Correspondence.

Electrically-Propelled Gyroscope.

To the Editor of the SCIENTIFIC AMERICAN:

In your number of July 15, page 50, you speak of electrically-propelled gyroscopes as being quite new.

The late Mr. George M. Hopkins had an electrically-propelled gyroscope fifteen to twenty years ago. His work upon the gyroscope is described in the Encyclopædia Britannica, ninth edition, under gyroscope. The first edition of "Experimental Science" has the cuts and description of the electrically-propelled gyroscope, which I have seen operated many times. When the writer was president of the Department of Physics, Brooklyn Institute, Mr. Hopkins demonstrated his numerous gyroscopes before the department. A short time afterward the Institute building was damaged by fire, and these valuable instruments were totally destroyed. It was a great loss.

It is due to the memory of this most skillful experimenter that his credit in this matter should be maintained. W. C. PECKHAM.

Stamford, N. Y., July 14, 1905.

The Rolling Motion of a Wheel.

To the Editor of the SCIENTIFIC AMERICAN:

I was much interested in reading the article "The Motion of a Rolling Wheel," by G. F. Starbuck, in the June 24 number of the SCIENTIFIC AMERICAN.

A very simple way to understand the motion of a rolling wheel is as follows: Motion of a body is relative and can only be judged by comparison with another body. In the case of a rolling wheel there are two distinct motions, the rotary motion of the wheel about its axis, and the horizontal motion of the wheel as a whole.

To understand it clearly lose sight for a moment of the idea that the rail is stationary and the wheel moving, as we only consider the rail stationary by comparison with surrounding objects, and imagine the wheel as revolving in space and the rail (or ground) traveling in a straight line at the same speed as a point on the rim of the wheel. A point on the rail touches the point on the rim of the wheel and for that instant there is no motion as regards these two points for they are both traveling at the same speed.

Halifax, N. S., July 1, 1905. E. G. STAYNER.

Wireless Telegraphy on Trains.

To the Editor of the SCIENTIFIC AMERICAN:

Wireless telegraphy on trains would act as a preventive of accidents in a great many cases. It could be used as an extra precaution in addition to the block system. On single-track roads, in case a train had disregarded its meeting point, or orders, and had gotten by the last telegraph office, the dispatcher could catch it with the wireless. Railroad officials, by having a wireless set in their private cars, could keep in touch with affairs while traveling over the road. In foggy or stormy weather, trains could keep informed as to other trains ahead or behind, thus avoiding rear-end collisions. It would also prove invaluable on electric lines, especially single-track, whereby meeting points of cars could be arranged.

Every main-line switch should be protected by interlocking, and handled from a tower or connected with an electric signal located some distance away from it; and in case of its being open, or tampered with in any way, this signal would show "danger," thus avoiding any such disaster as recently occurred to the Twentieth Century Limited. In case of a signal showing danger, trains could approach with caution, and set things to rights. This same signal would also be used to give warning, in case of broken rails or misplaced fishplates. By having these signals located at certain distances apart, a whole railroad could be guarded against wrecks, except unavoidable accidents, which are liable to occur at any time, in spite of man or mechanism. F. H. SIDNEY.

Boston, Mass., June 29, 1905.

A Life-Saving Coat.

A London tailor has invented a new life-saving coat and gaiters, with which it is possible for a person clothed therein to maintain an upright position when immersed in the water, even if not possessing any knowledge of swimming. The coat resembles in appearance an ordinary pilot coat; but it is fitted with an air belt; which is inflated with air through a tube. The gaiters each weigh two pounds, and are fitted with two brass wings or blades fastened to the back of the heel. As the wearer moves his feet in the water these wings open and shut, and not only propel the wearer along like oars, but enable him to maintain an upright position from the waist upward in the water. A practical demonstration of the utility of the invention was recently undertaken in the River Thames by the inventor, and its efficiency and life-saving qualities clearly shown, even when moving against the tide.

Electricity on Swedish Trunk Lines.

