in case of any accident. This cutting out is to prevent any injurious effects from short-circuiting, in the case of fire in the building, when the switch board, being wet by water from the fire engines, might give occasion to this trouble were the current turned on.

The general operations of the office are facilitated by the use of the cash carrier railroad and by pneumatic tubes. An elevated gallery occupies approximately the center of the main operating room. An extensive system of cable cash carriers, embracing 16 radiating lines, with four to six stations on each line, connects with all parts of the room. By this the messages are distributed from and returned to the central gallery. The cash carrier runs at the rate of about 750 feet a minute, enabling the most distant part of the room to be reached in 10 seconds. Twenty-four pneumatic house tubes terminate in this gallery; and four street pneumatic tubes running north to 23d Street, and intermediate offices, and four running south to exchanges below Wall Street, are also operated from this gallery. All messages coming in or going out from the main operating room must go through this central gallery.

Fig. 2 of the drawings shows the time repeater. At noon, every week day, the time is transmitted from the United States Naval Observatory at Washington. This signal has to be sent out over many lines in all directions; at present 60 different lines transmit it. The time repeater includes 92 repeating magnets. These are operated on a local circuit, which in its turn is governed by a relay connected to the Washington circuit. The repeating points of the 92 magnets are connected by loops to the main line switches. This apparatus represents a multiplication of relays, and can be used for sending 92 repetitions of one message over 92 different lines by a single operator, and it is contemplated on election nights and similar occasions to thus use it.

The average business done in this office is over 100,000 messages per day. The longest circuit is that extending from New York to San Francisco, about 3,400 miles long. Of the 750 lines leaving the building, the greater part are operated by the Morse system, the majority of the operators' desks seen in the engraving being devoted to this system. Besides this there are four Wheatstone, 42 duplex and 92 quadruplex lines, and two lines occupied by combination printing instruments. The office accommodates about 800 operators. Our thanks are due to Mr. Alfred S. Brown, Electrical Engineer of the Western Union Telegraph Co., for courtesies received.

Improvement in Stokehold Ventilation.

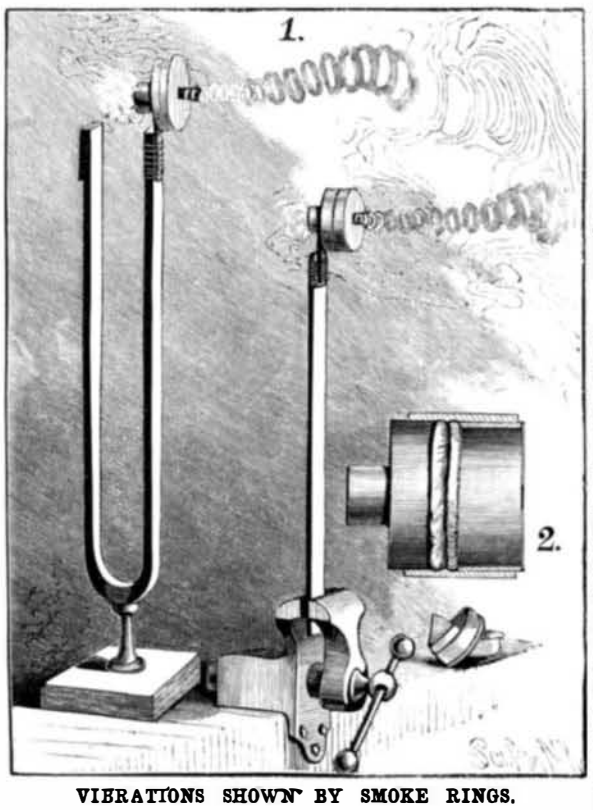
By the system of Mr. W. H. Martin the usual unsightly ventilating cowls on deck are done away with, the necessary down draught being obtained by the utilization of the heat radiated from the main boilers and uptakes. This lighter air is allowed to rise up through an enormous space between an inner and outer funnel, causing a powerful down current of fresh air through the stokehold combing, at the same time thoroughly preventing the rising of any smoke or dust to the deck, as is usual when cleaning fires and quenching ashes. To insure the fresh air reaching the stokehold floor, there is a light air-tight screen or bulkhead built in front of each end of the boilers, reaching from the deck right down to within 6 feet from the stokers' floor, the lower part being on hinges to allow access to the smoke box doors. As the whole of the air drawn off by the annular funnel space, to which is to be added that needed for combustion in the furnaces, has to pass down in front of these air screens, the result is a powerful draught of fresh air at all times, independent of the direction or force of the wind on deck, keeping the stokehold at a temperature considerably lower than in the sunshine on deck, and but from 5° to 15° Fah. above that in the shade. This system, which is much more economical than the fan, is in use on most Dutch steamers trading to the East Indies, and has proved to be of great value.

