undertaken by Government intervention. He proposed to impound the water, and bring it to London, passing to the eastward of Manchester into Birmingham, passing along the middle plateau of England to a large reservoir at Edgware at an altitude of 500 to 600 feet above London. The cost would be £21,000,000 and the water would supply 8,000,000 of people, and the cost, therefore, would compare well with that of other waterworks. There was nothing unusual, he said in the project except its magnitude. The distance from Ulswater to Edgeware was 260 miles, but Manchester was at present seeking powers to construct an aqueduct 100 miles in length; Liverpool proposed to bring water from North Wales, a distance of 70 miles; and Paris had recently constructed two aqueducts 168 miles in length, and why could not an aqueduct 260 miles in length be constructed for London?

Mr. Joseph Prestwich, one of the commissioners on river pollution, read a paper on underground waters, which he showed are subject to the same dangers as surface water; but the sources of contamination fail to make themselves so apparent, and they do not exist to the same amount. Artesian wells, he said, could often be used with great advantage.

Dr. Wright, medical officer of health at Cheltenham, said he believed it was the general opinion that the Conference should come to some practical conclusion, and he would therefore move — "That this congress desires to urge upon Her Majesty's Government the importance of taking steps, with the least possible delay by means of a small permanent scientific commission to investigate. and collect, for the information of the public, the facts connected with water-supply in the various districts throughout the United Kingdom, in order to facilitate the utilization of the national sources of water-supply, for the benefit of the country as a whole," as suggested by His Royal Highness the Prince of Wales, the President of the Society of Arts. The motion was put and unanimously agreed to. A vote of thanks was passed to the Prince of Wales for writing the letter which had led to the calling of the Conference together.

BURLINGTON (IOWA) WATER WORKS.

May 31, '78, was a gala day in Burlington. It was the crowning triumph of an effort to obtain a water supply for the city that dates back nearly a decade of years. The problem was not an easy one to solve. It is true, water in lavish abundance flows past the city. The supply is not only inexhaustible but the quality is superior to that furnished many American cities. The great river, with its rapid current and immense volume of water flowing down over the rock, gravel and sand that line its bed and send the water in eddying currents over and about its sand bars, is freed from organic impurities, and is surcharged with the oxygen that accomplishes its purification. There was the water in all its plentitude and purity, but it swept unheedingly onward, and left the ambitious "metropolis of Iowa" athirst and unprotected. For while it was possible for the crude water cart to supply, in a small way, the domestic necessities of the people, and sprinkle a few streets at a disproportionate cost for the results obtained, these primeval appliances afforded no protection against that dreaded enemy of all ages, the devouring flames. Progress in building up the city was checked by this deficiency in the protection of property. Capital shrank from investment where so great risks were incurred. This environment of peril fed upon the commerce, trade and industry of the city, for it not only discouraged the improvement of property, but it taxed the property owner with high rates of insurance.

But the citizens of Burlington had faith in the future of the city. They had an abiding faith that the Flint Hills, pierced by nine lines of railway and crowned with so many substantial evidences of an enduring progress, were yet destined to witness the triumph of man over every natural obstacle that stood between the city and its future growth. From the water level to the elevated plateau, that marked the beginning of the fertile stretch of prairie lands towards the west, is an elevation of about two hundred feet. To force water to that height and then distribute it with sufficient head to meet the requirement of every householder was

A DIFFICULT PROBLEM,

and one which troubled not a little every thoughtful citizen. At first glance it appeared simple enough, for, surely, where there are hills there can be built great reservoirs into which water may be pumped and left to distribute itself to consumers by the volition of its own gravity. But as a matter of fact *there are no hills in Burlington*! "A hill," says Noah Webster, LL. D. "is a natural elevation of land, or a mass of earth rising above the common level of the surrounding land." No such condition of things exists at Burlington. As the prairie land approaches the west bank of the Mississippi, streams of water, in past ages, have cut deep channels in the land in their descent to the river, and the numerous ravines thus formed are still affected by the washing away of the soil in each storm, that continues the labors of the centuries past. At the foot of several of these ravines that converge near the centre of the present city of Burlington there landed from their skiffs,

