THE TRUCKEE-CARSON IRRIGATION PROJECT.

BY HERBERT I. BENNETT.

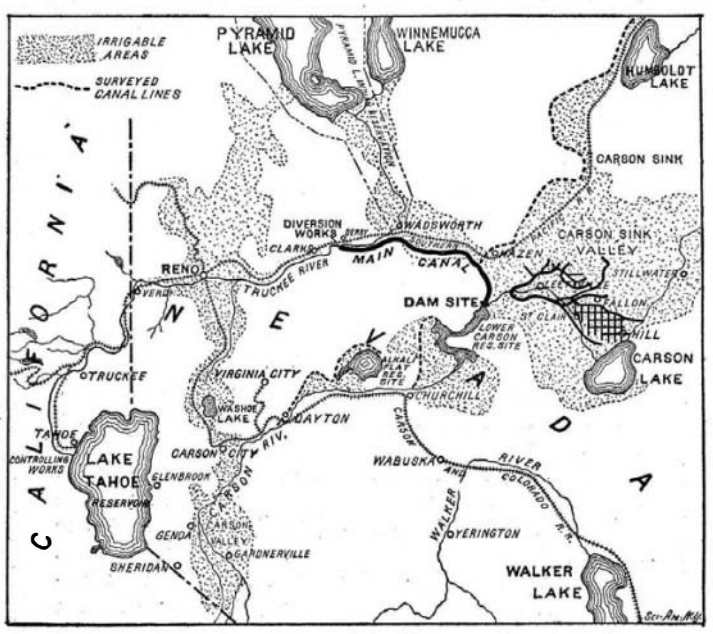
ONSIDERED apart from the fact that it was Bunker Hill Day, June 17, 1905, was an occasion of great moment to the interests of the State of Nevada, for then it was that the immense government irrigating canal known as the Main Truckee Canal, forming part of the Truckee-Carson Project, received its first water from the Truckee River, out in the western portion of Nevada.

The Truckee-Carson Project deals with the utilization, for the irrigation and reclaiming of the adjacent desert region, of the large volume of water flowing to absolute waste through the rivers of western Nevada.

Main Diverting Dam.—The top of the main diverting dam on the Truckee River, 24 miles east of Reno, on the Central Pacific division of the Southern Pacific Railroad, is 4,219 feet above sea level. This dam is 155 feet long between abutments, and at the north end of the dam proper is an earth embankment about 1,000 feet in length extending across the low grounds to the base of the hills and the railroad track. The main diverting dam, composed of fifteen piers, each five feet thick, at right angles to the course of the stream, divides the structure into sixteen openings, or bays, each of which is five feet in width. Each opening is closed by a cast-iron gate comprising two leaves, each being five feet in depth. The regulating gates diverting the water into the Main Truckee Canal are built immediately adjacent to and as a part of the main diverting dam. These gates comprise nine gates of the same type and are operated by the same means as those in the main diverting dam, but the piers separating them, and the arches spanning the openings, are of concrete reinforced with steel girders, the purpose being to diminish the width of the structure. The top of this main diverting dam is 21½ feet above the floor of the outlet gates. The total cost of the concrete main diversion dam and the 31-mile Main Truckee Canal was $1;250,000.

Main Truckee Canal.—The definite location of the Main Truckee Canal, designed to convey water from the Truckee River at the main diversion dam, above described, a distance of 31 miles to the Carson River, was begun in April, 1903. The Main Truckee Canal has a capacity for the first six miles of its course of 1,400 cubic feet per second, and for the remainder of its course of 1,200 cubic feet per second. Thirteen feet will be the uniform depth of water, and the top of banks is 2 feet above the high-water line. The width at the top varies from 24 to 63 feet, the narrow part being lined with Portland cement concrete, and having a heavy grade. Nearly two miles of the canal, exclusive of tunnels, are lined with cement, this being done to reduce the sectional area by diminishing the friction in the heavy rock cuts. Three tunnels lie along the Main Truckee Canal, all of which are concrete lined throughout. The grades of the canal vary from 1 foot in 7,000 feet in the earth sections, to 1 foot in 3,000 in the concrete-lined portions. There are two wasteways, designed for the purpose of emptying the canal quickly in the event of accidents to it, discharging the water back into the Truckee River. Two spillways are located along the canal. In the event of the water getting above a certain depth, the spillways are so arranged as to throw the overflow back into the Truckee River.