FOUR electric fans have been placed by the Crocker Wheeler Company in the turrets of the powerful iron vessel Miantonomoh, the intention being that they shall blow away the smoke from the guns.

AN EXPERIMENT IN ACOUSTICS.

BY GEO. M. HOPKINS.

In the annexed engraving is shown a very simple and effective method of indicating visibly the vibrations of a reed, tuning fork or diaphragm. It is not assumed that it can replace any of the existing methods of rendering visible indications of sonorous



VIBRATIONS SHOWN BY SMOKE RINGS.

vibrations, but it adds another very pretty acoustic experiment to the list of those already known.

In Fig. 1 are shown two forms of apparatus which yield practically the same results. In one a reed is clamped in a vise at one end and provided at the other end with slip of wood attached firmly by a wrapping of thread. To the wooden slip is glued an ordinary paper pill box, having a diameter of about two inches and a depth of ¾ inch to 1 inch. In the bottom of the box is made a 1 inch hole in which is secured the end of a paper tube 1 inch in diameter and about 1 inch long. The cover of the box is perforated with a ¼ inch round hole. If the material of the cover is coarse and thick, a larger hole is made and over it is glued a piece of fine thin Bristol board, which is perforated with a ¼ inch round hole.

In the box thus mounted is placed a strip of blotting paper bent into V-shape and rendered non-absorbent at the bend by means of melted wax paraffin or something of a similar nature. One end of the blotting paper is moistened with hydrochloric acid and the other with aqua ammonia. The particles of ammonium chloride which form by the combination of the vapors of ammonia and hydrochloric acid are so minute as to float in the air like particles of smoke.

When the reed is vibrated, a minute vortex ring is formed at each excursion of the box and thrown off in the manner illustrated. A reed having a low rate of vibration (say 32 or less per second) is required, and the amplitude of vibration must be small.

When the box is attached to a tuning fork, the action is prolonged. It is, of course, necessary to compensate for the box on one limb of the fork by a weight on the other.

In Fig. 2 is shown a cylindrical box considerably larger than those already described. It is divided into two compartments by a thin rubber diaphragm, and closed at the front, with the exception of a ¼ inch round aperture. Blotting paper, charged with hydrochloric acid and ammonia, is placed between the diaphragm and the apertured front, and sounds are uttered in the short tubes projecting from the box. The vibration of the diaphragm causes puffs of air to issue from the small aperture at the front of the box, carrying the fumes of ammonium chloride, which render the vortex rings visible. The sounds uttered are necessarily of very low pitch. If the vibrations are too frequent in any of the forms of this experiment, the rings merge into each other and the effect is lost. In the apparatus shown in Fig. 2, a mere flutter of the tongue or lips gives good results.

It is obvious that a burning substance capable of yielding a good volume of smoke will answer quite as well as the ammonium chloride.

DISTINGUISHED ELECTRICIANS.