FORTY-SIX YEARS AGO,

the first white men who undertook to settle in the lands of the Fox and Sac Indians. The famous Indian chief Black Hawk then ruled the wild domain, and whether the advance of the first white men had his acquiescence or not, it was in contravention of government treaties with the Indians, and federal troops from the post at Rock Island came down and drove the pale-faced intruders away and burned their cabins. But in 1833, after the Iowa lands were ceded to the government, the pioneers came back again and then began in earnest the settlement at the foot of the "Flint Hills." As the town grew it gradually filled up the semi-circular basin formed by the convergence of the various ravines until men began to penetrate these natural thoroughfares to the table lands above, and building improvements in time filled the openings and dotted the upper plains. And naturally to the ascending settlers the rugged blufts, when viewed from the lower plateau, assumed the character of "hills," and to this day they are known as such, until "North Hill," "West Hill," "South Hill," and "Prospect Hill," are popular terms for denoting the sections of the city not located on the lower level. And it was only natural that in the earlier days the popular estimate of the future system of water should embrace a reservoir, the city was located mainly at the foot of the bluffs. But as the city grew and nearly all the best residence property, and not a little of business property is now to be found on the upper elevations, it is obvious that the reservoir system grows every year more impracticable. However reluctantly our citizens have relinquished their favorite idea, recent surveys and careful investigations have removed all doubt and convinced them that a system of direct pressure is an imperative necessity. For while a reservoir might be constructed, at large expense, on the highest elevation in the city, it still would fail to supply water any higher than the first stories of thousands of buildings, and would entirely fail to meet the requirements of reliable protection from fire. There was therefore no other practical solution of the problem but a system of direct pressure which would furnish all the water required for domestic and general consumption, and which would also afford the very best fire protection wherever the street mains extended. The tests that were made yesterday we think fully justify the wisdom of the Burlington water company in adopting what is known as the Holly system of water works. The Holly system of water works has been adopted and is in use in more than seventy towns and cities in the United States. This number does not include some twenty or more built on the same or a similar plan by other parties than the Holly company. The chief advantages of this system over the older systems, are, 1, Secures by variable pressure a more reliable supply of water for all purposes. 2. Less cost for construction. 3. Less cost for maintenance. 4. Less cost for daily supply. 5. Affords the best fire protection in the world. 6. Largely reduces insurance risks and premiums. 7. Dispenses with fire engines in whole or in part. 8. Reduces fire department expenses. All the tests made thus far in Burlington fully substantiate these claims as we shall more fully show farther on in this article.

The history of the attempt to build water works in this city is a history full of doubt and unproductive effort prior to the organization of the present company Several ordinances were passed and companies organized, but the obstacles, both natural and human, always intervened and thwarted every attempt. Finally, on the 17th of July, 1877, the present water ordinance was adopted by a unanimous vote of the council—one member only being absent, out of the city. To meet the requirements of this ordinance the Burlington Water Company was organized with a capital stock of $300,000. The following is a list of the original stockholders:

Hon. Charles Mason, Hon. John H. Gear, Hon. John Patterson, T. W. Barhydt, Jas. C, McKell, R. Spencer, J. Darling, John G. Foote, S. E. Barnes, J. J. Burnham, H. H. Scott, E. M. Eisfeld, George Sweny, Thomas Hedge, Donahue & McCosh, William Salter, H. I. Chapman, T. W. Newman, J. Kroft, P. T. Smith, all residents of Burlington.

Directors.—Hon. Charles Mason, R. Spencer, Hon. John Patterson, James C. McKell, T. W. Barhydt.

Officers.—Hon. Charles Mason. president; Hon. John Patterson, vice president; James C. McKell, secretary and treasurer.

Hydraulic Engineer.—T. N. Boutelle.

Chief Engineer at the Water Works.—Ira Holly.

First Assistant.—Charles Hood.

Second Assistant.—M. J. Haddox.

PREPARING FOR BUSINESS.