Purpose of Main Truckee Canal.—The Main Truckee Canal permits of the union of the Truckee and Carson river waters in the valley of the Carson Sink, where below the Lower Carson Reservoir there are fully 175,000 acres of irrigable sage-brush lands, while there are at least 125,000 acres more at higher elevations, which can be supplied with water from the canal directly. The Main Truckee Canal will discharge its water into the Carson River at the site of the Lower Carson Reservoir, about nine miles west of Leetville, in Churchill County, Nevada. Thence the water flows in the channel of that stream about four and a half miles to the diversion dam at the head of the distributing system. This dam is 225 feet in length, with 23 gates, and is built of concrete and of the same general type as the main diverting dam at the head of the Main



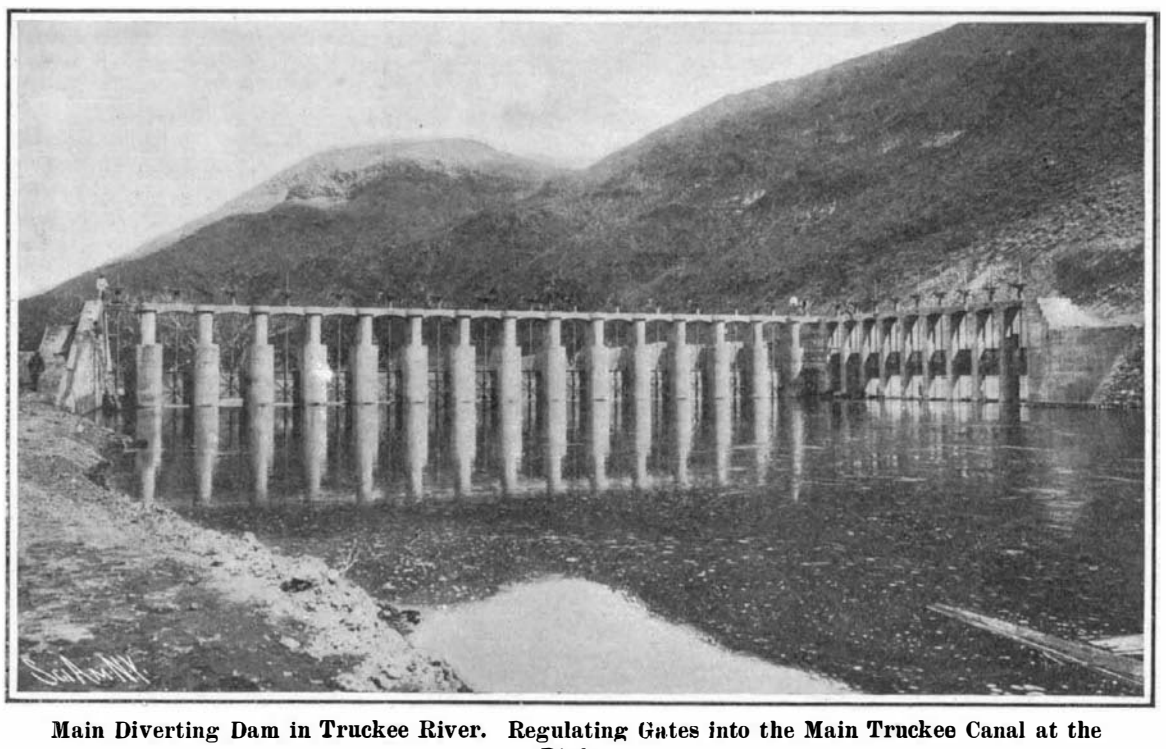
The Truckee-Carson Irrigation Project.

Truckee Canal, already fully described, and it directs the water into two main distributing canals on either side of the river. The canal on the south carries 12 feet of water, the capacity being 1,500 cubic feet per second. The north canal carries 6½ feet of water, with a capacity of 450 cubic feet per second. These two canals are at present completed for a total length of 38 miles, but with their main branches will eventually attain a total length of over 90 miles, while the laterals and drain ditches to be constructed in Carson Sink Valley alone will aggregate fully 1,200 miles. About 250 miles of these have already been finished, and are ready to distribute water to 50,000 acres of land. The extensions of this system in the Carson Sink Valley, completing the initial item and bringing under irrigation not less than 200,000 acres of land, will increase the total expense to about $2,700,000 and consume some two years' time. Further extensions of the Truckee-Carson Project to a total area of approximately 375,000 acres of land, involve the construction of expensive storage reservoirs and costly high-line canals. This work has been planned, however, and as the lands to be immediately watered are being rapidly taken by homeseekers, funds for the completion of the work will be provided by the payments to be made on the water rights therefor. It is estimated that the entire undertaking can thus be completed within nine years at an approximate total cost of $9,000,000. The soil is sandy loam and ashy in the main, and is well adapted to alfalfa, all forage crops, potatoes, onions, beets, and other vegetables; apples, pears, berries, and other hardier deciduous fruits. In the lower part of the Carson Sink Valley the soil is heavier, containing an admixture of clay. It is all valley land, covered with sagebrush and greasewood.

