Correspondence.

Block Signals and Automatic Control of Trains.

To the Editor of the SCIENTIFIC AMERICAN:

It may be of interest to you to know that the Boston Elevated Railway is equipped with a safety system similar to the one you suggest in the article "How much then is a man better than a sheep?" The electric controller is shut off automatically if the motorman relaxes his hold on it, even an instant; every home or red signal is connected with a tripper which lies between the rails, and in turn hits the train pipe valve which controls the air-brake. (If the signal be at danger.) Since the road has been in operation, only one passenger has been killed, and that through his own carelessness in passing across the platform while the train was rounding a sharp curve. If a motorman through his own neglect runs by a home signal, and the tripper stops him, the first offense is loss of ten days pay. Second offense, "settle up." I have yet to hear of such an occurrence, no collision has ever taken place, and it doesn't look possible for one to occur.

J. H. P.

47 Winter Street, Boston.

On the Curious Case of Regelation.

To the Editor of the SCIENTIFIC AMERICAN:

Re the "Case of Regelation" in your issue of the 21st of February last. You are right in saying that the water froze first over the surface, then over the bottom and around the periphery. The vessel having splayed sides, had not a coating of ice formed all around the receptacle, the effect of the expansion of the remainder of the water in freezing would merely have been to raise the surface ice higher as the freezing went on; but this raising of the surface ice was prevented by the adherence to it of the peripheral coating, and as the water must continue to freeze and to expand, it must either do so by bulging up the surface ice into a convex or dome-like shape, which is often noticed, and in fact always noticed under similar circumstances, or the expansion must take place by the freezing water bursting through the upper crust at its thinnest or weakest point; not, however, as you suppose, by a spurt or jet of water being projected from the interior and instantaneously frozen, and thus prevented from spreading itself over the surface, which also often happens, but by being gradually protruded through the perforated surface, congealing or freezing as it did so, and further and further protruded or pushed up or out from below; the plasticity of the ice, the while its cohesiveness causing it to adhere to and prevent it from tearing itself away from the periphery or surrounding lip of the crater of eruption.

This is not mere conjecture on my part. I have been studying the phenomenon for some years past, though in relation only to the question of plasticity of ice, which I have seen protruding from the lower end of spouts or water conductors from eaves gutters, and protruding more and more from day to day as the hydrostatic pressure from above forced the ice out further and further, until coming out of the curved end of the conductor near the sidewalk, the protruding ice was bent into a perfect semi-circle, and that of only a three-inch radius of intrados curvature, forming with the portion inside the curved end of pipe three-quarters of a complete circle.

The cohesion or adhesion of the protruding spica or horn of ice shown in your engraving to the periphery of the crater of eruption, without disruption, you would readily believe in, if like myself, and in a climate like this, you could see, as can be seen here every winter, snow (not ice) hanging from roof eaves, only a few inches in thickness and not less than from 20 to 24 inches vertically, without apparently any tendency in the overhanging portion to tear itself away from its parent sheet upon the roof.

It may be pertinent to state as explanatory of the "hydrostatic pressure" to which I allude that the phenomenon of ice plasticity is only observable during the early spring, when, while the ice in "spouts" or vertical water conductors persists below or in the shade or shadow of the morning sun, its rays have already been playing on our tinned roofs, galvanized iron eaves gutters, and metal pipings therefrom, thawing the ice within them from above, before the thaw or liquefaction of the inclosed column of ice obtains lower down; while when the sun reaches that portion of the metal conductor where the ice is, the column of ice within becomes loosened or detached from its adhesion to the metal, and allows the pressure from above to force it down and expel it gradually through the vent below; while intermittently with this hydrostatic action during the day, the effect after sunset is for the freezing to commence again from below upward, when the expansive action would again come into play from above and continue the forcing out of the ice from the lower end of the conductor.

CHARLES BAILLARGE, C.E.

Quebec, Canada.

The Cause of Thunder Again.

To the Editor of the SCIENTIFIC AMERICAN:

If the subject is not becoming threadbare, I would like, with your permission, to add something on "The Cause of Thunder." Your last correspondent on the subject, Mr. E. L. Bates, in your issue of February 14, does not seem to have improved very much on the "vacuum theory" taught by the "salaried and learned (?) professors of science," to whom he rather sneeringly alludes. In the experiment he describes of the electrolysis of water and subsequent explosion of the resulting oxygen and hydrogen gases, if he saw the water so produced "fall to the table" in visible drops or appreciable quantity, he must possess wonderful powers of vision (or imagination)! The amount of water produced in his experiment, all put together, would scarce suffice to make *one small drop*, and being intensely heated at the time of its formation, would be in the state of invisible vapor.

