mouth, Devonport, and Dover respectively, while the remaining three bases will be distributed along the eastern shores on the North Sea, which is the more exposed to attack from the European continent. Portsmouth, owing to the contiguity of the great naval dockyard, will constitute the principal base; but at the same time each station will be so appointed that it will be in a position to be independent of the paramount base, and be able to cope with any emergencies that may arise, such as the refitting, repair after accidents, and replenishing of supplies.

At Portsmouth the base will be quite isolated and independent of the dockyard itself. The situation selected for the station, and upon which the necessary arrangements have been carried to a very advanced stage, is completely isolated by water from all communication with the shore, thereby enabling absolute privacy to be maintained. A small dockyard is being constructed, and is being equipped with all the latest electrical and other power appliances for dealing with the work, together with numerous tanks for storing gasoline. A special type of floating dock is now approaching completion at the works of Vickers, Sons & Maxim, for dealing with submarine craft exclusively.

Similar arrangements and facilities are being carried out at Plymouth, the station in this case being also isolated by water, and at the same time guarding the entrance to the important dockyard at Devonport. At Dover, where the naval harbor is being pushed forward with all possible speed, the situation will comprise a floating workshop and dock near the harbor's entrance. This station will prove an important one in the strategical defensive scheme of the Admiralty, since it guards the Straits of Dover, and thus commands the only means of communication between the English Channel and the North Sea.

Each base is to be provided with a fast depot ship of sufficient speed, so as to be able to render prompt assistance in the event of a submarine breaking down. This vessel will have a torpedo boat to act as a tender.

Owing to the fact that the machinery of a submarine vessel requires frequent overhauling, the exact number of these craft which is to be stationed at each point in actual service, and the extent of the reserves, is not yet finally decided. It is anticipated, however, that each base will be equipped with six active boats, together with a sufficient supply of reserve craft to enable the above minimum number to be available for service at a moment's notice. In view, however, of the satisfaction and success of the latest types of submarines which have been constructed, it has been decided to push ahead with the construction of this class of fighting unit with all possible speed, while the various bases are to be completed and equipped during the present year.

THE ECONOMICS OF NEW YORK'S REFUSE DESTRUCTOR.

Some valuable information on the combined refuse destructor and power plant of New York was given in a recent number of the Engineering Record. Until recently no attempt had been made in America to combine power stations with refuse destructors, nor, in fact, to dispose of the towns' refuse by incineration. A destructor has now been put down capable of dealing with 10,000 pounds of refuse per hour. The refuse is delivered on to an apron conveyor which travels at a rate of about 70 feet per minute, the conveyors being 4 feet wide, having 6-inch sides, and a total length of 89 feet, from the front of the building to the discharge-point above the charging door on top of the furnace. The apron conveyor enables the rubbish to be sorted before it reaches the destructor, and about 60 per cent volume of the entire receipts is removed in this way by the trimming contractor, who pays for this privilege about $1.50 a ton. The 40 per cent which remains is delivered on to the charging platform. The furnaces are of the top-feed type, and each is divided longitudinally into two cells, each cell being 8 feet long by 4 feet wide. The consumption per unit area of grate of course varies with the material burned, but it is found that over 60 pounds of refuse per square foot can be burned under any conditions, so that with a total grate area (two furnaces) of 146 square feet the minimum capacity is about 10,000 pounds per hour. The power plant, which is intended for the lighting of Williamsburg Bridge and adjacent buildings, consists of two Stirling water-tube boilers, each of 200-horse-power capacity at 150 pounds per square inch, with economizer and auxiliaries; two 100-kilowatt and one 50-kilowatt direct-connected sets; and a battery for providing a day load. It is estimated that 1 pound of refuse evaporates 1½ pounds of water, which, at 60 pounds per square foot, is 13,140 pounds of steam per hour. The costs of destruction are compared with the previous costs of refuse disposal by dumping. The amount of refuse delivered per day to the destructor is 728 cubic yards, of which 465 cubic yards is taken out by the trimming contractor, leaving 263 cubic yards to be incinerated. The cost of dumping these 263 cubic yards at sea at the lowest rates yet secured would be $58.80. The costs of incineration are: Labor $8.33, foreman, $2.75, watchman, $2.12, sundries and repairs $2.50, interest $2.24: total $17.94. The ashes amount to 3.1 per cent, or 8.15 cubic yards, which must be dumped at sea at the cost of $1.66, bringing the total charges to $19.60, or a saving on the destructor of $34.20, or $10,260 per year of 300 days. This saving gives a return of 51 per cent on the first cost of the destructor, furnaces, and buildings, this cost being about $20,000. This figure, however, does not include the conveyor and boiler plant, as these introduce other economies, namely, the revenue from the trimming contractor and the production of power by means of the steam raised.

