shaft, contains less wire than the old style, and consequently has less resistance. The armature is of the closed circuit type, the core being made of large iron disks, insulated, the one from the other. The brushes on the dynamo are not moved in regulating. The field magnets of the dynamos are saturated to an extent necessary to produce the standard current, and any increase of current does not go around the field magnets, as is the case in other systems, increasing their strength and the current, but a path is provided outside the machine, so that the regulator may adjust the current-producing capacity of the dynamo to the standard, and thus insure the safety of the apparatus. Resistance, it is true, is made use of in regulating, but not for the purpose of compensating for the amount of resistance turned off on the line. In regulating, it is usual to let the current traverse the field magnet coils to the regulator. When the current is increased, dependence is placed upon the controlling magnet of the regulator moving a mechanism and the brushes on the commutator, thus short-circuiting the current through the armature. But the current in the field magnets is always the same as that on the lamp line. Suppose it is not necessary to burn all the lights, and some of them are turned off.

By the old method no reduction can be made in the current in the machine, but the surplus is short-circuited through the armature. This is a heating process, and, while the method will work under slight changes, and a few lights can be turned off with safety, users must be cautioned not to turn off lights below a certain number, say 50 per cent of the rated capacity of the machines; unless the lights can be reduced to one, and the one light be maintained at standard for any length of time on the largest machines, it is not automatic regulation. With the regulator of the new machine, on the other hand, as each light is turned off, the current in the machine is reduced. So, too, as lights are turned off, the current cannot build up, as is the tendency in other systems, because the source of its induction has less lines of force; the automatic adjustment allowing a sufficient amount of current to pass around the field magnet of the dynamo to produce on the lamp line the standard current. All this is what the projectors of the new system say for it.

A colony of bees is a notable exhibit; the bees, of the yellow striped Italian type, moving restlessly about because of the light coming through the glass case that incloses them and the store they have been laying in all summer. They are "city" honey gatherers, ranging the parks, the flower markets, the private gardens, and window flowering plants instead of the broad fields, and are the more interesting because of this fact. The hive is of the type used by the city bee keepers; a sect little known, yet quite numerous, so it is said. The combs are easily removable without disturbing the workers. Swarming is prevented by a simple device, and the bees safely wintered in their summer stands. The hives are kept upon the house roofs, whence, according to Mr. A. J. King, an authority, the bees range for four or five miles, sometimes as much as 100 lb. of honey being taken from a single hive, with enough remaining to keep the bees through the winter. He says he kept 100 hives for five years on a roof in Park Place, half a block from the Post Office, and with good results.

THE HOME OF THE HOP.

Puyallup valley, the center of the hop industry of Washington Territory, has recently completed the harvesting of an enormous crop, and its farmers are congratulating themselves on the price obtained—twenty-two cents per pound. The total cost, baled and delivered at the railroad, was nine cents, and the yield exceeded one ton to the acre.

The climate and soil of the Territory and of this particular valley are is so well adapted to the growth of the plant, and its freedom from the pests of lice, mildew, and other drawbacks experienced elsewhere is here so uniformly complete, that a maximum annual yield can be depended upon with the same certainty as the summer's sun.

The only "glorious uncertainty" about it is the market price. As this fluctuates from five to one hundred and twenty-five cents per pound, according to the supply and demand, the business is truly exciting.

An extensive grower, with hops at five cents per pound, finds himself unable to meet his liabilities, while the following year the same hop yard may pay a profit of $1,800 per acre if marketed at one dollar per pound.

As the land, cleared of timber and planted with vines, in rows seven feet apart and properly poled, costs $300 per acre, to which must be added a kiln or oven for drying and other paraphernalia, a man of small means can only commence on an extremely small scale.

The picking, which constitutes one-half of the expense of raising, is done by hand and must be paid for in cash every night. It furnishes light and agreeable employment for men, women, children, Indians and Chinese. The two latter excel the whites in rapidity and thoroughness. One dollar per box holding ten bushels is paid for gathering, and nimble fingers are necessary to fill two boxes per day.

The drying of the herb in the ovens is a delicate operation, requiring the experience of an expert, as its proper performance gives value to the commodity.

Experienced Foundrymen on Melting Iron.

BY ROBERT E. MASTERS.

Any one who is about to purchase a foundry cupola, after reading the gilt edge representations in the different circulars and catalogues they receive, is liable to become thoroughly confused about which style to select.