Again: it is safe to say that if enough oxygen and hydrogen to make the water of a cloudburst, such as he imagines, were to be suddenly exploded, say, above New York city, the concussion and flame produced would lay the greater part of the city in ruins; and yet this enormous energy would be barely equal to that consumed in previously decomposing an equal amount of water into these gases.

Again: the appearance due to an explosion of gases in the atmosphere would be entirely different from a flash of ordinary lightning.

Again: the lightning discharge is evidently close akin to the spark discharge of a Leyden jar or battery. This makes a loud and sharp sound under conditions where oxygen and hydrogen cannot possibly be produced and exploded. But it seems unnecessary to further multiply arguments to "explode" this theory!

Now as to the teachings of the learned (?) professors of science: Some, at least, teach that the probable cause of thunder is the violent concussion of the atmosphere along the track of the lightning flash, due to the intense heat (and consequent sudden expansion of the air and vapor) which we know to be produced by the discharge. (The Editor of the SCIENTIFIC AMERICAN clearly shows in his comments, that sudden expansion *due to heat* is the sole cause of the explosion and concussion in case of mixtures of oxygen and hydrogen.) This heat *may* make *high-pressure steam* from any water or water vapor along the track. (The writer, more than twenty years ago, advanced the view that this was the effective agent when the thunderbolt splinters a tree; but was never fully satisfied that such effects were not produced by lightning strokes even in the absence of water.) This intense heating and sudden expansion drives one layer of air against the next, almost exactly as is done by a bell or gong set into violent vibration by a blow. The layer of air next to the bell or gong is driven against the next layer, and it against the next, and so on, thus causing the "wave of condensation" which travels through the air, reaches the ear, and is perceived as sound. The sound made by the firing of a gun or any explosion can be explained in much the same way, without any reference to "air rushing into a vacuum."

Still the "vacuum theory" is by no means so absurd as your correspondent, Mr. Bates, is inclined to suppose. Did he ever perform the experiment of bursting a piece of bladder tied over the top of a cylindrical receiver on the plate of an air-pump, by exhausting the air from beneath it? Let him try this, and he will hear a sound surprisingly like "somethin' exploded."

As to why the rain so often comes down heavily and in large drops just after a heavy clap of thunder overhead, the following explanation seems probable. The small water spheres constituting the thunder cloud, heavily charged with the *same kind* of electricity (say, *positive*), mutually repel each other until the discharge of lightning takes place. Then the mutual repulsion ceases, and the agitation of the air, due in part at least to the jar or concussion of the thunder, causes many of the small spheres of water to coalesce into larger ones, which fall through the cloud, growing larger as they meet and unite with other cloud particles, and so we have the sudden downpour. It would appear that Mr. Reynolds' views are less off the right track than those of his critic.

I concur in the editor's views, as expressed in the comments on Mr. Bates' letter, except in what is said about the *pitch* of the sound indicating that the disturbance "must have a great length"—perhaps I do not catch his meaning on this point.

The length of the sound waves in thunder is probably always less than one hundred feet, and generally *much less* than this; whereas we have good reason to believe that the "length of the disturbance" (i. e., the length of the lightning flash), may be a mile or more—possibly several miles.

JAMES A. LYON,
Professor of Physics and Astronomy.

Clarksville, Tenn., February 21, 1903.

The Mills Peruvian Expedition for the Study of Solar Motion.

The D. O. Mills expedition of the University of California, sent by the Lick Observatory to spend two years in studying the motion of stars in the line of sight, sailed from San Francisco for Santiago on February 28.

The object of the investigations which are to be carried on, is to throw light on the great problem of the movement through space of our solar system. The expedition is headed by W. H. Wright, assistant astronomer of Lick Observatory.

About a century ago Tobias Mayer found that in the region of Arcturus and Vega there is a slight separation of the stars. In the region of Sirius and Aldebaran, on the contrary, the stars approach. Mayer concluded that this apparent change was due to perspective, and that the sun, and the planets which revolved around it, were moving toward the region of Arcturus and Vega. Mayer's theories have been confirmed.

The direction of motion was more easily determined than the velocity. After many attempts had been made, Prof. W. W. Campbell of the Lick Observatory adopted a very ingenious method which gave valuable results.