On the 19th of July President Mason formally notified the city authorities that the Burlington water company accepted the water ordinance, and on the 4th day of October a contract was entered into between the city of Burlington and the Burlington water company, granting the latter the right to build and operate water works in Burlington. The details of the ordinance are too lengthy to be summarized in this article, but it is proper to say in brief that the terms are believed to be favorable for the city without being oppressive to the water company, and that the result will be that the citizens will obtain water at as low rates as the citizens of any other city in Iowa, and that Burlington will have the very best fire protection and water for public uses at a comparatively low cost besides creating a sinking fund that will ultimately result in the city obtaining the ownership of the water works at first cost. Our citizens are generally highly pleased with the plan adopted to obtain water works and we are confident time will fully sustain this favorable judgment. Too much credit cannot be given Hon. Charles Mason, the president, Hon. John Patterson, vice-president, Captain J. C. McKell, secretary and treasurer, and other prominent citizens who have taken so active a part, and we may justly add, such great risks in this laudable enterprise. These gentlemen and their associates subscribed to the capital stock of the company to the amount of $300,000, and are personally liable in that amount for the indebtedness or misfortunes of the water company, and yet, strange as it may appear, they are limited in the profits to be derived from this heavy liability to the paltry dividend of twelve per cent. upon $30,000 of the stock, as the ordinance prohibits their paying up more than ten per cent. of the capital stock. Any excess of profit over that amount ($3,600 per annum) goes into the "water fund" with the water tax and water revenues, to be appropriated, at the discretion of the city council, to extend the mains, or reduce the water tax, or to increase the sinking fund, or to reduce the water rates to private consumers. The interests of tax payers and water consumers are carefully provided for and the stockholders have a limit on their profits that is quite disproportionate to the risks incurred. A grateful public, however, will hope for the company that success in this enterprise that will protect them from loss and insure to them that pecuniary profit as well as public appreciation to which they are certainly entitled.

THE HOLLY MANUFACTURING CO.

has been represented here by Dr. J. T. Cushing of Chicago, the general western agent, and by Mark S. Foote, Esq., local agent, who has had supervision of the Holly Company's affairs in Burlington, Mr. Charles C. Hildreth of Lockport, N. Y., secretary and treasurer, was present during the duty and steam tests. Messrs. Cushing and Hildreth are genial, courteous gentlemen, and have proved as popular with our citizens as the splendid system of water works they represent. It is to be regretted that some device could not be invented to transport them and the Holly works to Burlington, in order to incorporate their irrepressible enterprise in the citizenship of the metropolis. And we deem it due Mr. Mark S. Foote to make special note of his services in the construction of the works. The Holly company express great satisfaction with his management of their interests here, but we know that long before he became their agent he was an enthusiastic advocate of the direct pressure system, and in common with Mr. Spencer and others of our citizens practically familiar with the principle of the direct pressure system has never lost his faith in its advantages, nor ceased to advocate its especial adaptability to the perplexing topography of Burlington. To Mr. Foote, Burlington is largely indebted to-day for its water works.

LETTING THE CONTRACTS.

The Holly Manufacturing company having taken the contract for the entire works, immediately sought out parties to contract for the different kinds of work. The laying of the inlet pipe and crib was done by Mr. Truman Cowell, of Muscatine. The work was done in a first-class manner, although the contractor was greatly troubled by the quicksand on which the coffer dam was built. The work was completed in time, and was the first sub-contract finished.

The contract for building the filter bed and the buildings was given to Mr. A. W. Manning, of this city. The work on this contract was prosecuted during all of last winter, but few days being lost.

The laying of the street mains was done by Messrs. Russell & Alexander, of Chicago. When it is remembered nearly thirteen miles of pipes were laid by these contractors and put through the severest kind of a test without a break or a leaky or imperfect joint being found on the line, the reputation of these gentlemen is established. Their contract was finished two months and a half before the time stipulated, and in the progress of their work they ever had the comfort of the citizens in view and never blockaded the streets or delayed travel any more than was absolutely necessary.

