SCIENTIFIC AMERICAN

ESTABLISHED 1845

MUNN & CO., - - Editors and Proprietors

Published Weekly at

No. 361 Broadway, New York

TERMS TO SUBSCRIBERS

One copy, one year for the United States, Canada, or Mexico $3.00
One copy, one year, to any foreign country, postage prepaid. £0 16s. 5d. 4.00

THE SCIENTIFIC AMERICAN PUBLICATIONS.

Scientific American (Established 1845) ..... $3.00 a year
Scientific American Supplement (Established 1876) ..... 5.00 "
American Homes and Gardens ..... 3.00 "
Scientific American Export Edition (Established 1878) ..... 3.00 "

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MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, OCTOBER 7, 1905.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

TWO ENGINEERS IN THE CAB.

The time has certainly come for a protest against a certain type of locomotive, or rather against the present way of manning such locomotives, which constitutes a grave peril to the passengers on certain railroads. We refer to what is popularly known as the "Mother Hubbard" type, in which there are two cabs widely separated; one for the engineer, and the other for the fireman. The engineer's cab is located at about the mid-length of the boiler, and the fireman's cab or platform is in the usual position at the rear of the boiler. The only means of access to the engineer's cab, which is entirely inclosed, is by a narrow running board, reaching to the fireman's platform. The firebox is so wide that when the fireman is attending to his duties the engineer is practically shut off from his sight. When we remember that on many of the best managed roads there is a strict law that the fireman shall check off the signals with the engineer, we can see that, on the face of it, this separation of the two men introduces an element of risk in the misinterpretation of signals. But, over and above this is the far more serious risk that the engineer may be suddenly taken sick, or even stricken down in death by apoplexy or heart failure. Cases of the death of the engineer through heart failure or through being hit when leaning out of the cab have happened of late years with inexplicable frequency, and the last case of this kind, which occurred in the middle of last month, strikingly illustrates the dangers inherent in this form of engine. A "Chicago Limited" train, drawn by a locomotive of the "Mother Hubbard" type, was running at high speed in the night time, when the engineer suddenly fell dead in the cab, the fireman being in complete ignorance that anything was wrong. The tragedy was discovered only when the train ran at full speed through a station at which it should have stopped, noticing which, the fireman climbed into the cab, where he found the lifeless body of the engineer and brought the train to a stop. The type of locomotive referred to is a popular one on some lines, and it is an excellent design for the conditions under which it has to work. It has the one defect brought out by the above and similar incidents, the clear remedy for which is to place two men at all times in the cab.

COMPARISON OF TURBINES AND RECIPROCATING MARINE ENGINES IN SERVICE.

The Midland Railway Company has recently been in a position to gather what is undoubtedly the most valuable comparative data as yet secured, as to the relative performance of turbine and reciprocating engines when used in commercial service. The company recently built for their Irish and Isle of Man service four steamers, which were identical in everything but their motive power. This, in the case of two of them, the "Antrim" and "Donegal," consisted of reciprocating engines, and in the case of the others, the "Londonderry" and the "Manxman," consisted of Parsons turbines. Of the two turbine boats, the "Manxman" was provided with turbines of 25 per cent more power than those on the "Londonderry." By the terms of the contract the vessels were to maintain 20 knots per hour with two double-ended boilers under steam, and on the trial the "Antrim" under these conditions showed 20.6 knots, the "Londonderry" 21.6 knots, and the "Manxman" 22.65 knots per hour. With all the boilers in use, the respective speeds were 21.86, 22.36, and 23.12 knots per hour. During the trials the decrease in water consumption in the case of the "Londonderry" amounted to 8 per cent, and of the "Manxman" to 14 per cent, as compared with the two reciprocating-engine boats. It follows that there was a corresponding decrease in coal consumption by the turbine boats, the "Manxman" making 20.3 knots on the same amount of fuel that was burned by the "Antrim" when making 19.5 knots. There was a great economy in the amount of lubricating oil consumed, which in each turbine steamer amounted to 5 gallons per single trip. This again resulted in further economy, by the reduction of the staff in the engine room from four greasers to two. To these advantages must be added the almost complete absence of vibration. Furthermore, in the whole period of service the turbines have cost practically nothing for upkeep. There is a saving in the weight of the hull in the turbine steamers of about 30 tons, and in the weight of the engines, shafting, and propellers, of 85 tons. These two items together represent a saving of 115 tons, or 6 per cent of the weight of the steamer when running light.

