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THE EDWARD WESTON EXHIBIT AT THE INTERNATIONAL ELECTRICAL EXPOSITION, PHILADELPHIA.

In an exposition where apparatus connected with electric lighting occupied so important a place as it did in Philadelphia, it was meet that one to whom that branch of electric science owes so much should be represented by his work. Few persons save those immediately interested in the subject were aware how important a part Edward Weston had played in the electric lighting field until they examined this exhibit. For Weston, to his credit be it said, has been content to work silently in his Newark laboratory, and leave to others the pleasing duty of announcing from time to time the results of his investigations in the field of applied science. Perhaps no other man has of late years accomplished so much with so little display as Edward Weston; and his work, after standing the test of long and continuous use in the field, has been found to possess even more merit than he claimed for it when first introduced. The Weston exhibit was in the northern part of the main hall, and contained that which at the same time pleased the eye of the casual visitor and attracted the serious attention of the scientist. Facing the thoroughfare on the south, a sheet of water fell upon a mass of crystal rocks, concealed in the crevices of which a score of incandescence lamps lay hid that threw back with undiminished intensity the dazzling glow of similar lamps springing from the lilies and ferns growing upon either bank. Few of the thousands that daily visited the halls of the Exposition had ever seen lights glowing under water before, and the passages about the Weston exhibit were therefore frequently crowded with admiring spectators. Even in the arrangement of this waterfall could the careful and original work of Edward Weston be seen. The fountain in the center of the great hall was a ponderous affair; in fact, an ordinary spouting of water illuminated by electric lights in much the same manner as were those at the Munich and Paris expositions. But the mechanism which controlled the waterfall of the Weston exhibit was contrived with such nicety that, even near by, it looked like a huge mirror, curving outward; for the sheet of water seemed never for an instant to vary in dimensions, and was never broken. Yet seven hundred gallons of water fell every minute, coming from a centrifugal pump which in turn was coupled to a Weston electric motor.

On either side of the waterfall were groups of arc and incandescence lamps of the Weston type, and which have served to make the name of the United States Electric Lighting Company so well and favorably known.

It was a pardonable pride that induced Weston to exhibit these lamps in all the many varieties, for each type has scored a very decided success in the field for which it was designed. The arc lights stood what might be called a competitive examination not long since before the trustees of the Brooklyn Bridge; all the best known arc lamps in use being examined at the same time.

In two long rows they now stretch across the East River from New York to Brooklyn. The Weston incandescence lamps are made both large and small, and, as shown in the exhibit glowing from many-colored globes, are pleasing to the eye, constant, and diffusive. They are improvements on the Maxim type, which heretofore was used by the United States Electric Lighting Company. What is most remarkable about these incandescence lamps is, that they have been shown to have an average life of more than two thousand hours, which, in the dwelling house, where artificial light is required, on an average, five hours per diem the year round, would permit of their being left undisturbed and without renewal for the entire year.