PROPOSED NEW YORK, BROCKTON, AND BOSTON CANAL.

It is unquestionably true that one of the most dangerous sections of the coast line of the United States is that between Fisher's Island, Conn., and the extremity of Cape Cod. Major J. A. Willard, of the United States engineer's office at Newport, has prepared a map of this coastal region which shows the approximate location of 1,076 marine disasters, of which all but sixty have occurred within the period between 1880 and 1903. For years many authorities on the subject have advocated the cutting of a canal through Cape Cod, in order to obviate in this way the unnecessarily great and recurring loss to life and property annually suffered in the coastwise shipping industry. A proposal which has been frequently discussed within recent years is the construction of such a canal through the narrow part of the Cape from Buzzards Bay to Cape Cod Bay. A company has, however, been lately formed which has another canal project in view to furnish a route from New York to Boston materially shorter, though the original cost will be greater, than that provided by the above-mentioned canal. This plan is to run the artificial waterway from Fall River, using the Taunton River in part, through Taunton, Brockton, and Weymouth and so into Boston Harbor. That the project is feasible from an engineering standpoint is conceded by the experts consulted, though there are legislative difficulties to be overcome by the backers of the scheme, notwithstanding its undoubted usefulness to future navigation.

RECENT BALLOON ASCENSIONS IN THE VICINITY OF NEW YORK.

In endeavoring to introduce into America ballooning as a sport, Count de la Vaux, the president of the French Aero Club, made an ascension at West Point during the afternoon of Saturday, March 31. The ascension was arranged for by the Aero Club of America, and Charles Levée, a French aeronaut, accompanied the Count. As there was a strong wind early in the day, it was at first thought the ascension could not be made. Later in the day, however, the wind died down to about 12 or 15 miles an hour, and it was decided to make the attempt. The balloon, which was a large one of 18,000 cubic feet capacity, was finally inflated, some two hours being required for this purpose, and the gas being supplied from the government gas plant at the army training station. Shortly after 4:30 P. M. the balloon, carrying the two aeronauts, shot upward from the foot of the hill. The huge gas bag crashed against the branches of a tree on top of the hill, rebounded, and floated south and upward with the wind. The basket struck another tree, but the aeronauts escaped injury.

They threw out sand, soon after the start, which caused the balloon to rise rapidly before it floated diagonally across the Hudson. As soon as it was over the river, it began to descend. It fell so far that the spectators thought it would settle in the river; but finally the aeronauts threw out sufficient ballast to cause it to rise slowly and float with the wind over the hills on the east side of the river. In something like half an hour it disappeared from view over the hills just below Garrison, and in less than another half hour it descended in the vicinity of Peekskill, having covered a total distance of not more than ten miles.

On April 2 the same two aeronauts made an ascent from the Central Union Gas Works, at 138th Street and Walnut Avenue, in this city. This time they took with them Dr. Julian P. Thomas. The balloon, which was one of Count de la Vaux's largest, rose to an elevation of 3,500 feet, and was in the air for three-quarters of an hour. It descended nearby at Glendale, on Long Island, amid a crowd of several thousand persons who mobbed the aeronauts in an effort to obtain souvenirs.