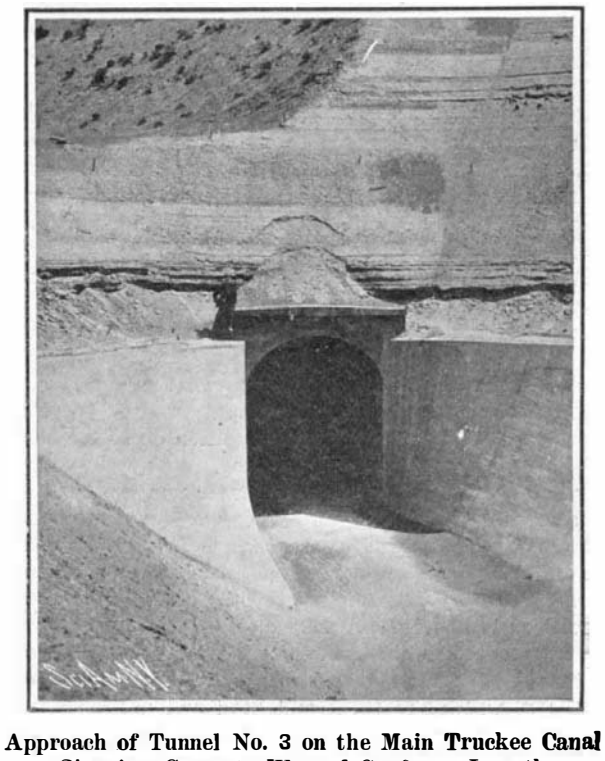
Drainage of Irrigated Lands.—The drainage of irrigated lands is a most important factor. It is necessary to prevent the concentration of alkali at the ground surface and to obviate waterlogging of the soil. The drainage system of the Truckee-Carson Project has increased the cost of the work from $5 to $10 per acre, but the prosperity of the settler depends upon the one about as much as upon the other. Title to the public lands is not given until all payments for water have been made, and lands held in private ownership are supplied with water as desired at the same price and upon the same terms as public lands. The public lands are now open to entry under the Homestead Act, no price being charged for the land, but the cost of irrigation will be assessed against the land as a charge for the water right, to be repaid in ten annual installments without interest, at the rate of $2.60 per annum per acre. This covers the cost of maintenance and operation during the ten-year period and provides for the delivery of water to each farm, and also for a comprehensive drainage system. At the conclusion of the ten-year period, the land and water rights belong to the holders of the land forever, with no further charge by the government. The care and maintenance of the irrigating system then passes into the hands of the landowners, under laws designed for their protection against corporate or individual greed and fraud.

Reclamation Service Plans.—The present plan of the United States Reclamation Service contemplates the diverting of the flood and waste waters of Truckee River, which cannot be controlled, into Winnemucca Lake. It is believed that these waters will be sufficient to keep this lake fresh, but it is certain that they would not suffice to maintain both Pyramid and Winnemucca Lakes, nor would they suffice to prevent the material reduction of the former lake, which has an area of over 235 square miles, and it is understood has been sounded to a depth of about 1,500 feet.

Care of Indians.—Regarding the government care of Indians at Pyramid Lake, in 1904 Congress passed an act providing for the allotment to each and every Indian residing on the Pyramid Lake Indian Reservation of five acres of land, which shall be supplied with water from the government irrigation system, the remaining agricultural land on the reservation controlled by the government canals to be disposed of at a price that will yield a sum sufficient to pay for water rights for the lands thus allotted to the Indians. It can thus be seen that the Indians will not suffer, even though Pyramid Lake does dry up on account of its main artery, the Truckee River, being diverted from it into the



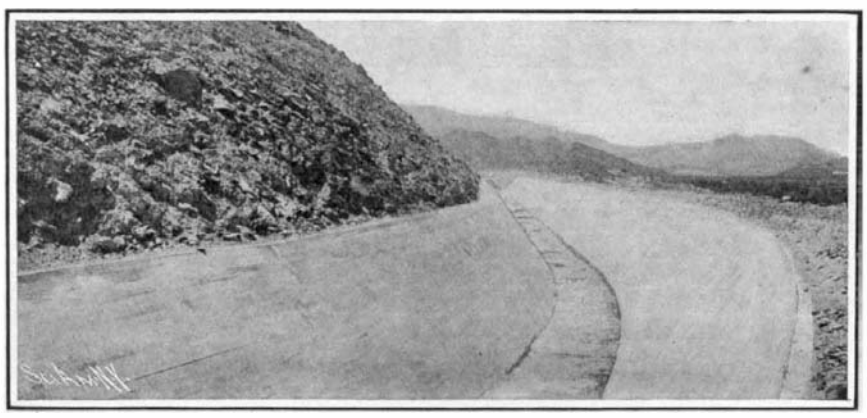
Main Diverting Dam in Truckee River. Regulating Gates into the Main Truckee Canal at the Right.



Approach of Tunnel No. 3 on the Main Truckee Canal Showing Concrete Warped Surface. Length of Tunnel, 1515 Feet.

irrigating canals. It is estimated that it will require over 400 years for Pyramid Lake to dry out, taking its present area and depth as a basis upon which to figure. When the lake runs dry, if it ever does, the Indians will have water from the irrigating system. Therefore there is no cause for alarm over the care of the Indians in the event of Pyramid Lake drying up.