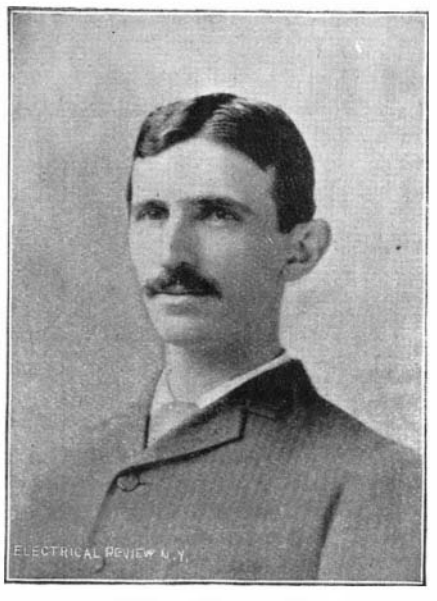
The portraits here presented represent men who, while they have achieved notability in the electric world, have, in so doing, shown that they possessed the requisites for success in any branch of work. Untiring industry, great ingenuity, and a belief in themselves would have made them great in any of the executive departments of life. Thomas Alva Edison's story has been told so often that it cannot but be a trite one. He was born on the 11th of February, 1847, at Milan, Ohio. He began life at the age of twelve as a train boy, soon advancing to be a news dealer with four young assistants. He then began practicing telegraphy, and at last obtained a position in Port Huron. He soon began to invent, and in 1864 he moved to Memphis and had one of his inventions, an automatic repeater, put into service. He struggled along, inventing, working at his profession, and experimenting, until he went to Boston in 1868, where he was able to open a workshop for developing his inventions. Shortly afterward he was retained by the Western Union Telegraph Company, and started an electrical laboratory at Newark, where he employed 300 men. In 1876 he moved to Menlo Park, New Jersey, and in 1887 left Menlo Park and erected in Orange, New Jersey, what is supposed to be the largest experimental laboratory of its kind in the world. His inventions, which are numbered by hundreds, center largely on electricity, although one of the most wonderful of his achievements, the phonograph, is not an electrical invention at all.

Alexander Graham Bell was born in Edinburgh, Scotland, March 3, 1847, being therefore almost exactly the same age as Edison. His father and grandfather were both language teachers, and the young Bell's attention was directed to language by the course of studies prescribed by his father. The synthesis of artificial speech, by Helmholtz's method, is said to have early engaged his attention, and he resolved to pursue one of the outcomes of his studies, multiple telegraphy,

THOMAS A. EDISON, ORANGE, N. J.

PROF. ALEXANDER GRAHAM BELL, WASHINGTON.

PROF. ELIHU THOMSON, LYNN, MASS.



NIKOLA TESLA, NEW YORK.

DISTINGUISHED ELECTRICIANS.

to a practical conclusion. It has been said that all this time the idea of speech transmission was an undercurrent of thought with him, and he has testified that, before 1870, he avowed his belief that we would one day speak by telegraph. Going through all sorts of experiments, he succeeded in inventing the telephone. He lectured on it before the Society of Arts, in Boston, May 25, 1876, exhibited it at the Centennial in Philadelphia, and in August of the same year speech, it was said, was transmitted over a telegraph line. He has received numerous honors, and has written numbers of papers on his other scientific work, such as the photophone. He has also, for years, studied the subject of speech for the deaf and dumb.

Elihu Thomson was born in Manchester, England, 1853, and at the age of 5 came to this country with his parents, who settled in Philadelphia, where he was educated, graduating from the Central High School in 1870. He experimented a great deal during his boyhood in electricity and chemistry, photography and similar subjects. Graduating at the age of 17, he spent six months as an analytical chemist in a laboratory, and was then appointed Assistant Professor of Chemistry and Physics in the High School, and was promoted to the chair of Professor of Chemistry and Mechanics in 1876. He frequently lectured and continually experimented during this period, in the Artisans' Night Schools, Franklin Institute and elsewhere. He was associated with Prof. Edwin J. Houston in some patents relating to dynamos, and upon these and other inventions based the American Electric Company, since called the Thomson-Houston Electric Company, organized in 1880, and became chief electrician of the company. His invention of electric welding and brazing has been fully described in the columns of the SCIENTIFIC AMERICAN and SUPPLEMENT. His very remarkable experiments in alternating current induction have done much to win for him an international renown. The air blast applied to switches and commutators for blowing away destructive arcs is a type of his practical way of reaching results. Like Edison, he holds a great number of patents.