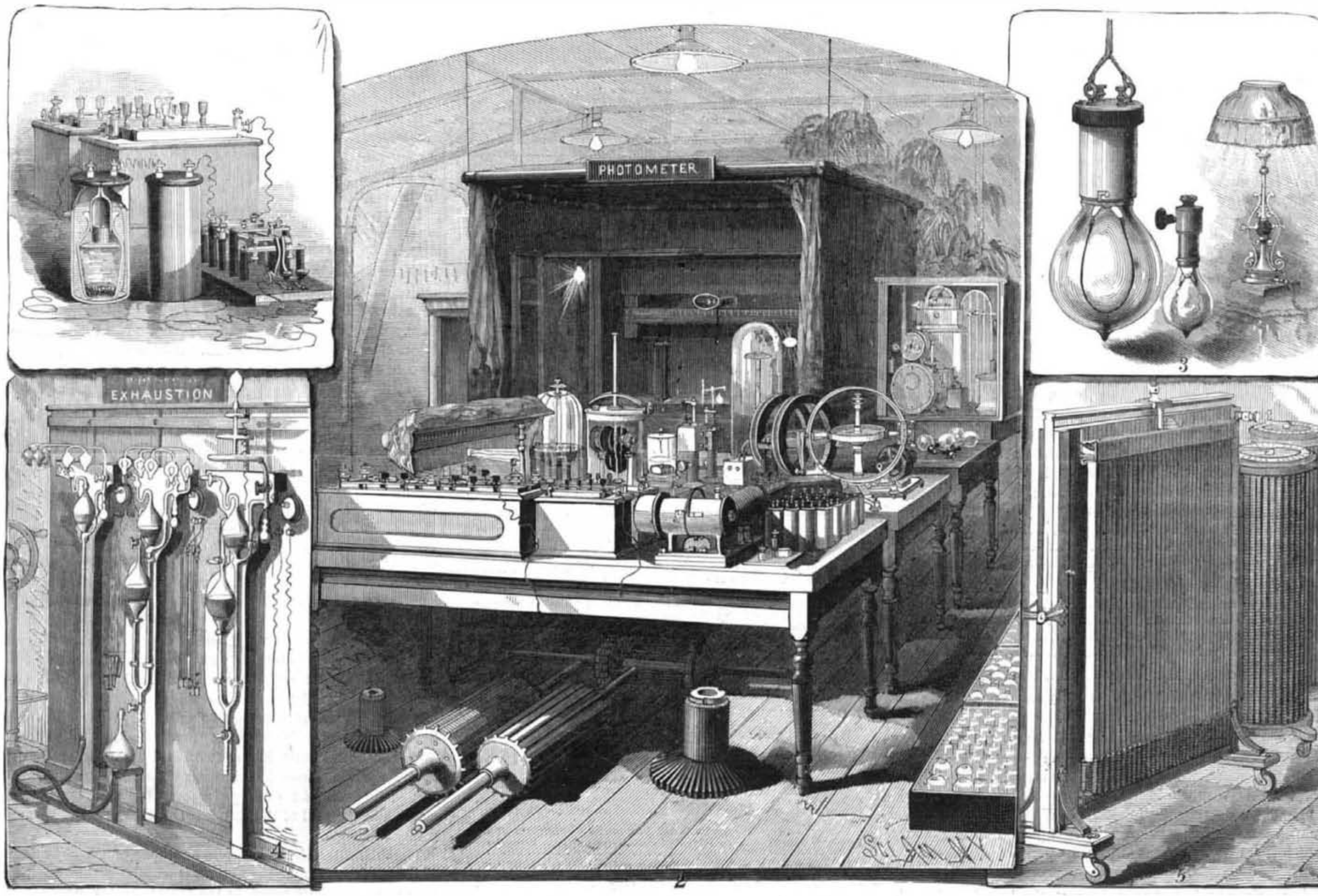
The large incandescence lamps in the exhibit were from 125 to 130 candle power, there being about 16 candle power of intensity in an ordinary five foot gas burner when new, and about eight or ten when long in use. The circuits of these were so arranged that they could be fed at long distances from the generators with the same size conductors as are commonly used in the arc light system. There is by no means so much loss of current while *in transitu* when these large incandescence lights are used as is the case with the smaller lamps, and the lights may, at the same time, be more widely distributed. These, as well as the small incandescence lights, may be used or turned down without in any way affecting the generating machine or the other lights, and a corresponding change is immediately discoverable in the current generated as well as in the power used.

The electric motor, as designed by Weston for use in the shop, was exhibited both at rest and in motion. For the latter exhibit the interior of a shop was shown, the tools being operated by the Weston motor, which ran rapidly, smoothly, and noiselessly. The electrometer, designed by Weston, while not as a whole novel, has interesting features, and is especially fitted for measuring the currents generated by the Weston dynamo. The system of lamp manufacture designed by Weston was practically exhibited from the hydrocarbon process for making the filaments to the treatment of the lamps at the mercury pumps.

One of the most interesting features of the Weston exhibit was what might not inappropriately be called the historical section, wherein were contained the various crude devices and mechanisms, the continued improvement of which finally led to the perfect lamps, switchboards, and like contrivances. The progress made by the inventor may thus be traced step by step, difficulty after difficulty is seen to have been met and mastered, until what seemed but a crude conception, and gave little hope from a practical standpoint, is observed to have gradually been reduced to a simple, smooth working, and efficient apparatus.

That part of the Weston exhibit which was designed to represent his system for central stations naturally attracted much attention. It contained three engines, together having an accumulated capacity of 250 horse power. There was a group of dynamos which fed about 1,500 lamps, scattered throughout the main hall, comprising 65 arc lights, 150 incandescence lights, each of 125 candle power, and 1,275 lamps of 16 candle power.

