Science and Art.

Measuring Falling Water.—No. 2.

[Concluded from page 216.]

From the many experiments made to ascertain the amount of water passing through notches in a given time, 6-10th, of the theoretic quantity may be taken for common practice, so that by the rules we have given, any person may easily calculate the power of any body of water passing through an orifice, or notch.

Templeton's Rules to ascertain the quantity of water flowing under a sluice and over a weir, in a second, are as follows:—"If the water flows under the sluice, multiply the square root of the depth, in feet, by 5·4, and by the area of orifice also in feet, and the product is the quantity of water discharged in cubic feet per second. If the water flows over a sluice or weir, multiply the square root of the depth in feet by 5·4, and two-thirds of the product, multiplied by the length and depth, also in feet, gives the number of cubic feet discharged per second, nearly.

Required the number of cubic feet per second that will issue from the orifice of a sluice 5 feet long and 9 inches wide, and 4 feet from the surface of the water. 2×5·4=10·8 velocity, and 5×·75×10·8=40·5 cubic feet per second."

This quantity of water, multiplied by 60×4, and 62·5; then divided by 33,000 will give the horse power of the water.

The following is the formula of Wm. Blackwell, given in a paper read by him on the subject before the London Institution of Civil Engineers, May 6th, 1851: $\sqrt{2gH}\times lH\times m$. Q is the discharge of cubic feet per second, 2g =64·3—the effect of gravity. H is the head in feet; lH is the section of steam, and m is the co-efficient of correction.

This is like the one given in the article last week.

We have the letters of three millwrights before us, all of whom agree in the use of the particular formulæ and rules given as applied to estimate the quantity of falling water through orifices, and its power. Their rule is to multiply the square root of the head by 8·5 for the velocity of water in feet per second; reduce this to inches, and multiply it into the area of the orifice in inches, for the quantity of water in cubic inches; which, divided by 1728 gives the amount in cubic feet falling in one second. Multiply this by 60 seconds, and 62·5 lbs., which will give the weight of water in lbs. per minute. The resultant, multiplied by the hight of the fall, and divided by 33,000 gives the horse power of the water. Thus,—What is the power of water passing through an orifice of 500 square inches under a six foot head? The velocity of the water operating through an orifice under such a head, one letter says, is 19 8-12 feet per second; the other says 17·5 feet per second. We will take the highest velocity (from a letter of A. P. Torrence, Oxford, Ga.,) 19·8-12×12 (inches in a foot)=236×500 (area of discharge)=118,000×60 (seconds in a minute)=7,080,000 (cubic inches of water per minute)÷1728 (cubic inches in a foot)=4097 1-4 (cubic feet of water per minute (×62 1-3 (lbs. in a foot) =255,194 lbs. of water falling 6 feet in one minute; 255,194×6 (distance fallen=1,531,-164÷33,000=46 1-3 horse power, from which if 25 per cent. be deducted, a good wheel, propelled by such water, will yield 34·5 horse power. With such a fall, and such an area of orifice, Messrs. Collins & Gilbert, of Troy, N. Y., state they build water wheels warranted to give out more than thirty horse power. These rules are those commonly used by our millwrights.

The factor 5·4, given by Templeton, embraces the co-efficient of correction used by most millwrights; but some use the factor 5·1 which we think is most correct; it embraces the corrective co-efficient ·6, given in the article last week, when 8·5 is used as the multiplicand for the effect of gravity. Thus what is the velocity of water per second flowing under a 4 foot head? V4×8·5×·6=10·2; also V4×5·1=10·2 ft. This shows the harmony of the two methods.

In these articles our object has been to present rules which are in common use, and such information connected with them as is not generally known. Our desire is to have such information free from error, so that it can be depended upon. We will again give the method of calculating the horse power of a certain quantity of water, to correct an error of a figure on page 208, in the amount of water.

