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THE ARTESIAN WELLS OF THE JAMES RIVER VALLEY, DAKOTA.

L. F. KORNS.

The James River Valley is one of the remarkable agricultural valleys of the country. The valley proper extends from Yankton on the south to Jamestown on the north, a distance of 300 miles. Most of this vast area is level. Entire townships can be plowed without a single obstruction to the plow.

This ideal agricultural valley was strangely passed by until about 1880. At this date the buffalo had gone farther west; but when the writer visited this valley early in the eighties, the prairie was dotted white with the bones of this noble animal.

The early pioneer found the most of Dakota inclined to drought, caused largely by extensive fires which left the surface bare. This caused drought, but since the protection of the grasses by settlement, moisture has so increased that this valley is now teeming with productive farms. This valley greatly resembles the valley of the Nile, but unlike that historic region has its surplus of water beneath instead of at the surface.

It is the greatest artesian well district known. A comparison with other districts will show that for pressure and area over which they are found, this valley far surpasses them all. There are some fine wells in France, but they are found only in favored localities. Some of the wells in France are of large bore, but in none does the pressure equal any one of fifty wells in the James Valley. Western California, from San Diego to near the northern boundary of the State, is proving itself to be a fine artesian district, but strong pressure is found only in limited areas. Nearly every city and many of the small villages from Yankton to Jamestown have wells, and the majority of these have a very heavy pressure.

The pioneer well was put down at Aberdeen, March, 1882, by the C., M. & St. P. R.R. Co. It is 961 feet deep, with a tube 5½ inches, made of 3-16 inch wrought iron. Water was found in sand rock. The water is soft, but cannot be used in boilers, as it foams. This well choked up with sand for a time, but afterward opened with its original force.

In 1884 the city put down a well 908 feet deep, $5\frac{8}{16}$ inch tube. A system of water works was put in. The city, with 5,000 inhabitants, has the best of fire protection. Four streams at one time can be thrown over the highest of buildings. Aberdeen and surrounding country are very level, so to get drainage a pumping system, such as Pullman, Ill., has, became necessary. Last year the city put down a well for power alone. The system is now completed, and the result is perfect. The pumps have a capacity of 50,000 gallons per hour. A float makes the pumps automatic, so that they work only when there is sewage to be raised. For a cost of only a few thousand dollars this city has water

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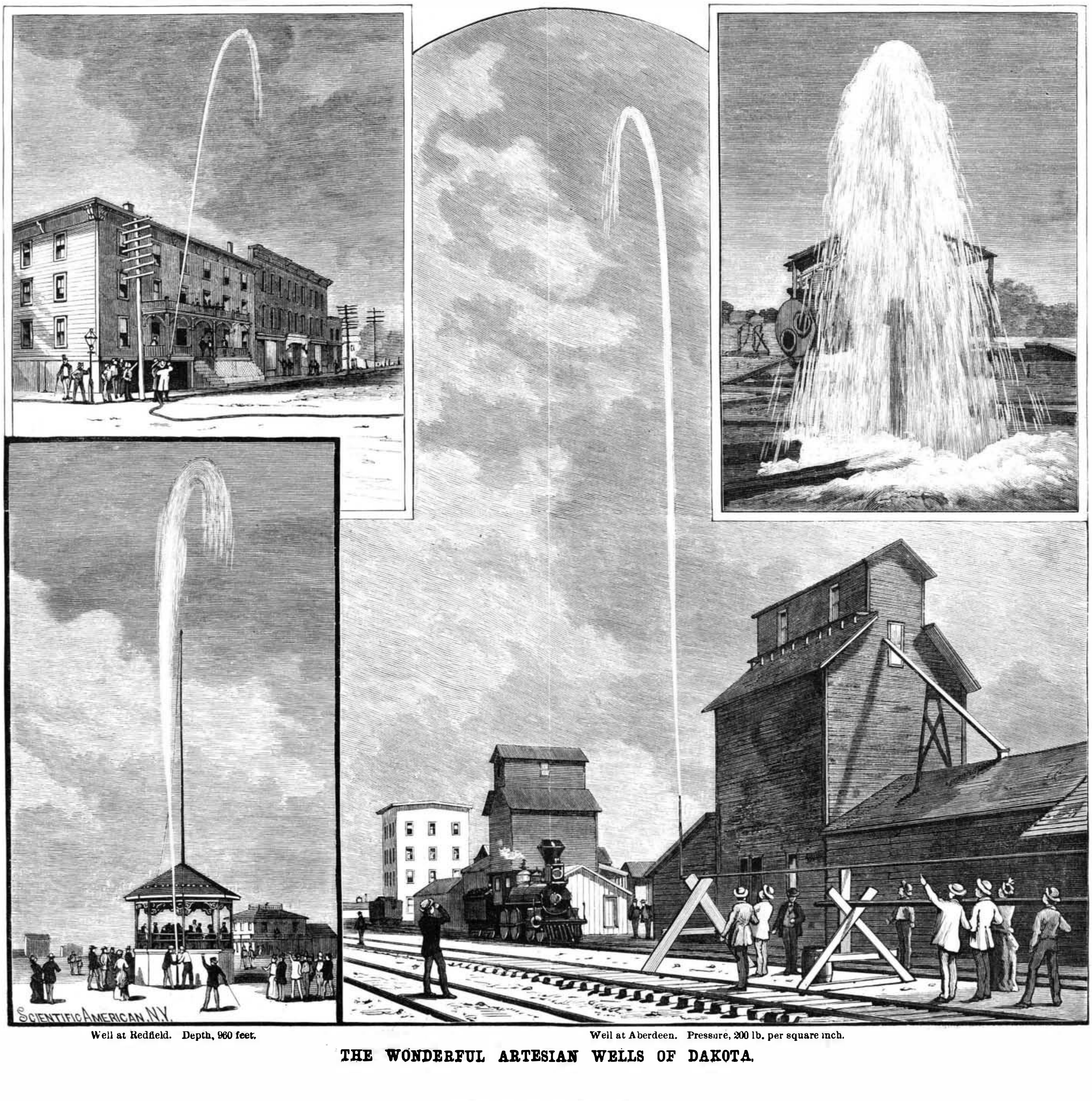
Fire Service at Yankton. Natural Flow through 6 inch Pipe of Yankton Well.



