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 "

The combined subscription rates and rates to foreign countries will be furnished upon application.
Remit by postal or express money order, or by bank draft or check.
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