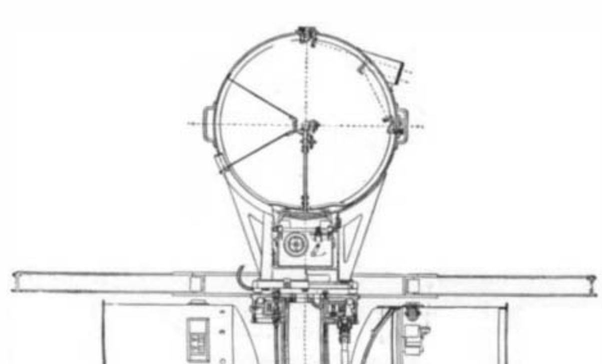
After the English company abandoned the construction of the northern tunnel in 1891, it was allowed to fill with water. When the work was taken in hand by the present company the tunnel was pumped out, and it was found that with the exception of some 470 feet, the work already done was in good condition. This was in the latter part of 1896, and from that time until 1902, when orders were given to proceed with construction, the tunnel was regularly pumped out and maintained in good condition. A new building was erected at the Jersey shaft, equipped with a very complete power plant, including hydraulic pumps and air compressors, etc. The shield which was used by the English company was overhauled and is being used in completing the north tunnel. It was designed for use only in silt, and as the tunnel has now reached a point where rock and boulders are encountered in the lower half of the excavation, it has been found necessary to build a heavy apron, extending 6 feet in advance of the upper half of the cutting edge of the shield, and reaching from side to side of the shield. This apron is built of 12-inch I-beams and ¾-inch steel plates, and it is strongly braced. Under the shelter of this apron, which is heavily shored up, the workmen are able to pass forward of the shield and drill and blast out the rock below it. This work is unique in horizontal shield excavation, and so far it has been carried forward with complete success.

The method of operating the hydraulic shield is so well known as to need no detailed description here. It is forced forward into the silt by means of hydraulic rams which are set up between the front edge of the completed iron lining of the tunnel and the rear edge of the shield. As it moves forward, the silt is squeezed through open inlets into the interior of the shield, where it is broken off, loaded into trucks, and drawn away from the heading by a cable. The finished tunnel is divided into three lengths by two air locks, one of which is shown in our accompanying engraving. It should be explained that the lower half of the tunnel, at the point where our picture is taken, was filled with excavated material from the heading, on which the two tracks are laid. Ultimately this material will be taken out and the full diameter of the tunnel exposed. In our engraving the two trolley tracks are clearly shown, together with the doors by which the cars pass through the air-tight diaphragm. Another of our engravings was made from a photograph taken in the rear of the shield at the present heading. In this case the material has been entirely removed, showing the full diameter. The two tracks shown are merely narrow-gage working tracks for the contractors. Ultimately, of course, a single track will be laid for the operation of trolley cars. The cable-hauling system is built in three sections, separated by the two air-locks. The first of these, which is 1,575 feet in length, extends from the Jersey shaft to the first air-lock; the second, 1,660 feet long, extends from the first to the second air-lock, while the third section reaches from the second air-lock to the working face. The cables are driven at a speed of 300 feet a minute and are capable of handling 300 tons of excavated material in every ten hours. One of our engravings represents a profile taken across the North River in the plan of the north tunnel. The completed portion of the tunnel is shown by light shading, while the darker shading shows the amount, about 800 feet, that has yet to be excavated.

TRUNKS AND LIMBS OF TREES GNAWED BY BEAVERS.

