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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE DARLINGTON APARTMENT HOUSE DISASTER.

The fatal disaster to the Darlington Apartment House, in which, at the present writing, over fifteen persons are known to have lost their lives, is one more of those ghastly tragedies which seem to be necessary to stir up the public conscience to the point at which it sets resolutely about the removal or correction of some menace to the security of life and property. The stolid inertia of public opinion can be overcome apparently only when life is sacrificed by wholesale. Then we wake up; demand reforms; and to some extent get them. For proof of this it is not necessary to go beyond a radius of a quarter of a mile from the spot where they are at the present moment taking out the unfortunate victims of willfully careless tall building construction. Not much more than a stone's throw away is the site of the Windsor Hotel tragedy, the inmates of which offered their lives as the purchase price of a thoroughly drastic investigation of the question of fire-escape conditions in this city. Matters are better now than they were before the Windsor Hotel fire. At least, we hope they are. Within a stone's throw of the Windsor Hotel site one may climb down into the tunnel of the New York Central Railroad Company, and on the easterly wall thereof, he will see the deep scars on the brickwork, which were made as the wreck of a coach, in which some score of unfortunates were crushed out of existence, was driven forward by the colliding engine. It needed apparently the sacrifice of twenty prominent business men of this city to set in motion the public sentiment which, in its turn, is bringing reforms in railroad management which will abolish forever the likelihood of a similar disaster.

The pile of wreckage with its entombed victims on West Forty-sixth Street teaches nothing new. Long before the falling of the building it was suspected that a considerable amount of "jerry" work was being done on the "bastard" steel structures, which are being run up continually in this city. We use the term "bastard" advisedly; for a structure that extends ten stories in height and depends for its rigidity upon the lugs and flanges of miserable, little, rectangular, cast-iron columns, has no rightful claim to the reputation for strength and security that goes with the term "steel construction." It was merely a question of time before on one or other of these structures a disaster such as this occurred. Buildings of the type of the Darlington are built purely for speculative purposes, and not a pound of material nor five minutes of time is going to enter into or be spent upon the construction of such buildings, more than is absolutely required by the laws of the Building Department. Moreover, the evidence of the building inspectors proves that in the case of this building, and doubtless of many others like it, there is a persistent effort to evade those rules of construction and erection which have been framed by the Building Department for the purpose of preventing just that very kind of disaster which has now happened. Unfortunately for the poor wretches who went down in the wreck, a flaw in the Building Department laws renders it impossible for the inspector to immediately stop construction on discovering faulty work. The law's delay between the making of such protests by the inspector and the stopping of the work is such that a contractor has some two weeks' grace before an injunction can be served.

As to the immediate cause of the wreck, it will be difficult to pronounce definitely until something more than a superficial examination can be made; but speaking broadly, it may be put down at once to faulty construction. It took but a single glance at the building by a representative of the SCIENTIFIC AMERICAN to satisfy him on this score. The cast-iron columns showed where they had been broken off, the seemingly inevitable blowholes. The maximum thickness of the shell of these columns at the street level appeared to be no more than the minimum allowed in any cast-iron column used throughout the whole building. There is a sudden decrease in the section of the cast-iron columns of the front wall of the building from 10 or 12 inches at the street level to 6 inches on the first floor. What this line of columns had been reduced to by the time it reached the tenth floor is a matter of interesting conjecture. The connections appeared to have been all bolted, not a rivet being visible in the wreck of the iron and steel work.

We are of the opinion that the cause of the collapse was the lack of proper sway-bracing to keep the structure in its true perpendicular position, coupled, probably, with eccentric loading. The crying evil of cast-iron column work, especially in a building of this kind, where the bending moments are very severe, is, that the whole work of resisting the bending, or what might be called shutting-up stresses of the steel and iron skeleton, is thrown upon the cast-iron connections at the columns, and upon the bolts by which the floor systems are tied to these columns. If the building is properly sway-braced as it goes up, and is stiffened by carrying up the brickwork and by putting in the concrete or tile floors close upon the heels of the erecting gang, the stresses upon these connections may be kept down within safe limits; but where, as in this case, the haste, carelessness, ignorance, or greed of the contractor led him, in direct defiance of the warnings of the Building Department, to carry the steel and ironwork up far in advance of the brickwork, etc., and without putting adequate sway-bracing in this lofty work, it becomes easily possible for the stress upon the cast-iron connections to exceed the breaking strength, and precipitate a disaster.

The lessons to be learned are, first, that the building inspectors should be given the necessary authority to stop work on the instant, or at least within an hour or two, of their discovery of faulty and dangerous construction; and, secondly, that the limit of the height of building in which cast-iron columns are permissible should be greatly reduced, especially for that class of structure which is put up merely for speculative purposes.

