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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.

INCREASING THE NEW YORK WATER SUPPLY.

If the citizens of New York understood that the margin between the city's present consumption of water and the minimum flow of the Croton River as recorded in past seasons of drought was of a negative character, the consumption exceeding the supply, they would surely be less extravagant in the use of water, and would make a decided effort to stop the serious waste which daily occurs. Meanwhile the Aqueduct commissioners, pending the construction of the great system of storage reservoirs, which has recently been the subject of favorable action by the New York State Legislature, are rushing the preliminary work for the construction of a new reservoir in the Croton watershed, which will have a capacity of ten billion gallons of water. The new structure, which is to be known as the Cross River reservoir, will impound the waters of a tributary of the Croton River, the area of whose watershed is about thirty square miles. Another dam, to be known as the Croton Falls reservoir, with a capacity of twenty billion gallons, will be located below the Cross River reservoir, and at a point below the junction of the east and west tributaries of the Croton River. These two works will add, therefore, a total of thirty billion gallons to the present total capacity of the various Croton watershed reservoirs, which in the aggregate amounts to sixty-six billion gallons. Although this represents an increase of about 45 per cent, it is a fact that with the new reservoirs completed, the total capacity of the system, in dry years such as have been known, would merely give a safe margin over the present daily consumption of 300,000,000 gallons.

Of the two new reservoirs upon which New York city will have to depend to tide it over until the great reservoirs in the upper Hudson district are completed, the Cross River reservoir is ready for bids, and the Croton Falls reservoir will be in a similar condition during the autumn. The Cross River dam, which will have an extreme height of 150 feet and a length of about 900 feet, will be constructed of cyclopean masonry with a facing of large concrete blocks, the latter having been adopted because they will represent a saving of $250,000 in money, and probably a considerable amount of time; for the securing of cut facing stone in sufficient quantities is in such work always a possible source of delay. During construction the river will be taken care of by two five-foot steel pipes, which will extend through the dam. There will be 248,000 yards of excavation to be done before the rockwork is commenced. In the dam itself there will be 132,000 cubic yards of cyclopean masonry and 6,000 cubic yards of monolithic concrete facing blocks. Some 870 acres will have to be cleared in the bed of the reservoir itself.

Since the element of greatest importance in the construction of the dam, next to its security, is the question of time, the chief engineer, Mr. J. Waldo Smith, is applying to it those methods of construction which enabled him to complete the Croton dam so rapidly. In the first place, on both the upstream and downstream sides of the dam, broad timber trestles will be constructed, to accommodate the railroad tracks that will bring the material to any part of the site. Within the structure of the dam will be built up a series of steel derricks, of the same kind as those used in completing the Croton dam, which were illustrated in the Scientific American of September 24, 1904. These towers will be inclosed in the masonry of the dam, as the latter is carried up. Three of these towers, 50 feet in height and 25 by 50 feet in plan, will be erected at intervals along the axis of the dam, and each will be equipped with four derricks. When the structure has been built up to a height of 50 feet, five other towers of the same dimensions in plan, and from 20 to 30 feet in height, will be erected, so as to enable the whole length of the dam to be served by the thirty-two derricks which shall be thus available. When the dam has been carried up to the top of these towers, or say to a height of 80 feet, the remaining portion will be built from wooden towers, each carrying one or two derricks, which will be built on the big trestles referred to, which will extend parallel with the face of the dam. The great success which attended this system of construction in the work of completing the Croton dam, is a guarantee that the new Cross River reservoir will be built with unusual rapidity. It is probable that the additional storage of ten billion gallons of this reservoir will be available by the autumn of 1907, and that by the summer of 1908 the Croton Falls reservoir will also be in operation. The total storage capacity of the Croton watershed will then be nearly one hundred billion gallons. Were the rainfall in the Croton watershed uniform from year to year, there would be no cause for anxiety for years to come. It is the possibility of a repetition of certain periods of light rainfall that makes the rapid execution of these two dams an imperative necessity.