The following afternoon an ascension was made by Paul Nocquet, a young Belgian sculptor of great promise. Nocquet rose from the same starting point at five o'clock, and was carried by a gentle northeasterly breeze slowly across the East River. An hour later his balloon was still above Long Island City, and during another hour it had drifted from Long Island City to Flushing and thence to Jamaica. At 7:50 P. M. it was seen above Cold Spring Harbor, on the north shore of Long Island. At this point it was lost to view. A change in the wind carried it directly toward the ocean. Shortly after ten o'clock it was found at the ocean's edge on Jones's beach, but the aeronaut was missing. Footprints in the sand showed that he had landed safely and had apparently tried to walk to Amityville, the lights of which must have been visible to him some six miles away. To do this he was obliged to swim several streams and cross muddy marshes. In his vain effort to reach the lights he fell exhausted about a mile from the balloon, and his body was found the next day in the marsh. The tragic end of this young man was entirely unnecessary and is well-nigh inexplicable, unless it be that he feared the tide would rise and cover the sand spit upon which he landed, and that he was unacquainted with the locality and did not know its dangers. There was a life-saving station less than a mile from where he landed, and he could easily have spent the night there. The ending of Nocquet's balloon voyage shows that only experienced aeronauts conversant with the country over which they are to travel, should attempt ascensions.

SCIENCE NOTES.

The following method of sticking hot charcoal powder to cold bodies is given by G. Tammann in Ann. d. Physik: On dipping a cold glass rod into hot powdered charcoal containing very little occluded gas, it is found, on withdrawing the rod, that a layer of the powder sticks to the rod, the thickness of the layer increasing with the difference of temperature between the powder and the glass. If the rod remains long enough in the powder to acquire its temperature the phenomenon does not take place, and, on the other hand, if the rod with the powder on it is held until the powder cools, it ceases to adhere. The other forms of carbon do not exhibit the phenomenon, which, however, is independent of the nature of the rod. With SiO_2 powder a slight amount sticks, but this does not fall off on cooling. The author shows by using a glass rod in one experiment and an earthed conductor in another, that the phenomenon is not of an electrical nature, no difference being observed in the two cases; also by performing the experiment in air at 0.5 millimeter pressure and finding no change, he shows that the cause is not to be found in the currents due to occluded gases. He therefore concludes that the attraction is due to a particular kind of field of force only existing with considerable temperature gradient.

Two out of the three types of rays emitted by the radio-active elements, known as the beta- and gamma-rays, are substantially of the same nature as those emitted by a Crookes tube. Thus the beta-ray is the familiar electron in motion and corresponds with the cathode-ray, while the gamma-rays result from the beta-rays in much the same way as the X-rays result from the cathode-rays. The difference is that the X-ray bulb acts under the action of a constant supply of external energy and ceases to work the moment the supply fails, whereas the radio-elements are entirely independent of external stimulus or supplies of energy. In the resemblance between the beta-rays and gamma-rays and the cathode-rays and X-rays of the Crookes tube there is an important difference. The electron which constitutes the cathode-ray travels ordinarily at a speed about one-tenth that of light, whereas the beta-rays of uranium travel with a speed about seven times greater. Like the cathode-rays, the beta-rays are deviated by a magnet, but with much greater difficulty. Some of the beta-rays of radium have a velocity 95 per cent that of light. The beta-rays are not penetrating enough, while the gamma-rays are too penetrating for radiography. Eight centimeters thickness of aluminium are necessary to absorb half the gamma-rays, while Rutherford has shown the effect on an electroscope of the gamma-rays from 30 milligrammes of radium bromide after passing through a foot thickness of iron.

All three radium emanations possess the extraordinary power of imparting to inactive solid objects in the neighborhood a new and distinct type of temporary activity. This "imparted activity" decays also according to regular laws, which are characteristic and distinctive in each case for the different elements from which they are derived. This process has been elucidated and shown to be due to a change occurring in the gaseous emanation. Gradually and continuously it turns into a new type of radio-active matter, non-volatile and so depositing itself as a film upon any solid object available. The films are invisible and unweighable, and are only known by their activity. Nevertheless, if such a surface rendered active by exposure to the emanation is scrubbed with sand-paper, the film is removed and the activity is then found on the sand-paper. In consequence mainly of these and allied phenomena the view was put forward in 1902 by Prof. Rutherford and Prof. Soddy that the radio-elements were in a state of continuous and spontaneous change, capable of an exact quantitative expression, and that the emanations and allied bodies were the products of these changes.