# Correspondence.

### TOURMALINE DETECTORS FOR NAVIGATORS.

To the Editor of the SCIENTIFIC AMERICAN:

In the June 5th issue of the SCIENTIFIC AMERICAN, C. A. H. asks if he can use a tourmaline to reduce the glare of sunlight reflected on water, so as to enable him to detect rocks lying under the water ahead of his boat. Light which has been reflected by water under an angle not very far from 37 deg. is partly polarized, and will therefore be reduced in intensity when passing through a tourmaline properly held before the eye. Light which comes from a submerged object passes easily through the tourmaline held in the position which extinguishes the reflected light. Made with a pan full of water and a submerged stone, the experiment is very successful, but practice alone would show how far the principle underlying it can be successfully applied to the detection of rocks submerged in rough water and observed from a moving boat under variable angles. A Nicol prism would probably prove more useful than a tourmaline. A slice of tourmaline, cut parallel to optical axis, costs about $1.50. A Nicol prism, 8 millimeters square, costs $3.50. Both can be had from dealers in laboratory apparatus. GUSTAVE MICHAUD.

Costa Rica State College.

### LIGHTNING.

To the Editor of the SCIENTIFIC AMERICAN:

Lightning is universally classified as chain, sheet, and ball, of prevalence in the order named; but, as to ball lightning, the recorded instances are so rare and questionable, with no evidence of its electrical nature, I am inclined to say that the information is not sufficient to enable one to form even a belief, much less a judgment, and least of all to formulate a rule respecting it.

Chain lightning has, perhaps, been as thoroughly studied and explained, and is as well understood, as any of the other great phenomena of nature.

With respect to sheet lightning, I think, the case is altogether different. This designation is given to that diffused illumination, best seen at night in heavy banks of clouds at a considerable distance from the observer, and said to be unaccompanied with thunder.

I have long doubted the existence of sheet lightning as a form, having concluded that it is but an appearance, a reflection, of chain lightning occurring behind a cloud, the chain throwing out a diffused illumination, as may be seen from the tongue of an electric headlight of a locomotive on a foggy night.

My first and greatest reason for coming to this conclusion is direct observation. I have seen, in small clouds, concurrently, sheet-lightning illumination at one edge and a tongue shoot out from the other. In such case, the obscured end of the chain is somewhere on the upper side of the cloud; and, as I have observed that the center of the field of the diffused illumination is directly opposite the visible tongue on the other edge of the cloud, I think we are justified in saying that if the chain is not the cause of this illumination, it is nevertheless such an accompaniment as finds therein a full explanation.

Another reason which has led me to conclude that sheet lightning is but an appearance, a reflection, from the chain, is, that the illumination always occurs on the upper side of a cloud at a point out of view of the observer, and he sees only the reflection at the margin of the cloud, or in the sky above the cloud, if at a considerable distance, no reason appearing why it should always be thus secluded.

The same diffused illumination or reflection may be seen in the sky beyond the horizon on a summer night from lightning occurring at such distances as to be below the range of vision. In such instances, the illuminations are always diffused, and the intervals in such perfect accord with our observations of thunderstorms at close range, I see no reason for not saying that they are due to the bolts of Jove.

My own experience confutes the alleged absence of thunder, that occurring only when the cloud is at too great a distance for it to be heard, said to be from ten to fifteen miles. I have frequently heard thunder accompany sheet lightning at close range, although this may still be open to the objection that the chain was playing simultaneously with the sheet; but, if so, it was above the clouds and out of sight.

My reason for calling attention to this at this time is, that the mountain-climbing season is now upon us; and if those who ascend to the top report the appearance of the lightning they see in storms below them, and those at the bottom do likewise respecting the lightning observed above them, they can determine the fact very readily.

If what I have said be true, then chain lightning, occurring on the under side of the cloud, will appear to those on the mountain above as diffused light around the edge, or sheet lightning; while the sheet lightning, as seen from the foot of the mountain, will be seen as a chain by those at the top.

In this manner, the scientific fact could be ascertained; and if you will call attention to it, the present season will doubtless see the determination of the matter. A. A. GRAHAM.

Topeka, Kan.