THE WARSHIPS OF THE FUTURE.

As the ally of Japan, Great Britain is probably in possession of the facts as to the behavior of the ships and general war *matériel* of the Japanese navy in the present war; and hence the naval programme for the present year, as far as it has been made known by the British government, may be accepted as embodying, in the distinctly novel features of the ships to be laid down, many of the lessons that have been learned. These changes are exactly those which the Scientific American has predicted would be brought about as the result of the war, namely, a great increase in gun power, and a corresponding increase in speed. Dealing first with the battleship (the foundation upon which a navy is built up, and around which its various elements are gathered) we note that the British Admiralty are to lay down a vessel which, if it proves to be satisfactory, will become the standard type of battleship for probably a decade to come. In the first place, the speed is to be that which only a few years ago was the standard speed for armored cruisers, namely, 21 knots an hour. This would be a remarkable battleship speed, even if sacrifices were made in the armor protection and the batteries; but as a matter of fact, in spite of the high speed adopted, the ship will be considerably larger and more powerfully armed than any battleship built or building to-day, exceeding even the "Lord Nelson" type of last year, which on a displacement of 16,500 tons is to carry four 12-inch and ten 9.2-inch guns.

The new ship will mount a battery of ten 12-inch guns, each of which will have a muzzle energy of about 50,000 foot-tons. All of these guns will be carried in turrets upon the main deck. There will be no intermediate battery; but for defense against torpedo-boat attack, the new ship will be fairly alive with high-velocity 3-inch guns, of which she will probably carry not less than two or three dozen. Steam will be supplied entirely by water-tube boilers, and she will be driven by Parsons steam turbines of 23,000 horse-power. The embodiment of such speed and gun power necessarily implies a great increase in the displacement, which in the new-type ship will be not less than 18,000 tons. The great powers of attack of this vessel can be best understood by a comparison with the two next most powerful battleships in the world, the British "Lord Nelson" and our own "Connecticut"; for while the total energy of a single broadside from the "Connecticut" is 297,000 foot-tons, and that of the "Lord Nelson" 312,000 foot-tons, the seven 12-inch guns of the new battleship which can be brought to bear on either broadside will have total muzzle energy of about 350,000 foot-tons. This is the energy at the muzzle; but since the big gun holds its energy longer than the smaller gun, it follows that at the long battle ranges at which the engagements of the present war have been fought, say three to six miles, a broadside from the new type of battleship, if every shot got home on the enemy, would have about 70 per cent more striking energy than the broadside of the "Connecticut," and about 30 per cent more than that of the "Lord Nelson." Furthermore, because of her excess of speed of about three knots an hour, she would have the "weather gage," and could choose the distance and the position that would be most favorable to herself.

A similar increase in speed and power is to be made in the new design of British armored cruisers, of which four are to be built. With their turbine engines, they are expected to realize a speed of 25 knots an hour. As in the battleships, the 6-inch gun will disappear, and with it the port or casemate method of mounting the gun; and a powerful armament of ten or twelve 9.2-inch guns will be carried on the main deck, all of them within turrets. Like the battleship, these vessels will have the weather gage of any armored cruisers afloat on the high seas; moreover, as the 9.2-inch gun is to be 50 calibers in length, its high velocity and great carrying power will render these armored cruisers a match for many of the smaller and older battleships, that are armed with short-caliber 12-inch guns. One of these 25-knot cruisers could, for instance, circle around the battleship "Iowa," at a range at which the chances of scoring a hit with the low-velocity 12-inch guns on that ship would be rather remote, and because of the flat trajectory of her own 50-caliber 9.2-inch guns, she would be capable, did she carry first-class gunners, of placing her shots with telling effect. Just here, as showing the rapid strides made by modern gunnery, we may mention that the 9.2-inch 50-caliber gun of this cruiser has about the same muzzle energy as the 35-caliber 12-inch gun of the "Iowa," and of course a much flatter trajectory. These four armored cruisers will constitute a squadron, whose 25-knot speed will enable them to refuse battle to the modern battleships; close with any battleships armed with 30 or 35-caliber pieces, and, by virtue of their long-range guns, have the battleships at a great disadvantage.