Well at Redfield. Depth, 960 feet. Well at Aberdeen. Pressure, 200 lb. per square inch.

THE WONDERFUL ARTESIAN WELLS OF DAKOTA.

THE ARTESIAN WELLS OF THE JAMES RIVER VALLEY, DAKOTA.

(*Continued from first page.*)

works and a pumping sewage system without cost of fuel, engineers, or even oil. The pressure of these wells is about 200 pounds per square inch. A two-foot vein of coal was struck in the first two wells.

Ellendale, north of Aberdeen thirty-seven miles, has a well 1,087 feet deep. Water was found in sand rock beneath an impervious stratum of shale. The water is clear and soft, with temperature of 67° and pressure of 150 pounds per square inch. The city has a system of water works costing less than $7,000.

The Redfield well is 960 feet deep. The tube in this well is of three sizes. The first 400 feet is 6 inches, the next 300 is 5⅝ inches, and the last 260 feet 4½ inches. Water was found in sand rock. Coal was found at different depths, and smelled of oil. The water is clear and soft, has temperature of 68° and pressure of 200 pounds per square inch. The city has a complete system of water works for fire, lawn, and house use. It takes four strong men to hold the hose.

The Huron well is 863 feet deep, having a 6 inch tube from top to bottom. Water was found in sand rock. The pressure is upward of 200 pounds per square inch. Water is a little hard, and most of the time clear. Temperature is 60°. Huron has two miles of water mains and two miles of side piping. Besides furnishing water for fire use, it runs motors for two laundries and four printing offices, using about 20 horse power. The Huron and Redfield wells are perhaps the best in the valley.

Yankton has two 6 inch wells, one 610 feet deep and one 600 feet deep. These wells furnish fire protection through 19,400 feet of pipes, and run the electric light, two printing presses, a tow mill, feed mill, and furniture factory. The water in these wells has a pressure of 56 pounds per square inch, and, unlike most of the other wells, is hard. It is, perhaps, the best drinking water of any of the wells in the valley. The second well did not diminish the flow of the first. Water was found in sand rock, temperature 62°.

The Jamestown well is 1,576 feet deep, and has a pressure of 100 pounds. Water is clear and soft, with temperature of 75°. At 300 feet quite a flow of gas was met. The city has a system of water works with the well.

The above wells are mentioned out of quite a number of equal value over a distance of 300 miles. These lie in about the center of the valley. A well at Andover, at the extreme east side of the valley, has a pressure of 100 pounds, while one at Ipswich, at the west side of the valley, has a pressure of 90 pounds. At Miller, 40 miles west of Huron, the pressure is 125 pounds. The greatest average pressure is in the center of the valley. The above figures will be at variance with the gauges as they are now found on the wells. The gauges are placed above the valve, where the pressure is greatly relieved by the overflow. The above figures, in most cases, give full pressure.

Noted wells in other parts of the world fall far below these. The well at Belle Plain, Iowa, which got beyond control and created such a scare, had only a fraction of the power of these wells. The Belle Plain well had a pressure of only about 25 pounds per square inch, and this lessened in a few days. Water was struck at only 86 feet, and the soil above it disintegrated so easily that a hole as large as a wagon wheel was made, out of which a large quantity of water flowed, and threatened for a time disaster to the city.

