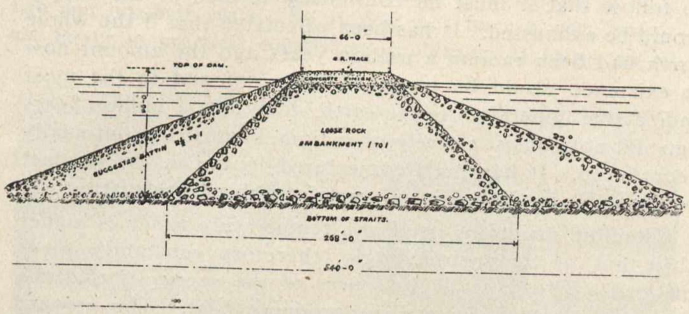
Loading and unloading cars and quarrying stone:

35 men to each car, 1,200 days, at $2 each per day..	$1,006,000
35 men to each car, 960 nights, at $2 per night....	806,200
400 men, hauling with scows, 1,020 days, at $2 each	816,000
Superintending and train hands..................	50,000
Engines, cars, rails and track-laying.............	300,000
100 scows, $20,000; incidentals, $1,800............	21,800

A total cost of $3,000,000.



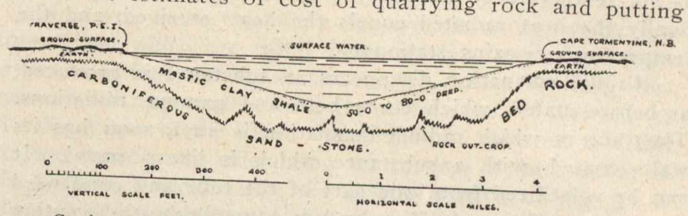
Cross Section of Proposed Embankment Across Northumberland Straits: together with Suggested Batter, as Designed by J. C. Underhay, C. E.

About 700,000 yards of this work would be above water, and would best have a concrete finish at an extra cost of $1 per yard. The foregoing calculations have been made assuming, as we are warranted in doing, that there is plenty of stone at each cape (Cape Tormentine, on New Brunswick side, and Cape Traverse, on Prince Edward Island side), and along the shores; and that cars could be so constructed and adapted to the work as to unload themselves with little help or loss of time. It would take about 350 acres at a depth of twelve feet to supply the stone to be put down by the cars.

Method of Construction.—Having full faith in the practicability and durability of the embankment, constructed of rough stone, dumped from the cars at each end of the work and from scows in the middle, which would roll out to about the angle mentioned, with a concrete finish above water. The work would require no expensive machinery nor skilled labor, and the money spent in a rough embankment of this kind would go into the pockets of the local men on each side of the Straits willing to do a fair day's work for a fair day's pay, while a costly masonry embankment would probably cost more than even a tunnel, with the same disadvantage of the greater part of the expenditure being for costly machinery and imported labor. Though no precedent exists for such a gigantic embankment, nor has any tunnel been bored where such conditions exist, nevertheless the history of the world teaches us how slow the public mind is to accept any new theory. As the work on the embankment progressed each year it would facilitate the communication between the Capes by narrowing the gap. The first season's work would narrow it by more than a mile on each side, besides about 1,870 yards in the middle."

J. A. Macdonald, a student member of the Canadian Society of Civil Engineers, of Hermanville, P.E.I., in forwarding Mr. Underhay's sketch, says:

"The writer considers a flare of 45 deg. insufficient, and suggests a batter or flare of 22 deg., or about 2½ to 1. This would increase the cost considerably. The writer also considers the estimates of cost of quarrying rock and putting



Section (Approximate) of Northumberland Straits: Between Cape Traverse, P.E.I.; and Cape Tormentine, N.B. Designed by J. C. Underhay, C. E.

it in place too low by 100 per cent., maybe more, and that the cost of the embankment would be not less than $10,000,000, instead of $3,000,000 or $4,000,000. The writer also thinks that with a batter of 2½ to 1 the embankment scheme is more practical than a tunnel."

RADIUM AND ITS CONNECTION WITH CHEMICAL AND PHYSICAL PROBLEMS.

BY JOHN WADDELL, B.A., D.Sc., SCHOOL OF MINING, KINGSTON.

(Concluded.)

From the measurement made of the deviation of the beta rays, as compared with that of the cathode rays, it appears that the two are similar, but that the velocity of the beta radiation is greater than that of the cathode rays. The cathode rays penetrate but slightly the walls of the tube in which they are produced electrically, but the beta radiations, on account of their high velocity, are very penetrative. This gives some idea of the energy with which beta rays are emitted, since cathode rays in an exhausted bulb are produced only by very powerful electric discharges. In the same way the gamma rays are probably similar to the Roentgen rays, but they also are much more penetrative. The photographic effect of the Roentgen bulb is mainly due to the Roentgen rays. The cathode rays escape but slightly from the bulb, and, though the Roentgen rays are not so penetrative as the gamma rays, yet there are more of them than are produced by the minute quantities of radium salt employed in the ordinary experiments.

Some radioactive substances give out alpha radiations only, but where beta radiations are emitted they are always accompanied by gamma radiations, and, just as Roentgen rays are produced by the stoppage of cathode rays, so it seems that the gamma rays are produced in the formation of beta radiations; that is, a sudden change of velocity of the particles gives a wave motion in the ether, just as a stone thrown violently upward through the surface of water by an explosion sets up waves similar to those produced by its fall.

The energy of the alpha radiations is very great, and when a particle strikes certain substances, such as zinc sulphide a change is produced that is accompanied by a flash of light. These flashes can by a proper arrangement, such as in the spinthariscope, be made plainly visible. It is calculated that a gram of radium loses in every second more than 100,000,000,000 alpha particles, so that in the spinthariscope the zinc sulphide screen is heavily bombarded.

If a compound of radium is heated or if it is dissolved, and air is passed over the hot substance or through the solution, a gas is carried off which is very radioactive. The quantity of gas is so small that it cannot be detected by the ordinary physical or chemical means, but it can be liquefied, and its rate of diffusion through another gas can be determined. This is owing to its effect on phosphorescent substances. If air containing the gas, which is called the radium emanation, passes through a tube containing zinc sulphide, the latter glows. If the tube is made very cold in any part, the emanation liquefies, and the zinc sulphide beyond that point ceases to glow. Though the emanation is a gas, it is not absorbed by liquids that absorb most gases. Moreover, it is not acted on by chemical reagents, it does not attack heated calcium, or magnesium, and is, in fact, like the group of gases, of which argon is the most conspicuous member.

As already said, the radium emanation is strongly radioactive—it gives out alpha radiations only. This is shown by the fact that if air containing the emanation is