In the new British destroyers, an even greater relative increase in speed is proposed. Two classes are to be built, one for work off the coasts, and the other for duties on the high seas. As in the case of the battleship, a type vessel, to be followed by others if it proves satisfactory, will be built, and the estimated speed, with turbine engines, is 36 knots an hour. This speed is to be no mere racecourse achievement, run over a measured mile under favorable conditions; for the 36 knots an hour trial speed must be maintained over a distance of nearly 300 knots, or for a period of eight hours' continuous steaming. Five destroyers will also be built which must maintain a speed of 33 knots an hour for a period of eight hours. The coast destroyers, of which a dozen are to be constructed, are to have a speed of 26 knots an hour.

It is significant that in this programme there is no mention made of the building of cruisers of the unprotected class, and herein the Scientific American finds a further verification of its stated belief that the torpedo-boat destroyer will grow in size, until it has rendered the unprotected cruiser or scout a superfluous type. The new 33-knot ships will probably be of not less than 1,000 tons displacement, and will combine in themselves the qualities both of the scout and the destroyer.

EYE-STRAIN AND HOW IT CAN BE RELIEVED.

In a recent number of the Journal of the American Medical Association, Dr. Lewis S. Dixon, of Boston, makes some interesting observations in regard to the above-named topic. He calls attention to the fact that the eye has always been studied simply as a part of the body, under physiology, and contends that it needed to be studied as an optical instrument, under optics, a branch of science in which our knowledge is mathematically accurate. The usual explanation that eyes are naturally weak and may be rested by an avoidance of work is declared to be erroneous, and the conviction is expressed that no organ of the body should fail to perform its own particular function or show difficulty in its performance unless something is out of order. The proper thing to do, according to Dr. Dixon, is not to give up its use, but to find the trouble, to correct it if possible, and to restore the organ to usefulness.

The writer informs us that the eye varies as much as everything else in the human body. "Each person," he states, "is born with his own pair of eyes; sometimes they are correct, oftener not so. Often they are not alike and cannot work together properly." Vision is corrected by the ciliary muscles, which are made to work; but when they are overtaxed, they are liable to exhaustion and this, in turn, gives rise to serious consequences. It is found to be an actual fact that eye-strain is often the principal factor producing nervous debility, hysteria, melancholia, vertigo, nausea, insomnia, nervous dyspepsia, palpitation of the heart, general nervousness, irritability, faintness, weariness, headaches, constipation, and dozens of other annoying conditions.

Eye-strain, the author maintains, is a permanent waste of nervous energy in correcting the slight congenital and permanent errors in the shape of the eyes. This waste is not felt by a strong, healthy system, but is ready to become a decided tax whenever the system gets below par, and its effects are intensified immensely by continued close work.

When once the muscles have been taxed to the point of exhaustion, and nervous reflexes or disturbances set up elsewhere, then any effort to force the eyes to continue their work may cause actual physical damage requiring a long time to repair. It is like the breakdown that comes from overwork in any other way—repair is slow and sometimes never perfect.

Now that the cause of eye-strain is known, we have the choice of two methods of relief—we may remove the conditions that make it a burden, or we may correct, but not remove, the cause.

Theoretically, the doctor insists, glasses should be worn constantly since the errors are fixed, but if the eyes can once learn how to rest, they are usually able to bear their overwork a fair share of the time without bad results; but they must have rest, and at frequent intervals.