The great well in the Place Hebert, Paris, France, is 2,359 feet deep and has a diameter of 3½ feet, yet it does not throw much over 1,000 gallons per minute, while many wells in the James Valley throw 3,000 gallons per minute.

The possibilities of the wells in this valley are beyond estimation. With millions of gallons flowing daily, there has been no diminution of the supply. Nature stores the supply, and it only awaits tapping and application. If one of the wells at Yankton, with a pressure of only 56 pounds, has taken the place of a 30 horse power engine, what can be done with a well with 200 pounds pressure? Then if larger bores were made, any amount of pressure desired could be obtained. Large bores should be made, because to get a certain amount of flow the valves have to be opened so wide that the water rushes out with such speed as to cause pieces of the sand rock to fly out of the well. This difficulty was met with to such an extent at Aberdeen that they were compelled to place a stone-arresting drum at the well.

That such an ideal power has not been utilized to a greater extent can only be accounted for by the fact that the country is so new. Gas was found in many of the wells. At Ashton, the cooking in a hotel is done by natural gas. If the proper system were employed, a good supply of gas might be had.

The query arises, Whence the source of all this water? Some believe it comes from the Missouri River. This cannot be true, because at Highmore, 40 miles west of Huron, there is a well with 25 pounds pressure, and the elevation is several hundred feet above the river. At Gettysburg, only 16 miles east of the river, they have drilled 1,300 feet without getting a flow. Drillings east of the valley (in Dakota) have been unsuccessful, striking almost invariably at a few hundred feet, without getting water, the Archæan rock, which is usually the bed of artesian water. The large lakes north have a less elevation. The theory is advanced that the flow is caused by the pressure of the earth or gas upon a subterranean basin. This theory is decidedly gaseous. This would imply a hermetically inclosed space, which would soon exhaust. No such basin has been found in any of the borings. Water is found in soft sand rock, being confined above by impervious shale. Small channels, sometimes, however, connecting with open water, may exist, as is indicated by numbers of small fish with eyes that have come out of two of the Aberdeen wells. Accepting, as we must, that water finds its level, and that it rises no higher unless acted upon by some external force, we must look to some place where the elevation and quantity are sufficient to supply these wells. These wells are undoubtedly fed from the Rocky Mountains.

Great care is required in putting down these wells where the pressure is so great. If any accident happens to the tubing after the full flow is met, it is almost impossible to overcome it. Nature has furnished no valves which may be closed while the well may be repaired. The wells at Frankfort and Groton are serious failures. Both of these have thrown muddy water most of the time since they were put down. The Groton well has covered acres of land with its mud, and, at one time, broke out in different parts of the town. Some break or disconnection has occurred above the impervious strata, and the dire consequences are hard to estimate. An inch tube by way of experiment was put down in the Frankfort well about 650 feet. It came out minus 130 feet, with the point scraped on one side and bent, which indicates that it got outside of the well down about 520 feet. It also indicates a space minus earth, as that 130 feet passed down outside of the well without meeting any resistance. The tube was put down by hand. That basin was not there when the well was put down.

It will be noticed that in some of the above tubings the iron is only 3-16 of an inch in thickness. This is too little to resist the enormous pressure at the bottom of a well of 1,000 feet depth, having a pressure of 200 pounds per square inch at the surface. Water exerts a pressure of about 43 pounds per square inch for each hundred feet in height. This would give such a well at the bottom a pressure, when the valve is closed at the top, of 630 pounds per square inch—a pressure nearly four times greater than a locomotive carries with a boiler twice as thick. A wisp of straw accidentally carried down 2,000 feet in the Place Hebert well was returned so compressed that it dropped in water like lead. Ordinarily the walls of the earth resist the pressure upon the pipes, but should a piece chip off, the pipe might burst at this point. Then if there were no impervious stratum above the break, the result might be like the two above mentioned wells.

Sometimes it is impossible to force a pipe down more than a few hundred feet. In this event a smaller tube is put down inside of the first. Sometimes as many as three sizes are put down. When the inside pipe is down far enough, there is no further use for the outside pipes. These cannot be easily drawn out, owing to the friction against the walls of the earth, so an ingenious method is employed of using a left hand thread at the proper depth, enabling them to take out the top parts of the inside pipes instead. This leaves a well of telescope appearance, with small end down. The inside pipes do not necessarily, when put down, fit the outside pipes water-tight, but when separated a swedging process is used, which makes them water-tight. If this is not thoroughly done, the water will escape, making the flow muddy, and if, as before mentioned, there is no impervious stratum above, the water will break out about the well.

The following analysis of the Jamestown water is perhaps an index to that of most of the water:

ANALYSIS OF ARTESIAN WATERS IN DAKOTA.

Jamestown—organic matter: free ammonia, 2·4 parts per million; albuminoid ammonia, 0·046 part per million; nitrites, traces; nitrates, none.