A single-phase electric locomotive has been designed for the Swedish government railroads, and experiments are to be carried out therewith, on the application of the electric power to the trunk railroads. Externally, there is no departure from the design of the conventional electric locomotive. Current is drawn from an overhead conductor, and is designed to work at a line pressure of 18,000 volts as a maximum, though arrangements are made to use several lower pressures, the lowest being 3,000 volts. The locomotive carries an oil-cooled auto-transformer to reduce the pressure for the motors, and an oil circuit breaker. The electro-pneumatic control system is used, a compressor driven by a single-phase motor supplying air for all auxiliary power purposes, such as switching, braking, sanding, etc. The locomotive and equipment weigh 25 tons, and are carried on four 41-inch wheels. Each pair of these is driven by a 150-brake-horse-power single-phase motor at 25 periods with a gear reduction of 18 to 70. The locomotive will handle a train at 40 miles an hour, and has been built by the British Westinghouse Company, Limited.

FIVE THOUSAND DEGREES OF HEAT.

BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

It has been rightly said that civilization began when man first discovered the use of fire. This is symbolized by the legend of Prometheus stealing the fire from heaven and thus conferring untold benefits upon mortals. Nearly all the arts are indebted to the use of fire, and in our modern times we obtain continually increasing sources of heat, such as are necessary for the progress of science and industry. The higher the heat we are able to obtain, the greater is the field for new discoveries and processes by which our horizon is widened.

This is exemplified in a striking way by the modern invention of the electric furnace. Here we reach the top of the scale, and many are the advantages we obtain from such a powerful source of heat. The blast furnace uses a heat of 2,400 deg. F. to produce the iron from the ore and send it out in a melted stream, while the Bessemer converter, the next step in the process, brings us 400 or 500 deg. higher. Then comes the oxy-hydrogen blowpipe. By the combustion of hydrogen and oxygen we obtain a small blue flame which gives us a heat of 3,600 deg., and is sufficient to melt platinum and other refractory metals. Here we approach the temperatures which were employed in the interior of the earth to form many of the minerals, among others the different gems. With the heat of the oxy hydrogen blowpipe we are now enabled to imitate some of these processes. One of the most remarkable of these results is the formation of the ruby, which is only alumina or the material of ordinary clay, crystallized at an intense heat. The ruby is formed by sifting powdered alumina into the gas stream which goes to the flame, and there it is melted and it deposits beyond the flame in a transparent mass. In this way rubies of large size weighing 10 or 15 carats can now be formed, and in quality and color they equal and even surpass the rubies found in the earth.

Now that we have succeeded in obtaining the ruby by artificial means, it is only natural that we should expect to go farther in the scale of heat and produce other gems that have been formed in early times by the intense heat of the earth's interior. We know that the diamond is after all only crystallized carbon, and in fact it has no essential difference in composition form ordinary charcoal. Both are nearly pure carbon, but the diamond has been brought to the crystalline form under the powerful forces and high heat which prevail in the interior of the globe, while charcoal is formed under the ordinary conditions of the earth's surface. There is thus an essential difference in the way these two forms of carbon have been produced. We find that when we attempt to produce the diamond we come face to face with great difficulties, seeing that we are obliged to imitate to some extent the immense forces which were in operation in the earth's interior and so reproduce nature's process if we wish to obtain the same result. How to imitate this process was the question, and for a long time scientists were even uncertain as to just how the diamond had been formed originally. We know that it was crystallized from carbon which was kept at a very high heat, but as it has never been proved that carbon has been melted at such a heat, the matter seemed problematic.