PANAMA CANAL IN FOUR YEARS.

Among the many engineers who have made a careful study of the Panama Canal problem, there is none that has so intimate a knowledge of its purely engineering features as M. Bunau-Varilla, who was for several years chief engineer of the late French Panama Canal Company. It is a fact that most of the later survey work and tentative plans of the Panama Canal that have been executed since the United States became interested as a probable purchaser of the property are based upon and include the very exhaustive engineering data that were obtained by the engineers of the old Panama company. That the former chief engineer maintains his qualification to speak with authority on this great question is shown by the invariable good judgment and sound engineering sense that have marked all of his published articles or spoken suggestions on the Panama Canal question.

The latest plan suggested by Bunau-Varilla, and recently laid before the President and before the International Board of Engineers, has so many features to recommend it, and is such a happy compromise of widely diverging schemes for canal construction, that we look to see it adopted unless some serious engineering difficulties, not anticipated by the former chief engineer, should present themselves. As matters stand, opinion is divided as to whether a sea-level canal should be built or one with locks; that is to say, whether the canal should have a summit level at 30, 60, or 90 feet, or be boldly cut through at tide level from ocean to ocean. The 90-foot level scheme is that of the original French company, and it has received the indorsement of an international board of engineers of high standing. The sea-level scheme, due originally to De Lesseps, was first seriously revived by the late Chief Engineer Wallace, who now appears to have based his calculations upon data which gave too optimistic an estimate. There can be but little doubt that Mr. Wallace's statements as to the low cost and short time in which the sea-level canal can be cut through must be taken with very grave reserve. At the same time there can be no doubt that the idea of the United States opening the canal at sea level has taken a strong hold upon the imagination, if not upon the judgment, of a large number of members of Congress, and of the people of the United States as a whole. If there should eventually be a consensus of expert opinion among the engineers that a sea-level canal can be built within a reasonable time and at a not too heavy cost, it will be found that the nation stands ready to indorse it.

Judging from the start that we have made in this great matter, it seems to be very certain that the immediate digging of a sea-level canal will require a length of time and an expenditure of money that will be prohibitive. On the other hand, if the original Panama Canal company's plan for a 90-foot level, but with an enlarged prism and longer and deeper locks, be adopted, it becomes a question, in view of the rapid increase in the size of ships and the bewildering growth and magnitude of the world's shipping, whether the construction of a canal with locks upon dimensions and by methods that prohibited any future enlargement or change would not be a short-sighted policy that might eventually lay a heavy restraining hand upon the future development of traffic by this great waterway.

As a compromise between these two plans the suggestion offered by M. Bunau-Varilla is very timely, and should it be approved by the International Board of Engineers, it would prove to be an admirable solution of the difficulty. He proposes to build a canal on the location which would be chosen if it were to be cut through at sea level, but to plan the various levels and locate the different locks with a strict view to securing the earliest possible opening of the canal; an event which, he believes, could be accomplished, if his suggestions are followed, within four years' time. The broad principle upon which he would proceed would be that of so accommodating the plans of the canal to the topographical features of the Isthmus that its opening could take place within the least possible time. Commencing with the Culebra cut, which is the determining factor, he points out that already the mountain has been cut down from 300 feet above sea level to 150 feet. He would place the summit level of the canal at 130 feet, cutting it to provide a uniform depth of 35 feet throughout. Descent to tide level would be made by eight locks, four on the Pacific and four on the Atlantic side; and it is because of the comparatively small amount of excavation that would have to be done, that he estimates that a canal built on these lines could be opened for navigation within four years.

