cost of repairing. In our illustration the plant is shown in use for bridge-repairing work, for which it is most eminently suited.

Such installations are useful in sparsely-populated countries like Ireland, where either labor is difficult to obtain, or the repairs have to be carried out some distance from a center of population. The wagon containing the installation can be rapidly conveyed to the spot, and the air compressor can be set in working order *en route*, so that it is possible to commence operations directly the structure in need of repair is reached.

RECENT OBSERVATIONS OF THE PLANET MERCURY.

BY EMILE GUARINI.

M. L. Rudaux, director of the private observatory of Donville, France, has devoted himself for ten years to the study of the planet Mercury, and, owing to the favorable situation of his observatory, has had an opportunity of making upon this planet a series of observations from which conclusions not lacking in interest have been drawn.

The planet Mercury was the last discovered by the ancients because, on account of the nearness to the sun, its brightness is lost in the dim light of dawn and dusk. Even with modern instruments it is difficult to observe. Its elongation of small amplitude; its location on the horizon or thereabout (always less clear than the high regions of the sky) at the most favorable instant for observations, and the great rapidity of its proper motion are all obstacles to be considered. Scientists are not even agreed as to the period of revolution of Mercury. Schiaparelli found that the planet rotates on its axis slowly in a time equal to that of its revolution around the sun and always presents the same face to the sun. Denning claims to have seen spots which have shifted in position upon it. Ever since the observations of these two astronomers a dispute has existed, certain astronomers having verified the displacement of the spots, and others not having observed it. Every contribution to the study of Mercury is therefore of importance, and from this point of view the observations of M. Rudaux, extending over a period of ten years (1892-1903), are most valuable.

In the first place, M. Rudaux has found that the phase observed is always less than the phase calculated, and in proportions which vary, but which are at times very notable. The majority of the observations have been made at the time of the eastern or evening elongations, and each time the phase has been found already in crescent, while the planet was reaching elongation and should have presented the aspect of a perfect half-disk. The apparent dichotomy therefore manifests itself before the epoch at which it ought theoretically to take place. The mean of such advance is from three to four days, but this figure appears to vary from two to five days. With the elongations of the morning the same phenomenon is observed, in inverse direction, the dichotomy manifesting itself with a retardation that appears to be of the same order as the advance for the eastern digressions.

Aside from these anomalies of the line of the phase or the terminator of the phase, M. Rudaux has noted that, very often, this terminator, instead of appearing in the geometrical form that should result from the illumination of a regular globe, presents deviations and distortions that indicate changes of level in the illuminated surface. Often also the southern horn appears truncated. As a general rule, these changes of level correspond to the various configurations of the disk. The projections seem to be caused by the illuminated regions, the depressions exhibiting themselves especially when the dark spots partially occupy the terminator.

The dark spots are very apparent, even more apparent than those of Mars. Sometimes they are almost black. It is difficult to observe them, however, because of the small size of the disk and of the rather poor quality of the images, which prevent their details from being made out and the limits of their contours from being fixed. As to general form, some appear roundish and others like wide bands connecting the first. Their color is gray, while the rest of the planet is of a yellowish or orange shade. The edge of the disk, the limb, is white and very luminous. The general luminosity of the planet decreases very rapidly from the edges toward the center, which is sometimes very dark.

M. Rudaux has, in addition, observed some light spots more or less white, and of which the accompanying figures show good specimens. They seem to be of two kinds, one of them sometimes very vague and apparently connected with certain configurations of the disk, and the other very white and often sharply defined under the form of caps and occupying pretty exactly the horns of the phase. All do not appear to have the same fixedness as the dark spots and seem to be due to phenomena of a rather temporary order.

One of our figures explains diagrammatically the anomalies of the phase. It must be taken, of course, for what it is worth, that is to say, a very plausible explanation of certain phenomena produced by Mercury. Like all diagrammatic figures, it is necessarily somewhat exaggerated in its details. But such as it is it remarkably reproduces what is required of it. In order to judge of it well, it must be looked at from a distance, say of 30 feet or more, or, better still, be observed in a camera with a slightly insufficient focusing. This will very well reproduce the aspect of the small telescopic image much influenced by atmospheric disturbances, those famous disturbances that make astronomers despair. What, now, are the conclusions that M. Rudaux draws from his observations?