The pipes for the works were furnished by Dennis Long & Co., Louisville, Kentucky, and H. R. Smith & Co., of Columbus, Ohio. The Mohawk & Hudson Manufacturing company, of Waterford, New York, furnished the Eddy valves. The quality of the material furnished was such that on the trial, at extreme pressure, but three breaks were found on the entire line. These were defects that could not have been foreseen. In many trials in other cities as many breaks have been found in one mile. These pipes were delivered during the winter, and were handled roughly in loading and unloading them from the cars, and the fact that so few breaks were discovered speaks much in praise of the manufacturers.

The general superintendence of the whole contract was under the direction of Mr. T. N. Boutelle, the engineer of the Burlington Water company. Mr. Boutelle is a civil engineer of large experience in the construction of water works. He has been connected with the erection of water works in Anamosa, Clinton, Marshalltown and other cities in Iowa and in many other cities in adjoining states. He drew up the plans for the Burlington works and directed their entire construction. The ability he displayed in his labors, these works, which are second to none in the state, fully attest. Mr. Boutelle's experience was of much value to the Burlington company, and the system and arrangement of the whole is due largely to his skill.

RIVER WORK.

The river work consists of an inlet crib constructed of pine timbers, firmly bolted together, filled with broken stone, placed on the bed of the Mississippi River, in 19 feet of water at low water mark, and distant from the shore about two hundred and fifty feet. A 24-inch iron pipe extends along the river bed from a crib to a filter on the shore. The filter is of stone masonry, 130 feet long, 20 feet wide, and provided with suitable filtering materials, which may be renewed or cleaned at any time. An independent inlet pipe is provided to convey water directly from the crib inlet to the pumps, should the demand at any time (as for fire protection) exceed the capacity of the filter.

THE BUILDINGS.

The engine, boiler and coal houses, located 150 feet from the river, are of stone, have iron roofs, are substantial and fire-proof, and of dimensions suitable for a duplicate set of pumping machinery. The smoke-stack is of brick and 120 feet high. The Burlington, Cedar Rapids & Northern, and the Burlington & Southwestern railways run between the buildings and river, making the delivery of coal convenient and inexpensive. The filter extends from the crib inlet, under the tracks of these railways, to a pump well inside the engine-house.

PUMPING MACHINERY.

The pumping machinery is the latest design of the Holly manufacturing company, and embraces all recent valuable improvements. It is especially adapted to the service required, and in finish and workmanship cannot be excelled. The engine is of the compound type, and guaranteed to perform a duty equal to raising sixty millions pounds of water, one foot, with one hundred pounds of coal, and to supply the quantity of water — three millions gallons daily — and the fire streams required by the ordinance. It has four steam cylinders, each nineteen inches in diameter, twenty-seven inches stroke, with four corresponding reciprocating pumps, each ten inches in diameter and twenty-seven inches stroke, attached by direct connections and erected on a heavy arched double frame of iron, set at an angle of ninety degrees, one steam cylinder and its pump being placed at each of the four corners. The frame supports at its top a shaft with an overhanging crank on either end, to which the four engines are connected by ordinary connecting rods. The cylinders and pumps are detachable at pleasure, and may be run singly, in pairs or all together, according to the demands for water supply from time to time. The engine is provided with the usual air-pump and jet-condenser, and by a peculiar arrangement of pipes and valves may be run on either the high, low, or compound steam pressure principles, and may be changed from one to the other at any moment by the engineer. This arrangement is necessary to secure economical daily pumping for domestic supply, which is done by compounding steam, and prompt increase of power for efficient fire protection, which is amply secured by converting the machine into a high pressure engine. When compounding the steam is taken directly from the boilers into one of the cylinders and exhausted into the remaining three, and when running high-pressure is taken directly into all of the cylinders, the latter operation increasing the power of the whole four to eight times. To supply this increase reserve boilers are provided, there being three in all, either of which alone will be sufficient to meet the ordinary demand.

