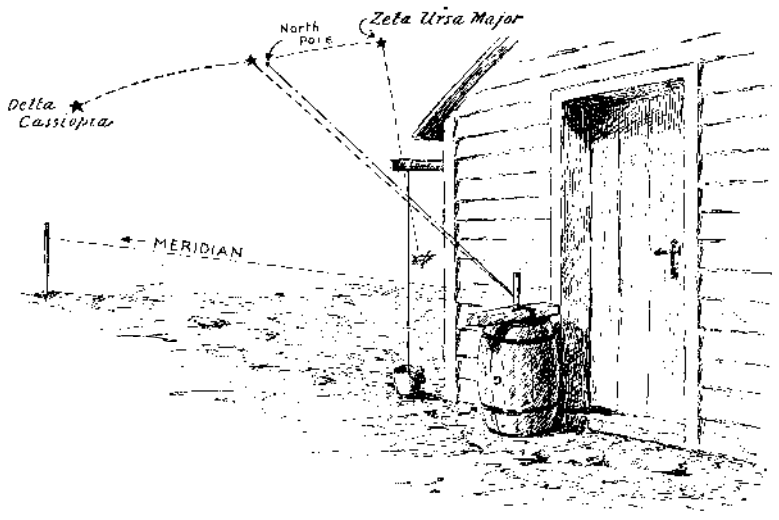
DETERMINING THE MERIDIAN WITHOUT INSTRUMENTS.

BY J. A. MACDONALD.

One of the simplest methods of determining the true meridian, and which calls for no mathematical instruments, or knowledge of the celestial sphere, is by observing Delta Cassiopeiæ over the vertical of Polaris. I recently made one of those observations, and found its accuracy by taking two other observations of Polaris at "hour angle" and at elongation. The method is so simple that most surveyors, from its very simplicity, ignore the method. This method is not at all new. Ellicott used it in 1785 in determining the line between Pennsylvania and Ohio. The method has often been described, but seldom or never illustrated. I show in the accompanying illustration the method, which I used a few days ago, and it speaks plainer than words and text can. The dotted line from the peepsight, attached to the block of wood lying on the kerosene barrel, to the pole star Polaris, is continued in the same plane to Delta Cassiopeiæ. When this ray is in perfect alignment, as seen at the peep-sight, with the plumb line, Polaris, and Delta Cassiopeiæ, Polaris is then within 3m. 42s. from the meridian. Watch in hand, the peep-sight is then moved westerly, keeping the star hid by the plumb line. At the expiration of 3m. 42s. the star is on the meridian, and the observer is looking directly north, as shown by the dot and dash line. Zeta Ursa Majoris is also in the meridian, approximately at the same time as Delta Cassiopeiæ, but is too high up to observe through a peep-sight. One eye, however, placed just before the plumb line, as shown in the picture, can range Zeta with Polaris very well. The dotted line shows the visual ray from the eye, going almost vertically through Zeta in the constellation of Ursa Major, and thence curving onward below the Pole to Polaris. Zeta is, however, in alignment with Polaris 42 seconds after Delta. The heavy block will lie unmoved on the cask till morning, when the meridian may be laid out by sighting to a stake some 100 feet to the north, as seen in the picture.



HOW THE MERIDIAN CAN BE ASCERTAINED WITHOUT ASTRONOMICAL INSTRUMENTS.

The northwest corner of a building is the best position, as shown in the drawing. The plumb line may be 10 or 12 feet long, and some 4 feet from the corner of the building. The cask may be set about 5 feet south of the plumb line. An ordinary compass sight is the best to screw on the scantling, though a piece of tin, with a slit, will answer.

WHY BARRELS ARE BROKEN BY ICE EXPANSION.

Correspondents who have studied this question have found that suspending a piece or stick of soft wood in the center of the cask prevents the breakage of the cask when the water is solidly frozen. It is asserted by some that a cask open at one end cannot burst, since the upper layer of ice has a free end to expand, but a correspondent shows this is not conclusive in the set of sketches herewith.