Although the 130-foot level canal would have a capacity far larger than the traffic that would immediately seek the new waterway, it would be considered as temporary and as serving its purpose merely while the work of cutting down the various lock-levels to tide level was being carried on. The proposed plans provide for carrying on this further work of excavation without in the least interfering with the existing traffic. This is rendered possible by carrying the masonry of the locks down to tide level, an arrangement which would permit of the upper portions of the locks being removed to keep pace with the gradual lowering of the summit level. It is estimated that the work of transforming a lock canal with 130-foot summit level into a sea-level canal would occupy a period of from five to seven years, the time varying according to the bottom width determined upon for the canal. If the bottom width were 150 feet, five years would suffice, and seven years if the bottom width adopted were 300 feet. Finally, according to this French engineer's estimate, the change from a lock to a sea-level canal can be made without incurring a greater cost of excavation per unit than would result in the immediate excavation of the sea-level canal as at present proposed.

RECENT ADVANCES IN SELECTIVE WIRELESS TELEGRAPHY.

Early in the experimental struggles of wireless telegraphy it was found that the parabolic reflector as a means for directing messages would have to be abandoned, since the power of the waves was so greatly cut down as to render it useless for commercial purposes, yet it was evident that without selectivity the field of the new art would be greatly circumscribed. Consequently, since those historic days many schemes have been proposed for accomplishing the desired result, ranging from the transmission of waves unidirectionally as cited, to the propagation of waves of predetermined length and which would act only on a receptor tuned to receive them.

One of the earliest devices for carrying out the first method was designed by M. Emile Guarini Foresio and consisted of inclosing the sending and receiving aerial wires in slotted sheaths with their openings facing each other, when the waves emitted by the one would be projected only in the direction of the other or complementary wire, while the sheath inclosing the latter would reflect such waves coming from all other directions, preventing them from impinging on the aerial proper, or if oscillations were set up in the sheath, the energy would be conducted to the earth and there dissipated. While experimentally possible, this method did not fulfill the exacting conditions required in practice with any marked degree of success, for, as in the earlier Marconi apparatus, there was an exceeding loss of energy and its usefulness was greatly limited by the restricted radius of the field it would cover.

A marked advance in sending wireless messages in a given direction has been brought out in Italy by Alessandro Artour, Esq., C.E., who has succeeded in producing circular and elliptical rays of electric waves which are sent forth in any desired direction with great power. Herr Zehnder was the first actually to produce circularly and elliptically polarized electric radiations experimentally, in 1894. His plan was to utilize a pair of plane polarizing grids made of a number of parallel wires attached to a frame and place them parallel to each other a short distance apart and with their wires crossed. These two grids will reflect electric waves in the same manner that wire gauze will reflect light, and if the crossed wires of the grids are separated a distance of one-eighth of a wave-length and the plane of the incident radiation is 45 degrees to the plane of the wires the reflected radiation will be circularly polarized, but if the relations of the planes are changed the polarization will be elliptical.

For the purposes of commercial wireless telegraphy this method is obviously impracticable, since the absorption losses would be prohibitively large. Signor Artour seems to have greatly reduced the dampening factor by devising a suitable apparatus for producing circularly and elliptically polarized electric radiation by a direct method, viz., connecting the secondary terminals of an ordinary induction coil with the balls of the usual spark-gap, while a third spark-ball is connected through a condenser with one side of the secondary circuit, the three balls being disposed as the vertices of an isosceles triangle. To set up and propagate circularly and elliptically polarized waves, the aerial wires are in the form of the letter X, with the positive and negative balls of the spark-gap connected thereto at the lower terminals respectively, while the third spark-ball leads to the earth. In this ingenious fashion circularly and elliptically polarized electric waves are directly produced without reflection; the

ray formed may be transmitted in any direction, while its effective range has been demonstrated up to a distance of 300 kilometers.

