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 "
Scientific American Building Edition (Established 1885). ..... 2.50 "
Scientific American Export Edition (Established 1878)..... 3.00 "

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MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, DECEMBER 7, 1901.

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.

RECONSTRUCTION OF THE CROTON DAM.

The board of three engineers appointed by the Aqueduct Commission to examine the design and condition of the core-wall embankments at the Croton Dam and at the Jerome Park Reservoir have reported, and the matter has been referred back to the chief engineer, Mr. William R. Hill, at whose request the investigation was made. It is recommended that the design of that portion of the Croton Dam which is to consist of an earthen embankment with a central core-wall be changed, to prevent the possibility which now exists of leakage and ultimate destruction of the dam. With regard to the Jerome Park Reservoir, the board states its opinion that there is no possible danger of sliding or sloughing of the bank, and that the utmost that can be anticipated is the seepage of a small amount of water through the embankment and the earth, and that this would be carried off by the sewers in the adjacent avenues. It is considered, therefore, that a large expenditure to absolutely prevent such seepage would not be warranted nor advisable.

Dealing first with the Jerome Park Reservoir, it should be explained that this is an artificial basin which is being excavated to form a reservoir of two billion gallons' capacity, the purpose of the scheme being to enlarge the total storage capacity of the local reservoirs within the city's boundary. The reservoir lies in a natural depression on the summit of the ridge of high land which extends between the Harlem Railroad and the line of the Putnam Railway. On a considerable portion of its perimeter the dam is shut in by rising ground, but on other sides it has been necessary to build an artificial embankment to impound the waters. This embankment consists of an earthen dam with a central core-wall or diaphragm of masonry. On certain stretches of this dam the core-wall stands upon a substratum of material which is permeable by water, and Mr. W. R. Hill, the new chief engineer of the Aqueduct Commission, considers that there is danger that when the reservoir is filled, the pressure due to a head of 24 feet would cause a serious leakage through this stratum, which in time might undercut the embankment and lead to serious damage. To test the possibility of such leakage, pits were sunk on the outside of the line of the embankment and coloring material was placed in holes sunk within the area of the basin. Mr. Hill found that the coloring matter passed entirely underneath the embankment, and showed itself after a lapse of time in the test pits. The expert board, however, as we have stated above, are of the opinion that this seepage will not be of sufficient amount to endanger the structure.

At the great Croton Dam, which is being built at the mouth of the Croton watershed for the purpose of impounding some thirty-two billion gallons of water, the problem is a far more serious one, and it is evidently considered by the board that the chief engineer's contention admits of no dispute. The great dam consists of three portions; the first 400 feet on the southern side of the valley is an earth dam with a thin, masonry core-wall; then follows the masonry dam, 650 feet in length, which extends to within 200 feet of the northern side of the valley, where the dam swings around upstream and parallel to the hillside for a distance of 1,000 feet, and finally turns in to a junction with the natural rock of the bluff. This 1,000 feet forms the spillway. In searching for foundations for the masonry dam it was necessary to go down 131 feet below the original depth of the river. The dam at its base measures 216 feet in an up and downstream direction, and the massive masonry rises to a height of 300 feet above the lowest foundation course. The earthen portion of the dam commences abruptly at the end of the masonry dam; a thin interior core-wall 18 feet in thickness at the base and 6 feet at the top extends from the masonry dam proper through to a junction with the side of the hill. This wall is backed on both the upstream and downstream sides by a filling of earth, with a slope in each case of two to one. By virtue of its rock foundation, its enormous width of base, its magnificently-built masonry, and its enormous mass, the masonry portion of this structure is everything that can be desired; but the chief engineer has always had the gravest doubts as to the permanence of the earthen dam, and it is his belief that the security of the whole work can only be assured by continuing the masonry structure clear across the valley and building it to a junction with the original rock of the hillside. That the expert board indorse this view of the situation is shown in the summary of their report to the Aqueduct Commission, the full text of which will be found in current issue of SUPPLEMENT. They state that the new Croton Dam is a reservoir of 125 feet depth of water retained by an artificial embankment, the outer toe of which is 5 feet lower than the bottom of the reservoir and which rests on a filling of earth 100 or more feet deep, which in turn rests on a steeply sloping rock surface. The percolation of water through this embankment to such an extent as may reasonably be expected under the existing conditions would be liable to induce sliding of the bank and its destruction.

We most heartily concur with the findings of the board as far as they concern the Croton Aqueduct. The failure of the masonry portion of the dam, letting loose over thirty billion gallons of water, would not merely produce enormous destruction in the valley below, but the powerful current set up within the reservoir itself would undoubtedly sweep away the old Croton embankment, which will be buried some 30 feet below the surface level of the new Croton Dam. In thus breaking down the embankment of the old reservoir it would deprive New York of its whole source of water supply, for both the old and the new aqueducts take their supply directly from the old Croton Reservoir.