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REPORT OF THE ARMY BOARD AS TO THE USEFULNESS OF THE LAKE TYPE OF SUBMARINE BOAT FOR COAST DEFENSE.

Some weeks ago, in our issue of December 26, 1903, we published an account of the submarine torpedo-boat "Protector," designed by Mr. Simon Lake. At that time the vessel was lying at Newport, R. I., awaiting trial by a naval board, but owing to ice in Narragansett Bay on January 12—the day set for the beginning of the trials—the board temporarily abandoned its work. A week later, with the water and weather conditions even more trying, an army board put the vessel through a series of maneuvers of a most convincing nature. The immediate result of the military examination of the vessel was an official report recommending the purchase of five submarines of the Lake type. That report, in turn, was referred to the General Staff of the army, and the General Staff has now added its confirmation to the recommendation of the examining board.

The examining board was composed of officers of the artillery corps, which now has control of the country's submarine coast defenses. These officers were Major Arthur Murray—senior officer of the School of Submarine Defense at Fort Totten, N. Y.—and his associates, Captains Charles J. Bailey and Charles F. Parker. These officers had likewise been detailed to watch the trials and performances of the submarines now in the navy, but they did not find those boats susceptible of military adaptation for coast defense. The "Protector," on the other hand, seemed to augur well for such service, and her performance on the day of trial, as well as the well-known sea-going record of the craft, are substantiation.

The military aspect of the question is summed up in the following particulars cited by the board; and, in passing, it may be said that this military view of the field of usefulness of the Lake submarine is quite coextensive with the widest field of service now contemplated by the navy.

FOR DEFENSE.

First: To take the place of fixed mines, by lying adjacent to the forts and attacking vessels attempting to reduce the works or to run past, particularly in important channels where it is impracticable to plant mines, owing to deep and rough water, extreme width, or the swiftness of currents.

Second: To supplement fixed mines, by attacking vessels approaching the mine fields or those which have crossed them.

Third: To lie outside mine fields for scouting or picket duty, keeping in telephonic communication as hereafter described.

Fourth: To pick up and to repair defective cable joints, junction-boxes, etc.

FOR ATTACK.

First: To run past the forts, and to attack vessels within the harbor.

Second: To drag for, pick up, and to cut multiple and branch cables on the bottom, or mine cables leading to buoyant mines or buoys.

Third: To sweep the channel, two submerged boats being connected by a light cable extending across all or a part of the mine field.

To a very large extent, the board's attention was centered upon the diving compartment. This compartment is located in the bow of the craft, and is separated from the crew-space lying immediately abaft by an air-lock; and both the diving compartment and the air-lock are fitted with air- and water-tight doors. The compartment is fitted with a connection to the low-pressure air system, and provided with a telephone communication with the living space, and a hydro-pneumatic gage with two hands, one of which registers the pressure of the water outside—due to depth—and the other the air pressure in the compartment. At the bottom of the compartment is an iron door, which can be opened outward. To open the door, the air-lock doors are first closed, and compressed air is admitted into the compartment until the gage hands indicate unity of air and water pressures. The door is then unfastened and allowed to swing open, thus giving, in clear water with the boat on the bottom, a good view of the sea bed.

This compartment provides for:

1. Mine cable cutting; or else repair of, or the burying of, mine cables and junction-boxes.
2. A channel for telephonic communication with the shore when the boat is on picket duty.
3. A way of escape for the crew, in case of the total disablement of the boat.

The board, remarking upon the ability of the "Protector" to run under gasoline propulsion with only the observing instrument and sighting-hood above water, said: "By reason of an automatic induction valve in the top of the sighting-hood, admitting air for the gasoline engines and excluding spray and water, the engines may be used in this condition of submergence; and this fact gives to the boat a large cruising radius at comparatively high speed, and renders it likely that under many conditions of sea, light, and weather, the craft may get within torpedo range without being seen, in the event even of the total disablement of her electrical equipment. In this condition, of course, the omniscope would be housed, and the sighting-hood, of a neutral color, could be discerned only with great difficulty. This ability of the boat to run under gasoline propulsion almost entirely submerged assumes considerable importance when it is considered that the *elements most liable to disability in the submarine boat of to-day are the storage battery and the electrical equipment.*"

The following quotation from the board's report gives the experience of its members:

The board was on board from 10:15 A. M. to 4 P. M. of January 19, 1904. From about 12 M. to 3 P. M. the boat was submerged, and from 12:40 to 2 P. M. the board was in the diving compartment, observing its operation and that of grappling for a cable.