INORGANIC MATTER.

Silica	35·70	2·0823
Alumina	3·50	0·2041
Carbonate of iron	2·20	0·1233
Carbonate of lime	188·00	10·7643
Sulphate of lime	249·00	14·5243
Sulphate of magnesia	154 20	8·9944
Sulphate of soda	1139·40	66·3602
Chloride of sodium	369·10	21·5296
Sulphate of potash	31·05	4·7526
Phosphates		a trace
Hardness		21°

The engravings are accurate representations of the enormous heights to which the water is thrown by natural pressure.

THE chemical journals announce as newly discovered solvents of Prussian blue, molybdic acid, which dissolves it in large quantity, and molybdate and tungstate of ammonia, which also dissolve it very readily.

Correspondence.

Occultation of Jupiter.

To the Editor of the Scientific American:

The occultation of Jupiter by the moon yesterday morning was very successfully observed here with the 10⅛ inch equatorial refractor. The sky was very clear indeed. The first contact was noted at 18 h. 45 m. 47 s. sidereal mean time. The last contact at emersion was recorded at 19 h. 37 m. 31 s. My daughter Anna (eleven years of age), who observed the phenomenon with the three inch finder attached to the large telescope, independently recorded the first contact one second earlier than above.

Jupiter was distinctly seen, although the sun was shining brightly, and the belts of the planet were easily visible in both telescopes.

WILLIAM R. BROOKS.

Smith Observatory, Geneva, N. Y., March 25, 1889.

English War Ships.

There is, says the London *Engineer*, a vague sense of something lacking which is not pleasant, and it seems strange that notwithstanding the enormous variety in type admissible in the navy, nothing has been produced which is perfect in one respect. Thus we have nothing superlatively fast, or steady, or safe from being sunk, or able to fight her guns to perfection. Compromise is no doubt an excellent thing, but it is possible perhaps to push it too far, and it seems as though it might be worth while to abandon some qualities wholly to secure the possession of others in perfection. Thus, for example, it might be worth while to arm ships of the Archer class with guns which they could really use at sea; and although something else would have to be sacrificed, it might be found better in the end to raise the turret guns of the Hero, which are now, we are told, so close to the deck that the explosion from them is likely seriously to damage the upper deck fittings in their line of fire. As it is now, all the fittings on the fore deck leak badly, and the mess deck is always afloat when steaming against a moderate sea. A trial of the strength of these fittings should be made by firing full charges right ahead. The great defect of the modern British navy is that we have always tried to combine too much in one ship. Our designers have behaved in effect like men who have to pack into one portmanteau what would fill three; they are reluctant to leave out anything, and the result is that the whole is crushed and spoiled. A very large sum is to be spent on the navy. Let us hope that, instead of building half a dozen ships, in each of which half a dozen more or less incompatible qualifications are to be combined somehow, the plan will for once be tried of building half a dozen different ships in each of which will be found some superlatively good qualities.

Deoxidized Bronze.

A representative of the *Iron Age* paid a visit recently to the foundry of the Deoxidized Metal Company, of Bridgeport, Conn., of which L. H. Bacon is president, O. C. Smith is secretary and treasurer, and W. W. Keys is superintendent. The works are equipped with 23 crucible melting holes, which are to be supplemented in the near future with a large reverberatory furnace, to be heated with oil, capable of melting 10,000 pound charges. The foundry is to be enlarged by the addition of a building on adjoining property recently acquired, which is to be 80×130 feet, and is to be used chiefly for heavy loam work. Until now the largest castings of deoxidized bronze made were the rings of digesters for the bisulphite wood pulp process, which weighed 8,500 pounds. Five rings and top and bottom casting composed such a digester, 22 feet long, 7 feet 8½ inches in diameter, and weighed 28,000 pounds. Soon larger digesters are to be made, weighing 45,000 pounds, the company having orders for 19 of these large and 17 small digesters. Tests made in 1886 by Dr. T. M. Drown, of the Massachusetts Institute of Technology, proved the resistance of the metal to the corrosive action of bisulphite of lime.

The Late Professor Proctor.

From a letter that has come into our hands, from the widow of the late Richard A. Proctor, it appears that the astronomer did not die of yellow fever, as has been commonly supposed, but of a low remittent malarial fever, that his wife and two of his children likewise suffered from. His son died of the same disease last November. Mrs. Proctor is desirous of making journalism a profession. As secretary and assistant editor of her husband in his literary work, she has had considerable experience, and has besides an aptitude and fondness for this class of work.

Mrs. Proctor has recently received a civil list pension of $500 as the result of a memorial signed by Sir John Lubbock, the Duke of Argyle, and other prominent countrymen of the deceased. Mrs. Proctor is at present residing at her home at Corona Lodge, Orange Lake, Florida.