IRRIGATION OF THE DELTA OF THE COLORADO.

No more interesting series of engineering problems has been worked out of late than those connected with the irrigation of the delta of the Colorado River, including lands in Arizona, California and Lower California, Mexico. At the time of writing (November 1, 1901) water is in use for the irrigation of several thousand acres of land, while it is expected that before the close of the coming winter fully 200,000 acres will be subject to irrigation.

The total area which will be brought under irrigation within two or three years on the delta is estimated as follows: In Arizona, from several canals leading from the Colorado River, 150,000 acres; in Lower California, from similar canals, 300,000 acres; in Southern California, from similar canals, 500,000 acres; in Southern California, from artesian wells, 50,000 acres. This makes a total of 1,000,000 acres of irrigable land where heretofore has been desert, and considerably the most forbidding desert on the American continent. That the addition of that vast amount of productive soil, most of which will be devoted to cattle raising, will greatly increase the productive power of the far Southwest is already being demonstrated.

The Colorado River delta includes land which ranges from about 100 feet above sea level to 380 feet below the level of the sea, the latter point being the Salton sink, or salt marsh, in Riverside County, California.

The character of the soil throughout the delta has great uniformity, and it is evident that to a great extent the deposit of silt, aside from shutting off the gulf water, is responsible for the desert character of the land. In the Southern California section, known as the Colorado desert, alone there is an area of about 75 miles square, not all of which is subject to reclamation, in which *no* water is known to exist for the preservation of the lives of the travelers, aside from that which is hauled in by the Southern Pacific Railroad and that which is being brought in for irrigation purposes, while the temperature ranges from a minimum of 20 deg. above zero in the winter to a maximum of about 116 deg. above zero in the summer, there being six or seven calendar months in each year during which the mercury records at least 100 deg.

The extreme dryness of the atmosphere causes so rapid evaporation of moisture from the skin that human temperature does not rise above normal blood heat when there is ample drinking water to feed the pores of the skin. But with an absence of drinking water, the skin becomes dry, fever ensues and delirium and death soon come. The Colorado Desert has thus claimed many victims, but the wide-reaching irrigation canals have put an end to that variety of suffering in this region forever, and one can live on the desert with a much greater degree of comfort than he can in many regions where the mercury marks a lower maximum temperature, but where the degree of humidity is greater.

It was some forty-five years ago that army engineers first called the attention of the government to the possibility of redeeming the Colorado delta by using the water of the river for irrigation. But long the project lay dormant, and while it was an ideal line of irrigation development for the government to undertake for the rescuing of its own lands, the venture awaited the initiative of several private individuals and corporations, one of which is constructing canals for the 500,000 acres in Southern California and the 300,000 acres in Lower California, under the direction of George Chaffey, C.E., and member of the Institute of Mechanical Engineers of London.

The task of making an adequate survey of the 500,000 acres in Southern California has proceeded continuously through all degrees of temperature, and as closely as possible earlier surveys have been followed, though they serve more to confuse than to assist the work.

At Hanlon's heading, just above the international line, on the California side of the Colorado River, water has been diverted through a temporary headgate into a canal capable of carrying water for the irrigation of over 100,000 acres of land, and later the permanent headgate will be constructed in a bluff of cement conglomerate, through which water will be admitted for the irrigation of the entire 800,000 acres to be placed under the system, this water being first taken into a large natural settling basin, from which a series of canals will lead.

A very large portion of the water is provided with a natural channel in Carter and New rivers, which lead for more than sixty miles on good grade through Lower California, delivering the water again at the international line, for use in irrigating the California lands. Thence the water is taken in a series of large canals, distributed through a series of laterals, and thence into the ditches of the individual farmers, the system being based on an allowance of four acre feet a year for all the land under the system.

The settlement of the delta is progressing rapidly, the population of the Colorado Desert alone making net gains of from five to ten persons a day, while the rate of increase is rising steadily. One year ago the desert was unpopulated. To-day about a thousand people have their homes on the land, and hundreds of families are only awaiting the arrival of water at their respective farms to take possession and begin the cultivation of the soil. Some remarkable records have been made in cultivating this desert land. Moving on barren ground, within sixty days a number of farmers have had crops of millet grown, harvested and stacked, with growths of corn and sorghum from four to six feet high. Thus the complexion of the desert is steadily changing, and as a result of irrigation under the several systems, within a year probably 200,000 acres of the delta lands will be under thorough cultivation.