Storage Reservoirs.—Lake Tahoe is one of ten storage reservoirs to be utilized in connection with the Truckee-Carson Project. The elevation of this lake's surface is to be controlled by means of regulating gates placed in the lake outlet, within a range of six feet between extreme high and low water level, this range being about 1½ feet less than the observed extreme range under natural conditions. It is conservatively estimated that by this regulation not less than 200,000 acre feet can annually be drawn from Lake Tahoe for irrigation purposes. The writer of this article is indebted to Mr. L. H. Taylor, engineer of the United States Reclamation Service in charge of the Truckee-Carson Project, for all data covered in the description of the work. Mr. Taylor took the writer over the Main Truckee Canal, explaining the operations carefully during the trip.



A Section of the Concrete-Lined Portion of the Main Truckee Canal.

Musical Insects.

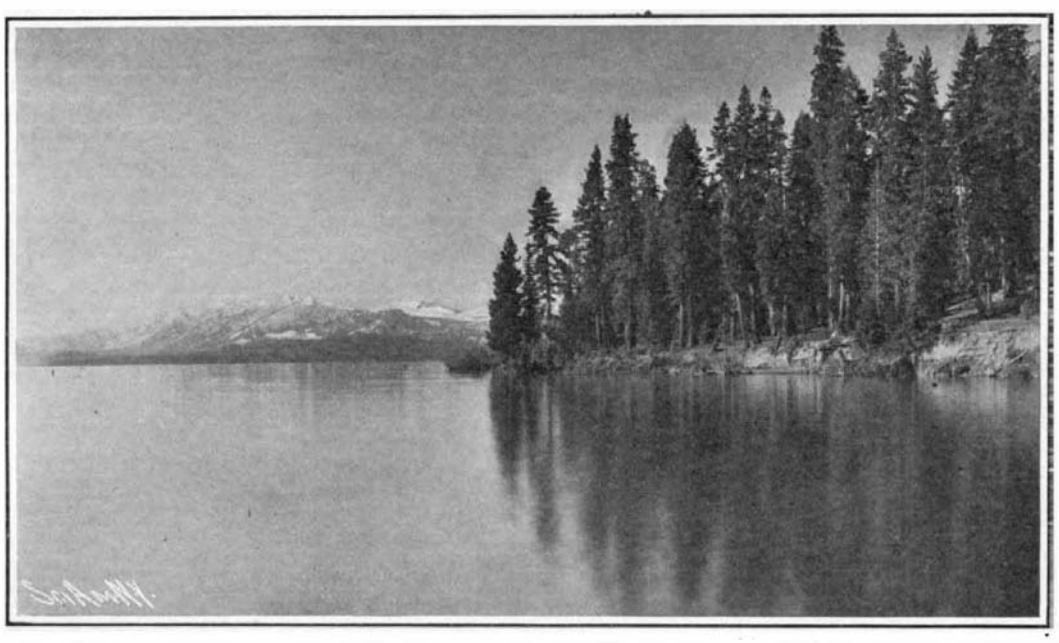
A poet, having once occasion to speak about crickets and grasshoppers, very happily termed them "violinists of the fields," and although at the time he was ignorant of the fact, he stated nothing more than a scientific truth which has recently been demonstrated by exhaustive investigations. Hitherto, naturalists have been devoting a little too much time to the study of actual sounds emitted by insects, rather than the methods by which the musical notes in question were really produced. It is now well known that the throat of insects has nothing to do with the production of such sounds, but that, on the contrary, they all use a kind of "instrument" with which Mother Nature has endowed them for the purpose. Microscopic examination has revealed the fact that in most cases this instrument has a striking resemblance to a rudimentary violin, at least as regards its principle.

Musical insects of the winged type may be divided into two groups: (1) Those which do not use their wings, and (2) those which do, for the production of sounds. Of the two, the latter species is by far the more numerous. A very curious fact in this connection is that all insects are tenors, deep bass voices being quite unknown; in addition to this, the males are always the performers, female insects being dumb—contenting themselves with stopping at home and looking after the children, instead of standing at the front door, singing like their lords and masters. Many insects sing by day, such, for instance, as the chickadee, which, however, are not of the "violinist" type, as they play upon a series of hard plates attached to the abdomen, much in the same way as a Spanish dancer uses the castanets. Another insect of this type is the black field cricket, which has its home in a small cave-like dwelling it prepares in the earth.

Other insects only sing by night, such, for instance, as the domestic and tree crickets, whose regular modulated notes are known to every one. The apparatus used by these insects exactly resembles a violin, the abdomen being partially endowed with small bridge-like edges or ridges against which the wings are rubbed, thus producing the strident note characteristic of the insect. Other insects, such as locusts and their kin, have veritable bows covered with fine ridges and attached to the wings by two button-like growths. Others have cavities covered over with a fine membrane which serve the office of resonators; in almost all insects of this type there is a parchment-like part of the abdomen which acts as a kind of sounding-board. Strange to say, many of these harmonious insects are deprived of hearing; crickets, however, are an exception, as they have sharp ears and cease their vocal efforts at the sound of approaching footsteps. Some insects, although apparently deprived of any means for the production of sounds, are none the less capable of making a noise in the world. A notable instance of this is to be found in a locust rejoicing in the euphonious name of *Microcentrum tetinervis*, which produces a short, monotonous note like two pieces of metal or flint rubbed together.