Let us take up each point in succession. Let us recall in the first place the anomaly that makes the visible part of the planet appear smaller than that which ought to result from its position and from its illumination by the sun. It seems that it is necessary to seek the cause of it in the nature of the matter of the planet. M. Rudaux sees therein an analogy with the moon. But Mercury, in consequence of the difficulty of observation, cannot show the thousand luminous and dark details that we see in our satellite, and the final result is a great loss of light, which destroys the true limit of illumination, so that the eye cannot succeed in penetrating the illuminated features that should be delineated therein. In the center, the aspect is more pronounced than toward the horns at the edge, where all the details show themselves more and more contracted in perspective one before another, the low parts appearing situated in the shade. The result is that the horns have a total brilliancy greater than that of the center.

The explanation given for the horns may likewise explain the great luminosity of the limb. Nevertheless, M. Rudaux, in showing this analogy with the moon, thinks that it is very certain that it is necessary to add the atmospheric phenomena thereto in order to exaggerate these aspects. In fact, the presence of an atmospheric stratum absorbing the solar rays, especially those which, tangent to the globe, traverse it at the greatest thickness, results in the limit of illumination being reduced by such absorption. Since such influence is exerted with a greater or less intensity according to the atmospheric conditions, certain variations observed by M. Rudaux would be explained, at the same time as the illumination of the disk upon its edges, by a greater and greater superposition of the illuminated strata. Upon the whole, the observer concludes that the surface of Mercury is quite broken and presents changes of level and eminences of a mean altitude of from 9,840 to 13,000 feet, very approximately. There are also some that are higher, especially in the southern hemisphere.

As for the nature of the dark spots, it would be difficult to give an exact definition of them. It is certain, however, that they appear to have some analogy with those of the moon. What is evident is that they really belong to the matter of the planet, without apparent variations in aspect. And what of the white caps that appear to occupy the poles of the planet? Could accumulations of snow and ice occur to form these white zones? For want of a better theory, it is not unreasonable to admit this and to explain the spots by the production of atmospheric condensation in these regions of high plateaux, and also by huge banks of accumulated clouds. This would explain the sometimes vague and nebulous aspect and the variability of these zones. At all events, meteorological accidents take place upon the entire planet, as is shown by the changing and hazy appearance of certain regions.

Such are the first results to which M. Rudaux has been led. They will, without any doubt, appear of interest through the new facts that they add to our knowledge of this little world of Mercury, which presents numerous problems, for the solution of which no effort should be spared.

