

By courtesy of "Railway and Locomotive Engineering," New York.

#### THE NEW LOCOMOTIVE THAT RUNS BACKWARD.

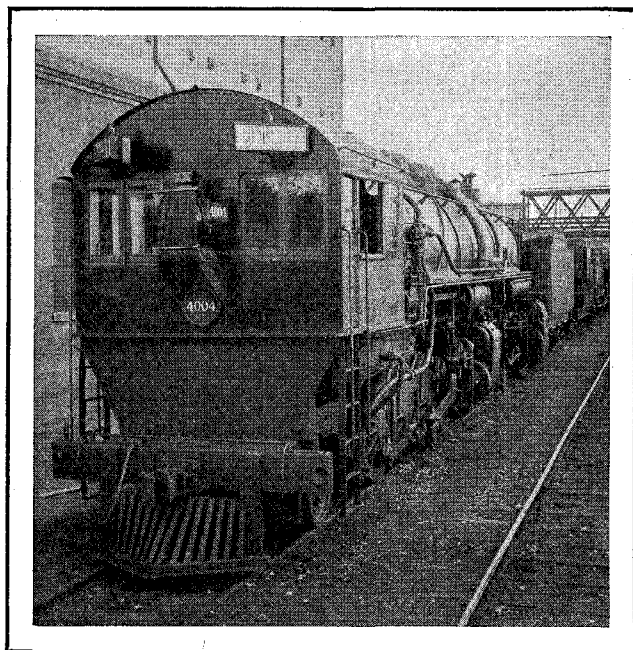
mountains and plains, that the Milky Way really was composed of innumerable stars; and, above all, they enabled him to discover the four satellites of Jupiter in January, 1610."

This Dutch or Galilean telescope, which was made on the principle of the familiar opera-glass, did not long remain the only telescope used by astronomers. In 1611 Kepler showed the advantages of the modern astronomical telescope and a year or two later Scheiner and Fontana constructed and made use of telescopes of this kind. The writer goes on:

"The importance of the invention of the telescope for the advancement of astronomy is not to be measured only by the insight it gave into the nature of the heavenly bodies, and the aid it rendered in following their movements more accurately. It also rendered an important service by making the Copernican system appear more natural and reasonable in the eyes of every unprejudiced thinker. Hitherto this system had probably to most people appeared to be nothing but a new way of 'saving the phenomena' (to use an expression of the ancients), that is, a new method of calculating the motions of the planets, which any one might use, whether he believed in the reality of the earth's motion or not. . . . To assume the earth to be one of the planets was a difficult thing,

Mercury deprived opponents of Copernicus of another favorite weapon, for they had been wont to proclaim that if Venus moved round the sun it ought to show phases like the moon. Again, the discovery of sun-spots, objects of a temporary nature, supplied a very striking proof that the Aristotelian doctrine of the immutability of all things celestial would have to be given up. While the analogy between the earth and the planets grew stronger every day, it was also of great importance that the fixed stars in the telescope appeared as mere luminous points, so that the apparent diameters of several minutes attributed to them by all previous observers were proved to have no existence. This put an end to the serious objection raised by Tycho Brahe, the greatest practical astronomer since Hipparchus, that a star having no annual parallax and yet showing a considerable apparent diameter must be incredibly large.

"As it were in a twinkling of an eye, the whole aspect of the universe had been changed by the invention of the telescope. That this was felt in some way, even by determined enemies of the idea of the earth's motion, may be seen from the statement made by Clavius, the chronologist, in 1611, that astronomers would have to look out for a system which would agree with the new discoveries, as the old one would not serve them any longer. The question could no longer be, 'Do you believe in the earth's motion?' it could now only be whether the arguments in favor of this motion were becoming so irresistible that the safest thing to do for its opponents would be to proclaim the doctrine to be heretical. This was accordingly done little more than seven years after the invention of the telescope."