The second method referred to holds out greater possibilities, although it has proven infinitely harder of solution; this is syntonization based on electrical resonance. Sir Oliver Lodge was the first to evolve a system of syntonic wireless telegraphy in which the coefficients of inductance, capacity, and resistance were considered. Since these early essays Lodge has, in conjunction with Dr. Alexander Muirhead, devised and invented many ingenious improvements relating to the practice of syntonic wireless telegraphy. In this connection it must be borne in mind that there is a well-defined demarkation between what is called *syntonic* and *selective* systems, although at first the object of the former was to produce the latter. Not very long ago these words were used synonymously, but as the art unfolded it was found that while a transmitter and its complementary receptor could be attuned to the same wave length and were made the better for it in every way, they were not by any means rendered selective.

The latest researches of the eminent physicist and electrician named that have been made public relate to syntonizing a transmitter and a receptor in which a greater certainty of action is obtained. The invention is the outcome of an experiment wherein a long wire attached to a discharging Leyden-jar circuit was thrown into violent electric oscillation in synchronism with the jar and this is combined with an "overflow," the result of another experiment, in which a long wire appendage was employed to set up oscillations in a Leyden-jar circuit and cause it to be charged to a point where it would overflow and disrupt a minute spark-gap; these two effects were again combined with a third, also discovered by Lodge, and produced by the "syntonic" Leyden jars; in this arrangement the oscillations of one discharging Leyden-jar or condenser circuit set up similar, though more feeble, oscillations of the same phase and frequency, in a distant Leyden-jar or condenser circuit tuned with a precision to the first.

The combination of these three very pretty laboratory experiments into a hard-and-fast commercial system has brought out several novel features, the chief one being the surging of violent electric oscillations in the condenser charged by the secondary of the induction coil and the impulses of which are conveyed to the upper end of the aerial wire resulting in a series of sharp recoil kicks. This sudden rebound exerts a much greater effect in the surrounding ether than a simple periodic oscillation would. On reaching the distant station these wires set up oscillations in the receiving wire to which is attached a condenser circuit similarly attuned to that of the emitting station; in the condenser or internal circuit the oscillations work up gradually in strength until they become strong enough to break down the resistance of the coherer. This is brought about as soon as the maximum potential attained by these oscillations in the condenser circuit is high enough to cause an electrostatic overflow which takes place through the coherer; this causes a reduction in the resistance of the latter and the consequent formation of a signal by the receiving device.

The novelty in this part of the invention is found in the mode in which the coherer is connected with the receiving condenser so that it will be impressed with the overflow or cumulative action of the waves, and such is the disposition of the circuits that it is, at the same time, protected from the direct action of the elevated conductor or any sudden impulse to which the latter is exposed.

While these inventions do not by any means solve the vexatious problems of selective wireless signaling, they are vitally important in that they show that more and more effective means are being constantly devised by which the requisite energy is reduced and the accuracy of the working is increased, while at the same time the accumulated knowledge must lead eventually to a system of selectivity and all that this much-abused term implies.

THE HEAVENS IN OCTOBER.

BY HENRY NORRIS RUSSELL, PH.D.

The best "landmarks of the sky" for a beginner in the study of the constellations are the groups of stars which lie near the pole, for these, in our latitude, are visible at all hours of the night and in all seasons of the year. How this happens can be very clearly illustrated by a simple photographic observation, which can be made with any camera.

Choose a clear moonless night, point the camera toward the pole star, and expose for a couple of hours (using the largest stop). When the plate is developed the stars will appear, not as points, but as long trails, owing to their apparent motion, and these trails will all be arcs of circles, with a common center. This shows that the apparent motion of the heavens, which causes the sun, moon, and stars to rise and set, is really a rotation about a fixed point, which astronomers call the celestial pole. Each star describes a circle about this pole every day. If the star is near the pole, the whole of this circle is above our horizon, and the star never sets. For stars farther from the pole, a larger and larger part of the circle lies below the horizon. Stars in the southern sky describe circles about the south celestial pole, which is as far below our horizon as the north pole is above it, so that some southern stars are only visible to us for a small part of their circuit, and others still farther south never rise above our horizon at all.