### FIRST AMERICAN TO CROSS THE CHANNEL THROUGH THE AIR.

To the Editor of the SCIENTIFIC AMERICAN:

In view of the admirable though sensational flight of M. Bleriot across the English Channel during the past fortnight, and in further view of the reported apathy of those wonderful American aeroplanists, the Wright brothers, toward attempting any similar flight, it may be of interest to your readers who are interested in aerostatics to know that the first flight through the air across the English Channel was successfully accomplished by an American in company with a Frenchman.

My authority for this statement is Wise's "Aeronautics," published by John Wise in 1850.

This rare and interesting volume, on page 54, chapter vi, contains this statement:

"The most remarkable aerial voyage that was made soon after the discovery of aerostatic machinery was accomplished by M. Blanchard, in company with Dr. Jefferies, an American physician, who was at the time residing in England. On the 7th of January, 1785, in a clear frosty day, the balloon was launched from the cliff of Dover, and after a somewhat perilous adventure they crossed the Channel in something less than three hours. The balloon after its release rose slowly and majestically in the air; they passed over several ships and enjoyed a grand prospect of the numerous objects below them. They soon, however, found themselves beginning to descend, which put them to the necessity of throwing over half their ballast, when they were carried one-third way across the Channel. When they got about half way across, they found themselves descending again, upon which they threw over the balance of their sand; also some books they had with them. All this failed to overcome the gravitating power of the balloon. They next commenced throwing overboard their apparatus—cords, grapples, and bottles. An empty bottle seemed to emit smoke as it descended, and when it struck the water, the shock of the concussion was sensibly felt by the aeronauts. Still, their machine continued to descend, when they next betook themselves to throwing off their clothing; but having now nearly reached the French coast, the balloon began to ascend again and arose to a considerable height, without compelling them to dispense with much of their apparel. They passed over the highlands between Cape Blanc and Calais, and landed near the edge of the forest of Guinnes, not far beyond Calais. The magistrates of the town treated the aerial travelers with the utmost kindness and hospitality. The King of France made M. Blanchard a present of 12,000 livres, as a token of appreciation of the aeronaut's perseverance and skill in the newly-discovered art."

With apologies for my intrusion upon your time, but with the hope that the contribution may be of some general interest. P. W. A. FITZSIMMONS,

Member Michigan Aero Club.

### THE NUMBER OF OUR ANCESTORS.

To the Editor of the SCIENTIFIC AMERICAN:

As to the problem which vexes Mr. Venning and Mr. Constable, concerning the number of a man's ancestors, allow me to state that their difficulty arises from a false sociologic assumption.

They assume that a man must have had four grandparents. This is not so. He may have had only two. For a long period in human society all daughters of one family were the wives of all sons of the family indiscriminately. This "consanguine group" is an established fact in sociology. All races, at one time or another, passed through it. As long as it lasted, one's ancestors, no matter how far back he traced them, would still be only two.

Hence one can have had $2^x$ ancestors $x$ generations ago only if we make the $x$ so small that it falls within the time since the consanguine group was outgrown. That time is only a petty fraction of the time man has been on earth. To establish a rule on what holds true during that fraction, and seek to apply it to the ages that went before, is false reasoning.

In present society, however, consanguineous marriages having been pretty well eliminated, the $2^x$ rule does hold true. Considering the little corner of time covered by present institutions, John Brown, $x$ generations ago, had $2^x$ ancestors. No doubt about it.

The difficulty in reconciling this mathematical fact with our ordinary conceptions of the matter comes from the implied thought: Each of us, far enough back, would have had millions of ancestors, at this rate. Since there are many millions of us to-day, the earth would once have been so thickly crowded as to be simply uninhabitable, which we know was not so.

This difficulty vanishes at once when we remember that such a state of affairs could only exist if every pair of parents gave birth to only one offspring, and each man's ancestors were thus his, and his alone. But since the majority of parents produce many more than one child, this Simon-pure possession of our ancestors all to ourselves is an impossible thing. Our ancestors are all inter-owned by the race; each of our forebears is the forebear of a host of others also. And when each man counts up his own individually, those "own" have also been counted up as "theirs" by hundreds or thousands of others, and any attempted total based on these countings can be nothing but a reduplicated monstrosity.