Each of them is represented to do more than any or all the kinds that have ever been operated. On account of some peculiarity in their construction, one is made to believe they cause the wind to do a contortion act or go through some performance that "melts the iron more rapidly than any cupola" that has ever been introduced, and each one of them will "produce a hotter and more fluid iron of uniform strength all through the heat" than can possibly be obtained from any other, and no matter which one is selected, we are told it will effect a saving in fuel of from 25 to 40 and even as high as 50 per cent over any other cupola that has been offered on the market. And so the Arabian Nights stories go on, followed by a lot of references and records of wonderful results obtained until the unsophisticated foundryman concludes, by the introduction of one of the cupolas, he will require little else than wind to melt his iron.

Foundry foremen have told me that the publishing of such phenomenal results in melting iron as occasionally appear in circulars and mechanical journals has injured them in the estimation of the firm who employed them. For instance, a superintendent who is not a practical foundryman, and therefore does not know that the most advantageous conditions must exist in cupola, blast, fuel, and iron to produce the best results, reads an account of high figures obtained in melting by some one who is ambitious to have his name attached to a performance that is to surpass all previous records. The superintendent does not stop to consider anything about the size of the cupola, or whether it is a 7,000 or a 70,000 pound heat, but he goes to the foreman of the foundry and points out the economy of melting at the figures contained in the account. Occasionally a foreman who has not the courage to stand up for what he knows to be right, and is afraid he will be considered incompetent, makes the coke weigh light and the iron weigh heavy in what he calls a trial heat, and presents a report that satisfies the superintendent, and another magical melting act goes on record.

During the past fifteen years the writer has traveled considerably, and while investigating this question has operated cupolas of various types from 18 in. to 72 in. inside diameter. I have in a plain 38 in. cupola, where everything was in right proportion and worked in harmony, melted 10 pounds of iron to one of fuel in a heat of 24,000 pounds, and the metal was fluid enough to run light castings clean and solid, but I do not pretend that these figures are a basis for any one else to work on, for I have then gone in a foundry where they had the most approved and improved type of cupola, and could not melt 7½ to 1 and call the iron melted if the fate of the nation depended on the result. I have never been able to reach the extraordinary high figures claimed by some men. My experience in actual practice has been on an average of 7 to 1, and in the exercise of strict economy it has often been less than that figure; much depends on the class of iron melted and the quality of work to be poured with the fluid iron.

I have frequently called at foundries where these monumental reports originate, in hopes I could see Aladdin with his wonderful lamp operating the cupola; but the days I called on the different foundrymen claiming to melt with such a low percentage of fuel there was always some reason why the lamp could not be rubbed up to its proper brilliancy to make the genii appear and produce the results published. If space allowed, I could tell some very amusing stories of how some of these reports are made up.

Mr. W. W. Snow, manager of the Ramapo Car Wheel Works, who I believe has had as much iron melted as any man in the United States, tells me that 7 to 7½ pounds of iron to one of fuel gives him better results than a higher ratio in producing good solid clean castings, even in large heats. From conversations and correspondence I have had with a large number of other prominent foundrymen, I select the following letters on this subject from gentlemen who are well known as contributors to the technical press:

From Thomas D. West, author of "American Foundry Practice and Moulder's Text-Book," Cleveland, Ohio:

"With reference to fuel and melting, I can only say that best of conditions must prevail, and the iron cannot be expected to successfully run light castings where 1 to 10 or less fuel is used in the cupolas now being generally used in the country.

"As for myself, I find no *economy* in trying to exceed 1 to 7½. To express what I mean by *economy* would fill many sheets, but my articles on this subject show the stand I take.

"It will not pay any foundry in the long run to try melting with lowest percentage of fuel possible. Any one could melt 1 to 10, and even higher, but the question is, what kind of liquid metal would be produced?"

From Geo. Vair, manager J. D. Murray Manufacturing Company Foundry, Wausau, Wisconsin:

"Our average result for good hot iron is 1 to 6, using Connellsville coke. We have no scrap at present, and our pig is heavy. I have melted at a higher ratio than this, but the castings would show cold shuts, therefore I consider it more economy for me to melt 1 to 6 or even less than above that figure.

"There are better cupolas than the one we are operating, especially for coke, from which better results may be obtained; but were it known, more cupolas would be found melting 1 to 5 than over 1 to 7, and it is an injustice to foundrymen to advertise such big results merely to gain reputation."

From David Spence, Supt. Foundry Geo. W. Brown & Co., Galesburg, Illinois:

"In regard to melting I could never do better than 1 to 7 and get good results. Where they claim such big things in melting there are always two piles of castings, the good and the bad, and it is hard to tell which is the largest. My experience has been with a plain shell, and in every case I have remodeled to suit myself with good results.