If we make a print from our negative, and mark the beginning or end of each trail with a conspicuous dot (to avoid confusion due to overlapping trails), we can easily identify the stars visible on our photograph, and in particular the pole star. It will be seen that the latter is not exactly at the celestial pole, but is some little way off in the direction of Cassiopeia. We see also that our photograph shows much fainter stars close to the pole than some distance away. This is because the close circumpolar stars have shorter trails, so that their light is less spread out on the plate, and a fainter star can thus produce a visible impression.

Of the circumpolar constellations, the most familiar is the Great Bear. At the present season this is not very conspicuous, as it lies below the pole, with the Dipper close to the northern horizon, and the Pointers almost under the pole star.

A line drawn from the middle of the Dipper handle through the pole leads us to Cassiopeia, whose principal stars form a zigzag line in the Milky Way, resembling an irregular letter W. A line drawn to the left through the pole star at right angles to this last line, points out the head of Draco, formed by a quadrilateral of stars, of which the faintest is double, much too close for the naked eye, but separable with a strong field glass. The constellation extends in a long line of stars, first upward to the right, then down to the left, then again to the right, above the Dipper. Within its curve it incloses the smaller constellation of Ursa Minor, which contains one other star about equal in brightness to Polaris.

The remaining circumpolar constellations are inconspicuous, Cepheus, which lies between Draco and Cassiopeia, being the most prominent.

To the east of Cassiopeia and below it is Perseus, whose principal features are a curved line of stars in the Milky Way, and a single bright star south of them, which is the remarkable variable Algol. Between Perseus and Cassiopeia is a bright spot in the Milky Way, which the telescope shows to be a very fine star cluster.

Below Perseus on the left is Auriga, recognized by the very bright star Capella and the irregular pentagon which it forms with the neighboring stars. On the right is Taurus with the unmistakable group of the Pleiades, and the bright red star Aldebaran. The very bright object between them is the planet Jupiter. The great square of Pegasus is southeast of the zenith, and Andromeda lies between it and Perseus. Cygnus and Aquila lie in the Milky Way to the westward, and Lyra farther northwest, with Hercules below it.

Below the groups already named are the dullest of the zodiacal constellations. Sagittarius is just setting. Capricornus follows it, marked only by a pair of small stars—both double—southeast of Altair. Aquarius comes next, and can be identified by a little group, shaped like the letter Y, lying on its side, which lies southwest of the great square of Pegasus. Pisces has no conspicuous stars, but Aries contains a small but rather conspicuous triangle, with very unequal angles, which lies below Andromeda and to the right of Perseus.

The large constellation Cetus fills the southern sky, but contains nothing to delay us at present. The isolated bright star low down in the south is Fomalhaut, in the Southern Fish. Saturn, which is a good deal brighter, is higher up and farther west.

THE PLANETS.

Mercury is morning star till the 12th, when he passes through superior conjunction and becomes an evening star. Throughout the month he is too near the sun to be seen with the naked eye.

Venus is morning star in Leo and Virgo, rising at about 4 A. M. in the middle of the month.

Mars is evening star in Sagittarius, setting between 9 and 10 P. M. all the month. On the 8th he is in conjunction with Uranus, which is about 1¾ degrees south of him.

Jupiter is in Taurus, rising about 8 P. M. on the 15th, and is rapidly becoming the most conspicuous object in the evening sky.

Saturn is in Aquarius, and crosses the meridian about 9 P. M. on the 1st, and 7:15 P. M. on the 31st. He is therefore very conveniently observable in the evening. A very small telescope will show his rings, and one a little larger will show his brightest satellite, Titan. This is west of the planet on the 4th, north on the 8th, and so on, its period being 16 days.

Uranus is in Sagittarius, and can best be identified by its proximity to Mars on the 8th. Neptune is in Gemini, and comes to the meridian about 5 A. M. in the middle of the month.