On the south tunnel new air-locks have been installed, the necessary machinery is being built, and it is probable that the actual construction of the tunnel will be taken up again in the fall of the present year. The shield for this work, which was designed by Jacobs & Davies, engineers of the company, is shown in the accompanying engraving. It will be seen that it is divided by one horizontal and two vertical frames and by transverse diaphragms. The shell is double and the whole construction is calculated to give great stiffness and resistance to distortion. It is provided in front with a movable working platform which, if necessary, may be carried forward of the cutting edge. In the rear it is provided with the necessary hydraulic jacks, valves, etc., for carrying forward the shield and for swinging the erector—a massive arm which moves something like the hands of a clock, and is used for picking up the cast-iron plates and placing them in position ready for bolting up. It is interesting to know that in spite of the difficult nature of the material through which the tunnel is now being driven, there being rock below and soft silt in the upper half of the tunnel, progress is being made at the rate of between 4 and 5 feet a day. The work is rendered particularly hazardous by the fact that there is a hydraulic head due to 65 feet of water, and that there is only 10 feet of soft silt between this hydraulic pressure and the roof of the tunnel. The successful financing of the company was completed through the efforts of Mr. William G. McAdoo, the president, associated with a few trolley capitalists, and to him we are indebted for the facts given.



SECTIONAL VIEW OF HELIGOLAND LIGHTHOUSE PROJECTORS.

MODERN SEARCHLIGHTS.

BY FRANK C. PERKINS.

(*Continued from first page.*)

carried to an extreme. Undoubtedly one-tenth of a second is sufficient to make the maximum impression on the eye, when the light is brilliant. But with a hazy atmosphere, and the light much diminished, it is doubtful whether a longer duration should not be allowed. The experiment will be watched with great interest, both on account of the bold deviation from the ordinary plan which has been so long followed, and also on the ground of economy, which is claimed for the new method. It is stated that on the first night of trial the light was seen at the pier at Büsum, a distance of 40 miles, which in itself seems sufficient to clear away all doubts of the visibility of a flash of short duration.

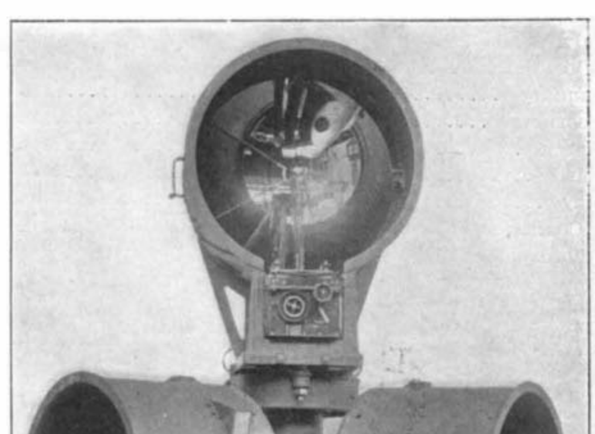
The front-page illustration shows a Schuckert searchlight with an Iris shutter, half closed, which has a diameter of 6 feet 6 inches and throws a beam of light of 316 million candle power. This search light is electrically controlled by two levers, one of which controls the motor mounted in the base of the searchlight which operates the projector in a vertical direction through a train of gears, and the other starts or stops the electric motor which controls the horizontal movement of the beam of light. The Iris shutter is used in order to make the projector perfectly light-tight at any moment desired, and it operates similarly to this type of shutter as applied to modern cameras. The leaves of the Iris diaphragm slide within a fixed diaphragm located in the axis of the ray of light and provided with a fold. On some of the German searchlights an apparatus known as a "double disperser" is provided, in order to convert concentrated light rapidly into diffused light. This arrangement consists of two parallel systems of cylindrical lenses, which may be slid against one another, whereby the angle of dispersion of the emitted ray can be varied at will. By means of this apparatus the angle of dispersion of the light can be varied within limits of from 2 degrees to 45 degrees if desired.

THE BEAVER AS A DAM-BUILDER.

A remarkable beaver dam has lately been discovered near Stroudsburg, Pa. The work of the animals is so extensive that it seems almost incredible they could have built the dam in question, but this is proved by the evidence of residents of the vicinity, who are strictly reliable.

The dam in question was discovered about two years ago, by a farmer living near its site. It is located in a swamp, which for many years had been drained of its surface water, except in a few spots. Noting that most of the swamp was under water, although but little rainfall had occurred, the curiosity of the farmer was aroused, and he made an investigation which led to the discovery. The dam has been constructed around the northern edge of the swamp, extending in a zigzag course, evidently to avoid obstruction, and to increase its strength. It is about 125 feet in length, and the top is wide enough for a man to walk upon, without difficulty, ranging from a foot to two feet in width. At present the top is about three inches above the surface of the pond which has been created by the dam, the water being from two to four feet deep.