The dislike to wearing glasses is so great and universal, the reason for wearing them so little understood, and the temptation to the oculist to avoid forcing such an unpleasant remedy on his patients is so strong, that they have been worn generally for close work only, or for temporary relief, and as little as possible. But if glasses are needed at all they are really more beneficial when worn for resting or distant vision than for close work; but that is exactly opposite, the author tells us, to what people wish to do or find agreeable. Too many people decide to follow their own inclination, but are sure to find later that the cost of so doing is much greater than they had expected.

Glasses do not do a bit of the work the eyes ought to do; they simply correct imperfections. In conclusion Dr. Dixon states that, contrary to the general idea, sharp, clear sight, so highly prized and the boast of many, is not the proof or the test of a good eye; for many who have the keenest vision cannot use their eyes much or with any comfort. Easy vision, he maintains, vision that can be used and enjoyed freely, without thought or fatigue, is the proper test of a good eye.

ELECTRIC WAVES AND LIQUIDS.

An Italian scientist, Prof. V. Buscemi, has recently made a series of observations in order to determine the transparency of liquids for electric waves. For such experiments it is necessary to have a very sensitive apparatus for detecting the waves and making the comparative measurements. The author used an apparatus which is based, like Prof. Fleming's, upon the magnetization of iron by the action of the electric waves, but here he uses a galvanometer instead of a telephone. To produce the waves he places the oscillator in an iron case provided with a copper cover. In order to have a complete metallic continuity of the case, the border of the cover has a flange form and dips into a circular groove containing mercury. In one of the sides of the case is a two-inch opening, over which he can dispose a glass tank some 0.25 inch thick. The latter is fixed to the case by a lead cement which is found to be entirely opaque to the electric waves. In this way none of the waves can leave the case without passing through the liquid contained in the tank. By this arrangement Prof. Buscemi found that among the liquids which absorbed the electric waves, the acids occupy the first place, as their absorbing power is greatest. Distilled water is much less transparent than air, and the latter is less so than vaseline oil. A solution of salt (one per cent) is opaque when in a thin layer, also sea water which contains some three per cent of salt. Ether, benzine, and petroleum are more transparent than distilled water, but less so than air.

RECLAMATION WORK IN SOUTHERN CALIFORNIA.

BY C. J. BLANCHARD.

The American Riviera, that beautiful valley in southwestern California in which nestles the delightful city of Los Angeles, is confronted with a perplexing problem. It is a question of water supply to meet the increasing needs of a community growing with remarkable rapidity.

The cultural development and rapid increase of population in the valleys are limited by the available water supply. As far back as a quarter of a century this supply was fully appropriated, and underground sources began to be drawn upon. To-day these wonderful reservoirs, hidden deep in the earth, which the optimistic westerners had come to regard as inexhaustible, are showing signs of giving out. Within ten years the artesian areas in which flowing water is or has been found have shrunk from 375 to 250 square miles, a loss of 33 per cent. The conditions naturally occasion grave concern, for it is recognized that upon the regulation of the acreage which safely may be supplied with underground waters for irrigation, depends in a large measure the future greatness of these coastal valleys.

Several years ago the United States Geological Survey began a systematic study of the peculiar conditions in this district, and very interesting and important data have been collected concerning the geologic and hydrographic features. The people of southern California are squarely facing these problems, and a determined effort on their part is being made to bring into this section new and distant water supplies, not only to provide for present conditions, but to meet fully the needs of the future. Distant watersheds are being examined, and plans for lifting streams from their present beds and carrying them over and through mountain areas, at a cost of millions of dollars, are being discussed in a manner thoroughly characteristic of this progressive people.

Historically, southern California offers one of the most interesting chapters on irrigation to be found anywhere in the arid West. It was during the period when our nation was yet in embryo, before Boston's tea party and the Declaration of Independence had startled the great monarchies of the Old World, that the mission fathers in this far-off valley on the Pacific slope began to teach the Indians the gentle art of husbandry. Coincident with the establishment of the Church, the cultivation of the soil by irrigation was undertaken. With the aid of the Indian converts stone dams were thrown across some of the streams, lines of canals were constructed covering wide areas, and even pipe lines made of burnt tile and mortar were utilized to make tillable the stubborn glebe.