Thus it is true that for modern non-consanguineous times, a man had $2^x$ ancestors $x$ generations ago. But the rule holds good only for those times, and within those times the enormous totals urged in disproof of the rule are seen to be purely fictitious.

New York, N. Y. SOLON DE LEON, A. B.

### THE LONG ISLAND PORTAL OF THE PENNSYLVANIA SUB-RIVER TUNNELS.

Although the immense improvements undertaken by the Pennsylvania Railway in bringing its lines under the rivers east and west of Manhattan to a station in the heart of New York city have aroused a great deal of popular interest, especially on such epoch-making occasions as the meeting of tunnel headings under the Hudson and East Rivers and the recent placing of the last stone of the immense terminal station, there is one section of the work of considerable engineering interest which has received very little attention from the press.

This is the section just west of the Sunnyside yard on Long Island, where the tunnels emerge from the ground, and the point of especial interest is the crossing of one tunnel over another.

The object of this cross-over is to bring both east-bound tracks to the same side of the station at Sunnyside, no other point being available for such a cross-over without unnecessary complication of trackage at one of the stations.

From the point where it diverges from the present main line near Harrison, N. J., the Pennsylvania's road to New York is a double-track line, one track being carried in each of the two tubes under the Hudson to the terminal station at 33rd Street. One track and tunnel are used exclusively for west-bound and the other for east-bound traffic, but on entering the station each track spreads out fanwise.

The handsome terminal building appears so large from the outside, with its half a million cubic feet of granite—1,140 carloads—27,000 tons of steel, and 15,000,000 bricks, that it is a little difficult to realize that much the greater part of the station proper is underground. The underground area of the station is about 28 acres, and includes 16 miles of standing room for trains on 21 different tracks, adjacent to over 4 miles of passenger platforms.

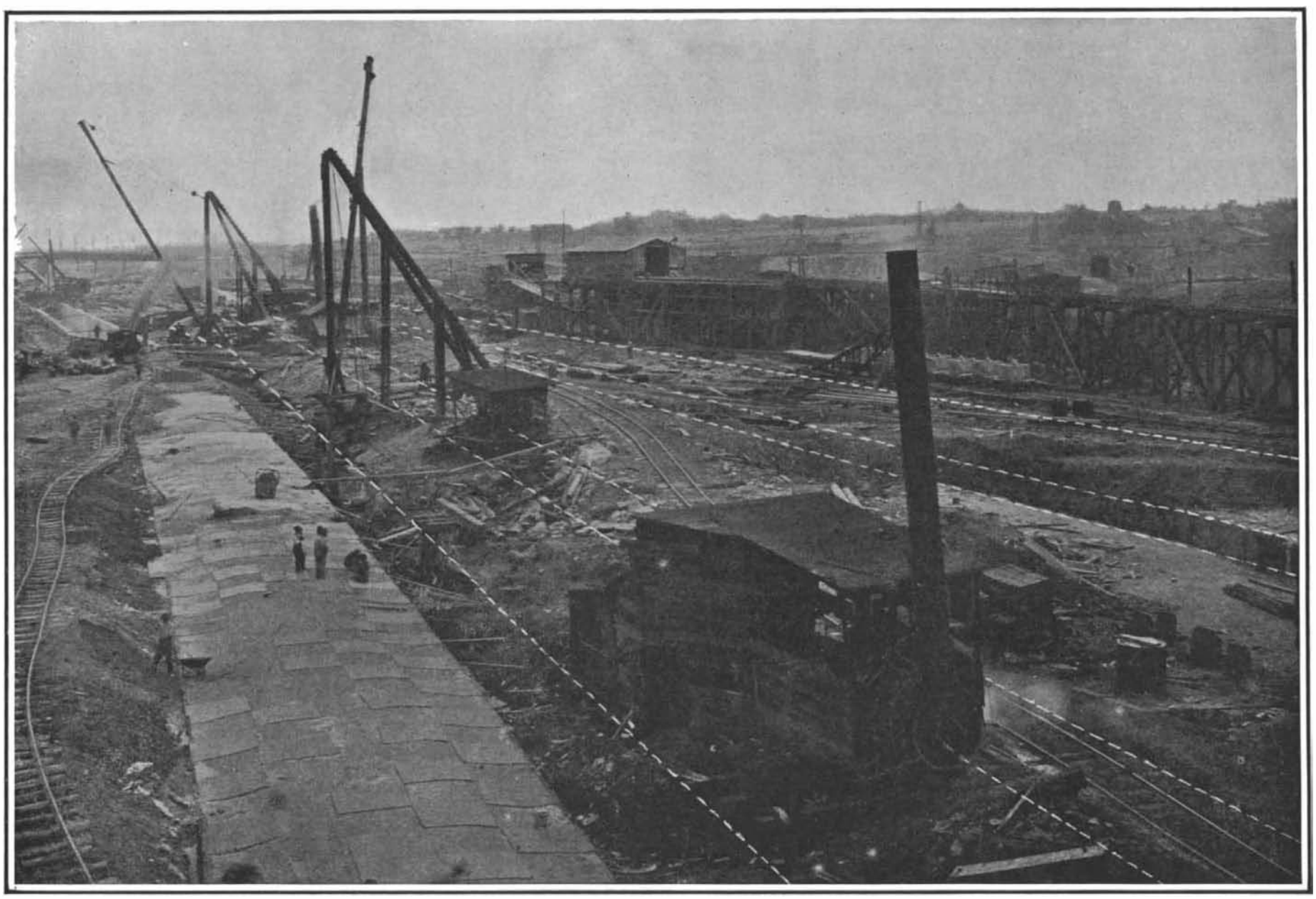
From the station eastward the tracks converge again into first 6 and then 4 tracks, carried in two wide tunnels underground and four single-track tunnels under the East River.