The circuits from the dynamos and from the ouside lines were all brought to a switchboard, by means of which the dynamos were coupled together as desired. By this any of the outside circuits could be coupled up or coupled to any of the dynamos, and rapidly changed from one battery of dynamos to another; the others meantime not being appreciably affected. By means of the Weston switchboard the



THE EDWARD WESTON EXHIBIT AT THE INTERNATIONAL ELECTRICAL EXPOSITION, PHILADELPHIA.

dynamos could be connected with either of the three engines. The wires leading to the switchboard were carefully protected, as in the large central stations which have been established in New York city and elsewhere by the United States Electric Lighting Company, which, as said before, uses the Weston patents. Any combination can be made by means of this switchboard with any combinations of machines, and by means of cables the circuits are connected with the machines. A plug on either end of the cables serves, the one end to connect with the circuits, the other with the machines. In order to prevent lightning from reaching the dynamos during thunder storms, lightning arresters are affixed to each circuit. From the switchboard the circuits are extended, and so arranged that the lamps may be adjusted to each circuit. It does not injure the outside circuit when these lamps are either placed in position or removed. All the lamps are tested upon the circuit upon which they are to be used before being regularly adjusted on the line.

The types of dynamo machines exhibited for the arc and incandescence systems, as devised by Weston, do not materially differ, save in the winding of the armature and field coils, these being somewhat modified in order to produce the different kinds of currents that are demanded. The current generated by these machines does not pulsate, but, on the contrary, is continuous, which, besides giving a very steady light, is less dangerous than that of the pulsating type.

In the Weston arc lamps exhibited, the arc or distance between the carbons is short, being one thirty-second of an inch in length or thereabouts. There is a palpable advantage in this, for it permits a given number of lamps to be worked with a current the tension of which is correspondingly low.

The large incandescence lamps shown in such profusion in the Weston exhibit were really the only lamps in the Exposition which showed a new and important departure in this type of illumination, although there were those of the smaller description which exhibited marked improvement when considered from an economical standpoint. The big lamp can be used in multiple arc or multiple series at points far removed from the generator.

In the Weston dynamo the current generated has an E. M. F. of 1,500 volts. In the two great incandescence machines exhibited the E. M. F. was shown to be of 160 volts, the small lamp machines having an E. M. F. of 120 volts or thereabouts. The field magnet of the Weston machine resembles the letter C, having the poles in the center; the magnets are wound in shunt circuit, and are oblong in section.

The armature, which revolves between the poles, is composed of a core of iron disks strung like beads upon the shaft, being insulated the one from the other by disks of paper. The type of cylinder thus constructed may be said to be a modification of that employed in the Siemens machine. There are numerous coils, which serve to equalize the current generated, and brass bearings serve to insulate the shaft from the magnet.

In the automatic rheostat exhibited in connection with the arc lights, a magnet wound in shunt circuit attracts an armature connected with ratchet wheels. When, by reason of the turning off of lights, the current shows too great intensity, the armature acts, rotates the wheel, and this leads to more resistance being thrown into the field circuit. The field magnets, as a consequence, exert less magnetism; a smaller current results, and the power which has been driving the machine may be reduced. The resistance is released by an opposite process, and the full power of the shunt circuit may be thrown upon the magnet.

The incandescence system of lighting must be able, if it would be generally employed, to compete with gas in cost. Hence it may not prove uninteresting, having described the Weston incandescence light, to explain what it has accomplished when practically compared in cost with gas by persons having no interest in either the one or the other. A large manufacturing firm of Olneyville, R. I., recently tested two Weston dynamo machines, one of one hundred lights capacity and the other of fifty lights. The test was made during an entire year, from April 15, 1883, to April 15, 1884—3,397 hours, an average of 11 hours each working day; the object being to discover whether incandescence lighting or gas was the cheapest. The following figures were given by the firm as the result of their experience:

Number of lamps in the two circuits	170
Number of lamps broken in 3,400 hours	133
Average life of lamps	2,207 hours.

The cost of operating for the entire year was as follows:

133 lamps broken, at $1.50 each	$199.50
Cost of power	500.00
Cost of attendance	468.00
Cost of brushes, oil, and other supplies	52.00
Interest, 6 per cent, on $4,100	246.00
Total	$1,465.50

They compare this with what they had previously paid for gas as hereunder:

Cost of gas, 170 seven-foot burners, 3,397 hours, 4,042,430 feet of gas, at $2.00 per M	$8,048.86

In Providence, where they say gas may be had for $1.75 per M., this cost would have been reduced to $7,074.26. This shows, as they say, that their Weston incandescence lamps cost them only one-fourth cent per lamp per hour, which is equivalent to gas at 37 cents per thousand feet.

ACCORDING to the last annual report, the American Association for the Advancement of Science had 2,011 members.