The water mains are of cast iron, tested at the foundry to withstand three hundred pounds hydrostatic pressure per square inch, and have since been subjected to a further test, after being laid in the ground, of two hundred pounds, which is twenty-five per cent. greater than will be required in practice. The lengths and sizes of mains are, in round numbers, as follows: One-third of a mile of sixteen inch; one mile and a half of twelve-inch; two miles of ten inch; four and three-quarter miles of eight inch; two and a half miles of six inch, and one mile and three-quarters of four inch, a total of a little over twelve miles and a half of street mains. The mains are all laid in trenches cut in solid rock. Additional mains are already petitioned for by the citizens.

HYDRANTS AND VALVES.

The fire hydrants are of the Holly patent, full size with double discharge and frost jacket. There are one hundred and fifty-seven in all giving three huudred and fourteen hose attachments, one hydrant being placed at each street crossing on the lines of the mains, with a hydrant between in some instances. The stop gates or valves are sixty-four in number, of the Eddy patent. These are placed in the mains at suitable points for shutting off water in case of necessity or convenience, from any of the lines.

THE DUTY TEST.

On Wednesday, May 29, at 10:30 A. M., was begun a "duty test" of the works, to ascertain whether the Holly machinery would fulfil certain economic requirements of the ordinance. The engineers are required to raise sixty million pounds of water one foot with each one huudred pounds of coal, while pumping at the rate of three million gallons of water in twenty-four hours. The machinery was worked twenty-four hours without stopping. It had not been used for the previous twelve hours, and the coal was of inferior quality. The following official figures show the result, which was entirely satisfactory throughout:

Number of steam cylinders	4
Number of pumps	4
Diameter of steam cylinders, in inches	19
Diameter of pump pistons, inches	10 1-32
Length of stroke, in inches	27
Discharge of four pumps each revolution, in gallons	72 1-8
Duration of test	24 hrs, 17 min.
Number of revolutions	45,812
Average pressure on water gauge in pounds	86 2-10
Average height from water gauge, in feet	27
Total head of water equal to feet	226
Coal burned, in pounds	8,730
Duty in pounds, raised one foot per one hundred pounds of coal	71,514,000

The contract required 60,000,000 foot pounds duty, which was exceeded by nearly twenty per cent.

The quantity of water pumped during the run was 3,204,240 gallons, which was at the rate of 3,166,704 gallons for twenty-four hours, or five per cent. in excess of contract guarantee.

The last trial was a most magnificent display. A valve at the corner of Main and Jefferson streets was arranged to throw a three-inch stream. This display commenced at 5:10 p. m., and the column of water shot up immediately to the height of 170 feet.

The stream stopped at this height for a few moments, but in a short time the pressure was increased and the water went higher and higher until it far exceeded anything ever anticipated by any person, except those who had seen previous performances of the Holly pumps. When the full pressure was reached the column was measured and found to be two hundred and eighty-three feet high! The programme stated that this stream was to be thrown for ten minutes only, but it was kept up for twice that length of time, and the immense amount of water that was thrown during the time may be known, when according to the register kept by the engineer at the pumps, two thousand eight hundred and eight gallons of water were delivered each minute during this trial, and no other hydrant was open at the time. The wind was blowing just strong enough to let the water fall on the roofs of the houses on the west side of Main street and the gutters on the roofs were not large enough to carry off the water which poured from the eaves in volumes. This last test was a grand sight, and a close to the proceedings of the day and satised every one as to the power of Holly enginfie and pumps.

AT THE WORKS

all moved as smoothly as a drawing-room reception. The engineers were calm as a May morning, and all was as "serene" as the president of the United States, The engines and pumps worked steadily; the steam guages showed an even pressure, and the moderate fires and leisurely movements of the firemen showed there was no "forcing" of boilers or machinery. One boiler was not used at all. The engines were worked on the compound plan, the steam entering all four cylinders at high pressure, but condensed on the other stroke, thus creating a vacuum and utilizing the atmospheric pressure. Large crowds stood around and watched the beautiful working of the machinery with undisguised admiration. The following "cold, glittering facts" will tell the "expert" reader better than descriptive language, the work done by the machinery.