The farmer who made the discovery at first thought that the work had been done by boys for sport, but noticing the footprints of animals upon the top of the structure, he followed these, and found some pieces of wood, which apparently bore the marks of an animal's teeth. The wood was taken to a naturalist who resided in the vicinity, and after careful examination the latter pronounced the marks to be from beaver



PROJECTORS OF THE HELIGOLAND LIGHTHOUSE.

teeth. Further investigation in the vicinity showed that the animals had felled a number of trees near the dam, to use in its construction. The largest pieces yet found in it are 8 inches in diameter by actual measurement. The principal material used, besides branches and twigs, was mud, which had been deftly worked into it so solidly that a man weighing 235 pounds has walked upon the top without affecting it.

The wood which has been used includes beech, white ash, and oak. In cutting the trees, the animals worked in a circle around the trunk, making deeper indentations on the side toward the dam so that the trees would fall into the water in the proper direction. Judging by the size of the marks found, it is believed that some of the beavers are unusually large animals, but there have been only two or three seen since the dam was constructed. The discovery has aroused such interest that many naturalists have since visited the locality. Their belief is that the swamp has been "beaver ground" for many years, and that here has existed one of the very few colonies of these animals in the northern part of the country. The swamp is owned by Judge Edinger, of Stroudsburg, who has been making a study of the dam since it was located. So interested has he become that he will allow no one to attempt to trap or shoot the animals, and, with the aid of the Zoological Society of Philadelphia, has had a State law enacted purposely to protect them.

That Point Reyes Wind Record.

For the last two or three months, accounts have been going the round both of the daily and the technical press, in which it is stated that at Point Reyes, about 35 miles north of San Francisco, the wind recently blew continuously for three days at a rate considerably over 100 miles an hour, and that speeds up to 135 miles have been recorded. It is also asserted that for two years the Point Reyes station has taken the world's record for speed of winds.

The Scientific American has taken the trouble to investigate these statements and is informed by the Weather Bureau that there are no records of "wind velocity of 135 miles having been attained at Point Reyes." From the establishment of the station at Point Reyes Light on March 1, 1889, to the end of May, 1903, the following are the maximum velocities recorded during the several months:

January	75	July	90
February	98	August	64
March	108	September	72
April	84	October	70
May	120	November	82
June	80	December	77

During May, 1903, a very severe storm raged at Point Reyes for a number of days, and for nine consecutive days the wind blew at an average of 52 miles per hour.

Even if 135 miles an hour had been attained by the wind, at this point, still that velocity would not have broken all records in this country. We are assured by the Weather Bureau that one of its stations was in operation at Mount Washington, N. H., from June, 1871, to September, 1887, and that for three months, July, August, and September, the following maximum velocities were recorded:

January	186	July	120
February	168	August	120
March	156	September	116
April	182	October	160
May	128	December	180

Compared with these high velocities the Point Reyes records pale into insignificance.

Death of Dr. Ludwig Mond.

Dr. Ludwig Mond, the well-known chemist, died recently in Rome. Born in Cassell, Germany, in 1839, he was educated at Marburg and Heidelberg. He emigrated to England in 1862, and there introduced his well-known process for recovering sulphur in alkali works. Eleven years later he established the largest alkali works in the world at Winnington, England. He was the inventor of a process for the manufacture of chlorine and of a method of producing gas for heating and power purposes. In last week's Supplement will be found a good description of Mond gas and its manufacture. Dr. Mond also invented a ga battery and a process of making pure nickel. The latter was based on the formation of what he called nickel carbonyl, a chemical compound which he discovered and investigated with Langer and Quincke. The Davis-Faraday research laboratory, now famous throughout the scientific world, was founded by him in 1896. Besides being a scientist of rare parts, Dr. Mond was an art lover, whose collection of early Italian masters is one of the finest in England.

The heaviest train load ever hauled by one locomotive was recently reported. A train of eighty-four loaded cars, weighing in the aggregate 4,787.5 tons, was hauled a distance of 63 miles, at the rate of 13 miles an hour.