When the American pioneer came to California, attracted by the discovery of gold, he quickly noted the abundant crops of the missions which followed irrigation, and it was not long before many of the abandoned mining ditches were utilized for agriculture.

Early in the sixties of the last century there began an era of substantial development, with works of more permanent and enduring character. By 1880 so precious was the water found to be, and so abundant the rewards following its application to the soil, that practically the entire flow of the streams was diverted and utilized. Stimulated by the very high values of the California citrus lands and the small acreage under irrigation compared with the irrigable area, a thorough investigation was begun of all the possibilities for water development.

The physiographic features of the valley are varied and interesting. The San Gabriel and San Bernardino mountains, which constitute the northern and eastern boundaries of the valley, intercept the moisture-laden clouds from the Pacific. The precipitation on their western slopes forms the perennial streams, the diversion of which has made possible the high state of cultivation that has given some of the orchard lands values of from $500 to $2,000 per acre. Owing to the steep slopes of the mountains, and to the fact that the greater part of the annual rainfall occurs during winter storms of short duration, there has always been a heavy loss of water through floods. The narrow river canyons offer slight opportunity for storage, and but few projects of this kind actually have been constructed.

These valleys and plains are not normal, but are made up of a series of deep filled troughs separated by ridges, which rise higher and higher toward the interior. These troughs and their separating ridges have been formed by geologic processes. The rivers, having existed before the geologic period which created the troughs and ridges, have maintained their way across them from the higher mountains to the sea, cutting their channels through series of ridges and filling the intervening basins with sands, gravels, and clays. As the streams emerge from the mountain canyons their velocity is lessened, and the heavier bowlders, gathered by erosion, are first deposited. The deposit becomes finer and finer as the streams proceed, until the tiny particles which sift downward form a sheet of impervious clay. These clay caps slope with the streams, and the water percolating through the gravels of the basins accumulates behind them, gathering pressure from the ever-increasing weight of waters, and producing artesian wells wherever the clay covering is pierced. When the underflow encounters the ridge at the outlet of an upper valley, the water is forced to the surface, and flows on to the next basin where, unless diverted, it sinks into another gravel-filled basin. These basins are not only storage reservoirs, but act as effective regulators of the hide-and-seek rivers, protecting them from evaporation and contamination, and producing a remarkable uniformity of flow at the canyon.

The history of irrigation in this valley is one of steady growth and development. Southern California now leads the United States in the diversity of methods of application, in scientific and detailed distribution, and in the expensive character and boldness of design of its irrigation works. All the irrigation conduits are either cement-lined canals or pipes. The irrigation systems in this part of the State are known all over the world. Surface water, drainage water, seepage water, water from artesian wells, from tunnels penetrating the mountains, and waters impounded in reservoirs are alike utilized.

This intensive development was partly the result of a series of dry years which began about a decade ago. The preceding ten years were years of unusual rainfall, and the acreage brought under cultivation was in excess of that which could be supplied by surface streams when the dry period came on. California's most important and valuable crops are perennial plants, citrus and deciduous fruits, and walnuts, and the failure of the water supply for a single season means an enormous loss to the irrigator. The successful installation of the Gage canal system, which was completed in 1886 to cover 7,500 acres of citrus lands, and which furnished a splendid example of the feasibility of utilizing the underground waters, gave an impetus to the development of this source which has been continued until now there are nearly 3,000 wells and about 1,600 pumping plants in operation, representing a capital of approximately $3,500,000, and having a combined continuous flow of from 400 to 500 second-feet. There are few important irrigation systems whose supply has not been augmented during the past ten years by artesian or pumped waters, to make up the deficiency in stream flow.