Boiler pressure during day from	60 to 70 pounds.
Water pressure, test No. 1	150 "
Water pressure, test No. 2	140 "
Water pressure, display No. 3	130 "
Water pressure, display No. 4	145 "
Water pressure, test No. 5	115 "
Water pressure, display No. 6	120 "
Water pressure, 1¾-inch stream, Congregational church	130 "
Water pressure, 1 inch stream, 1000 feet hose	150 "
Water pressure, 3-inch stream	145 "
Number gallons, test No. 1	1,200 gallons per minute.
" " test No. 2	1,200 " " "
" " test No. 3	1,800 " " "
" " display No. 4	216 " " "
" " test No. 5	1,728 " " "
" " test No. 6	3,000
" " 1¾ inch stieam, Congregational church.	850 " " "
" " 8 1-inch streams, 1000 feet hose	216 " " "
" " 3-inch stream	2,808 " " "
" " water per day	3,000,000 to 5,000,000

A number of visitors from other cities were present during the day having come for the purpose of examining the workings of the Holly system. Janesville, Wisconsin sent a delegation from her city council and citizens, composed of the following gentlemen: Henry Palmer, J. A. Blunt, James Church, D. Denis, J. B. Fitzgibbons, S. Hutchinson, Edward Ruger, and G. A. Libbey. Keokuk was represented as follows: W. C. Stripe, chief engineer of the Keokuk water works; William Leighton, president, and Secretary Niles. Also Messrs. C. B. Armitage, S. P. Pond, Truman Cowell, John Jones, Guy Wells and John Crawford. Rock Island, Galesburg, Monmouth and Geneseo, Ill., were represented. Mr. S. Van Cleve, superintendent of the Des Moines water works, was present and assisted at both the duty and fire stream tests.

In conclusion we cannot do our readers, and especially our own citizens a better service than to make a brief mention of the inventor of the Holly system and his various improved machines and engines. The inventor is Mr. Birdsell F. Holly, of Lockport, New York, at which place the system was first introduced in 1863. He is the uncle of our Ira Holly, and a brother of A. P. Holly who has been engaged here for some time in putting in the machinery. Several disastrous fires having occurred in Lockport, Mr. Holly conceived the idea of a stationary fire engine. The Holly manufacturing company was organized to carry out Mr. Holly's plans which were at once successful and have since achieved such noticable triumphs. More water works on the Holly system have been built in the United States than all other systems taken together. In the state of Ohio alone the Holly system is in operation in eleven cities, and perhaps we cannot do better in this connection than to make the following extract from the Dayton, (O.) *Journal:*

"Water was played upon the fire — seven streams from the Holly hydrants — over two hours, when it was thoroughly extinguished. The streams were thrown far over the tops of the buildings, and tore away the shingles from the roof, illustrating the power of the streams to the complete satisfaction of spectators. Mr. John H. Winters, of Winters' bank, adjoining, reported no damage of consequence from water. He said the Holly water works at the Beckle House fire, and in the fire last night, had saved to Dayton their whole cost."

CONGRATULATION.

At the close of the day it was hard to find any person who had any objections to find against the Holly system of water works. The works have exceeded the contract so much in every particular, that a general expression of satisfaction was heard, that our city was extremely fortunate in securing the best system of water works in the west. The people of Burlington are gratified at the completion of the works and at the possession of one of the surest possible protections from fire. They are also gratified at the prospect of the future of our city which will increase in manufactures, etc., through the conveniences afforded by water works, and from no one who has the best interest of the city at heart can be heard any word of grumbling or discontent at the cost this necessity will place upon our city. For Burlington we predict a steady progress toward prosperity. We have now all the essentials of a first-class city. The future looks brighter, and to the enterprising men who have labored long and earnestly to give us this latest need, the *Hawkeye* joins in wishing them the fullest realization of their most sanguine expectations.—*Burlington Hawkeye.*

THE PROGRESS OF WATER WORKS ENGINEERING IN TWENTY CENTURIES.