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"A BETTER VIEW OF THE TRACK CAN BE OBTAINED."

so long as absolutely nothing was known about the other planets. As to the moon, the ancients had supposed that it must be a body rather like the earth, and the telescope only confirmed this hypothesis. But adversaries of the Copernican system had always asked how the earth could carry the moon along with it during the annual motion round the sun, or why the moon alone should form an exception to the general rule by moving round a planet instead of round the sun. Now Galileo could point to the undeniable fact that Jupiter, during its orbital motion, carried four satellites or moons along with it. The discovery of the phases of Venus and

#### BACKWARD ENGINES

A RATHER curious development is seen in the latest type of locomotives on the Southern Pacific, which are run cab-first, the smoke-stack end bringing up the rear. Says *Railway and Locomotive Engineering* (New York, January):

"Experience gained in operating these engines through tunnels and snow-sheds has proved the desirability of placing the engine crew where a better view of the track can be obtained. Accordingly the new Southern Pacific locomotives are designed to run with the fire-box end first, and the tender back of the smoke-box. With a coal-burning locomotive such a plan would, of course, be impracticable, but no difficulty is anticipated when using oil as fuel.

"In the new design the cab is entered through side doorways, reached by suitable ladders. An unobstructed view of the track is obtained through the front windows. The cab fittings are conveniently arranged within easy reach of the engineman, who occupies the right-hand side when looking ahead. The Ragonet power gear is employed, and its cylinder is placed as on the previous locomotives. . . . With this gear so placed it has been necessary to run a shaft across the boiler back-head, in order to make connection with the operating-lever. This arrangement, however, in no way interferes with the convenience of the cab fittings.

"The main frames are securely braced, under the cab, by a steel casting, to which the bumper is bolted. The latter supports a stub pilot. The bumper is placed well forward to protect the occupants of the cab from buffing and collision shocks. The deck-plate at the smoke-box end of the locomotive is of cast steel, and is provided with a chafing-block and a suitable pocket for the tender draw-bar. The tender is of the Associated Lines standard design, with rectangular tank, and equipped for oil-burning locomotives."



## A NEW FACT ABOUT METEOR PATHS

WHY is it that the points in the sky from which shooting stars appear to radiate change places slowly in some cases from day to day, while in others they remain stationary? This is due, Professor Pickering, of Harvard, has recently told us, to the relative dispositions of the earth's orbit and that of the swarm to which the meteors belong. Says a writer in *Cosmos* (Paris, January 1):

"It is well known that meteors belonging to the same system of shooting stars describe paths that are parallel one to another. When they enter our atmosphere, they appear to diverge from a single point of the heavens called a 'radiant.' The position of this point depends on the motion of the earth combined with that of the meteors, and if the meteoric swarm is sufficiently extensive to require several days for the earth to traverse it, the position of the point of emanation changes, because the direction of the earth's motion alters during this time, on account of the curvature of the orbit. In the case of the Perseids, for instance, which are visible during two or three weeks, in July and August, the position of the radiant is displaced by about a degree a day, because the direction of the earth deviates approximately by the same quantity. This is a well-known fact.

"Nevertheless, Mr. Denning, who for many years has devoted himself especially to the study of meteors, has many times observed stationary meteoric radiants. The shooting stars that proceed from these particular points must thus move in a direction that remains the same for days or weeks. Several other observers have also noted this curious phenomenon, but none of the numerous explanations hitherto advanced has been confirmed.

"*The Astronomical Bulletin of France* (December) reports a new explanation made by Prof. W. H. Pickering; it is the more worthy of interest in that it is based on our present knowledge of meteoric orbits. The meteors describe elliptical orbits inclined slightly or not at all to the plane of the terrestrial orbit, and they move in the same direction as the earth, so that their radiant appears stationary."—*Translation made for THE LITERARY DIGEST.*

