of the canal differ so greatly in their amount of rise and fall.

In the maps taken from the survey report for 1904 it is noticeable that the cotidal lines converge or crowd together in the vicinity of the Leeward Islands as in a locality just west of Acapulco, Mexico, which indicates a rapid change in the time of tide across the nodal lines of the stationary waves described above. By cotidal lines, as the term itself indicates, is meant an assemblage of points where tides occur at the same absolute time. The maps also show that the time of tide changes but little in going along the Pacific coast of Central America or in going from the United States to the Bermudas or even to Porto Rico. For the facts upon which this article is based we are indebted to the courtesy of the Coast and Geodetic Survey.

AN ELECTRICAL ANALOGUE FOR RESPIRATION.

Hæmoglobin, the coloring matter of the red corpuscles of the blood, is remarkable for the facility with which it unites with oxygen to form oxyhæmoglobin, which, in turn, parts as easily with the oxygen thus acquired and becomes reduced back to hæmoglobin. It is this property that fits the substance for the part which it plays in the respiration of warm-blooded animals. It absorbs oxygen in the lungs and, after having been distributed through the body in the form of oxyhæmoglobin, gives up the oxygen which it has brought with it. Even outside the body hæmoglobin absorbs oxygen from the air and readily gives it up to reducing agents—for example, to the hydrogen evolved at the cathode of a galvanic cell. It may therefore take the place of manganese dioxide as a depolarizer in a zinc and sal ammoniac battery.

A rod of gas retort carbon is painted with several coats of an aqueous solution of hæmoglobin and immersed, with a rod of zinc, in a solution of sal ammoniac and common salt, in which hæmoglobin is insoluble. The electromotive force remains constant for a short time after the circuit is closed, then falls off suddenly as the last of the oxyhæmoglobin is reduced, but it may be restored to its initial value by leaving the circuit open a while or, more rapidly, by blowing air into the liquid. The cell, therefore, produces energy from the consumption of atmospheric oxygen, as the living body does, through respiration.

The analogy goes even further, for if the cell is placed in an atmosphere containing carbonic oxide it does not recuperate in the manner described above. It is poisoned, and by the same substance that poisons animals under like conditions—the very stable compound carboxyhæmoglobin.

Long experience has proved this peculiar battery to be very suitable for bell-ringing and similar purposes, if it is set in the open air. The cost of maintenance is very small.

THE BRITISH NAVAL PROGRAMME FOR 1905.

BY OUR LONDON CORRESPONDENT.

The serious and far-reaching alteration in the balance of naval power in Europe, caused by the destruction of the Russian Pacific fleet by the Japanese, has manifested itself in the naval estimates of Great Britain for the coming year. So great is this influence, that not only has the amount of money allotted for naval purposes been appreciably reduced, but several war vessels authorized in the 1904 programme have been definitely abandoned, while for the first time in twenty years the personnel of the navy is to be diminished. Such a radical departure from progression on the part of the British government serves to throw the effect produced by the destruction of Russia's navy into significance, since had there been no war in the East, Great Britain would have been compelled to maintain the policy which has been carefully followed each successive year for many years past.

Another fact that has affected the British naval plans is the reorganization of the navy carried out by Sir John Fisher upon his accession to the premier post of the Admiralty. By his scheme all the less valuable and obsolete vessels in the British navy have been eliminated. Over one hundred vessels have been removed by his drastic measure, with the consequence that the navy has been rendered more heterogeneous and efficient, and is now a better fighting force than ever.

The sum estimated to fulfill the requirements of the British navy during the coming year is $166,945,000, as compared with $184,445,000 required for 1904, showing a reduction of $18,500,000. Of this sum $47,830,000 is to be devoted to new construction, representing a decrease of $10,440,000 upon the amount expended for this purpose last year. Of the programme authorized last year, it is intended to abandon the construction of one armored cruiser and a number of destroyers. Exactly how many of the latter it has been decided to forego is not divulged, however.

