a larger share in all works undertaken to promote the welfare of their country.

The author does not claim to be a botanist, nor does Dr. Schlich, who preceded Mr. Ribbentrop, nor does their successor, Mr H. C. Hill, the present Inspector-General of Forests. It is necessary to mention this because in England, also among scientific men, the opinion prevails that forestry is a branch of botany, and that a forester who is not a botanist cannot claim to be a scientific man. Dr. Schlich's great merit while holding the appointment in India was to organise that branch of forestry which deals with the plans regulating the working of the forests, a business which is based more upon mathematics than upon botany. Mr. Ribbentrop's great achievement has been to study and correctly to appreciate the peculiar sylvicultural requirements of the great variety of trees and bamboos with which the forester has to deal in India. Through his labours the management of teak, of sal, sissoo, deodar, and of other important trees when growing by themselves or in company with other kinds or with bamboos, their regeneration, natural or artificial, and their subsequent treatment under different conditions of soil and climate, is much better understood now than it was twenty years ago. These are great results, which, provided no retrograde measures are adopted, will bear fruit in steadily increasing the productive powers and capital value of the forests, and will contribute largely to the welfare of the millions inhabiting the British Indian Empire.

DIETRICH BRANDIS.

SUBMARINE BOATS.

THE building of five submarine boats for the British Navy not only forms quite a new departure but also, perhaps, the advent of the nucleus for an instrument of war of novel design. The boats (says *Engineering*, March 29), which are being built by Messrs. Vickers, Sons and Maxim, Ltd., are of the *Holland* improved type and are 63 ft. 4 in. in length over all, 11 ft. 9 in. beam, and 120 tons displacement submerged, and they will be capable of expelling torpedoes either with the boat at rest, during the run on the surface, or steaming at any speed submerged. When running on the surface the boats will be propelled by a gasoline engine (of marine type, inverted, and with four single acting cylinders). The amount of fuel carried will suffice for a run of about 400 miles with a maximum speed of about 9 knots, and when submerged an electric motor of the waterproof type, worked with storage batteries, will give the vessel a speed of seven knots, which can be maintained for four hours. The general operation of the boat is given as follows:—"Before it is desired to make a dive, the boat is brought to 'awash' condition, with only the conning tower ports above the water. The dive is then made at a small angle until the proper depth is reached, when by automatic means the boat is brought to a horizontal position. After the discharge of the torpedo from the fixed bow tube, the compensation for the weight of the torpedo is made automatically, causing only a slight change of trim for a few seconds. Provision is made for quick rising and diving, the time of appearance of the conning tower above the water being dependent on the skill of the navigator." In the United States Navy the *Holland* has undergone most exacting trials and has proved herself "stable in service working," and it is here we get the most convincing testimony, where Admiral Hitchborn, chief constructor in the United States Navy, states in his official report, "The *Holland* has shown herself capable of such complete control in the vertical plane that she may be kept within a few inches of any desired depth while moving, or brought to the surface and taken under again in a very short time: her direction and control in the horizontal plane on the surface is effected with the same facility as any other craft, and submerged is limited only by the difficulties of vision: her crew are provided for on board with reasonable comfort and perfect safety for such periods as she may be in service and working either upon the surface or submerged; and her armament, consisting entirely of torpedoes, gives her great offensive power."

THE CURRENTS IN THE GULF OF ST. LAWRENCE.

IN a former article (January 24, 1901, p. 311) we gave a summary, from a pamphlet recently issued, on the currents in the Gulf of St. Lawrence, in which we noticed some points of general application to similar researches elsewhere. This pamphlet, issued by the Department of Marine and Fisheries, Canada, gives concisely the results of investigations in th summer seasons of three years in that Gulf, conducted by Mr. W. Bell Dawson, in charge of the Survey of Tides and Currents. It is primarily for the benefit of practical seamen; but it also contains an explanation of the hydrography of the Gulf, on which this Survey has thrown considerable light; and it is this part that we now summarise.

General Characteristics of the Gulf of St. Lawrence.—With the exception of the currents in the various straits and near the heads of the bays, the currents met with in the open Gulf seldom exceed one knot. They are, therefore, the more easily influenced by strong winds, especially at the surface of the water. Currents which have a greater speed than this are found in Belle Isle and Cabot Straits, in Northumberland Strait, off the Gapsé coast, in the Gut of Canso, and locally in channels between islands and at the mouths of rivers.

The water of the Gulf may be roughly divided by a line running from South-west Point of Anticosti to the middle of Cabot Strait. Along the south-western side of this line the water has a lower density, as it is apparently made a little fresher by the outflow of the St. Lawrence River. To the north-east of this line, throughout the north-eastern arm of the Gulf, the water has the same density as in the open Atlantic.

The general drift of this water of lower density is outward, towards the Atlantic. This gives rise to two constant currents, one at the mouth of the St. Lawrence along the Gaspé coast, which may be called the "Gaspé Current," and the other on the west side of Cabot Strait around Cape North, which may be called the "Cape Breton Current." A third constant current is found on the west side of Newfoundland, making northeastward from the Bay of Islands towards Rich Point.

It is to be noted that in calling these currents constant it is only meant that they usually or most frequently run in the one direction. During certain winds they may be much disturbed, or their direction may even be reversed.

Temperature.—It appears that in general the temperature of the surface water merely rises with the progress of the season; and it is also natural that the water should become warmer to a greater depth as the season advances. Even this has its limitations, however; as at a depth of 50 fathoms no greater rise in temperature has yet been found than from 32° to 34°, between the month of June and the end of September.

At all three angles of the Gulf it was found that the coldest water forms a layer between the depths of 30 and 50 fathoms. In the vicinity of Belle Isle Strait, the same low temperatures are also found at these depths; although there the temperature towards the surface is relatively lower, as a rule, than in other regions. It is probable that this cold layer extends very generally over the Gulf area. Below this cold layer, in the deep channel of the Gulf, the temperature from 100 to 200 fathoms is found to range very constantly from 38° to 41°. This result was obtained in Cabot Strait, and also between the Gaspé coast and Anticosti, 220 miles further in from the Atlantic, along the deep channel. This deep channel runs into the Gulf from the Atlantic basin through Cabot Strait, and maintains a continuous depth of some 200 fathoms across the middle of the Gulf to the mouth of the St. Lawrence River. It still has a depth of 100 fathoms half-way up the estuary on the Lower St. Lawrence.

Density.—It may be stated broadly that throughout the north-eastern portion of the Gulf the average surface density ranges from 1·0235 to nearly 1·0245; while in the south-western portion the density is below 1·0235, ranging usually down to 1·0220, and falling in the Gaspé Current itself to 1·0210. The dividing line between these two portions of the Gulf runs approximately from South-west Point, Anticosti, to a point in the middle of Cabot Strait. The densities in the border region near this dividing line naturally vary to some extent. The density of the north-eastern portion is practically the same as in the open Atlantic, as it was there found to range from 1·0237 to 1·0242, as shown by seven determinations made at the end of June off the south and south-east coasts of Nova Scotia.

This result is important in showing that the lower densities found in the south-western portion of the Gulf of St. Lawrence are confined to that side; and this also accords with the conclusion that the general set or drift across the Gulf is in the direction of a line from Gaspé to Cape Breton. On the other hand, the endeavour to obtain some differences locally, which would correspond with the various directions of the current, was without result; although a large number of temperatures as well as densities were taken for this purpose.

The deep water as found from samples taken at depths of 100