To bring the east-bound and west-bound tracks into their natural alternate order as the 21 tracks converge leaving the station would obviously cause a great complication of trackage, and the same would apply to an only slightly less extent at the Sunnyside yard. A cross-over could not conveniently be made in rock tunneling, and less so under the river, so the place selected as most convenient was the "cut and cover" sections between Avenue A and Sunnyside.

The tunnels are now complete all the way from Bergen Hill, N. J., under both rivers and Manhattan Island to Avenue A, Long Island City, and the section including Sunnyside yard and the "cut and cover" concrete tunnels for several hundred feet west of it is also practically complete. The latter is shown in one of our illustrations, the position of the completed portions of the tunnels being shown in dotted lines, and the retaining walls of the cuts where the tunnels emerge being visible in the distance on the left of the picture. Along the left side of the picture is the brick-covered concrete top of the A or northernmost of the four river tunnels, which is now complete all the way to the Manhattan terminal. The next section westward, where the cross-over is being made, is shown in our other illustration. On the left in the distance, where clouds of steam may be seen arising, drilling is still in progress for further excavation of rock to make room for D tunnel (the southernmost of the four), the completed part of which is hidden by the massive shoring supporting the ground under the Long Island Railroad tracks seen in the picture. The material excavated here is hoisted by the numerous cranes shown and used to bury A tunnel on the right of the picture. High in the middle the concrete lining of C tunnel may be seen, having been carried up to that level at a gradient of 1.9 per cent from the bulkhead line, below which, in the river, all four tubes are at the same level, the other three rising to the point shown at only 1.22 to 1.26 per cent.

**View looking west at Pennsylvania Railroad tunnels as they near the surface in Long Island City.**

This view shows the point where C tunnel crosses over B near the Long Island portal.



**View looking east from same point; Sunnyside yard in the distance.**

On the left is seen the brick-covered concrete top of one completed tunnel; dotted lines show position of completed portions of the others, to be joined to those shown in course of construction in other view.

**THE LONG ISLAND PORTAL OF THE PENNSYLVANIA SUB-RIVER TUNNELS.**

Low in the foreground may be seen the entrance to B tunnel, which has now crossed under C to assume the relative position occupied farther back along the line by C tunnel.

Immediately behind the pile of earth on the right of the picture is the portal of the Steinway Belmont tunnels, leading under the river to the New York Central station.