He states: There is a resistance very soon. A barrel of water placed on a flat surface without air circulating under it forms ice first at the open top, then at sides, last at bottom. This difference continues, increasing the thickness at top and angles until there is formed an egg-shaped chamber around the remaining water. The ice is heaviest at top and thinnest at middle of bottom. As the increased pressure caused by expansion of freezing presses against the barrel, the weakest surrounding wall must give. If the bottom with its thin layer of ice is stronger than the top ice, this last will break, relieving the pressure (Fig. 4); but frequently the greater thickness at top resists at the expense of the bottom.

A piece of wood two or three feet long, suspended with lower end at center of barrel, the water under pressure will escape between it and the surrounding ice to top, congealing there in layers, forming an elevation several inches high. This escaping water prevents the wood from becoming tightly fixed in ice, and the increased pressure beneath may cause it to rise several inches through the ice, as seen in Fig. 3.

Fig. 1 shows the first stage of the ice formation. Fig. 2 is the second stage, showing the extra thickness at the top and the beginning of the ice uplift.

It is a well-known fact that water begins to expand while it is seven degrees above its freezing temperature, and the expansion continues as it becomes ice. In the change from water to ice the expansion is about one-ninth, and this amount of space must be provided somewhere. Usually a strong barrel will hold, and the ice will give way at the top, but the use of a stick of timber no doubt is helpful in preventing possible breakage.

The Current Supplement.

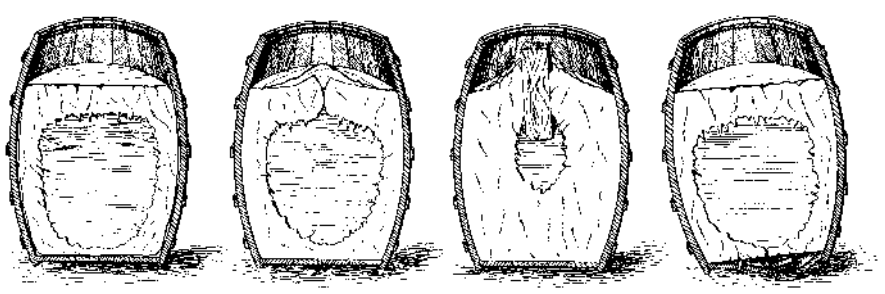
The current SUPPLEMENT, No. 1515, opens with an exhaustive article by Mr. Arthur Gulston on "Ice-breakers and Their Service." The paper is very fully illustrated with photographs of almost every type of ice-breaker now in use. Prof. N. Monroe Hopkins presents his fourth paper on "Experimental Electrochemistry." The present installment describes some novel experiments in electrolytical induction. Mr. William Bateson discourses on "Breeding and Heredity." A new process of testing lubricating oils is described, which depends upon a novel electrical principle. The method consists in measuring the internal resistance of a column of fluid, at the base of which some particles of the oil to be studied are set in motion. The greater the internal friction of the oil to be tested, the greater will be the effect upon the column. Two of the largest French railway companies have been employing American locomotives. M. Daniel Bellet presents an interesting account of the results obtained with these engines. Mr. Israel C. Russell writes on the co-operation of American geographical societies. Another installment of Prof. G. W. Ritchey's interesting paper on the making and testing of optical mirrors appears. The present installment discusses the testing and figuring of paraboloidal mirrors, and testing and figuring convex hyperparaboloidal mirrors. "The Influence of Boric Acid and Borax on Digestion and Health" gives a *resumé* of Dr. Wiley's painstaking investigations.

Another Borelly Comet.

On December 28, Borelly at Marseilles discovered a comet which has been observed by Prof. Kreutz at Kiel, Cohn at Koenigsberg, Hammond at Washington, Seares at Columbian, Mo., Barnard at Yerkes Observatory, and Aitken at Lick Observatory. The last-mentioned astronomer has computed the following ephemeris from observations made on December 31 and January 1:

1905 Jan. 5.5d.	R. A. 1 h., 23 m. 8s.	Dec. — 4° 12′	Light 0.94
1905 Jan. 9.5	R. A. 1 h.. 28 m. 52s.	Dec. — 1° 04′	
1905 Jan. 13.5	R. A. 1 h,, 34 m. 56s.	Dec. + 1° 59′	
1905 Jan. 17.5	R. A. 1 h., 41 m. 20s.	Dec. + 4° 50′	Light 0.77

The electric underground tube railroad of London has established a unique achievement in the dispatch of thirty-one trains per hour in either direction. This is equivalent to one train in less than every two minutes, which is additionally remarkable when it is remembered that the trains have to be dispatched from one platform. When the railroad was first opened a service of fifteen trains per hour was established. But as the working of the railroad became more familiar the service was accelerated until the present service has been attained. This service is maintained between the hours of 8 and 10 in the morning and from 5 to 7 in the afternoon to cope with the rush of traffic that is set up at those times. It is believed, however, that thirty-one trains per hour marks the limit under the existing conditions, as the time occupied in switching a train from the arrival to the dispatch platforms at the termini cannot be accelerated.