THE MOON.

First quarter occurs at 8 A. M. on the 5th, full moon at 6 A. M. on the 13th, last quarter at 8 A. M. on the 21st, and new moon at 2 A. M. on the 28th. The moon is nearest us on the 27th, and farthest away on the 14th. She is in conjunction with Mars on the 4th, Saturn on the 8th, Jupiter on the 17th, Venus on the 26th, and Mercury on the 28th.

Princeton University.

SCIENCE NOTES.

Some interesting photos and particulars of huge gorillas hitherto unknown have been obtained by M. Eugene Brusseaux, a French official and explorer from Northern Africa. One of these huge monsters was shot by one of the official's sharpshooters. The animal measured 7 feet 6 inches in height, was 4 feet in width across the shoulders, and weighed 720 pounds. One of the hands when dismembered weighed 6 pounds. It required the united efforts of eight native soldiers to drag the corpse of the beast from the point where it was killed to the French residency at Quessou, the administrative center of Central Sangha. The animal was here skinned and buried. Reports have been received at this station frequently during the past few months of the presence of these huge monsters in the upper valleys of Lonani and Sangereh, but hitherto it had been impossible to come to close quarters with them. According to native reports, however, the animals are unusually ferocious, not hesitating to attack caravans during their passage through the country. The beasts differ essentially from the gorillas familiarly known. The ears are small, the shoulders and thighs are covered with dense and long black hair, while the chest and stomach are almost bare. It is believed that they belong to a species that has not heretofore been known.

The action of ultra-violet rays upon glass has been observed by Franz Fischer, a German scientist. In order to make the researches, he uses a mercury arc contained in a quartz tube as a source of the rays. Samples of different kinds of glass are placed quite near the tube, separated from it by a very thin layer of air, or the air can be replaced by hydrogen. By using a water-cooling device the apparatus is not allowed to become unduly heated. This precaution is not always needed, however. He uses a low tension of 18 volts on the arc. Under these conditions he exposes eight samples of glass to the light of the arc. Four of them are not acted upon, and remain colorless. The other four take a strong violet color at the end of 12 hours. The color can be seen at the end of 15 minutes exposure. Upon analyzing the samples of glass it is found that the ones which are colored all contain manganese, while in the other specimens it is absent, or nearly so. These results seem to explain the phenomenon which was observed by Crookes, who observed that pieces of glass exposed to the sun at an altitude of 12,000 feet at Myni, Bolivia, took a violet color by degrees. At this altitude the sun's light contains a large proportion of ultra-violet rays which act upon the manganese salts of the glass and cause the violet coloration. It is found that the color quickly disappears when the glass is heated to the softening point. Then when it is cooled and again exposed to the mercury arc, it takes the violet color, as before. That it is only the rays of short wave-lengths which produce the color is proved by placing a sheet of mica over the glass, and in this case no color is formed. The mica itself is not colored in this case.

Researches on Radium and Radio-activity.—In a paper read before the Société des Ingénieurs Civils M. Besson explains the method by which M. and Mme. Curie were led to discover new radio-active bodies in the ores of uranium, and reviews the preparation of radium, the composition of the Becquerel rays emitted by radium, and the demonstration of MM. Curie and Dewar that radium is converted into helium; and finds in this decomposition the source of the energy of radium. He holds that the decomposition for bodies of light atomic weight would be general; uranium would be converted into radium, then into helium; thorium would be converted into argon. He states that the ores recently discovered in the Department of Saône-et-Loire are pyromorphites, probably rendered radio-active by emanations proceeding from dissolution in water of the phosphites of uranium found in the same lands. The simplest process for search is that of photographic plates. It is sufficient to pulverize the ore believed to be radio-active, to put it in a cup and leave it for twenty-four hours, well surrounded with black paper. By comparing the marks produced by a small parcel of the uranium metal with those produced by the ore supposed to be radio-active, it is easy to ascertain whether this contains radium or not.