Nikola Tesla was born at Smiljan, a small place on the Austrian border, and is now 35 years of age. His education was received at Carlstadt in Croatia; he too showed the experimental bent and eventually entered the polytechnic school in Gratz, Austria. Here he studied engineering and devoted his spare time to studying electricity; on graduation he entered the engineering department of the telegraph at Buda-Pesth, and in 1881 took up the electric light and the construction of dynamo machines as his especial work. He is said to have been greatly impressed by the drawbacks incident to the employment of the commutator and collecting brushes on dynamos and motors. But his recent work and that which has brought his name more prominently before the world than ever before has been with alternating currents. Employing a dynamo giving 20,000 alternations in a single second, he has produced what may be properly termed the most remarkable experimental results recently attained by electricity. With these alternations used in the production of the most beautiful lighting effects, he succeeded in showing or at least in indicating the possibility of producing electric light without any conductors whatever. Two very striking points brought out were the construction of his apparatus. In his transformer he employs a liquid insulator, the point being that the perforations of its material naturally do no harm, as they instantly close up again. Another point was that these currents of high frequency have no effect on the animal system, being apparently perfectly safe, however great their intensity or high the potential difference developed in their circuit.

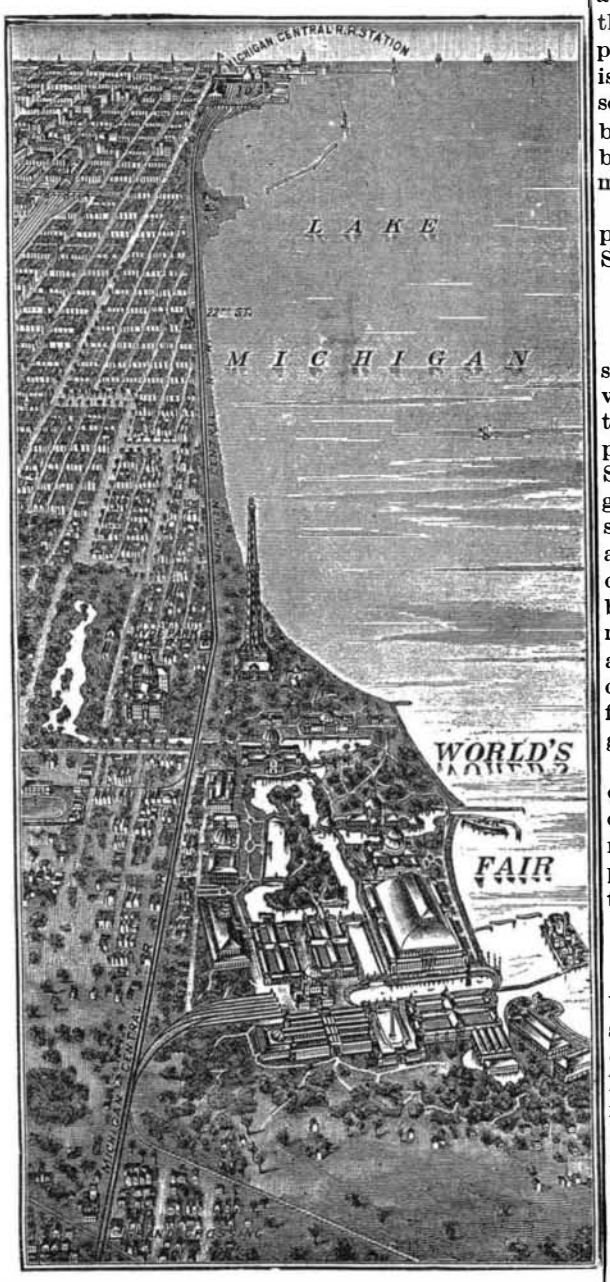
Production of Quicksilver at New Almaden.