An idea of the massive nature of the work may be formed from the size and number of the shores required to hold up the outer forms of the upper tunnel.

The work is being covered up as fast as completed, and about a year from now, as passengers are carried through the tunnels, they will probably be unconscious even of the difference of gradient between tunnels B and C, and there will be no evidence on the surface of the immense work here shown of carrying one tunnel over the other.

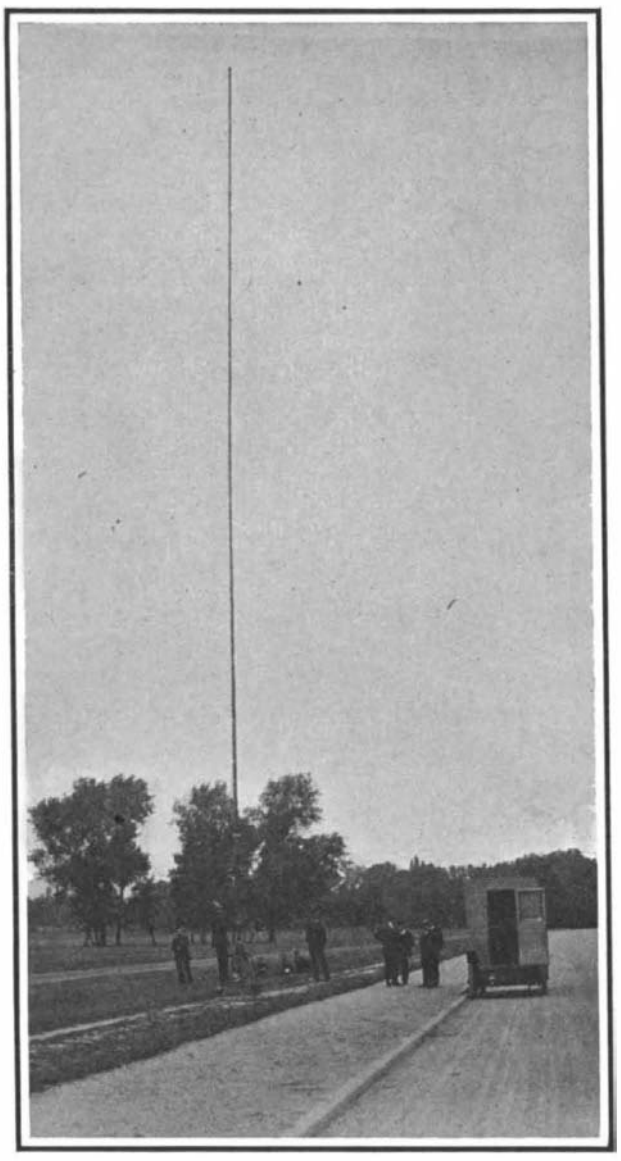
## AN AUTOMOBILE WIRELESS TELEGRAPH STATION.

The officers of the telegraph corps of the French army have been experimenting with an automobile wireless telegraph station. Externally, the vehicle resembles a limousine of the ordinary type. The wireless apparatus is not conspicuously visible through the glass windows. The mast, its base, and the winch by which it is raised are carried on the roof of the car and covered with an awning. The car, all parts of which are movable, is divided into two compartments. The forward compartment contains the sparking coil and other dangerous instruments, the rear compartment contains a 5-horse-power dynamo, the receivers, the operating key, and a comfortable seat.

The car and apparatus weigh 6,160 pounds. The weight is increased to 7,260 pounds by the addition of the crew of six men, with their baggage. The car is driven by a motor of 22 horse-power, and can maintain a speed of 26 miles per hour on a level road, and more than 6 miles per hour in ascending a grade of 14 per cent.

The antenna is set up very easily and rapidly, owing to the ingenious telescopic construction of the mast, which, when lowered, consists of a number of concentric metal tubes about ten feet in length. The central and smallest tube incloses a steel wire about ⅛ inch in diameter, coiled very closely into a helix, so that it resembles a strongly compressed spiral spring, or the wire wrapping of a rubber hose. The wire, similarly coiled, is extended into the base of the mast, where it is gripped by two pairs of wheels which are operated by cranks and gearing. By this mechanism the wire is forced upward, carrying with it the central tube, which, when extended to its full height, draws after it the second tube, which in like manner draws out the third tube, and so on. Although the elevation of the smaller tubes leaves the lower part of the wire inclosed in larger tubes which allow it to bend slightly it remains sufficiently stiff to keep all the tubes practically vertical.