It was the eminent French chemist, Prof. Henri Moissan, who found the first clue to the mystery and on following the matter up he was finally able to imitate the process of nature and actually form the diamond in minute crystals, and we may hope in the future to produce larger diamonds which will be as clear and brilliant as those we find in the earth. The way Prof. Moissan studied the formation of the different kinds of carbon and the wonderful results he obtained with the electric furnace form an interesting chapter in the history of science. In fact, the electric furnace soon began to prove of great value in forming all kinds of new compounds which we had never been able to obtain before. We will speak principally of the diamond, as it is the most interesting of the bodies which the electric furnace has produced. M. Moissan was led to his discovery by observing a specimen of meteorite from Diablo Cañon, Arizona. A large block cut from it had been sent to him at Paris. The mass was mainly composed of iron, and upon analyzing it he found that it contained many small black diamonds and some transparent diamonds of crystalline form. The way in which Nature formed the diamond seemed to be shown here in an unexpected manner. We are led to suppose that the carbon must have crystallized and separated from the mass of iron. The carbon was no doubt dissolved in the iron when in a melted state at a very high heat and on cooling the carbon took the crystalline form, just as any soluble salt may crystallize when the solution is cooled. Here the action is somewhat different, as it requires a high pressure to make the diamond crystallize. This pressure was no doubt obtained in a very natural way when the mass became solid, as we can imagine that when the outside was suddenly cooled the inside had to expand and was now at a very high pressure. Thus cooled, the mass deposited the diamond crystals as we find them. If we could reproduce the same conditions it might be possible to obtain the diamond, but how to proceed was the question. We must make the carbon dissolve in melted iron at a very intense heat, such as no doubt prevails in the interior of the earth or in the highly heated bodies from which the meteorites come.

The electric furnace was here called upon to give us the necessary heat. The electric arc is, in fact, one of the most powerful sources of heat that exists, and when the arc is produced on a large scale and confined in a narrow space we have a heat that cannot be surpassed, and we obtain, in fact, a heat of 5,000 degrees. Thus originated the electric furnace, which is now one of the most marvelous resources of modern science. Here we have electric force transformed directly into heat, and we no longer use heat obtained from chemical combustion as before. The modern electric furnace uses very simple means to obtain its wonderful effects. Two carbon rods, of two or three inches diameter, project into a cavity formed in a chalk block. The electric arc is formed in the center just over a carbon crucible. A cover of chalk a few inches thick is placed on the top and the arc is entirely confined, so that nearly all the heat is kept inside. It is a striking fact that owing to the non-conducting property of the chalk the operator can place his hand upon the top cover, and a piece of ice will remain on it for a long time without melting.

It is a striking spectacle to watch the electric furnace when in action. Long flames shoot out from either side through the openings, giving a blinding light accompanied by a loud hissing noise which the arc produces. The operators are obliged to wear glasses which are nearly black, so as to protect their eyes from the intense light while they watch the progress of the heating. In such a furnace we reach the extraordinary heat of 5,000 degrees, and at this point nearly everything can be melted. Even the chalk block fuses on the inside. A striking experiment is to boil silica or ordinary sand or flint in a carbon crucible. Not only does the sand melt and boil, but it is given off in the form of vapor. By using a perforated cover and placing a bell-jar over the furnace for an instant we see the vapors condense on the inside of the jar in fine powder. Almost all known matter is melted and volatilized at such a high heat. Here we have no less than 150 horse-power constantly transformed into heat. Naturally, to produce such a great force requires considerable expense; thus to run the electric furnace which is illustrated here costs about 80 cents a minute or $48 an hour. To run it all day long one would therefore have to pay some $500 or more.

Once in possession of the electric furnace, M. Moissan tried to reproduce the process which nature was supposed to have used to form the diamond. The essential part was to dissolve the carbon in iron which has been kept in fusion at 5,000 deg. At such a high heat iron dissolves a large amount of carbon. The next step is to cool the mass suddenly so as to form a solid crust, while the inside of the mass is still in the molten state. Then when the inside begins to cool it tries to expand, but is imprisoned in the outer layer. An immense pressure is the result, and in such case the carbon is expected to come out in the form of crystals. The process is a simple one, but of course requires great care in carrying it out. To the iron which is melted and kept at a white heat in the furnace we add the right amount of carbon in the form of small grains of charcoal. The cover is placed on the furnace and the carbon is soon dissolved. Then the furnace is opened and the operator seizes the crucible with a pair of tongs and plunges it quickly into a bucket of water. A brilliant display of fireworks is the result and sparks fly in all directions, accompanied by a loud hissing noise. There is no explosion, as was feared when first making the experiment, and there is really no danger in carrying it out. The best results are obtained when the mass is cooled very sud-