So far the field of insect voices has not been widely explored. It would be interesting to study them from the point of view of musical notation, and also to determine whether their song alters in any way according to season, hour of the day, age of the insect, and meteorological conditions.

Now is the time for those who are interested in this still unexplored field to keep ears and eyes open, for does not the cricket sing in the fields in the genial summer months? The proper study of mankind is man, we are told, yet methinks time would often be better employed in studying some of the members of the humbler walks of life upon which the Creator has showered just as much love and attention, in many cases to better purpose and a truer "at-one-ness" with Nature than can be found in man.

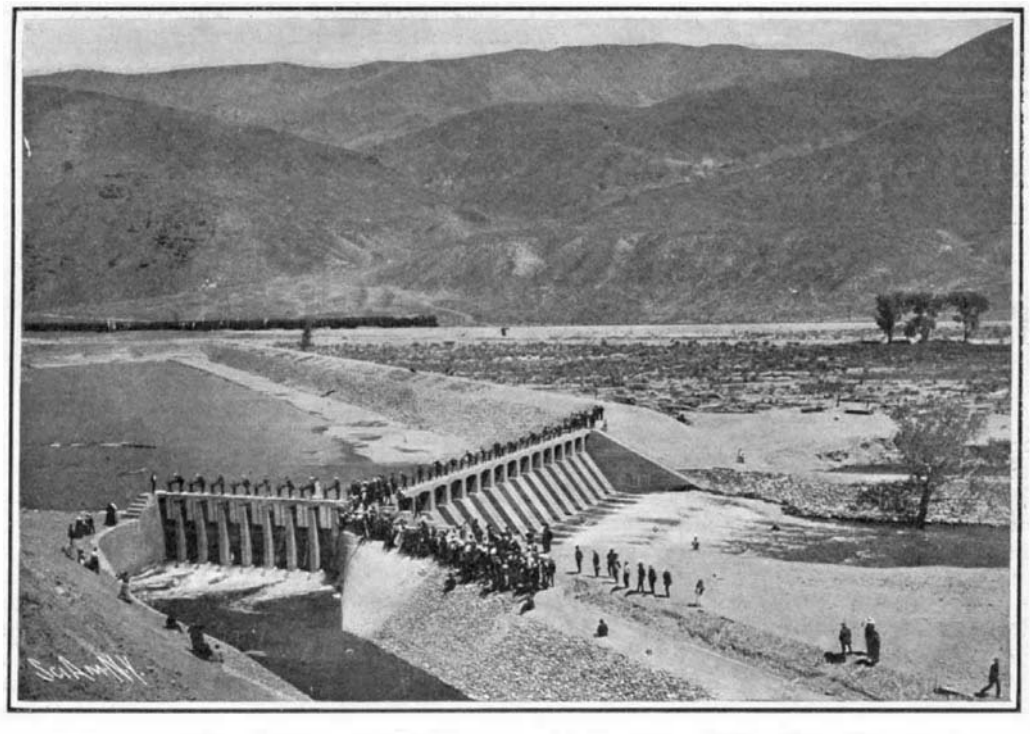


Lake Tahoe in California and Nevada. Elevation, 6,225 Feet. One of the Storage Reservoirs to be Used in Connection with the Truckee-Carson Project.

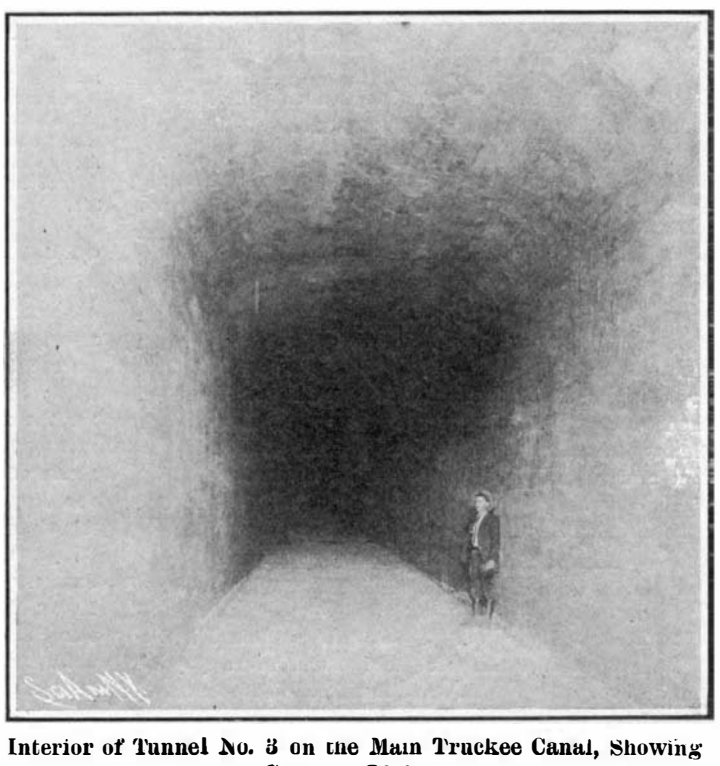
Proposed Improvements in Submarines.