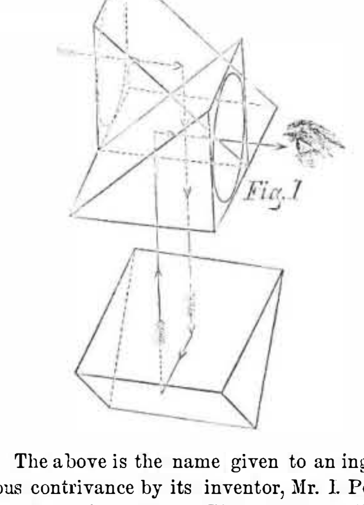
What is the horse power of 40 cubic feet of water passing over 6 foot fall every second? 40×62·5×6×60÷33,000=27·27. From this deduct one-fourth, for loss by friction, &c., and the actual power is 20·46; or, by the old allowance, one-third, and the actual power is 18·18 H. P.

We have been thus particular and minute in order that persons who have falls of water, may be able to calculate their power for themselves.

An engineer, in this city, informed us that he erected a steam engine of twenty-five horse power in a factory at Greenfield, Conn., and yoked it to the main shaft which had been driven by a breast wheel stated to be seventy horse power. The water was shut off from the wheel, and the engine (not working above the rated power) drove the whole machinery, turning the water wheel also. This surprised him, for the water wheel of 70 horse power had not been able to do more than drive the machinery in the factory. He came to the conclusion that the common method of calculating the horse power of water—was compared with the steam engine—was wrong, and he reasoned thus:

"Supposing there is a fall of water 16 feet high, with an orifice of two square feet (24×12 inches,) letting on the water to an overshot wheel; only 32 cubic feet of water will merely be discharged per second, which, by the common rules of calculating, would give no less than 68 cubic feet. By the law of falling bodies, a molecule of water will fall in a trunk from zero through 16 feet in a second, and no more; true, it will have attained a velocity of 32 feet at the end of the second, but its average velocity from zero is only 16 feet per second, that is, a trunk of water 16 feet deep, with an open bottom, will only discharge its contents once every second. This quantity, multiplied into the hight of the trunk, for the pressure, is the real horse power."

The Napoleon III. Spy Glass.



The above is the name given to an ingenious contrivance by its inventor, Mr. I. Porro, a retired officer of the Piedmontese military engineers. We condense the following description from the Paris *Illustration.*

The improvement consists in so arranging a series of prismatic lenses that the larger portion of the spy glass may be placed in a vertical case; as, for example, in the head of a cane. Convenience in holding, traveling, and economy of space is thus secured, while the power of the spy glass is, in some respects, improved.

A short instrument, like that shown in fig. 2, when held in the hand, is less liable to oscillation, and enables the observer to point it correctly and steady, and to measure by means of an *ocular micrometer* the distance to a given point, whenever the absolute size of the body observed is known, and *vice versa;* it is also very convenient for transportation, making a pocket instrument without the usual sliding tubes, which prevent a correct centering of the lenses.

This spy glass consists of an objective rectangular prism, fig. 1, ground in the shape of a lens on one of its catheti, and throwing back below, by reflection on its hypothenuse, the horizontal rays from the exterior body observed. These rays meet a second rectangular prism, where, by the last reflection, they are thrown on the ocular or anterior cathetus, also shaped like a lens. The distance between

the objective glass and the eye is consequently but the thickness of a prism, (hardly two inches,) the real length of the apparatus becomes vertical, is hidden inside of the handle, which affords the observer a means to hold it in a steady position. The arrows indicate the direction in which the rays of light are reflected. The exterior shape, fig. 2, is very handy, not liable to get out of order, and the whole is quite portable, and the instrument very powerful. A is the eye glass. B thumb screw for regulating the focus. The greatest difficulty the inventor had to contend against was to obtain perfect achromatism; in this, we are told, he has fortunately succeeded perfectly: his instruments are as free from colored spectra and aberration as the most perfect spy glasses constructed in the ordinary manner. A small micrometer is also adapted for the purpose of computing distances. The inventor has secured patents in France, and other European countries.

[For the Scientific American.]

Safety Life Ships.