THE CONVERSION OF GRAPE TENDRILS INTO FRUIT CLUSTERS.

It is not generally known that grape tendrils and clusters are identical in origin and anatomical structure, and are frequently changed from one to the other in nature. In the wild state grapes develop tendrils as a means of lifting themselves up into the light and air, and are essential to their well-being; but in the vineyards of to-day, where the vines are carefully trellised by human help, these tendrils are not necessary and are considered a useless draft on the energies of the plant.

In France there is a belief among many growers that the development of large tendrils near what would normally be a fruit cluster tends to make the latter "run to tendrils." It is a common practice of growers passing through the vineyard to remove these tendrils, particularly the larger ones. For the purpose of following the evolution of tendrils into grape clusters Mr. E. Durand, of France, made a series of experiments with several varieties of grapes. The experiments took the form of different methods of treating the tendrils. In one lot that portion of the grape tendril which bears a little leaf at its base was entirely removed. In the second lot this same ramification was removed and in addition the extreme tip of the remaining branch of the tendril was pinched, removing 1 to 2 millimeters or more of the tip. In the third lot the tendrils were allowed to grow freely. The different operations were performed early enough in the season to note the effect of these methods of treating the tendrils on their production of flower buds and fruits.

In the case of the Chasselas variety, out of 292 tendrils not operated upon in any way, 11 tendrils bore flowers, producing in all 230 flower buds, thus showing that tendrils are naturally capable of diversion into flower clusters. Of 298 tendrils which had that ramification entirely removed which bears a small leaf at its base, 58 tendrils bore flowers, having a total of 500 flower buds. Where this same ramification was removed and the tip of the remaining branch of the tendril pinched, 294 tendrils produced 25 fruit clusters, having 223 flower buds. These figures show a difference between the tendrils which had one branch removed and those which were allowed to grow freely, of 270 flower buds, apparently due to the effect of

pinching. Owing to the fact of insects, diseases, etc., not more than half these extra buds set will produce fruit. This reduced to figures means 25 to 30 grammes of fruit per vine, an amount considered too small to pay for the trouble of pinching.

In some varieties under observation a large number of flower clusters were borne naturally on the tendrils. Thus, for example, with the variety Yapindjack from the Orient 15 bunches of grapes and 26 fertile tendrils were borne on 8 shoots naturally, against only 16 tendrils which were not fertile. It is thought that with this variety pinching the tendril, as above noted, would produce a very large increase in fruitfulness.

CAVE DRAWINGS OF THE PALÆOLITHIC EPOCH.

BY OUR PARIS CORRESPONDENT.

In a paper lately read before the Academie des Sciences, Messrs. Capitan and Breuil give a description of two caves or grottoes which they have discovered, whose walls are covered with a remarkable series of drawings of animals which date from the palæolithic epoch. The first of these grottoes, at Combarelles (France), is a long tunnel 690 feet long and varying from 4½ to 6 feet wide. Its height is sometimes 9 feet and again as low as 1½ feet. At the beginning the walls are covered with a stalagmite formation under which some rare lines are seen, but at 360 feet the clearly defined figures begin and continue to the back of the cave over a length of 300 feet, making 600 feet of wall which is more or less covered by the drawings. Most of the figures are covered with a stalagmite coating which sometimes completely hides them; many of them are 3 feet long and 2 to 3 feet high, while others are much smaller. They represent animals for the most part, and many of them are striking in their execution. All the figures are of a correct design and present details which are easily recognizable. Certain figures such as the horse are quite remarkable and show the same character as the best figures engraved on bone of the same epoch. The animals, drawn in whole or in part, include especially the horse and equidæ, the bull, aurochs, wild goat. Saiga antelope, reindeer and mammoth. All the figures are of such correct execution that there is no doubt as to their interpretation, such, for instance, as a horse of remarkable design which seems to carry on its back a kind of covering ornamented with triangles; an equide with straight mane having the upper part of the neck very convex and the tail planted very low, also a reindeer whose reproduction is strikingly faithful. The same is true for an aurochs and the head of a wild goat with long horns curved back toward the rear. As to the mammoth, a number of drawings show its well-known features, a very high forehead, curved tusks, hair completely covering the animal and indicated by a number of lines; the trunk is sometimes straight and sometimes curved backward. Some of the figures are entirely covered with the stalagmite formation. It is out of the question that the figures were executed at a period when the reindeer and mammoth were extant in France, which places them in the palæolithic epoch.