No discomfort was experienced under the air pressure in the diving chamber, and the remaining part of the interior was quite as comfortable as any surface boat of its size would have been. Lunch was cooked and served while submerged.

PROGRAMME.

1. Proceeded from Fort Adams (Newport, R. I.) some three miles up Narragansett Bay in cruising condition, using engines.
2. Passed from cruising to awash condition, housing all external fittings, except a wooden mast installed for the naval test.
3. Continued surface run in awash condition.
4. Passed to submerged condition by filling ballast tanks.
5. Maneuvered on the bottom of the bay, by using storage batteries and motors to propel the boat.
6. Filled diving chamber with compressed air, opened door in bottom, and, with a grapnel, picked up a telephone cable by moving slowly over its approximate position.
7. Passed from submerged to awash, and thence to cruising condition, and returned to Fort Adams by a surface run, using storage batteries and motors.

In passing from the submerged to the awash condition, it was found that an ice floe had drifted over the boat, which, on rising, broke through the floe and emerged with its deck completely covered with some eight inches or more of ice, which remained on deck while passing to the cruising condition. It was also found that the wooden mast above mentioned had been broken by the ice while the boat was maneuvering under it.

The weather was very cold (zero), the bay full of ice, and it would have been difficult to have chosen more adverse conditions for the test.

CONCLUSIONS AND RECOMMENDATIONS.

For Defense.

The board believes that this type of submarine boat is a most valuable auxiliary to the fixed mine defense, and, in cases where channels cannot be mined owing to depth, rough water, swift tides, or width of channel, it will give the nearest approach to absolute protection now known to the board. The boat can lie for an indefinite time adjacent to the point to be defended, in either cruising, awash, or submerged condition by its anchors being upon the bottom. It is thus ready for instant use, practically independent of the state of the water, and in telephonic connection with the shore. It can also patrol a mined or unmined channel, invisible to the enemy, and able to discharge its torpedoes at all times. It possesses the power of utilizing its engines in every condition except the totally submerged, and can always charge its storage batteries while so doing, necessitating its return to shore only when gasoline must be replenished. In narrow channels the boat or boats would have a fixed position, with a telephone cable buoyed or anchored at the bottom. In wide channels they would patrol or lie in mid-channel, or where they could readily meet approaching vessels.

As a picket or scout boat, outside the mine field or even at extreme range of gun fire, telephone communication can be sustained, and information received and instructions sent for attacking approaching vessels.

The test at Newport demonstrated the ease with which the boat can locate and pick up cables and, with minor alterations in the present model, junction-boxes, etc., can be taken into the diving compartment and repaired at leisure while absolutely protected from hostile interference. The faculty possessed by the boat of maneuvering on the bottom and sending out divers, leaves little or nothing to be desired in its facilities for doing this work.

For Attack.

The boat shows great superiority over any existing means of attacking mine fields known to the board.

It can run by any mine field, as at present installed, with but little or no danger from the explosion of any particular mine or from gun-fire, during the few seconds it exposes the sighting-hood for observation, and can attack at its pleasure vessels in the harbor.

The board personally witnessed the ease with which cables can be grappled, raised, and cut, while the boat is maneuvering on the bottom. Mine cables can be swept for, found, and cut, or a diver can be sent out for that purpose.

It should be noted that, with one exception, no seamen are needed aboard, this exception being the man who steers and handles the boat.

The crew is as follows: One navigator, who is also the diver; one chief engineer, one assistant engineer, one electrician, one machinist, one deck hand, one cook.

The board recommends consideration of the foregoing by the General Staff. The question of the use of the Whitehead torpedo as part of the fixed mine defense, fired from tubes on shore, is now receiving consideration. Where channels are wide and waters swift, this use of the Whitehead will be very limited. With boats of this type the Whitehead can, it is believed, be carried within certain effective range in all ordinary channels, and this, alone, will warrant the consideration asked.

The board recommends, in consequence of its conclusions, that five of these boats be purchased for use in submarine defense, as follows:

One for the School of Submarine Defense, for experimental work.

One for the eastern entrance of Long Island Sound.

One for the entrance to Chesapeake Bay.

One for San Francisco Harbor.

One for Puget Sound.

The necessity for this kind of defense in the four localities named, needs no demonstration, to those acquainted with them.

Narragansett Bay will be entirely free of ice in about four weeks, and then the naval board will try out the "Protector."

RESULTS OF RECENT EXPERIMENTS WITH N-RAYS.