The English naval department is carrying out experiments with a new type of periscope for submarines. The accident to the submarine "A1," which was run down by a liner and sunk, demonstrated the deficiency of the existing instrument, which renders only an arc of the surrounding sea visible. With the latest type, however, the whole circle of the surface is rendered visible. The Admiralty also propose to test various methods of eliminating the foul air from the interior during a long period of submersion. When the craft is submerged the noxious gases, owing to their density, settle to the bottom of the craft. It is proposed to experiment with fans for maintaining a constant circulation of the atmosphere within the boat, and to eject the noxious foul gases by jets of compressed air. These in combination will, it is anticipated, enable the unhealthy fumes to be passed through the exhaust pipe leading out through the deck abaft the conning tower and thus leave the interior constantly sweet and healthy.

Destruction of the Worms Which Attack Old Woods.—Mix 8 grammes of corrosive sublimate with 100 grammes of alcohol. Put the solution in the worm-holes, and stop them with wax or gum lac of the color of the wood.—Formulaire.



Formal Opening of the Truckee-Carson Project, June 17, 1905. The Main Dam is 4,219 Feet Above the Sea Level.



Interior of Tunnel No. 3 on the Main Truckee Canal, Showing Concrete Lining.

THE TRUCKEE-CARSON IRRIGATING PROJECT.

Drouillard's Drifter Balloon Float.

The drifter balloon float is an ingenious and very simple apparatus which is used to carry from a vessel in distress to land, and *vice versa*, a rope by means of which the passengers and crew of the vessel can be rescued.

It is formed by a specially-shaped balloon, which presents to the wind a plain surface 1.8 meters long, 1.3 meters high, and 1.2 meters wide at base (71, 51, and 47 inches). This balloon tows an apparatus formed by two pieces of timber joined to form a right angle, of which the vertical beam is 2 meters long and 0.55 meter high (79.7 and 21.6 inches) and the horizontal piece 1.2 meters by 0.3 meter wide (47 by 11.8 inches). In order that it may be maintained in a proper position, there is lead attached to the under side as ballast. This "drifter" again tows a rope 1,500 to 2,000 meters (4,918 to 6,560 feet) long, which is to be used as a pass rope between the vessel in distress and the land.

The drifter is connected with the balloon float by a regulating arrangement by means of which, before the drifter is thrown at sea, an angle from 60 deg. to 90 deg. from the direction of the wind is supposed to be obtained.

The balloon float is composed of three wooden or light metal hoops, covered with a special tissue. When not in use it folds up like an accordion and occupies a very small space.

The apparatus as used for experiments is covered with cotton cloth, but when in practical use it is to be covered with strong sail tissue in order to be able to stand heavy seas and contact with the rocks when landing. To use it one draws the folds apart and it inflates itself automatically; the valve is then closed and the balloon is fastened to the drifter. The inflation can be completed, if necessary, by various means indicated by the inventor; its weight is 7 kilogrammes (15.4 pounds).

When not in use the drifter is folded up into four parts by means of hinges and occupies a very small space. When in use its four parts are maintained open by two hooks and an iron bar; the required angle is then regulated by means of the webfoot (*patte d'oie*), the line employed as a pass rope is attached, and the whole apparatus is thrown into the sea. The weight of the drifter is about 30 kilogrammes (66 pounds).

The balloon float then draws the drifter to a distance with a speed and strength proportionate to the force of the wind, for the stronger the wind the more efficacious the appliance; the drifter steers it like a rudder.

On the arrival of the line carrier either on board the ship in distress or on the shore, it is drawn out of the water. If ashore, the person who receives it draws out the iron rod which maintains the vertical piece of timber on the horizontal one, and discloses a steel hammer weighing 3.5 kilogrammes (7.7 pounds) and an iron stake of the same weight, which are incased in the vertical timber. The stake is then driven into the soil, the towed line solidly fastened to it, and a connection is thus established between the land and the ship in distress.

The balloon float is provided externally with loops and strings, to which, in case of collision or foundering of the ship, 18 to 20 persons can cling and there wait for help. They may be carried to land by the balloon float.

On September 17 and 18, 1902, a small model apparatus drifted against the wind at an angle of 120 deg. in the course of trials carried out in the roads of Royan in the presence of deputies and prominent persons.

