

$\theta$  being the zenith distance. The residuals from the formula were satisfactorily small (in no case exceeding .002 sec.), and appeared to be purely accidental.

Values of the formula were computed for different zenith distances, and from these a table was prepared giving the zenith distances at which the value of  $\Delta c$  changed from one unit (in terms of .001 sec.) to the next; it is this table which is used in the reduction of transits.

It may be remarked that the strictly logical method of procedure would be to treat the sine and cosine terms independently. Thus, if the complete representation is given by

$$\Delta c = a_0 + a_1 \cos \theta + a_2 \cos 2\theta + a_3 \cos 3\theta + \dots + b_1 \sin \theta + b_2 \sin 2\theta + b_3 \sin 3\theta + \dots$$

the terms with largest coefficients should be chosen without combining the sine and cosine terms in pairs. This mode of procedure would in the actual case considered have changed the adopted formula slightly, in that the term involving  $\sin 2\theta$  (coefficient - .0002) would have been omitted, and that involving  $\sin 12\theta$  (coefficient - .0005) would probably have been included. Had the tables not been completed originally with the formula as given above, this change would have been made. As, however, the change in adopted pivot errors would have been extremely minute, it has not, up to the present at least, been thought worth while to make the change.

### THE NEW DOCK AT SINGAPORE.

The completion of the King's Dock at Singapore marks an important stage in the scheme of extension and reconstruction works undertaken by the Singapore Harbor Board. The new dock is the largest dry dock in the far east. Its length from the outer stop to the head is 892 ft. 6 in., and from the inner stop to the head 876 ft.; the width at the entrance 100 ft., and inside the dock between the copings 128 ft.; and the depth on the outer sill 34 ft. at high water, and 24 ft. at extreme low water. By means of a central caisson the dock can be divided into an inner and an outer portion, 502 ft. and 346 ft. long, respectively.

With the exception of the entrances, which are of Cornish granite ashlar, the dock is constructed entirely of concrete. The altars consist of moulded concrete blocks, and the remainder of the face is of fine concrete masswork. Three rows of granite keel block courses run the length of the dock under a corresponding number of heavy timber keel blocks, the remainder of the floor being of mass concrete.

For filling the dock two culverts 7 ft. high by 4 ft. 6 in. wide are provided, and for emptying it there are two culverts measuring 10 ft. by 6 ft. The pumping station contains two Gwynnes' 60 in. centrifugal pumps; each has two suctions 36 in. in diameter, and they are together capable of emptying the dock, which contains 22 million gallons of water, in less than two hours against a maximum lift of 39 ft. Each of the pumps is direct coupled to a compound condensing engine of about 1,100 horse-power, having cylinders 24 in. and 46 in. in diameter with a stroke of 24 in. Steam is furnished at 160 lbs. pressure by three boilers, each able to evaporate 12,300 lbs. of water an hour.

Two ship caissons are provided, each weighing 826 tons, including ballast, and as they are identical in size they are interchangeable. Included in the equipment are four ten-ton and eight five-ton capstans, a five-ton crane, a fifteen-ton crane and penstocks, all the appliances being worked electrically by power generated at the Board's own power station. The cost has been over \$2,000,000.

### SHELLFISH CONSERVATION AND SEWAGE DISPOSAL.

THE American Public Health Association has a committee on sewage collection and disposal which will submit a majority and minority report at the convention in Colorado Springs this week. The question of conservation of the shellfish industry is one reason for the lack of unanimous opinion on the part of the committee. In connection with this question Mr. George A. Johnson, consulting engineer, New York City, and a member of the committee, has favored us with a copy of his comments upon the present situation.

He outlines the reversal of conditions since the day when the aborigines made free use of shellfish as food. Since that time huge sewer outfalls in the neighborhood of shellfish grounds have greatly altered public opinion on the advisability of their use as a fish. The shellfish industry has grown until the value of the total annual output of nearly 40,000,000 bushels amounts to approximately \$20,000,000. Where shellfish formerly grew in a naturally pure state the grounds are more or less subjected to currents of contaminated water.

Another point touched upon is the certainty of epidemics of typhoid fever and other disorders as a result of the use of polluted oysters for foods.

It is a problem how shellfish grounds may be protected from contamination from this source. The best grounds are found in the mouths of rivers and bays near the ocean, which is unfortunate, as such waters are usually subjected to pollution by the sewage of cities and towns located directly on or tributary to them. The report goes on to state that although shellfish in constantly changing, unpolluted water will become purified in from one to two weeks, this department of oyster purification has not been receiving adequate attention, although deserving of exhaustive study.

Another point is that shellfish will continue to be used as food, and that, "except in special well adapted cases it is impossible, on financial and other grounds, to conserve absolutely the purity of shellfish by sewage treatment. Complete treatment of the sewage entering waters which flow over shellfish layings will improve existing conditions, and in special cases almost, if indeed not entirely, remove the existing danger; but to be thoroughly effective a condition is required which is seldom, if ever, found at sewage treatment works to-day. There would be required not only extreme conscientiousness in the operation of the sewage treatment works, paralleling the vigilance with which good water filtration works are watched, but also interstate co-operation, the whole order of affairs being supervised by a supreme authority vested by law with power to approve or condemn.

"The conservation of the shellfish industry is a difficult problem, made so by the fact that common law rights of sewage disposal into the sea and its estuaries have been and are being extensively utilized. To set these conditions back a century solely for the sake of conserving the oyster industry, where no other offence is created, is a matter which, if pressed, will engage active sanitary, financial and legal minds for many years to come."

The new Canadian Northern road from Toronto to Ottawa will be opened about October 15th. The line is one of the main connecting links of the Canadian Northern Ontario lines, and will open a straight connection from Northern Ontario and Toronto to Montreal and Quebec.