Electrical Notes.

The production of aluminium is given in a report on aluminium and bauxite for 1902, by Dr. Joseph Struthers, issued by the United States Geological Survey. The production of aluminium in the United States during 1902 was approximately 7,300,000 pounds, as compared with 7,150,000 pounds in 1901, the sole producer being the Pittsburg Reduction Company, which has large plants in operation at Niagara Falls and at Shawinigan Falls, Quebec, Canada, and is installing a large plant on the St. Lawrence River.

The problem of smelting steel by electricity has for some time attracted the attention of inventors, and many experiments have been made to achieve the desired end. In the beginning of the year 1900 an electric steel furnace, without electrodes, was built at Gysinge, in Sweden, and its action watched with considerable curiosity as to its successful operation. After a few experiments, the first ingot was produced and the steel was found to be of an excellent quality. Thus, the problem was solved in a technical way, although considerable progress was necessary before the process could be considered a commercial success. In November, 1900, a larger furnace was built on the same lines as the first one and proved much more successful than its predecessor. In August, 1901, both furnaces were ruined by fire and the firm experimenting with them decided to build a steel works. This information comes from the Trading and Shipping Journal of Gothenburg, Sweden, and is not as complete, electrically, as might be desired. However, it is stated that in the new works a 300 horse power dynamo, direct-connected to a turbine, will furnish the current. The new furnace will hold 3,970 pounds, and its yearly output is estimated to be in the neighborhood of 1,500 tons if charged with cold, raw material. The steel made under this process is said to be of a superior quality, characterized by strength, density, uniformity, toughness and the ease with which it can be worked in cold, unhardened condition, even when containing a very high degree of carbon. Tungsten steel manufactured by this process is said to make stronger magnets than other tungsten steel and does not warp in the hardening. Microscopic experiments have shown that the electrically made steel is not different in any way from crucible steel.

Prof. McKendrick, F.R.S., has been carrying out a series of experiments with a highly sensitive galvanometer, to demonstrate electrical phenomena of muscles, nerves, and heart in certain fishes, which on account of these peculiarities are described as electric fishes. These inhabitants of the seas have the power of giving electrical shocks from specially constructed and living electrical batteries. There are in all about fifty known species of fishes that possess these electrical organs, but only the electrical properties of five or six have been studied in detail. The best known are various species of torpedo, belonging to the skate family, found in the Mediterranean and Adriatic Seas; the gymnotus, an eel found in the region of the Orinoco in South America; the malapterurus, the raash or thunderer fish, of the Arabs, a native of the Nile, the Niger, Senegal, and other African rivers, and various species of skate found in the seas around Great Britain. The electrical fishes do not belong to any one class or group—some are found in fresh water, while others inhabit the sea. They possess two distinct types of electrical organs. One closely relates in structure to muscle, as found in the torpedo, gymnotus, and skate, while the other presents more of the characters of the structure of a secreting gland, as illustrated by the electric organ of the thunderer fish. Both types are built upon a vast number of microscopical elements, each of which is supplied with a nerve fiber. These nerve fibers come from large nerves that originate in the nerve centers, brain, or spinal cord, and in these centers are found special large nerve cells, with which the nerve fibers of the electric organs are connected, and from which they spring. Yet the electricity is not generated in the electric centers, and conveyed by the electric nerves to the electric organ, but it is generated in the electric organ itself. It is only produced, however, so as to give a shock when set in action by nervous impulses transmitted to it from the electric centers by the electric nerves. According to Prof. McKendrick, there are few departments of physiological science in which can be found a more striking example of organic adaptiveness than in the construction of the electric fishes. In these animals there are specialized organs for the production of electricity on an economical basis far surpassing anything yet contrived by man. The organs are either modified muscles or modified glands, structures which in all animals manifest electrical properties. The problem, however, of the evolution of electric organs is the same as that confronting us when we trace the growth in the animal world of any organ of sense, or for that matter of any organ in the body. Whether they are merely the result of mechanical causality or otherwise, Prof. McKendrick contends is too abstruse a problem for the supply of a conclusive explanation.