During the trials which took place at La Pallice-Rochelle on the 19th of September, 1903, the inventor proposed to carry a rope from land to a ship in distress (a buoy was moored instead of a ship). The apparatus, set at 90 deg., was thrown into the sea from the north lighthouse at La Pallice, and, in spite of a contrary current of about 2 knots, passed within 6 meters (19.7 feet) of the buoy, at a distance of 400 meters (1,312 feet) from its starting point, making an angle of 90 deg., the time occupied being only thirteen minutes. The wind was light (6 meters, or 19.7 feet, per second) and east-northeast, while the direction taken by the apparatus was north-northeast.

Many prominent persons were present at this experiment and warmly congratulated the inventor.

The invention should prove to be a very useful one on account of its simplicity and practicability.

Statistics of Cities Having a Population of Over 25,000 in 1902 and 1903.

The Bureau of the Census has just published Bulletin 20, presenting statistics of cities having a population of over 25,000. This bulletin contains comparatively few statistics relating to the population living in these cities, but is for the most part a compilation of data relative to the resources, transactions, plant, and machinery of the municipal corporations, forming a sort of statistical inventory and balance sheet.

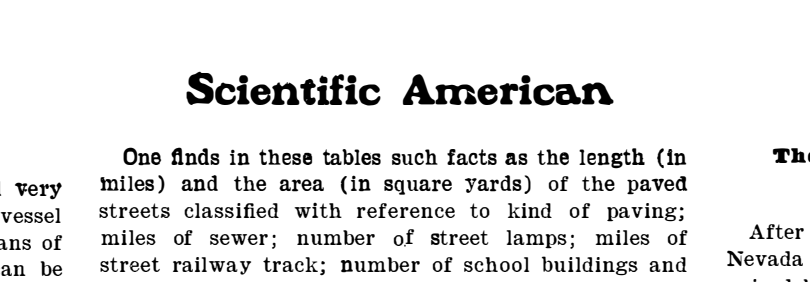
One finds in these tables such facts as the length (in miles) and the area (in square yards) of the paved streets classified with reference to kind of paving; miles of sewer; number of street lamps; miles of street railway track; number of school buildings and number of teachers and pupils; the number of public libraries with the number of volumes they contain; the number of almshouses and orphan asylums with the number of inmates; the number of policemen, and the number of arrests they have made; the number of firemen and fire engines, the number of fires occurring during the year, and property loss from such fires; the number of marriages recorded in the office of the city or county clerk and likewise the number of divorces. There are also tables showing the total population of each city, and the deaths and death rates from each of the principal causes of death.

But by far the greater part of the tabular matter consists of financial statistics presenting the expenditures and receipts of each city classified by departments and offices, the public debt, sinking funds, etc. By reference to these tables one may readily compare the cost of government and of the several departments of government in different cities.

In the aggregate the financial transactions of the 175 cities included in this report equal in magnitude those of the national government. The total corporate receipts for these cities amounted to $541,624,203, while the revenues of the United States government in the fiscal year 1904, exclusive of postal revenues, were $540,631,749. The total corporate expenditures of the cities were $535,804,200; the expenditures of the United States government were $582,402,321. The national debt in 1904 amounted to $895,157,410; the aggregate debt of the 175 cities, exclusive of sinking fund assets, was $1,134,578,783. The receipts, expenditures, and debt for the city of New York represent about one-third of the city totals.

OBSERVATION OF SOLAR ECLIPSE AT SEA.

By the courtesy of Mr. Vernon H. Brown, of the Cunard Company, we have been favored with the following observations of the solar eclipse of August 29 to 30, as taken on board the R. M. S. "Lucania" by Capt. J. B. Watt. The accompanying diagrams, drawn at the time, show the apparent path of the moon across the sun's surface, and the apparent positions of the sun and moon at the times given. The observations were taken during a westward passage.



THE ECLIPSE OF THE SUN AS OBSERVED ON THE "LUCANIA."

Correct G. M. T.	Position. Lat. N.	Position. Long. W.	Correct A. T. S.	Distance between limbs. ⊙ D.	Correct time interval.
H. M. S.			H. M. S.		M. S.
23 36 30	43° 41½′	46° 50′	20 28 29	10′ 30″	25 30
00 02 00	46 37	46 53¼	20 53 25	03 50	33 30
00 35 30	46 32¼	47 19¾	21 25 30	13 00	34 00
01 09 30	46 28¼	47 30	21 58 50	31 45	.. ..

Sun's diameter = 1·0. Magnitude of Eclipse = 0·879.

Sun obscured by clouds until 23 h. 36 m. 30 s. G. M. T. when distance between limbs was 10′ 30″.

Maximum Eclipse occurred at 00 h. 02 m. 00 s. G. M. T. when distance between limbs was 03′ 50″.

Last contact occurred at 01 h. 09 m. 30 s. G. M. T. when ⊙ diameter was 31′ 45″.

Interval between Maximum Eclipses and last contact 01 h. 07 m. 30 s.

Official Meteorological Summary, New York, N. Y., August, 1905.