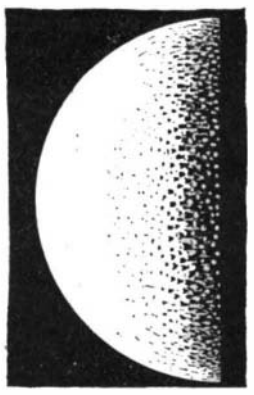
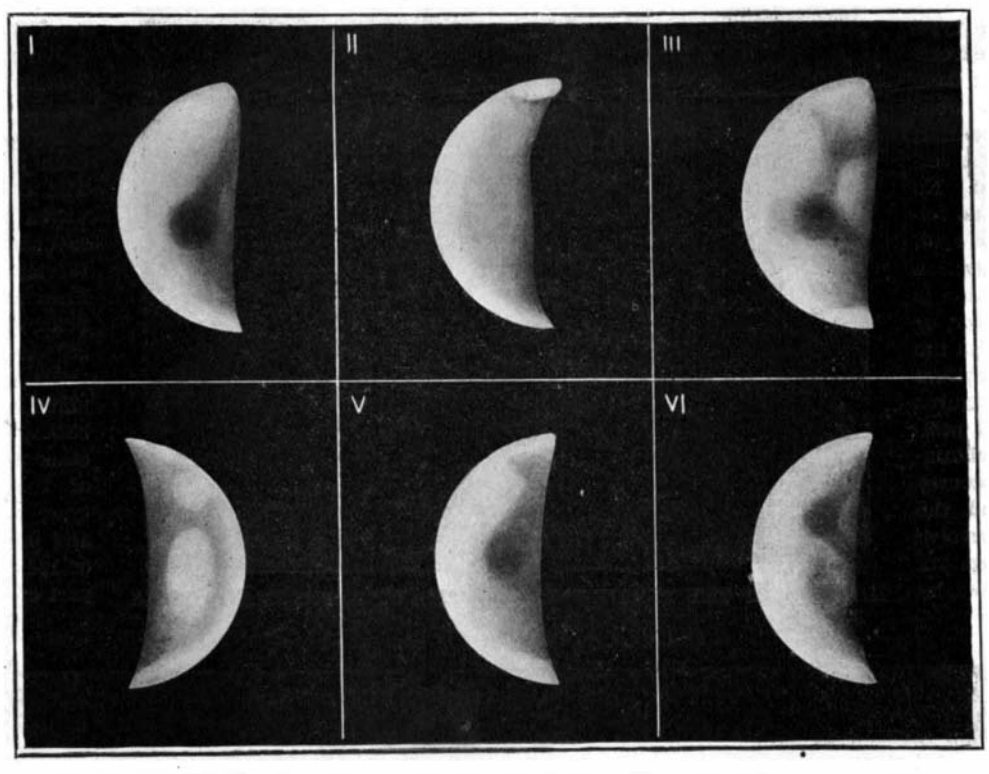


Diagram Explaining Some Anomalies in Mercury's Phases.



PHASES OF MERCURY AND THE SPOTS OBSERVED UPON THE PLANET'S SURFACE.

Dr. Cook's Return.

Dr. Frederick Cook, who unsuccessfully attempted last summer to ascend Mount McKinley, in Alaska, the highest mountain in North America, has recently returned to his home in Brooklyn.

Dr. Cook said to a representative of the New York Times that the trip had completely established the fact that it is impossible to scale Mount McKinley, 20,400 feet high, from its western side, but that three routes were noted on the eastern slope, by one of which it is possible the summit may be reached.

"Following the suggestion of Mr. Brooks of the Geological Survey," said Dr. Cook, "we determined to attack the west side of the mountain, and made our start from Cook Inlet at Tyonek. Our equipment of 2,200 pounds was carried on fifteen pack ponies from the Yackimer Indian Reservation. We followed an Indian trail to the Kuchatua River, crossing the Beluga and Skewentna rivers by boat. On the way I climbed Mount Yenlo, 4,500 feet, and obtained a good view and survey of the whole McKinley Range.

"We followed up the Kuchatua in a westerly direction, crossed the McKinley Range, through Simpson Pass, and proceeding along the northwestern slope of the McKinley Range above the timber line, we reached Mount McKinley on August 14. This left us but fourteen days in which to make our trial, the practicable season ending September 1.

"We first attacked the mountain from the southwest, but were stopped by a glacier which interrupted the route some 2,000 feet below us. In the second attempt we reached an elevation of 11,400 feet when we were stopped by a spur of the main mountain, with almost perpendicular slopes of granite rock, forming an impassable obstacle to any ascent from that side. The mountain is an almost continuous series of granite cliffs, corniced by overhanging glaciers. We were greatly hampered by the advance of winter and heavy snow, which made it necessary for 2,000 feet of the climb to dig away thirteen inches of snow before cutting the steps in the glacial ice.

"After finding the western slope entirely impracticable, we had to get out of the country quickly, and instead of returning the way we had come, we decided to cross the range and come down the east side, traveling over 100 miles of unexplored country. We found a break in the range fifty miles northeast of Mount McKinley, at an elevation of 6,000 feet, crossed it, and dropped down into the valley of the Sushitna, striking the Chulitna, the largest tributary of the Sushitna River. This flows through a remarkable cañon, which made it necessary to abandon our horses and take to rafts, on which we came down through the unexplored eastern foothills of Mount McKinley.