The Quicksilver Mines and Reduction Works of New Almaden are fifteen miles south of the city of San Jose, Santa Clara County, California, in the Santa Cruz Mountains, at an elevation of 1,700 feet above the sea. These mines were first worked for quicksilver in 1845, but the operations were on a small scale, and no record exists earlier than 1850. They have been the most productive quicksilver mines in the world, excepting only the mine of Almaden, in Spain. They are developed to a depth of 2,300 feet, and the workings extend horizontally over an area one mile square.

From January 1, 1864, to December 31, 1891, the number of feet of drifting and sinking in the mines of the company, as shown by the records, amounted to 49·11 miles, at a cost of $2,191,831.95. This does not include the excavation made in extracting ore during the period named, nor any expenses for the same, while for the ground opened up during the previous period (from 1850 to 1864) 15 more miles of drifting and sinking can be added.

The reduction works consist of eight furnaces, include the most improved methods for working quicksilver ores, and may be considered as the most complete and perfect in every respect in the world.

The total product of all the mines on the company's



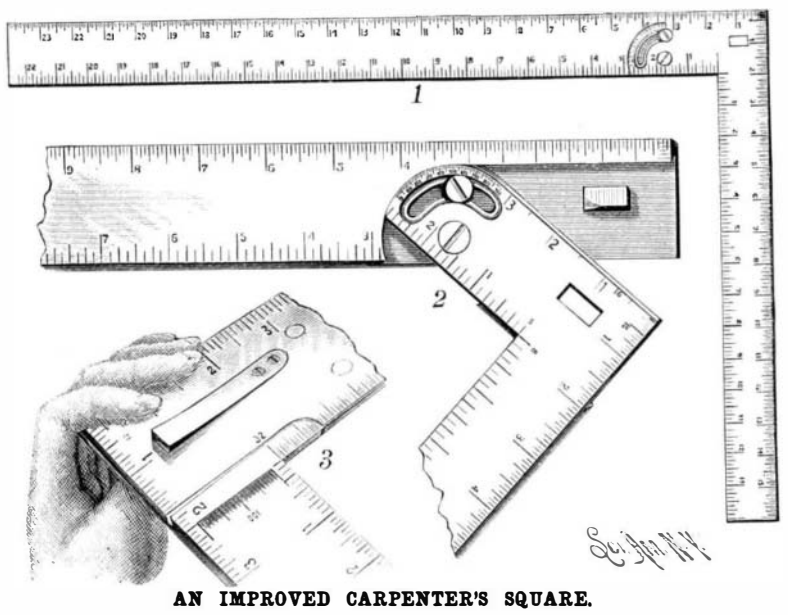
A BIRD'S EYE VIEW OF THE GREAT EXPOSITION.

property for thirty-eight years has been 924,659 flasks of 76½ lb. each, or 70,736,413½ lb.

The total earnings of the company for twenty-one years past have been about $15,000,000, and the total profits a little over $5,000,000.

AN IMPROVED CARPENTER'S SQUARE.

In this square the arms are pivotally secured together, so that one may be swung with relation to the other throughout an arc of ninety degrees, the joint between the two arms being such that there is a minimum of strain upon the pivotal point, and the bearing of such extent that there will be no liability of the parts wearing so as to be thrown out of a true perpendicular to each other when opened. The longer arm of the square has a shallow recess extending in for some distance from one end, the wall of the recess being undercut, and the recess terminating in a curve. In this recess is pivoted an angled extension of the shorter arm of the square, the curved portion being provided with graduated division marks up to ninety degrees, and between the pivotal screw and the curved end is a curved slot in which is a set screw, by means of which the two arms may be locked at any desired angle of adjustment. For automatically locking the two arms of the square in the ordinary position for use as a square, a flat bar spring is located in a shallow recess in one side, as shown in Fig. 3, a nose or latch on the free end of this spring projecting through in the path of the pivoted arm as shown in Fig. 2, so that when the latter is swung back it will be locked in the position represented in Fig. 1. It will be seen that this square can be readily folded to go in a regular tool box, and that by its use an angle or bevel can easily be measured or marked out with great exactness.