Engineering Notes.

Prof. Slaby has demonstrated after exhaustive experiments that the surface of the earth plays an important part as a conductor of Hertzian waves, for which many have heretofore regarded the air as the only conductor. He constructed an artificial earth which was immunized from external influence by covering the floor of his laboratory with zinc. He then experimented with waves on the floor until his theory was proved.

A recent test of Low Moor staybolt iron, made by one of the leading American railroad companies, gave the following excellent results. Three specimens were tested and the average figures were: Tensile strength, 51,020 lbs. per square inch; elastic limit, 29,656 lbs.; elongation in 8 in., 30.58 per cent. All of the test pieces passed the bot and cold bending tests. The chemical analysis showed: Silicon, .074 per cent; phosphorus, .083 per cent; iron, 99.43 per cent; carbon and manganese, traces; sulphur, none.

Some interesting experiments have been carried out with a new monorail system devised by a French engineer, M. Devic. The inventor has built a model upon the scale of one-tenth of what the actual train is to be, and with this he has attained a speed of 13 miles an hour. The train is to be propelled by electric power, and in order that high speed may be attained, the inventor relies upon two factors—diminution of weight and a more effective grip of the driving wheels upon the single track of the railroad. The inventor claims to have designed a rail which will afford the wheels sufficient grip irrespective of the weight they may be supporting. Further experiments with a much larger model are to be carried out at Nemours to prove the utility and advantages of the system. M. Devic is sanguine of attaining a speed up to 200 miles per hour.

So much persistent effort has, in recent years, been expended in cutting down boiler and engine weights on warships—and not always for the best of the service—that to the naval engineer there must be a good deal of satisfaction in reading a recent paper presented to the Institution of Naval Architects by W. H. Whiting, Assistant Director of Naval Construction of the British Navy, dealing with "The Effect of Modern Accessories on the Size and Cost of Warships." The substance of Mr. Whiting's paper is that there are a hundred and one different ways, and many of them not very useful ways, in which the weight of a modern warship has been increased. Few of them have anything to do with the propelling power of the ship, and all of them might be carefully scrutinized and revised with the certain result of advantageously lightening the ship by a great many thousands of pounds. The fondness for unnecessarily heavy brass fittings of all kinds, for example, has often been mentioned as one of the things which might well be restricted, and while this is only a little thing in itself, it is the little things which count severely in the aggregate. Take so insignificant a matter as paint, for illustration! Mr. Whiting says that one who has not the records before him may well be incredulous at the enormous weight of paint worked into a ship. The most serious feature is that the process never ceases, and the greater the pride in the ship, the greater the tendency to sink her with white lead. He mentions a case in which there was removed from the inner surface of a portion of the crew space of a destroyer paint of a weight of over two pounds per square foot. This is, no doubt, exceptional; but it may well be questioned whether all officers realize how, by a rigid economy in paint, they may not inappreciably benefit their ship. A curious development, further, has been the desire for screw gear on board ship. Not merely in rigging, but in many fittings, such as awnings, ridge-ropes, guard-chains and ropes, and in the securing of all kinds of gear, lashings have given place to screws and slips, which not only add directly to the weight, but impose greater strains on the fittings. The screws mean bigger awnings, bigger stanchions, and so on.—Cassier's Magazine.

The Current Supplement.

The London correspondent of the Scientific American begins the current Supplement, No. 1442, with an article in which he describes the method by which London's "tubes" were constructed. Dr. Charles Minor Blackford discusses the new Cuban telegraphic service. The third installment of the article on the Schroeder contact process of sulphuric acid manufacture comes from the pen of Dr. Charles L. Reese. The recent disaster which occurred on the Paris Metropolitan Underground renders rather timely a description of the details of construction of the tunnel. "Colors for Soaps and Perfumes" is the title of an article which will probably be of interest to the manufacturing chemist. Cyril Davenport tells much that is instructive and interesting on the making of mezzotints. Among minor articles may be mentioned those which describe the arduous work of the expert train dispatcher, totemism, pearls of western Europe, underwriters' laboratories, and the cultivation of India rubber trees.