"We discovered two glaciers, one probably the largest in the interior of Alaska, and made a rapid survey of the east slope of the range. On September 15, two weeks later than we should have remained, we left

Mount McKinley, and in five days had reached tide water at Cook Inlet."

The trip was one of great hardship, on the return trip especially the men's clothing being drenched constantly by frequent immersions in the glacial streams. They opened up the best hunting grounds in America for caribou, mountain sheep, and moose, Dr. Cook says, the western foothills being a great game preserve.

"Mount McKinley is of granite weighted down with not less than fifty disconnected glaciers, with everywhere precipitous walls," said Dr. Cook. "It is probably the most difficult mountain in America to ascend on account of the distance from the coast line, supplies having to be carried 400 miles through difficult country, and the Arctic conditions encountered from the start. On the east side there are three glaciers, which terminate at an altitude of about 11,000 feet and over these a route to the upper valleys of the summit may be found."

High mountains are always conspicuous, and we invariably find in descriptions of the continents and islands mention of the culminating points of those lands. The following table gives the names and heights of the twenty-four great mountains of the world which are the highest points in all the continents and in the most important islands, arranged in the order of their altitude:

Mount Everest, Asia	29,000
Aconcagua, South America	23,091
Mount McKinley, North America	20,467
Kilimanjaro, Africa	19,680
Mont Blanc, Europe	15,800
Mauna Kea, Hawaii	13,808
Kinabalu, Borneo	13,094
Mount Victoria, New Guinea	13,202
Gunung Korintji, Sumatra	12,480
Fujiyama, Japan	12,400
Mount Erebus, Victoria Land	12,365
Mount Cook, New Zealand	12,350
Pico de Teide, Canary Islands	12,234
Gunung Semeru, Java	12,037
Lompobattang, Celebes	10,069
Petermann, Greenland	9,184
Cinto, Corsica	8,888
Tsiafajavona, Madagascar	8,626
Pedrotallegalla, Ceylon	8,331
Ida, Crete	8,058
Mount Townsend, Australia	7,347
Oreafa Joekul, Iceland	6,428
Chydenius, Spitzbergen	5,576
Cradle Mount, Tasmania	5,395

DR. GRETH'S AIRSHIP.

BY ARTHUR INKERSLEY.

Dr. August Greth, an Alsatian by birth and a physician by profession, made an ascent over the city and bay of San Francisco on Sunday, October 18, in an airship of his own invention. For twenty years he has taken an interest in aeronautics, and has had nine patents for airships granted by the United States. The ascent was made from Market and Eleventh Streets, San Francisco. The airship sailed over the westerly part of the city, sometimes at a height of 2,000 feet, and at times at half that altitude. When it reached 2,000 feet, the motor was started, and the airship responded by descending several hundred feet and moving in a semicircle, first to the north and then to the south. While passing over the Presidio reservation, the craft first ascended quickly and then began to descend. At last it fell into the bay, on the surface of which it floated, the navigator swinging from his car into the rigging. Dr. Greth and the balloon were picked up and towed to the shore by a crew from the life-saving station of the Presidio reservation. The doctor was wet only up to the waist, and explained that he could easily have crossed Golden Gate and made a landing in Marin County, or have gone over to Alameda County and descended there, but that the expense of bringing back the airship from either of these counties would have been much greater. So he purposely descended in the bay.

Dr. Greth said that the balloon was entirely under his control for the greater part of the time that he was in the air, and would have been completely so except for certain defects in the motor and the balloon. The motor is a gasoline one, nominally of 10 horse power, but really developing only 6 horse power, and weighing 500 pounds. The balloon is not provided with automatic expansion-valves such as are fitted to the airships of Santos-Dumont. At 2,000 feet the motor failed, and the gas in the envelope, under the hot sun, expanded rapidly. Not being able to descend by the aid of the motor, Dr. Greth was obliged to let some gas escape from the balloon, which was so tense from the expanded gas that there was danger that it might burst. After letting out a quantity of gas, Dr. Greth tried to get the motor to work again, but was not able to do so.