While the underground reservoirs, which have proven of incalculable value to the irrigators of southern California, are of such enormous extent that they more than compensate for the lack of storage facilities, the fact can no longer be overlooked that the drain put upon them in the past few years has resulted in a notable decline in the water levels. A system of observations upon the fluctuations of ground-water levels is in progress under the direction of the United States Geological Survey, but it will be of increasing value if continued for a period of years. One notable fact has been discovered. The water level has been steadily declining, even in years of normal rainfall, so that the reclamation of virgin lands through the indiscriminate increase in the number of wells is a menace to the present irrigation systems. A series of years of increased rainfall may possibly restore the volume of ground water, but it is an unsafe assumption to make in the absence of scientific records showing this to be a fact.

ENGINEERING NOTES.

Like so many other details not only in marine engineering but in other lines of work, features which are introduced in a practical way in recent times are found to have a comparatively ancient origin. This is true of the water tube boiler, which in its recent use dates from about 1880. The excavations at Pompeii have shown small boilers almost identical in construction with some of the best of our water tube boilers, although they were doubtless only used for a circulation of hot water.

During the official trials of the new turbine steamer "Onward" for the Dover-Calais channel service of the South-Eastern Railroad, a record for this class of vessel was established. The "Onward," which was built by the Messrs. Denny Bros., of Dumbarton, is practically a sister ship to the "Queen," which has been plying upon this route for many months past with complete success. A large number of improvements, however, have been embodied both in speed and comfort. In the mile run on the Firth of Clyde, a mean speed of 22.54 knots was attained. Another noteworthy feature of the trials was the remarkable speed of fifteen and a half knots which was attained with turbines reversed. The "Onward" will be able to cover the distance between Dover and Calais in 45 minutes, which is an acceleration of ten minutes upon the scheduled time of the sister ship "Queen."

Municipalities have a right to insist upon the abatement of black smoke by all users of steam boilers, without regard to the purposes for which the steam is used or the means to be adopted for abatement. This, because smoke is a public nuisance and because it can be abated without hardship to the owner of the plant. Nevertheless, when the evil is present and has been present for a period of years, it is not good policy to be too radical in the enforcement of the statutes. The law should be definite and stringent and the penalties adequate, but they should be enforced with discretion by officials who have some technical and practical knowledge of smoke abatement. It is absurd to talk of putting this matter into the hands of the police or of the health officer. The official having charge of this work should be a trained engineer, if possible a technically educated man, and he should be entirely above graft in any of its disguises.

German papers state that acetylene gas, generated from calcium carbide by the simple addition of water, has not met expectations, which, however, were very great. On account of the ease with which a gas for lighting purposes could be obtained, it was believed that it would be used very extensively, but the boom in the acetylene industry did not last long. New uses for the gas have been looked for for some time. The latest invention is its use as an explosive. By means of an air mixture, explosive force is obtained which can compete with that of powder and dynamite. The explosion takes place in an air chamber and is caused by an electric spark. For this purpose carbide of calcium is reduced to small particles and put into a cartridge, consisting of a tin box. In this the carbide lies at the bottom and above it is a partition filled with water. Above this is a vacant space with the electric percussion device. On the side of the cartridge is an iron pin by means of which the partition between the carbide and the water can be perforated. After the drill hole has been completed the cartridge is placed into it and the hole is closed with a wooden stopper. Then the protruding iron pin is dealt a blow, by which the partition is perforated and the water is caused to come in contact with the carbide, whereby acetylene gas is generated. This mixes with the air of the drill hole. After five minutes the gas is ignited by an electric spark. By this method of blasting the rock is said to be not thrown out but rent with innumerable cracks, so that it can be easily removed afterward. About 1.7 ounces of carbide, which produce about 16 quarts of acetylene gas, is used for each cartridge.—Mines and Minerals.

At the commencement exercises of the Western University of Pennsylvania, the honorary degree of Doctor of Science was conferred upon Dr. Marcus Benjamin, of the United States National Museum, whose name will doubtless be familiar to the readers of the SCIENTIFIC AMERICAN as that of a frequent and valued contributor.