EFFECT OF FREEZING WATER IN AN OPEN BARREL.

Prof. Waldstein's Proposed Excavation of Herculaneum.

Prof. Charles Waldstein, of Cambridge University, England, lectured recently in New York on a plan of his to excavate the city of Herculaneum which, together with Pompeii, succumbed to Vesuvius. It is Prof. Waldstein's plan to have the United States and the principal countries of Europe co-operate in unearthing the ancient town.

The last excavations were undertaken in 1875. To continue work would require a sum of money which no single government would care to appropriate. Indeed, the task may be said to be a rather difficult engineering feat, inasmuch as the modern city of Resina is built upon the ancient site, and must be preserved so far as possible.

Prof. Waldstein has formulated a plan whereby the work is to be supervised by national committees in each country, the honorary head of each to be the ruler of the particular country. An international committee is to be headed by the King of Italy, and an international staff is to be appointed with whom the Italian archæologists into whose hands the work will be intrusted are to consult.

That the execution of a plan such as Prof. Waldstein proposes would mean the acquisition of priceless archæological treasures can hardly be doubted. Herculaneum, historically considered, is a far more interesting city than Pompeii. Pompeii was but a provincial town inhabited by Romans of the lower class. Herculaneum, on the other hand, was a city of villas, and its inhabitants were the *élite* of the empire. More Greek than Roman in its artistic atmosphere, the city retained its distinctive character up to the time of its destruction and attracted many Greek artists and writers. The finds which were made a quarter of a century ago during the interrupted excavations gave promise of still more important discoveries. "In one house alone," said Prof. Waldstein, "sixty-five copies of one work on Epicurean philosophy were discovered. . . . May we not find in Herculaneum the lost books of Livy, the great lost dramatist, and throw new light on the early history of Christianity?"

Herculaneum was more fortunate, from the archæological standpoint, than Pompeii. Unlike the latter city, it was not covered with ashes which destroyed everything that was perishable, but was overwhelmed to a depth of 80 feet with a kind of soft mud which has acted as an excellent preservative of wood, papyri, statuary, and other objects. After the eruption of Vesuvius many Pompeians returned to their homes and hastily removed whatever valuables had escaped the eruption. The depth to which Herculaneum was buried prevented a similar procedure by its people. For that reason the excavation of Herculaneum means the revelation of a Roman city exactly as it was left in the highest state of its development.

Legal Life of a Railroad Ticket.

A decision as to the life of a railroad ticket, which is attracting considerable attention, has been rendered in favor of the Southern Pacific Company by the Civil Court of Appeals at San Antonio, Tex. The court has decided that a railroad ticket which is not used within a reasonable time after issuance, is barred by the statute of limitation. The case arose out of the sale of a ticket by the Southern Pacific on April 29, 1885. The ticket was for a trip from Houston to San Antonio. The man who bought it died without using it. Fifteen years later it was sold. Late in 1899 it was offered to a Southern Pacific conductor. The latter refused to accept it and the man refusing to pay his fare was ejected. There was nothing irregular in the ticket or in its purpose and transfer. In deciding against the man in his damage suit for ejectment, the court holds that "it was never contemplated that the ticket should be held for nearly half of an average lifetime before it was presented for the purpose for which it was purchased. The ticket held by the appellant could not occupy any better position as to the statute of limitation than a promissory note payable on demand."—The Railway and Engineering Review.

At New Rochelle, N. Y., on October 8, Henry A. Gouge, a well-known sanitary engineer and inventor, died, aged 76 years. He was the inventor of one of the earliest safety car heaters, the device bearing his name, and this was in service on the New York Central Railroad until a short time ago. He was also the inventor of a system of ventilating public school houses and other public buildings. He was born at Hartford, Conn., and had lived at New Rochelle over 25 years.