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THE SCIENTIFIC AMERICAN SUPPLEMENT

No. 462,

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COMPOSITE STEEL AND IRON.

According to the recently published statements of a master railroad car builder, the union of ordinary machinery steel scrap with iron scrap in making a pile for forging into bars is ruinous to the entire work. The bars showed handsomely on the surface, but when broken the fracture showed that the metal was unsound and not homogeneous; the steel and iron had not welded. In some of the bars the flaws were in the form of wide cracks, while in others there were seams completely separating the two metals; true welding had nowhere taken place.

If this result of experiments is to be received as conclusive, working mechanics must have been greatly mistaken in their estimates of machinery and other low steels. The general belief has been that these steels were so scarcely removed from iron that their union by welding was one of the easiest of processes. We find no difficulty in uniting by welding the highest cast steel with iron; all our large cutting implements are so made; and the union of the two is not a mere cementing or gluing together, but is a chemical combination. It is somewhat singular (if it is true) that low steel and iron cannot be thoroughly united under the influence of the welding heat and the compressive action of making a bar from a fagot. Certainly such a union is possible; for in the ordinary scythe there are three equally longitudinal strips of iron, low steel, and crucible steel, and it would be difficult to find cracks or seams in any one of the thousands of scythe blades turned out every week from the factories of Western Connecticut. The report of the master car builder was probably based upon imperfectly recorded experiments.

USES OF GAS PIPE.

The machine shop is a great user up of "unconsidered trifles"—at least the job shop is. There was a shrewd job shop machinist in an Eastern city who procured a large portion of his stock at the junk shops or the sale of the results of fires. Gas pipe, shafting, iron plates, rods, bars, and all sorts of metallic fixtures found a congenial home in his shop. Gas pipe he doted on. From pipe he fashioned a number of articles which otherwise would have been made of the solid bar.

Gas pipe of convenient diameters was cut off in the lathe to lengths, plugged at one end with iron, and at the other end with iron and steel, and welded and finished into barrels for ratchet drills. The iron plug was drilled and tapped to receive the screw of the drill, and the iron plug with a steel center became the conical top of the barrel. The barrel thus made was sufficiently strong, was much lighter than one made from solid iron, and cheaper.

A very particular workman at the lathe, who prided himself on his skill with the hand tool, made a set of handles for his turning tools from gas pipe. He cut off the pipe to length; heated and drew it near the end by means of "fuller" and the anvil horn; turned and polished it; filled it half full or more of plaster of Paris; then put the shank of a tool in the handle, and poured melted lead around it. The tool could be readily removed, and the lead held the shank or tang of another tool just as closely as the first.

For bolting work to a chuck on lathe or drill, or securing it to a planer or boring machine, long washers—tubes—are frequently required. If thin washers are used, it is almost impossible to get a hold on a pile of twenty or more so as to be secure. Varying lengths of gas pipe do the business thoroughly.

It is possible to make very effective hollow shafts for some small machines from piping; there is generally stock left enough after turning and finishing to secure a pulley, or other wheel, by set screw or key; or in some cases the pulley, if of iron, may be shrunk on.

For truing the grindstone there is no better hand implement than a piece of gas pipe from half inch to full inch, according to the fancy of the workman. Such a razer will always present a cutting edge.

DRILLING AND BORING WOOD.

The hand drill or breast drill, originally intended for the hand drilling of metals, has taken its place among woodworking tools. In many instances it has displaced the bit-brace, or at least has filled a requirement left unsatisfactorily supplied by the bit-brace. The breast drill may be used for drill, gimlet, or bit, and its speed—on the best forms—may be changed at will without a change of speed of the hand. It has its advantage, also, in the more natural motion of the hand—the vertical crank movement instead of the horizontal crank motion. A drilled hole in wood, for whatever purpose, is better than a bored hole. The drill cuts a clean hole; not merely finding its way between the fibers by displacing them, but removing the material entire as it advances. The gimlet form of wood borer is crude at best; a thread at the end is supposed to enter the solid wood, and by spiral friction pull the cutting portion after it. This cutting portion is a twist like a twist drill or auger, supposed to deliver the chips—which it never does deliver. The pressure of the hand is necessary to force the gimlet into the wood, and the pull of the hand is required to release it and empty the chips.

The drill cuts a clean hole, and has none of the objections of the gimlet. Unlike the gimlet, it may be resharpened so long as it lasts. Its speed in the breast drill is very much greater than that of the gimlet in the bit-brace.