Atmospheric pressure: Highest, 30.24; lowest, 29.67; mean, 29.99. Temperature: Highest, 88, date, 11th; lowest, 57, date, 28th; mean of warmest day, 82, date, 11th; coolest day, 62, date, 16th; mean of maximum for the month, 78.8; mean of minimum, 65.6; absolute mean, 72.2; normal, 72.6; deficiency compared with mean of 35 years, —0.4. Warmest mean temperature for August, 77, in 1900. Coldest mean, 69, in 1903. Absolute maximum and minimum for this month for 35 years, 96 and 51. Average daily deficiency since January 1, —0.4. Precipitation, 5.23; greatest in 24 hours, 1.81, date, 15th and 16th; average of this month for 35 years, 4.61. Excess, +0.62; deficiency since January 1, —1.09. Greatest precipitation, 10.42, in 1875; least, 1.18, in 1886. Wind: Prevailing direction, south; total movement, 7,177 miles; average hourly velocity, 9.6 miles; maximum velocity, 37 miles per hour. Thunderstorms, 6th, 8th, 10th, 13th, 15th, 16th, 24th, 29th, 30th. Clear days, 8; partly cloudy, 12; cloudy, 11.

The "Mizpah Ledge"—A Tonopah Miner's Experience.

BY H. C. CUTTING.

After completing a compilation of the statutes of Nevada in 1900, my health became very much impaired by the long strain of office work, so that I decided to turn my attention to prospecting and mining. Going south from Reno into Esmeralda County, a locality which was very familiar to me, I first heard of the discovery of Tonopah on arriving at Hawthorne, the county seat, a small town set right out in the desert, whose perspective on all sides was only a barren waste of sand and sage brush, with a background of precipitous mountains. At Sodaville I heard a great deal of talk of the new find, which was about sixty miles east by south of that place. I learned that the discovery was made by Jim Butler, whom I knew quite well by correspondence, as Jim had served as county superintendent of schools during my term as State superintendent of public instruction. I heard that he had given leases to a number of the prospectors then in the country, and soon received a letter from him inviting me to come down to Tonopah, offering me a lease as an inducement for the trip.

Arriving at Tonopah on the 14th day of January, I was the possessor of just four silver dollars. My first investment was in a poker game, which netted me a month's board and $12, with which I commenced operations on lease No. 19.

The camp at that time consisted of half a dozen or more tents and about thirty people, all highly enthusiastic over the new camp, and indulging in dreams of wealth which in a number of cases were realized. Everyone was flat "broke," including the owner of the property, but the little store, which had on sale a small and varied stock, was generous in extending credit to the men whose sole capital was a pair of willing hands and a lease on the big find. My lease, as I have stated, was No. 19, the first on the Mizpah Ledge, the other leases from 1 to 18 having been granted on the Valley View and Burro Ledges. Not a scratch of the pen secured any of these contracts. They were all oral, and the boundary of each man's working ground was marked simply by setting up a stone monument at each end of the ground allotted, which in most cases was one hundred feet on the strike of the ledge.

We experienced a hard struggle to get tools to work with, powder with which to break the ground, and food to support us while we were delving in Mother Earth's treasure box. It was just as remarked by a stranger who arrived in the camp after the lessees had been working about four months: "There is nothing in this camp but money"; and after we had been working about three or four months we had plenty of that, but it was extremely difficult to get supplies. We were more than sixty miles from the nearest railroad station, and the base of the supply was at Reno, 240 miles distant. The railroad facilities were very poor, as the Carson and Colorado Railroad, which runs from Moundhouse south, was narrow gage, very poorly equipped, and the sudden rush of business just about paralyzed the little road.

It required a long time to stock the road from Sodaville, the railroad terminus, to Tonopah with wagons and horses sufficient to supply the people who rushed in, and there was never a time when anyone in the camp could say that he had a "square" meal. For ten days at a stretch the camp lived on sardines, canned salmon, and crackers. This condition put the boarding-house keeper out of business, for these items of food were very expensive, but they were all that could be secured.

During this leasing period in the development of Tonopah the brotherhood of man was most strikingly manifested. Everything in the camp was common property, and no one quarreled with his neighbor. If my neighbor had powder, he divided it with me as long as it lasted. If I had an overcoat and he had none, he wore mine. You were liable to find some new arrival in your bed when you came off the hill after a day's work, but it was all taken good-naturedly.

A circumstance which is worthy of special mention, and is perhaps unprecedented in the annals of mining camps, was the fact that nothing but Jim Butler's word was given to secure to the lessees their rights on the property. There was not a quarrel nor a lawsuit in the camp, although a difference of six inches in a man's line might result in a difference to him of a sum written with five or six figures. I recall when I drew the papers by which the present owners of the mine took the property over from Butler, that an effort was made to have the discoverer cancel the leases he had given, but he refused, and consented to sell only with the expressed agreement that those working on the property should continue to operate under their leases until the first of the year, when they expired; and every promise given by Jim Butler was carefully carried out and secured. Had I the literary ability and you the space, I feel that a