The mast, with its aluminium support, weighs about 400 pounds. The telescoped mast is first screwed to its base and then raised to a vertical position by four men. A few seconds' work at the cranks then extends it to a height of 66 feet. The five wires of the antenna are attached to the top of the mast. Four of these wires, each about 160 feet long, are distributed at equal angular distances around the mast and are attached to the ground by other wires, insulated from them, so that the lower ends of the antenna wires are about 26 feet above the ground. The fifth antenna wire is connected with each of the others and is extended, through a hole in one of the glass windows of the car, to the apparatus inside. The mast is also anchored to the ground by stays, attached below the summit. When the antenna has been set up the motor is geared to the dynamo, only 3 horse-power being usually employed.



The mast fully extended.

The station can be made ready for operation in six minutes. Its normal radius of action exceeds 90 miles. As two men suffice to operate it, continuous service can be assured by dividing the crew of six men into three watches of eight hours each.

The French army already possesses wireless stations drawn by horses. Each station comprises two wagons, one of which carries twelve men and a gasoline motor. It takes half an hour to set up one of these stations and the radius of action is only about 60 miles. Nevertheless, the stations are superior to those of the German army, the installation of which occupies 45 minutes, with a greater number of men. The French army is the only one that possesses an automobile wireless station.

The installation of wireless stations on dirigible balloons has been contemplated, but the problem presents an almost insuperable difficulty. The highly-charged antenna, by its inductive action on the wires by which the car is suspended from the balloon, would cause sparks which might ignite the hydrogen which escapes from the staunchest of gas bags. The danger could be diminished by substituting non-metallic ropes for the steel wires, but even the ropes would become conductors when wet.

This danger does not exist in the case of aeroplanes. It is estimated by experts that the total weight of an aerial wireless station need not greatly exceed 100 pounds. The station could be operated by one man, in addition to the aeronaut. The day—apparently not very distant—when an aeroplane shall carry the weight of three men will soon be followed by the combination of those two present marvels—wireless telegraphy and mechanical flight.

### Making Briquettes.

Briquette making formed the subject of a paper recently read before the South Wales Institute of Engineers by Prof. W. Galloway. Small coal, as is well known, cannot be burned so economically in the furnaces of boilers in its original state as when in the form of briquettes. Briquettes made exclusively with anthracite coal burn too slowly, and it is advisable to mix a certain proportion of bituminous coal to overcome this objection. Up to the present, no kind of agglomerating material other than pitch or resin, or a mixture of these, has given satisfactory results. Briquettes made with resin alone become soft and lose their shape in the fire; those having a mixture of 4 per cent of pitch and 1½ per cent of resin give better results. It is of interest to note that the total output in the United Kingdom in 1906 amounted to 1,513,220 tons, while Germany produced 14,500,851 tons of this fuel in the same year. The paper contains full descriptions and drawings of the mixing and drying machinery and presses required for briquette making, together with estimates of labor required and costs. For example, at an English works making 102¼ tons of briquettes per day of ten hours, the total cost, including labor, materials, fuel and stores, interest and depreciation, works out to 9s. 7.45d. per ton.

The linking of India and Ceylon by railway is again under discussion. There is said to be no serious engineering difficulty connected with the bridging of the Paumben Channel, nor at the south end of the line, for the island of Mannar is already practically attached to Ceylon. But between the southern end of the island of Rameswaram and the northern end of the island of Mannar there is a distance of about 38 miles, marked by an almost continuous coral reef, either covered with shallow water or rising above the level of the sea in numerous coral islets—the "stepping-stones" of Adam's Bridge—to be bridged.

An automobile wireless telegraph station.

Erecting the telescoping mast.

AN AUTOMOBILE WIRELESS TELEGRAPH STATION.