"Last May I was on a visit to New York. While there I took charge of a cast for a friend of mine. They use a —— patent cupola, but I could not get the big results claimed, such as 1 to 12 and 1 to 14. I should like to make a visit to one of these shops where they get such great results. I have had charge of foundries in Nova Scotia, Boston, Connecticut, and Illinois, and I have failed to find it only on paper."

From L. C. Jewett, Supt. Otis Bros. & Co., Yonkers, New York:

"The very best melting that I have ever done was 7½ to 1; that was in a good cupola with an excellent blast and excellent Lehigh coal, and in a heat of 18 tons, in Hartford, Conn. At present we are melting about 6½ to 1. The Wyoming Valley coal I am using is not as hard or durable as the Lehigh Valley, consequently have to replenish the bed oftener. Considering the quality of the fuel, I do not feel discouraged with the new cupola I recently put up. The following is the result of a heat:

Amount of iron melted	20,000 lb.
Amount of fuel consumed	3,100 "
Ratio of fuel to iron used	1 to 6·45

"It should be said, however, that *I melt iron*, and I claim good results cannot be obtained unless iron is melted hot. My ladles and cupola are in good condition when the heat is over, and bottom drops clean.

"With good Lehigh coal in a heat of 10 tons I feel sure I could reach 7½ to 1, but one thing certain: I will have the iron hot enough to look like white watered silk as it comes from the spout if it takes 4 to 1.

"Here is a heat at the rate of 8½ to 1:

Amount of iron melted	20,000 lb.
Amount of fuel consumed	2,400 "

"We have a cupola that lines to 46", air chamber all round with 12 tuyeres evenly distributed, tuyeres 15" from bottom plate, No. 6 Sturtevant fan running 2,800 revolutions, and I want to see some one take off a heat at the above figures with best anthracite coal and make a success of it. What I mean is, more castings will be lost for not running or poured short from the metal sticking to the ladles and thereby deceiving the moulders; the value of said loss would be greater than it would to have melted at the rate of 2 to 1 of coal.

"Let us analyze the two heats given at 1 to 8½. We have 700 pounds of coal saved over the figures in the first heat. Our coal costs us here $5.50 per gross ton; taking the 700 pounds we have saved at the spigot $1.72, and wasted at the bung by bad castings, badly bunged-up ladles and cupola, and, worst of all, bad temper from melters to core boy, well, say $10 in a ten ton heat; that is not extravagant to lose by cold shuts, etc., as the result of dull iron.

"I am not conceited, and when you find any one who can melt on an average at big figures, please send him to me, as I am anxious to learn how it is done."

We will not stop to consider heats of 25 to 100 tons, for they are the exception and not the rule, but will take them as they average in foundries throughout the country. I have before me about all the reports of cupola workings that have been published for several years past, and I find among them a number from men who claim, with cupolas of 35 in. to 40 in. inside diameter, and in heats of less than 18,000 pounds of iron, to be able to melt from twelve to over nineteen pounds of iron to one pound of fuel. For instance, the following figures look well on paper:

Amount of iron melted.	Amount of fuel consumed.	Ratio of fuel to iron used.
17,920 pounds.	1,232 pounds.	1 to 14·54 pounds.
9,800 "	635 "	1 " 15·43 "
8,800 "	530 "	1 " 16·60 "
10,700 "	610 "	1 " 17·54 "
13,100 "	680 "	1 " 19 26 "

Simply because I have not been able to reach these high figures, or see any one else do it, I do not say that it cannot be done. I try to be progressive, and am a thorough advocate of any improvement in machinery or advancement in mechanical work, but I am not going to try to compel any man who is in my employ as foundry foreman to produce results in melting iron that are beyond anything I have known to be accomplished.

I would like to see some of these figures demonstrated, and I am now talking to the men who claim to produce them. I will present any man with $250 who will come to our works (Marshall, Texas) and melt 18,000 pounds of iron in a 38 in. cupola at a ratio of over fourteen pounds of iron to one of fuel, and have the metal fluid enough to produce good, clean, solid castings for locomotives, architectural work, and machinery. These figures will give the one who undertakes it the highest amount of iron to melt and the lowest ratio of iron to fuel given in the above table.

I will furnish as good, or better, cupola to melt in than can be found in the average foundry; good blast, first-class dry Connellsville coke, Scotch and American pig iron, and a regular run of car and locomotive cast scrap. All I ask is to do the weighing on the charging floor and keep the figures jointly with the man who is to accomplish it, and I will take pleasure in publishing the results.

WE have the greatest number of miles of railroad track of any country in the world, but the Argentine Republic can beat us and every one else for taking their straight. On the road from Buenos Ayres to the foot of the Andes is a stretch of 211 miles without a curve.