Ungava Bay in northern Quebec, Frobisher Bay and Cumberland Sound on Baffin Island, and the Bay of Fundy in the Maritimes, an arm of the Atlantic ocean separating New Brunswick and Nova Scotia. The Fundy tidal range, that is the difference between successive high and low water marks, reaches a value of 15.9 m in the Minas Basin at the head of the Bay, making it one of the highest in the world. During the past 50 years, several schemes have been advanced to build tidal plants on Fundy, but except for one project by the Americans none has ever been attempted. During President Roosevelt's make-work program in 1933, construction was started on the Maine coast of the Bay of Fundy (in Passamaquoddy Bay), but it was never completed because of a lack of funds. In 1969, a four-year study sponsored by the Canadian Government in conjunction with the provinces of New Brunswick and Nova Scotia was published which examined all aspects of tidal power plant development in Fundy. The report of the Atlantic Tidal Power Programming Board (ATPPB) suggested the best sites for the plants to be built with predictions of the power output that could be expected from the project on completion. In view of the huge costs of construction, however, a sum that might run well in excess of a billion dollars, the project was not deemed economically feasible. (The report was drawn up before the sudden rise in the cost of fossil fuels in the early 1970s.)

Because such large amounts of money and construction time would have to be spent on a tidal power plant project, it is important to have a fairly detailed knowledge of how the physical system behaves (the tidal wave in the selected bay or estuary) and to predict reliably how the constructed plants would disturb or alter the system's natural state. It would be a costly mistake to build the system only to find that its presence diminished the tidal wave to the point where the energy return no longer justified the economic investment.

Mathematical model

One of the simplest ways of obtaining this information is to build a mathematical model that reflects the behaviour of the marine system, a set of equations that simulate the movements of the tidal waters as they ebb and flow through the Fundy basin. The proposed changes can then be made to the model (in this case the addition of the tidal barriers) and the resultant effects on the system studied. Expensive errors can therefore be avoided and the best sites for the tidal barriers chosen, the degree of confidence in the results being reflected in the precision with which the model simulates the real system.

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The Bay of Fundy tide is so powerful that it causes the water to reverse direction and run "uphill" at the mouth of the Saint John River, New Brunswick, creating the Reversing Falls (above). *Some day the Fundy tide may be harnessed to produce energy.*

Such a mathematical approach is being attempted by Dr. G.F.D. Duff, chairman of the University of Toronto's Mathematics Department. With the aid of a National Research Council operating grant, he is setting up a model that simulates the tidal motion of the waters from the head of the Bay of Fundy out through the Gulf of Maine and extending across the North Altantic ocean to the coasts of Africa and South America.

Resonance likened to "swing"

Dr. Duff took all the information available on the area between the continental shelf and the headwaters of the Bay of Fundy, the geographic and oceanographic dimensions, and embodied them in a mathematical model that described the surface wave characteristics of the waters. The results showed that a factor that was unusually strong in the system was resonance, which is best understood by considering the example of a child on a swing. If an adult pushes the child at the top of each swing, the amplitude or height of the swing increases. The push has a period or interval very close to that of the swing, and the two are said to be in resonance.

"Like the swing, each body of water has its own natural period of oscillation," says Dr. Duff, "and the mathematical model demonstrated that the waters in the Fundy system out to the continental shelf have a natural period very close to that of the lunar tides. In other words the lunar "push" on the oscillating aquatic system occurs at precisely the right time or in just the proper phase to result in a resonating system. Resonance therefore makes a significant contribution to the high tidal wave that characterizes the system."

Dr. Duff explains that detailed numerical calculations were also done on the effects of erecting tidal barriers at sites that were considered in the ATPPB feasibility study. It appears that the barrier proposed for Economy Point will not make much difference to the tidal regime, but he feels that more definitive results require a much larger model, of the sort that he is presently devising. There has been some suggestion that the regime, or amplitude of the tide, would actually be increased by a barrier at Economy Point, but Dr. Duff believes that no one model can yet be said to reflect accurately the real system and as such it is still too early to make a conclusive statement.

"The tantalizing part of this whole

(Continued on P. 8)