When a luminous body which is moving away from the observer is examined in a spectroscope, the lines which appear in its spectrum will be shifted out of their true position in one direction, but are moved to the other side if the body is approaching the observer. Similar effects are observed if the body be stationary and the observer's position changes. The degrees of displacement of the lines enable one to determine the rate of motion in the line of sight.

An especially powerful spectroscope was constructed, with the aid of which the velocity of the solar system was determined. Prof. Campbell, after having studied the motions of some 283 stars, concluded that the sun was moving at the rate of 12 miles a second. A continuation of the studies has not led him to alter the conclusion which he has reached.

At Mount Hamilton, where Prof. Campbell studied solar motion, the astronomical field is comparatively limited. Many portions of the southern heavens can never be seen at all. In order, therefore, to determine with absolute accuracy the velocity of the motion of the solar system, it was necessary to study the motion of the stars in the southern hemisphere. It is for this purpose that the D. O. Mills expedition has been dispatched southward. Of the instruments which have been taken along, the most important is a reflecting telescope made by Brashear. Its aperture is over 36 inches. Its focus is 17½ feet from the concave mirror. About two years will be spent in studying the stars in the southern hemisphere.

Still Another Wireless Telegraphy System.

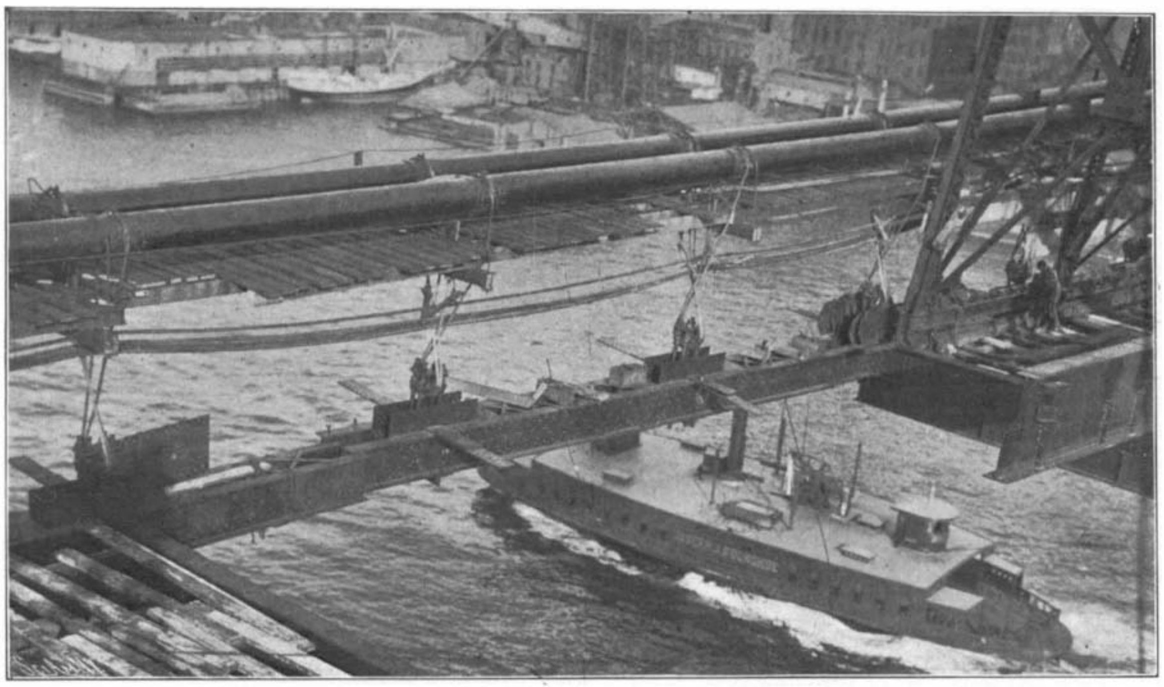
News comes from England that Sir Oliver Lodge and Dr. Alexander Muirhead, a well-known telegraphic expert, have succeeded in producing a system of wireless telegraphy for which wonderful things are promised. The meager details which have been received are anything but clear. It is said that the new coherer, which is the novel feature of the system, and which is the invention of Prof. Lodge, consists of a small steel disk rotating in light contact with a column of mercury through an oil film. A decoherer is not employed, for the Kelvin-Muirhead siphon recorder is worked upon directly, giving, it is said, signals almost equal to the best submarine telegraph work system.

The Current Supplement.