During the coming year the following vessels are to be laid down—one battleship, four armored cruisers, twelve coastal destroyers, six ocean-going destroyers, and eleven submarines. No details, however, are forthcoming of these new ships. During the past year the present fleet has been augmented by four battleships—"King Edward VII.," "Commonwealth," "Swiftsure," and "Triumph"; one armored cruiser; four third-class cruisers; twelve submarines; nine destroyers; four torpedo boats, and one river gunboat. There are now in course of construction 62 vessels, comprising 8 battleships, 15 armored cruisers, 1 second-class cruiser, 1 third-class cruiser, 8 scouts, 18 destroyers, and 11 submarines.

With regard to the destroyers, in the course of the development of this class of fighting unit, two qualities have successively predominated, namely, speed and seakeeping power. Their study of the tactical and other questions involved has led the Department to the conclusion that two classes of destroyers are requisite, one especially for ocean-going operations, and the other for use in the narrow seas. The Naval Board has accordingly decided to combine the qualities of speed and sea-keeping power in a special type of ocean-going destroyer which will be expensive, and of which therefore the number must be comparatively few, and to design a new type of coastal destroyer which will be comparatively cheap, and of which consequently a large number can be obtained.

The policy of sending ships to private yards has proved completely successful, and the arrears in the repairs of the fleet have been completely overcome. It is not therefore necessary to provide during the coming year for repairs of any ships in private yards. It is intended to utilize the government yards for the purpose of keeping the present vessels in complete repair rather than to employ them for new constructional work. The building of new vessels has been demonstrated by actual experience to be carried out with greater economy in private than in the government yards, while on the other hand, repairs can be more cheaply effected in the latter than in the former.

It is intended to continue the experiments with oil fuel, but it is now quite certain that oil has firmly become established as part of the fuel in the navy, and every arrangement is being made for its supply, storage, and distribution. In connection with this point, it may be stated that already huge reservoirs are in course of erection at Portsmouth dockyard for the storage of the oil, and suitable apparatus is being installed for the transfer of the latter to the compartments intended for storage in the holds of the battleships with facility and celerity.

During the coming year a large number of heavy guns are to be constructed, to meet the armament requirements of the vessels now in course of erection. These weapons comprise 12-inch 45-caliber and 9.2-inch 50-caliber weapons for the battleships, and 9.2-inch and 7.5-inch 50-caliber guns for the first-class armored cruisers.

Exhaustive experiments have been carried out with night sights, with the result that a good optical sight has been obtained, which is to be adopted in the more important gun mountings. A new type of armor-piercing projectile, from which greater penetration can be obtained, has been satisfactorily tested, and is being introduced for all guns of 6-inch and higher caliber. Improvements in submerged discharges and torpedo rooms are being effected, to enable more rapid loading to be carried out. A new torpedo with increased range and speed has been designed, and severe and prolonged trials are now in progress with it upon the torpedo range at Portland. Searchlights have been improved by the general introduction of automatic lamps. Experiments are also in progress at sea with electrically-controlled projectors.

Another important feature, and one which will commend itself to engineers, is the policy of standardization that has been adopted. By co-operation with the machinery manufacturers it has been found practicable to make almost the whole of the main and auxiliary machinery and boilers fitted in ships of the same class, of similar design and interchangeable. In the six first-class armored cruisers of the "Duke of Edinburgh" class, this principle has been brought into effect, and it is now in process of development for the machinery of ships of the "Lord Nelson" and "Minotaur" types. By dealing with vessels in classes, progress is not retarded by such standardization. Admiralty representatives have been associated with the various sub-committees of the Standards Committee, and Admiralty and commercial practice have been assimilated in many features with benefit to each.

The First Lord of the Admiralty states that the fleet has "never been in more perfect state of repair than it is at the present moment," which is most satisfactory, and is due in no small measure to the rigorous policy of the department during the past two or three years, and the wholesale elimination from the fighting strength of all those vessels which do not coincide with modern naval requirements, and which could only be rendered efficient and up-to-date by the expenditure of large sums of money. It is also intended to inaugurate a policy by which, while fewer ships will be in course of construction simultaneously, the time occupied in such work will be considerably expedited. At the present time the building of a battleship, from the laying down of the keel to its actual commission, varies from 30 to 36 months. This work, however, under the new scheme is to be appreciably accelerated.