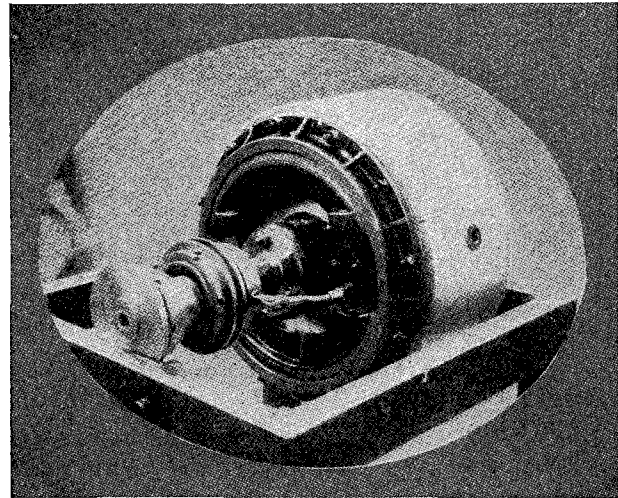
## A POLITICAL MEETING BY TELEPHONE

ATTEMPTS have frequently been made to transmit over the telephone the whole effect of a theatrical performance with the accompanying applause, or a public address or sermon with the responses of the audience. The most elaborate—perhaps the most successful—attempt of this kind was made recently at Birmingham, England, in connection with the heated political campaign. A political meeting, with an address by Mr. Balfour and all the attendant sounds, was carried, by means of a device of great sensitiveness called the "electrophone," over the telephone wires seven miles to "Highbury," the estate of Mr. Joseph Chamberlain, the former Liberal-Unionist leader, who was thus able to hear all that was going on. Says a correspondent of *La Nature* (Paris):

"With the aid of a company recently formed for the exploitation of the invention about to be briefly described, twenty transmitters had been installed inside the rail of the platform. These transmitters contained an extremely sensitive microphonic arrangement. Telephone lines, starting from these transmitters, passed under the platform and united into a bundle before making connection with the Birmingham telephone system. Of course devices were provided for protecting the wires from atmospheric electricity, and, in fact, a violent thunder-storm burst over the region without affecting at all the clearness of the transmission. It should be added that connection was also made to the long-distance wires, so that the notabilities of the Conservative party, assembled in the London offices of the Electrophone Company, could hear, word for word, the speech of their leader. To obtain such a brilliant result, it was necessary to use 25,000 feet of copper wire. The installation, ordered on short notice, was set up in ten working-hours. It made possible this journalistic prodigy: the stenographic report of the speech, published in the morning papers next day, was accompanied by a long letter from Mr. Chamberlain in which he commented on the declarations of his colleague. In an interview

on the subject, the ex-Colonial Minister declared that the double receiver held to his ears had brought the words of Mr. Balfour to him as clearly as if he had been sitting immediately in front of the platform. The hurrahs of the audience were the only unreal note, for they came to him like 'the noise of the waves breaking on the rocks.' This impression is explained by the position of the transmitters, which were all turned toward the orator, and were thus only imperfectly influenced by the noises coming from the hall."—*Translation made for THE LITERARY DIGEST.*

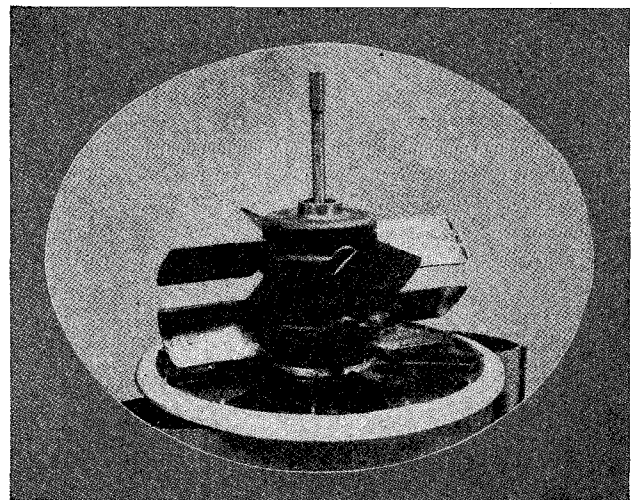
**A HYDRAULIC MOTOR-CAR GEAR**—An interesting principle is utilized in the transmission apparatus of the Torbina car. A paddle-wheel sets in motion water in a closed case and this moving water in turn acts on a second wheel, thus transmitting



HYDRAULIC TRANSMISSION APPARATUS—OUTSIDE.

the motion, there being no solid connection between the parts under ordinary conditions. The blades of these wheels may be set at right angles to their motion or may be inclined to it, thus varying the amount of slip through the water which practically alters the "gear." Says *The Illustrated London News*, from which we take the accompanying pictures:

"The Torbina car has a hydraulic transmission apparatus consisting of a paddle-wheel, with twin-blades running in water, which can be deflected so as to displace a maximum or minimum quantity of liquid. In the maximum position the whole apparatus is automatically locked solid, and in the intermediate angles the slip is



HYDRAULIC TRANSMISSION APPARATUS—INSIDE.

utilized to obtain the varying drives. The makers . . . claim that this form of gear-changing gives increased flexibility. They also maintain that it makes possible an almost universal use of the top-speed gear, and at the same time effects a large saving in the tire bill."