The current SUPPLEMENT, No. 1419, opens with an interesting and well-illustrated article on the French Beet Sugar Industry. Mr. M. M. Kann describes an artificial abrasive produced from steel, which is nothing more or less than crushed steel and steel emery. Dr. F. W. F. Riehl tells of a most interesting discovery of his, which is the apparent change of position of the bull's eye of a target at certain times. Mr. Wilhelm Staedel gives an account of crystallized peroxide of hydrogen, and Frederic Soddy tells something of the radio-activity of uranium. Mr. Willett M. Hays, of the United States Department of Agriculture, discourses on how some important results in plant breeding are accomplished, illustrating his text by many clear illustrations. Dr. Frederic Lee presents a paper on the scientific aspect of modern medicine. F. T. Jane offers another installment of the Naval War Game between the United States and Germany. Before the Institution of Electrical Engineers at London, Prof. R. S. Hutton and Mr. J. E. Petavel read a paper on "High Temperature Electro-Chemistry: Notes on Experimental and Technical Electric Furnaces." This paper, revised for the SCIENTIFIC AMERICAN SUPPLEMENT by Prof. Hutton himself, is published. Randolph I. Geare presents the last of his series of articles on Venomous Serpents. In the present installment he discusses snake venom, poison fangs, and treatment for snake bite.

COMPLETION OF THE FLOOR OF THE NEW EAST RIVER BRIDGE.

In January last the Pennsylvania Steel Company, who have the contract of the construction of the floor system of the new East River Bridge, received notice to commence construction. In spite of the fact that it was the depth of winter, they have made such excellent progress that last week the floor system had been built entirely across the 1,600-foot span, ready for the work of building the stiffening trusses and lateral connections. The floor proper of the bridge consists of a series of transverse plate steel girders 4½ feet in depth, which extend entirely across the floor of the bridge for its full width of 120 feet. These girders occur at each point of support of the floor system by means of vertical suspenders from the main cables above; and the distance between them is exactly 20 feet. The spaces between these girders, or floor beams as they are called, are bridged by parallel longitudinal lines of plate-steel girders of a little more than half the depth of the floor beams. There are altogether twenty-three parallel lines of these longitudinal stringers in the width of the bridge, and they extend entirely throughout the structure from anchorage to anchorage. Twenty feet in from the outside of the roadways, and lying in a vertical plane between each pair of cables, are the two great stiffening trusses, which extend the full length of the bridge. Extending between the top chords of these trusses at each panel point, and above the roadway, is a large and heavy truss which serves by means of vertical ties to support the floor beams at two intermediate points between the stiffening trusses, thus relieving the bending stress on the floor beams, and permitting them to be made shallower than would otherwise be possible.

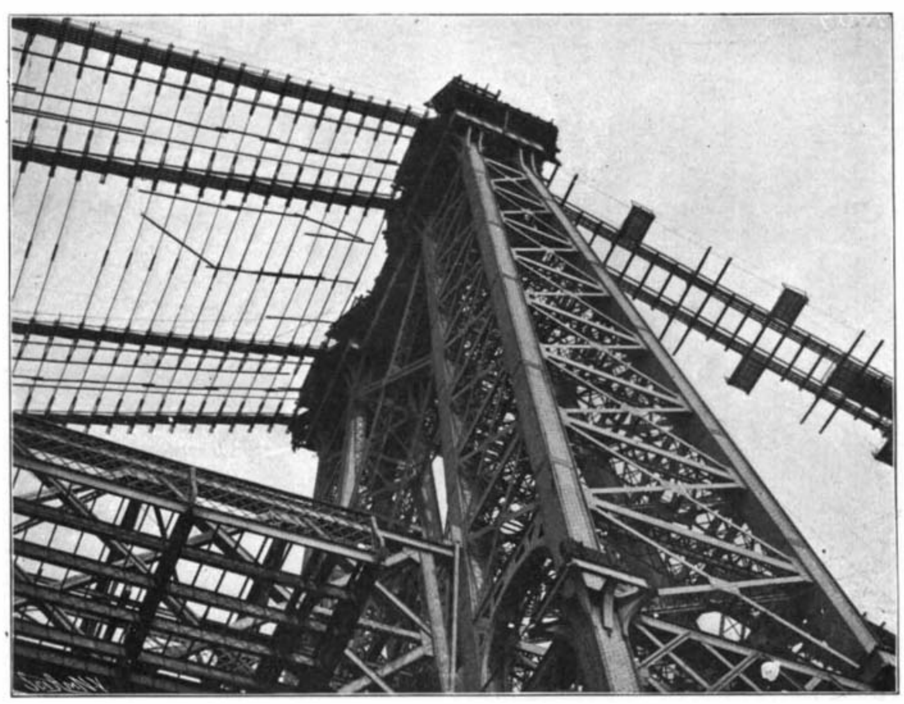


Making the Final Connections at the Center of the 1600-foot Span. The Member Shown Suspended from the Cables is a 60-foot Section of the Bottom Chord of the Stiffening Truss.