AN IMPROVED CARPENTER'S SQUARE.

For further information relative to this recently patented invention, address Mr. F. W. Palmer, agent, Station F, New York City.

THE DEDICATION CEREMONIES.

The ceremonies attending the dedication of the exposition buildings, October 11, 12, and 13, 1892, are to be very elaborate and impressive. The committee having the matter in hand will devote $300,000 to that purpose. It is expected that the President of the United States and his cabinet, many of the senators and congressmen and governors of the States, numerous representatives of foreign governments, and 10,000 militia and several thousand regulars will be present. A dedication ode and marches, written for the occasion, will be rendered with full choral and orchestral accompaniment. Patriotic and other music, a dedicatory oration, a pageant of symbolical floats representing the "Procession of the Centuries," and magnificent displays of fireworks will be among the chief features of the programme.

A grand dedication ball, probably in the Auditorium, on the night of October 13, 1892, will conclude the exercises dedicatory of the exposition buildings. Many representatives of foreign countries are expected to be present, and the event will be, to an extent, international in character.

A New Theory of the Origin of Petroleum.

An interesting compound of carbon with the metal barium, possessing the composition C_2Ba, is described, says *Nature*, by M. Maquenne in the current number of the *Comptes Rendus*. It may be considered, perhaps, as an acetylide of barium—that is, a compound formed by the replacement of the hydrogen of acetylene, C_2H_2, by metallic barium. For immediately it is brought in contact with water, pure acetylene gas is evolved with great rapidity. M. Maquenne has obtained the new substance by the direct action of metallic barium, employed in the form of an amalgam consisting of one part barium and four parts mercury, upon powdered retort charcoal. Upon distilling such a mixture in a current of hydrogen, when the mercury had been expelled and the temperature attained redness, an energetic reaction was found to occur between the barium and the carbon, with production of the new carbide or acetylide. The hydrogen took no part in the reaction, and M. Maquenne has subsequently found that it may be replaced by nitrogen; the latter, however, being less advantageous, inasmuch as the carbide produced is then admixed with more or less cyanide. The new substance, as obtained when hydrogen is employed to furnish the atmosphere, consists of a gray, friable mass, which remains quite unaltered when heated to bright redness. The moment, however, it is thrown into cold water it is decomposed, with a rapid effervescence of a gas which possesses the odor of acetylene, burns in the air with a luminous flame, precipitates a red substance resembling acetylide of copper from an ammoniacal solution of cuprous chloride, and, in short, possesses all the properties of acetylene. M. Maquenne adds that the acetylene thus obtained is remarkably pure. The reaction with water may be expressed by the equation—

$$C_2Ba + 2H_2O = C_2H_2 + Ba(OH)_2.$$

Barium acetylide would appear to be analogous to the compounds obtained by M. Berthelot by heating the metals of the alkalies in a current of acetylene, and also to the acetylide of calcium prepared by Wohler. The direct formation of this substance from barium and carbon, together with its reaction with water, afford another mode of synthesizing acetylene, which M. Maquenne considers to be of interest from the point of view of the formation of the natural hydrocarbons. He considers it probable that other metals possess this same property of forming acetylides under the influence of high temperatures. If, therefore, as M. Berthelot has attempted to show, it is a fact that acetylene forms the primary material, or starting point, for the formation of other hydrocarbons, it is quite possible that such compounds of metals with carbon, upon coming in contact with water under conditions of more or less pressure, may give rise to the production of the immense stores of natural hydrocarbons, such as those which exist in the petroleum wells of Russia and the New World.