The inventor and his associates are not men of means, and are handicapped by the lack of funds to equip the airship properly. Dr. Greth says that a motor suitable for his purpose will cost $1,000, and that, when he has it, he will sail the airship at will at a speed of thirty miles an hour in calm air. When the wind is favorable, its velocity will be added to the rate at which the airship will travel.

The inventor has had to be content with two propellers, but his intention is to have four, two at each end of the frame. The propellers are to work separately or together, and at any desired angle, so that the ship can be turned in any direction, even against a strong wind. The propellers are all to be run by one motor in the body of the car. Dr. Greth believes that the only practicable airship is one that is supported by a gas lighter than air. He is satisfied that a dirigible airship buoyed up by a balloon is practicable, and says that his own craft, if properly equipped, will go through the air under all conditions of weather at a high rate of speed and will be perfectly under control.

Dr. Greth's airship consists of a balloon, which, when inflated, has a length of 75 feet and a maximum diameter of 25 feet. From the balloon is suspended a frame, which supports the motor and the platform for the navigator. Dr. Greth has done away with the balloonette used by Santos-Dumont and Stanley Spencer, which nitrates the hydrogen gas by mixing air with it. Dr. Greth has a netting over his balloon, which keeps it taut on the top and at the ends, preventing it from buckling. The frame is only seven feet below the balloon, thus rendering the ship more dirigible. By proper manipulation of the four propellers, the balloon can be kept always in a horizontal position, can be raised or lowered, and driven in any direction at will. All that the inventor wants is a powerful enough motor of light weight, and then he will demonstrate the practicability of his theory of navigating the air. He hopes that the partial success of his machine, poorly equipped as it is, will prove the means of supplying him with the funds necessary to equip his airship properly. His machine is more buoyant and more dirigible than those which have the frame swung at a distance of twenty feet below the balloon.

The Current Supplement.

The current SUPPLEMENT, No. 1453, opens with a most striking picture of a peak in England's mountainous region, a peak which may be ascended only at great risk to life and limb. An article on the operation of gas ranges gives a vast amount of practical information that will surely be found of value. McLennan and Burton present the results of some experiments on the electrical conductivity of air. Mr. Emile Guarini describes the De Mare electrothermic fan. "The Light Aluminium Alloys" is the title of a very instructive paper read by Dr. Joseph W. Richards before the American Society for Testing Materials. Prof. Léonce Fabre tells much that is of value in an article on the treatment of finely divided ores. "How Woven Hose is Made" is a subject which is discussed by Mr. Day Allen Willey. The paper on Geography read by Capt. Ettrick W. Creak before the British Association for the Advancement of Science is presented in full. Miss Mary Proctor describes the proposed Amherst College Observatory in full. A horological curiosity in the way of a one-wheel watch is also described.

Failure of the Second Ziegler Expedition.

Dispatches from Europe state that the second Ziegler North Pole expedition has failed to reach Franz Josef Land. Mr. Ziegler does not credit the report. A letter was received not so very long ago from Mr. Fiala, who stated that it was probable that his ship would reach Franz Josef Land and winter there. Otherwise it would have been necessary to return to Norway before this. The ship had not coal enough to keep under steam all this time. Had she failed, Mr. Ziegler believes he would certainly have heard from Mr. Fiala by this time.

Extermination of the Clam.

The clam seems to be sharing the fate of the lobster. It is fast disappearing—so fast, indeed, that the United States Fish Commission is endeavoring to propagate the mollusk by artificial culture. The Fish Commission has confined its attention to the soft or long clam. The State of New York, on the other hand, is studying the round or hard clam. Both researches seem promising from the results thus far obtained.