Messrs. Editors—The daily press having spoken upon the subject of safety at sea, it is but reasonable to suppose that there are many like myself who believe that your paper—the most widely-circulated mechanical and engineering journal in the United States—should also show the absurdity of sending ships to sea with no other protection against foundering than the shell of the vessel. We have heard of bulkheads until the subject has become as common-place as a household word, but we seldom pause to inquire what kind of bulkheads are meant.

The common sense of ship owners and masters has caused them to abandon the lumbering wooden tank for holding water in a ship's hold, substituting iron, because iron tanks were stronger, less bulky, and more durable than wood; and yet, strange to say, they build wooden bulkheads around the engines and boilers of an ocean steamer; in other words they build boxes of iron to hold water, and of wood to hold fire; and this we are called upon to regard as an improvement. Will the common sense of this commercial community lead them to expect that these longitudinal and transverse bulkheads around the engines and boilers can be kept water-tight, even though they were calked at the termination of every voyage?

It is fearful to contemplate how horror-stricken the unfortunate passengers and crew would be in case of a rupture like that of the *Arctic,* to find that the leak through the seams of the bulkheads was scarcely less than those of the vessel itself. It is high time the traveling public looked to their own safety, and resolved to take passage in no steamer that has the bulkheads around their engines of wood, to become a tinder-box in case of fire, and a seive in case of flood. These bulkheads should be of plate-iron, extending from the ceiling to the lower deck, and be made water-tight; then, and not until then, will the ocean traveler feel that he is secured against the dangers of the ship, which are sometimes even greater than those of the sea.

New York. A Ship Builder.

Mr. Mechi, the celebrated English farmer, affirms that every farmer who cultivates a farm of two or three hundred acres without the use of a steam-engine has a great lesson to learn in agricultural economy.

Literary Notices.

The Annual of Scientific Discovery for 1856—D. A. Wells, the editor, has, in this volume, given us another choice and excellent epitome of the progress of science and invention during another year. The editorial notes are excellent, and the selections exhibit an extensive acquaintance with the subjects treated. It is divided into various distinct parts, under which certain discoveries are described. The chapter devoted to the mechanics is unusually large and replete with accounts of new inventions. The chapter devoted to chemical science also contains a great amount of information useful to every person in every rank of life—the mechanic, merchant, and laborer, as well as the chemist. There are also separate chapters devoted to Natural Philosophy, Geology, Astronomy, Geography, and Botany, in each of which there is much to instruct and interest the reader. Dr. Wells possesses great tact, discrimination, and industry in preparing such a work as this; and we do not know of a single annual more useful for families than this. It is a neatly printed volume, containing about 400 closely printed pages, and is illustrated with a steel plate of Col. Richard M. Hoe, of this city. Published by Gould & Lincoln, Boston, and Geo. P. Putnam & Co., this city.

The College Review—This magazine for the present month has a long and able article on "Debating as a means of educational discipline." The other articles are very good, especially one devoted to the Public Schools of New York City. The editors of this Review are Absalom Peters, D.D., associate S. S. Randall. The latter may have a predilection in favor of the schools which he superintends, but we assure him they require a thorough reformation. The scholars in our Public Schools are compelled to study too many different subjects at once. Girls and boys of nine and ten years of age are scarcely able to carry to and from school the quantity of books they have to study. They learn a little of everything superficially, and nothing well. N. A. Calkins, 348 Broadway, Publisher.

The Edinburgh Review—This periodical is the oldest of the British Quarterlies, and maintains a reputation second to none and equalled by few. The number for this quarter—just issued by its enterprising publishers L. Scott & Co., 54 Gold st.—is an excellent one. It contains ten original essays, the first of which is on the "Civil wars of Cromwell," and the last one on the "Russian campaigns in Asia." This number commences a new volume—a good time for subscribing by those who wish to become acquainted with British criticism.

The United States Magazine for this month contains an elaborate article on the manufacture of fire-proof safes, illustrated with a number of wood cuts. Published by J. M. Emreson & Co., No. 1 Spruce st.

The Quarterly Law Journal—This able Review for this quarter contains a very able essay on "Legislative Tinkering." The other articles are also excellent. It is edited by A. B. Guigon, and published by J. W. Randolph, Richmond, Va.