The second grotto was discovered at Font-de-Gaume, about a mile from the first. It opens midway up a chalk cliff at 60 feet above the soil of the valley. It has the form of a tunnel 380 feet long with three irregular branches of 45, 63 and 144 feet. Its width varies from 6 to 9 feet and its height sometimes exceeds 21 to 24 feet. In some places the walls come close together, forming narrow passages. The first figures of animals begin at 200 feet from the entrance, after a very narrow passage which opens at 5 feet from the ground in the middle of a stalagmite wall. The general character of the drawings is quite different from those of Combarelles and they have not the same energy and vigor of drawing. They are nearly all formed of a finely engraved line, accentuated by a band of black color from two to four-fifths of an inch wide and circumscribing the whole of the animal. Sometimes certain parts, such as the paws, are entirely painted with this black color; and some of the animals, such as a great reindeer 4½ feet long and a small equide 18 inches long, are entirely painted in black, forming veritable silhouettes like many of the Greek vase paintings. Sometimes the line is traced with red ocher, and in some cases it is very wide. But in most cases the animals, whose outline is indicated by a black line, have their whole surface covered with red ocher. Some parts, such as the head of an aurochs, seem to be painted with black and red, giving a brown color. On others the head is black and the remainder brown. These first examples of fresco painting have been applied sometimes over a series of lines engraved upon the animal and in other cases the lines have been scratched upon the painted surface. Again, the outline is sometimes brought out by an external scratched background, recalling some of the modern engraving processes. A number of the figures are covered with a stalagmite coating which is sometimes nearly an inch thick. Some of the figures are nearly on a level with the ground and others are as high up as 12 feet. Certain of them, for instance, a great aurochs entirely painted in red, measure 8 feet long, and they vary from this down to 18 inches. They represent for the most part the aurochs, of which there are 49 examples, reindeer, equidæ, deer, antelope, mammoth and a few geometric ornaments. It is probable that these figures are of a somewhat later date than those of Combarelles.

NEBULA IN NOVA PERSEI.

BY MARY PROCTOR.

The photographs of the faint nebula surrounding the new star in Perseus referred to by Prof. Henry Norris Russell in the SCIENTIFIC AMERICAN for November 30, have just been received by the writer from Prof. G. W. Ritchey of the Yerkes Observatory. They are made from his original negatives of September 20 and November 13 respectively.

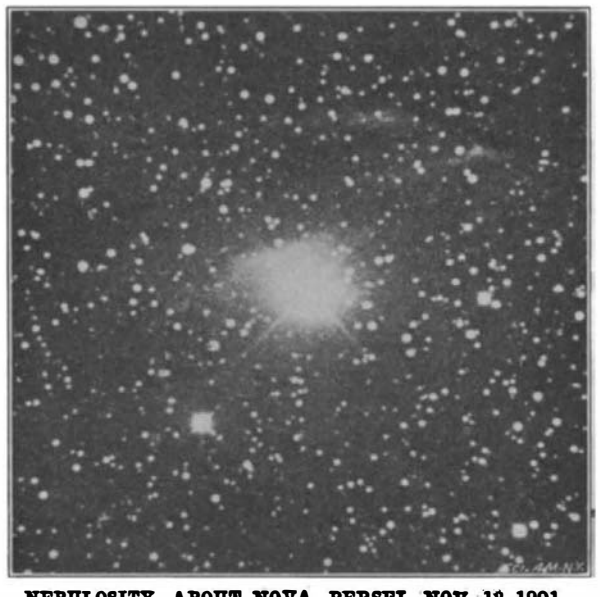
It will be remembered that attention was called in

NEBULOSITY ABOUT NOVA PERSEI, SEPT. 20, 1901.
Photographed by Prof. G. W. Ritchey, with the Two-foot Reflecting Telescope of the Yerkes Observatory. Exposure, 3 hours and 50 minutes.

Prof. Russell's article to the fact that photographs of Nova Persei revealed the presence of a very faint nebula surrounding the star. Later photographs show that enormous changes have taken place in the nebula, confirming a theory long ago advanced by Sir William Herschel, according to which changes take place in the nebulæ in the course of time.

This theory has not been generally accepted, but now it may be said to be proved by these photographs, showing actual changes which have taken place in the nebula surrounding Nova Persei during the brief period of seven weeks. This would seem to indicate that the gaseous matter forming nebulæ is ever undergoing a process of change and formation, and that from this material—the star-dust scattered throughout the depths of space—new worlds and star-systems are being evolved.