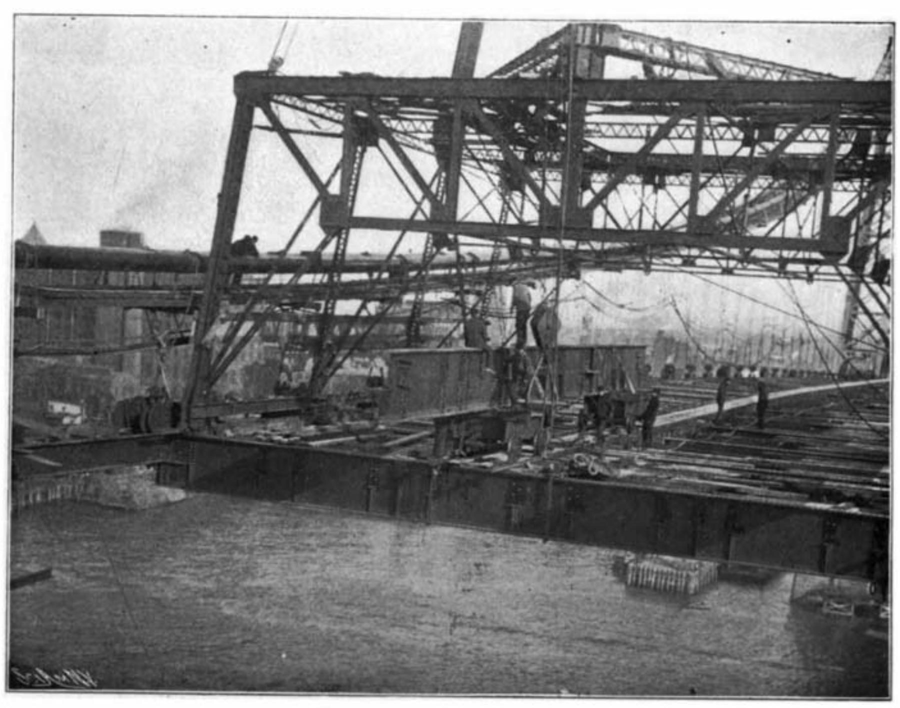
The work that has already been completed by the contractors consists of that portion of the floor system that lies between and includes the bottom chords of the stiffening trusses, and it is made up of these two bottom chords, the floor beams, the longitudinal girders, and the series of steel bents upon which the elevated railroads will be carried. This portion of the floor was erected first, and as soon as it was connected up at the center, the bridge workmen commenced building on the external cantilever brackets which form a continuation of the floor beams and extend beyond the stiffening trusses to carry the two 20-foot roadways.

When the contractors started to build out the roadway from the towers, the main span between these towers consisted of the four great cables with steel-wire suspenders hung from them at intervals of 20 feet. At the bottom of each suspender, as they were left by the cable contractors, were four heavy steel bolts, complete with nuts at each end of the bolts. The length of the suspenders had been so graduated that the bottom of the suspender bolts was in proper relation to the curve which the floor of the bridge is designed to assume when the whole load of the completed floor system is hung on the suspenders. The process of erection consisted in first building out the bottom chords of the two stiffening trusses in sections, and bolting them to the suspender bolts mentioned above, and then putting in place and bolting up between the chords the network of floor beams and stringers. For carrying on this erection, the contractors built two large travelers, each carried on four axles 20 feet apart, with a stiff-leg

View Looking Along Axis of Bridge, Showing the Floor Between Cables Erected Cantilever Extensions of the Floorbeams, Extending 20 Feet Beyond the Cables, will be Bolted on, Making a Total Width of Floor of 120 Feet.



Vertical View Looking Up One of the Towers. Taken Before Cables Were Strung.



The Traveler and Derrick, With Which the Erection Was Done. Preparing to Lift a 10-ton Floorbeam into Position.

COMPLETION OF THE FLOOR OF THE NEW EAST RIVER BRIDGE.