What a change has taken place in countries where great civilizations have flourished, from the time when the lone savage lay down by the river's brink to slake his thirst, to a long-after period, when some world-renowned city, full of luxury and art, received its supply through magnificent artificial channels, constructed with transcendant skill, and of a monumental durability that could be overcome only by the earthquake or the ruthless violence of man!

And what has been the progress since the period of the great aqueducts? Structures more wonderful have been built it is true; but for the supply of water to cities we are enabled, from a thorough comprehension of the capabilities of iron, to meet the same ends by less costly means. The mighty energy of steam, the fertility of modern invention, and the general advance of science, have likewise in nothing more powerfully ministered to the wants of man than in bringing this great necessity of life within his immediate reach. With the vast structures of ancient Rome we need not be ashamed to contrast the mighty giants of iron, which to quench the thirst of our great metropolis, labor from morn till night with the effort of ten thousand horses. On to the tops of the hills and into our very chambers is the liquid forced.

But what is the liquid, and whence is it obtained? Some bright and pure from springs and wells, but most of doubtful hue and flavor drawn from a sewage-polluted stream, the instinctive appreciation of which cannot easily be set aside. Rome, with but few of the advantages at our disposal, did not stop to consider the great expense of fetching water, pure and clear, from the distant hills. Fortunately, however, there are to be found many modern examples of praiseworthy and happy selections of source, and also of thorough artificial purification.

But on the score of quantity what can be said? In ancient Rome the daily consumption was at the rate of three hundred gallons for each individual, so liberal was the use of water for baths and fountains. In the present day thirty gallons are consedered to be a wasteful quantity; this is the change in the estimate of what is necessary for comfort and for health; this is the progress of the last two thousand years.—*Humber's Treatise on Water Supply.*

BOOK NOTICE.

The Railway Builder; A Hand-book for estimating the probable cost of American Railway Construction and Equipment. By Wm. J. Nicolls, C. E. Philadelphia: Henry Carey Baird & Co., Industrial Publishers, Booksellers and Importers, 810 Walnut street. 1878. Price $2.00.

Such is the text of the title page of an exceedingly neat work, in the form of a pocket-book, now before us. The author in his preface says that he realizes "the fact that other books have been published covering the same ground in detail, and that numerous works by engineers of known ability and reputation are also in existence, which contain an immense fund of general information and most of the tables necessary for calculation. But they are either in a condensed form, or clothed in formulas and symbols totally unknown to the average railroad man." We should not be inclined to favor the book on the latter clause, for we are of opinion that the "average railroad man" should know, at least something, of the formulæ and symbols used in his professional literature, and it is in a great measure on account of the country now being overrun with men of such poor attainments that the profession is in such a depressed state, there being an enormous excess of pseudo-engineers over the demand for engineering services. But to the really practical man the work will be of great service, undoubtedly. We have often expressed ourself in support of literature of this class, provided it be based on the latest and most trustworthy facts and compiled or composed in such a manner, as to render real service when called upon. Such books save an incalculable loss of time: the manual in question can be easily carried in the pocket and far away from works of a more technical character, there are few questions on purely railway matters that will not find a practical solution in its pages. It treats upon: Field operations, Preliminary Surveys; Cost of Earthwork; Permanent Way; Frogs and Switches; Equipment, and Depots and Structures. Under the four latter heads there is much valuable and practical information,—seldom found in so useful a form,—illustrated with many woodcuts.

The book, as we have said, is very attractive in form, and very portable; it contains some 231 pages, is well printed on toned paper, and is altogether a creditable production.

NEW USES FOR SLATE.

This country is peculiarly rich in building materials, and especially rich in deposits of slate of the finest quality, which sooner or later is to assume a degree of importance hitherto unknown in building construction. At present there is a growing demand for slate in large buildings for the construction of stairs, for which it is most admirably adapted. Its advantages are in its comparative lightness, strength and durability. One great advantage of slate over marble is the ease with which it can be prepared. Risers and treads are split to nearly the requisite thickness, and readily worked down to a smooth surface, when they are treated almost as though they were of wood, though of course slate demands iron construction. Fine examples of slate stairs can be seen in the Delaware and Hudson Canal Company's building, and in the *Evening Post* building in New York, and it is greatly to the credit of R. M. Hunt, Esq., that he has taken such an advanced position in the use of this material.