SCIENCE NOTES.

An important discovery of a new mineral has been made in Ceylon by Prof. W. R. Dunstan in the course of a mineral survey. The discovery, which has been named thorianite, is richly impregnated with the rare earth thoria, the proportion being approximately 75 per cent. What is of commercial importance, however, is the fact that the mineral is not combined with silica.

In a paper recently read before the Académie des Sciences, M. Victor Cremieu describes a series of researches upon liquid drops suspended in a mass of liquid of the same density, with which they do not mix. The drops are thus free from the action of gravity and their mutual attraction is counterbalanced by the pressure of the liquid. If the distance which separates the drops is considerable with relation to their diameter, the capillary forces are quite negligible. Nevertheless, he observed that the drops approached each other slowly, whatever might be the ratio of their diameter and distance apart. In the present experiments he operated with a mass of liquid kept at a constant temperature and free from all disturbances. The liquid was a mixture of distilled water and alcohol, and the drops were formed of pure olive oil. The mixture, which has the same density as the oil, is placed in a vessel four inches high and six inches in diameter, covered with a glass plate. The oil drops are introduced by means of a capillary tube. The jar is surrounded by a metal cylinder to protect it from radiation from the observer, and the vertical and horizontal movement of the drops is observed by means of slits in the cylinder. It is found that the drop always rises in the liquid, as it is impossible to have an exact equality of the density, and a very slight chemical change also occurs which modifies the initial density. With a single drop, it is found that it always rises in a straight line, starting from any point in the vessel. But with two drops the effect is different. The drops were from one to five millimeters in diameter and placed twenty-five millimeters from the sides. They were one hundred millimeters apart at first. Two hours' readings were made of their position, and it was found that they rise in a slight curve, so as to approach each other. Adding a third drop causes a deviation in that direction, and the latter also rises in a curve. These experiments are difficult to carry out, and only six observations were obtained in two months, but they gave very constant results. The author is now studying the effect of solids suspended in a liquid in the same way.

M. Le Roux has carefully studied low temperatures upon phosphorescence, using liquid air. Some previous researches show that the phosphorescence is weakened or extinguished at low temperatures. In the present case he uses a light blue calcium sulphide whose light varies with the temperature when at about the heat of the human body. He places the sulphide in small sealed tubes and excites them together by magnesium light. When one of the tubes is placed in liquid air the phosphorescence is completely extinguished. On taking out the tube the light returns at the end of a few seconds, and its intensity has a maximum value when the tube comes back to the temperature of the air. It appears somewhat higher than that of the check tube according as the cooled tube has remained more or less in extinction. This is explained at once by the hypothesis that the cooling only suspends the phosphorescence, without destroying it, even partially. The phosphorescence is preserved in the potential form. Therefore when the tube returns to the same temperature as the check tube, it is brighter, since it resumes its former value, while the check tube has already weakened. A second question may be asked. When the body is initially at a temperature where the luminous energy which it acquired would become continually latent, may it acquire such energy in the latent form alone? The experiments show that such is the case. A tube of sulphide, made inactive by placing it for a long time in the dark, was plunged in a bath of liquid air while still deprived of light. The whole was taken into the light and together with a check tube was excited by magnesium light. On bringing it again into the dark room, the immersed tube showed no light, as might be expected, but when taken out of the bath and allowed to heat, it became luminous and brighter than the check tube as before. It is to be remarked that the acquired luminous potential energy has always been the maximum which the light could produce upon the body. The conclusion may be reached that the maximum luminous potential energy which a given light can give to a certain body is independent of the temperature. The temperature factor only has an influence upon the speed of transformation of the potential luminous energy into actual luminous energy.

A weighing machine, said to be the most powerful in the world, is being made in Birmingham. It is capable of registering a load of 220 tons.