The total power generated and used by the St. Louis Exhibition will be in the neighborhood of 50,000 horse power. Over 80 per cent of the electric energy will be in 6,600-volt, three-phase, 25-cycle current. The largest unit will be an 8,000-horsepower steam turbine, and the next largest a 5,000-horsepower compound horizontal and vertical reciprocating steam engine. The largest steam engine in the Paris Exposition of 1900 was rated at 4,000 horse power.

General Programme of Competitive Trials of Subsurface and Submarine Torpedo Boats.

The following rules have been drawn up for governing the competitive tests of the new Holland boat "Fulton" and the Lake boat "Protector." The trials are to be held at Newport, R. I., November 16.

Each boat must be provided with a small mast whose top is 25 feet above the water line of the vessel when she is afloat, and 5 feet above any of the other pipes or apparatus projecting above the deck. The mast of the "Protector" will be painted with alternate bands of black and white, and that of the "Fulton" with alternate bands of red and yellow, and on top of each mast will be mounted a small sheet of metal which will act as a pennant and be painted a distinguishing color. By means of the mast and pennant, it will be possible to at all times know the exact position of the competing boats, even when they are submerged.

The tests will be of such a character as to determine the following points:

1. The maximum speed at which the boat can be operated under the conditions of service for which it was designed. Speed trials will be made in (*a*) the light condition, the vessel having all ballast tanks empty and being propelled by its gasoline engines; (*b*) in the awash condition, in which the boat is ready for instant diving and propelled by its electric motors, a dive being made at the end of the measured mile; and (*c*) in the submerged condition at a sufficient depth for not more than 3 feet of the mast to project above the surface.

2. The maneuvering powers of each boat under various conditions of operation for which the maximum speeds as described above are determined, will be noted during the different trials, and special tests may be made to demonstrate further the character of the qualities possessed by each vessel. These tests will include those necessary to show the ability of the vessel to remain in any position and to reverse her direction of motion when submerged, i. e., when going ahead submerged, to stop and go astern with as slight changes as practicable in her trim and depth of submersion.

3. The ability of each vessel to maintain steadiness of route in both the horizontal and vertical directions, when navigated in either the awash or submerged conditions, will be noted during the various trials and extra tests may be made to further demonstrate the character of these qualities possessed by each vessel.

4. The times to pass from the light condition to the awash condition, and to dive from the awash condition to certain prescribed depths, will be noted during the various trials.

5. Trials will be made to show the times required by each vessel to discharge the full number of torpedoes carried, and to fully demonstrate the ability of the vessel to perform with efficiency all functions connected with her torpedo outfit.

Torpedoes will be fired while the vessel is on the surface and also when totally submerged. The firing trials will be made either as separate tests or as part of the service trials.

6. Trials will be made to show the radius of action when running totally submerged.

7. Trials to demonstrate the habitability of the vessel by requiring the entire crew to remain on board 24 hours, during which time the vessel shall be self-sustaining. An air supply for 12 hours for full crew and two additional persons must be carried.

8. Service trials approximating in the closest possible manner the probable and reasonable requirements of submarine warfare will be held. They will fulfill the following conditions:

(*a*) Service test of submarine operating from a shore base against a vessel in the open sea, by the boats going in light condition out to a stake vessel, submerging, approaching a second stake vessel, and discharging torpedoes between two cutters 300 feet apart. Two target spaces will be provided, so that both boats can fire at the same time. The use of periscopes or other sighting apparatus is permitted, but account will be taken of the time such instruments are visible, the least possible surface disturbance being the desideratum.

(*b*) A second similar test will be made for demonstrating the conditions of operation when the periscope is not used.

(*c*) A test with the boats starting from open sea, approaching and entering the harbor in a submerged condition, and cutting and removing a length of cable such as is used for harbor mines. The time required will receive consideration, and vessels must be navigated at the highest speed possible under the circumstances.

Marconi Receives a Nobel Prize.

The Academy of Sciences, which awards the Nobel prize, has decided that the recipients for this year shall be as follows: Literature, Henrik Ibsen and Bjornstjerne Bjornson; physics, Signor Marconi; and medicine, Dr. Finsen.