Slate wears like steel. This is a most important requisite in material for stairways. Marble grinds out under the tread of passing feet where seemingly no impression is made on slate. The stairs of the Pennsylvania Hospital were built of slate, from Pennsylvania quarries, in 1859. Recently a careful examination was made to test the amount of wear on the treads, and it was found to be imperceptible; as on laying a straight edge lengthwise of the step, there was not space enough to admit the insertion of a knife blade. Such a result is very remarkable, to say the least, and is worthy the thoughtful attention of our builders. In color, slate possesses a decided advantage over marble, as the color of the latter is cold while that of the brown slate is rich and warm. Slate, too, can be had in unlimited quantities of a fine grain, and so beautiful in color as to admirably adapt it for panels in wainscoting.

Lately there has been an increasing demand for slate in the place of marble in urinals, largely on account of its imperviousness to moisture, as well as for its superior cheapness. A piece of slate may be kept in water for weeks with no perceptible increase in weight. An important feature, too, is the ease with which it may be worked, admitting of perfect joints so necessary in large water closets.

CORRESPONDENCE.

U. S. Coast Survey Sloop "Steadfast,
Indian River, Fla., May 27th, 1878.

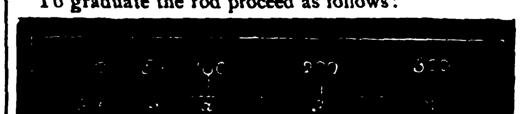
Sir:—I should like to give, for the benefit of your readers, the method I have employed for accurately dividing a telemeter-rod so that the correct distances from the center of the instrument may be obtained without computation.

From the center of the instrument measure a distance of d' of [illegible] mine the interval t', included between the parallel wires. Measure f, the focal length of the telescope for parallel rays, viz., the distance from the object-glass to the cross-wires when the telescope is focussed on a remote object; and the distance k from the object-glass to the center of the instrument. Let w denote the distance between the parallel cross-wires, and compute the ratio $\frac{w}{f}$ from the formula $\frac{w}{f} = \frac{t'}{d' - (f + k)}$, then the interval t comprised between the parallel wires at any distance d is

$$t = \frac{w}{f} d - \frac{w}{f}(f + k) \qquad (1)$$

Example.—Wurdemann Pivot Level No. 16. $d' = 100$ feet, $t' = 1.3175$ ft., $f = 1.35$ ft., $k = 0.69$ ft.; hence $\frac{w}{f} = 0.01345$ and formula (1) becomes $t = 0.01345\, d - 0.027$ ft.

To graduate the rod proceed as follows:



Lay off ab = second term in formula (1) = 0.027 ft. in the example, then lay off ad = its *observed value* = 1.3175 ft. in the example, and divide the rod proportionately, starting from b, viz.: $bg = 2bd$, $bn = 3bd$, $bs = \frac{bd}{2}$, etc.

For precise measurement, two targets may be used, one fixed and the second movable. The rod should always be held vertical. The *correction* to be applied to the reading on account of slope is $c = r \sin.^2 a$ where r = reading and a = angle of elevation or depression. This correction is always minus and can easily be taken from a table by inspection. An approximate formula is $c_{100} = 0.03a^{\circ 2}$, that is the correction for a reading of 100 equals 0.03 of the square of the angle of elevation in degrees. This formula is sufficiently close for any case in ordinary hilly country; for corrections less than 30 the error of formula is less than ¼.

In running a telemeter traverse with a rod graduated according to the manner described, between points of a triangulation, the greatest error was 5 ft. in 1000, and the average error in a distance of 9 miles was 2 feet in 1000. As the error was + in all cases, it is probable that it was due to some extent to want of verticality of the rod. The telescope used on this work was an inferior one. It is a waste of time and eyesight to attempt precision with a poor telescope. In my practice I have found inverting telescopes much to be preferred for clearness of image.

Very respectfully yours,
Horace Andrews, C. E.