The negative for September 20 was made with an ex-



NEBULOSITY ABOUT NOVA PERSEI, NOV. 13, 1901.
Photographed by Prof. G. W. Ritchey with the Two-foot Telescope of the Yerkes Observatory. Exposure, 7 hours.

posure of 3 hours 50 minutes, and for November 13 with an exposure of 7 hours. The enlargement from the original negatives is about five diameters in each case. The negative of November 13 shows the outer parts of the nebula to have grown much fainter (though the exposure was 3 hours 10 minutes longer), while the strong wisp near the central star (Nova Persei) is much stronger.

The measurement of the negative indicates that the nebula has expanded about *one minute of arc* in all directions in seven weeks, also that it has rotated about the Nova (in the direction of the motion of the hands of a watch) through an angle of about 3 or 4 degrees in that time. The change in density of the wisp near the star is so great that it is difficult to state positively whether there has been a change of shape or position in it.

The rate of motion is of course enormous—far beyond anything known in the stellar universe before. Indeed, if we assume a parallax of 0.01 seconds for the star, the motion of the strong condensation of nebulosity approximates *that of light*. Prof. Chase of Yale has shown that the parallax is extremely small—probably too small for measurement.

The idea is suggested that the enormous changes are not due to *motion of matter* at all, but to change of illumination, electrical or other. But, according to Prof. Ritchey, the change is like that of an expanding ring. Many of the condensations, in fact all of them, are easily recognized in the two photographs, despite this change of position.

These photographs were made with the two-foot reflecting telescope of the Yerkes Observatory, which was made entirely in the optical and instrument laboratories of the Observatory. The mirror of the instrument was made by Prof. G. W. Ritchey, and the greater part of the mounting, including the clockwork, was constructed from his designs and under his supervision. He considers that this instrument is better suited for the work of photographing very faint nebulæ than any other in America, as the focal length of the instrument is very short (aperture being 23½ inches, focal length 93 inches), so that the light-concentration is very great.

SCIENCE NOTES.

A chief merit in acetylene lies in its true rendering of color shades at night, says the Acetylene Gas Journal. One of the recent large installations designed to take advantage of this characteristic is that reported from Muhlbach, in Alsace, in a cotton mill employing 500 hands. Between 800 and 900 jets of acetylene are now in operation daily. But the design is ultimately to employ 1,300 flames. Naturally enough, it is reported that all operatives are highly pleased with this and other qualities of acetylene.

The State Arid Land Grant Commission, which was created by the Legislature with power to reclaim lands given to the State by the general government, under the Carey act, has just celebrated the opening of the great canal system in District No. 4, which comprises 33,000 acres of rich land in the Dearborn Valley, Montana. The State purposes to sell this land in tracts of 160 acres to actual settlers at the cost of placing water upon the land, allowing payment to be made in ten annual installments with 6 per cent interest. Eleven thousand acres are now ready for settlement.

Consul Ravndal reports from Beirut that olive oil has many uses, but more substitutes, and few salads are compounded without the aid of one of them. Cotton-seed oil is a favorite substitute, but, according to an Egyptian newspaper, this is soon to find a sturdy rival in the form of the seed of the sunflower. Experiments made by German chemists have convinced them, it seems, of the availability of this cheap raw material, and it may shortly become a valuable article of commerce. It is said to be convertible to many uses, and, besides having possibilities as a lamp oil, may be used for dyeing purposes, and will be of service in soap making.

The directors of the Pan-American Exposition Company and a number of creditors conferred November 14 and listened to the reading of the financial report of the Company. The report shows the total liabilities of the Company at present to be $3,326,114.69 net, assuming that the assets of $146,454.15 are collectable at face. The Company owes for operating expenses and on construction work $577,945.73, which item is, of course, embodied in the figures of total liabilities. An interesting fact shown by the report is the total cost to the exposition company of the exposition. The cost, according to the report, was $8,860,757.20. The total receipts from admissions after May 1 were $2,467,066.58, and the receipts from concessions were $3,011,522.79. The balance due to first mortgage bondholders is $174,979 and to second mortgage bondholders $500,000, both of which are included in the liabilities as given.

California olive growers are preparing to harvest their crop. In every orchard in the State the trees are loaded with the fruit, and the acreage devoted to the cultivation of olives is much larger this year than ever before. In recent years the yearly crop of olives seldom ran over 2,000 barrels, or, taking seven barrels to the ton, about 286 tons. The growers who sell their olives as they come from the trees have formerly received $60 per ton for their product, or about 3 cents a pound. It costs 1 cent a pound to pick the fruit, thus allowing the growers $40 a ton for their olives. This year the total crop of the State will reach 800 tons, or 5,600 barrels, an increase of 3,600 barrels over last year. The price this year has dropped 33 1-3 per cent. Olives now bring only $40 a ton as they come from the tree, half of which goes to the pickers, thus allowing the growers only $20 a ton.