M. Blondlot has now succeeded in measuring the wave length of the new N-rays, and finds that the wave lengths are shorter than for light rays. In the first place, he shows that the rays are equally refracted by a prism. To study the dispersion and the wave lengths of the N-rays, M. Blondlot uses a method similar to that employed in the case of light. Prisms and lenses of aluminium are used, as this metal does not store up the rays like some other bodies. For the dispersion experiments, the rays are produced by a Nernst lamp inclosed in a sheet-iron box having an opening closed by an aluminium shutter. The rays are then passed through an inch thickness of pine, a second aluminium sheet, and two thicknesses of black paper, so as to eliminate all other radiation. In front of the screens and at 6 inches from the burner is placed a large screen of wet cardboard, which cuts off all the rays except a beam passing through a slit 1-5 inch wide and 1.4 inch long, cut out of the cardboard. The beam falls on an aluminium prism whose refracting angle is 27 deg., 15 min. One face of the prism is perpendicular to the beam. With this arrangement, it is found that several beams of N-rays are dispersed horizontally from the other face of the prism. To locate them, a narrow band of sulphide of calcium is moved about the region. Its increase in brightness shows the presence of the rays. Different beams were found and their index of refraction measured. These indices are 1.04, 1.09, 1.29, 1.36, 1.40, 1.48, 1.68, 1.85. To check up the results, the images of the burner were formed by means of an aluminium lens, measuring their distance from the lens. The latter (plano-convex) had a 2.6-inch radius of curvature. A 2-inch hole was made in the cardboard screen. The lens was placed at a known distance from the incandescent burner, and the image of the burner was explored by the phosphorescent screen. This method gave similar results for the indices of refraction of the different beams.

The next step was to measure the wave lengths of the various beams, and it was found, contrary to expectations, that these are much shorter than light waves. With the above disposition, the beams obtained were quite distinct from each other. The beam to be observed is let fall on a second screen of wet cardboard having a narrow slit of 0.06 inch. To explore this narrow beam, an arm moving around a circular transit scale holds a vertical sheet of aluminium having a slit 1-400 inch wide, filled with the phosphorescent sulphide. Placed in the path of the beam, the exploring screen shows that the beam is narrow and uniform, and not accompanied by diffraction fringes. After this preparation, the beam is let fall upon a diffraction grating on glass (one of the Brunner pattern was used, ruled to 1-200 millimeter). The rays coming through the grating are explored by turning the phosphorescent screen through different angles, and it is found that a system of diffraction fringes exists, as in the case of light. However, the bands are closer together and are practically equidistant. This shows that the N-rays have much shorter wave-lengths than those of light. By rotating the exploring screen, the distance between the bands is measured. The angle of rotation is very small, and it is measured by a mirror and telescope, preferably between every tenth ray. From these distances and the ruling of the grating, the wave length is deduced by the usual formulæ. Different gratings gave practically the same wave-lengths, which are as follows for five of the beams:

Index of refraction.	Values of μ
1.04	0.00815
1.19	0.0099
1.4	0.0117
1.68	0.0146
1.85	0.0176

The Newton's ring method was also used and gave similar results. These measurements show that the wave lengths of the N-rays are considerably shorter than those of light rays. It is a noteworthy fact that the wave length of the N-rays increases with the index of refraction, which is the contrary to the case of light rays.

In a paper recently presented to the Académie des Sciences, M. De Lepinay shows that the N-rays are produced by sonorous bodies in vibration. The fact that compression or bending of a body causes it to emit N-rays (as M. Blondlot found) led the author to suppose that sound vibrations should produce the same effect, seeing that a sounding body undergoes alternating strains which, although very slight, are, on the other hand, repeated many times per second. This was found to be true, using a phosphorescent screen to detect the rays. The bodies used were a tuning-fork, a bronze bell, and, especially, a large steel cylinder suspended by two cords and vibrating transversely from the blow of a hammer. The latter gave the best results. The phosphorescence increases on producing the vibrations, and diminishes progressively when the vibrations are suddenly stopped. It is found that the sonorous body is not the exclusive source of the N-rays, but also the air which surrounds it and transmits the vibrations. The air, in fact, undergoes alternate strains and forms a source of the rays. It is found that the action of the vibrating cylinder upon the phosphorescent screen still keeps up if a lead plate 0.1 inch thick or a screen of distilled water 1 inch thick is disposed so as to absorb all the N-rays coming from the vibrating body, without hindering the propagation of the vibrations to a point near the phosphorescent body. Still more striking are the experiments made with a siren as the source of sound, as in this case there are no metal parts engaged in the vibration, this being produced by the air alone. The action on the phosphorescent sulphide is clearly observed when it is placed a little above the revolving disk. Seeing that the N-rays have the property of increasing the brightness of a body which is feebly illuminated, an interesting experiment is the following: The revolving disk of the siren itself is used as the illuminated screen, and it receives a dim light from a window at a distance, so regulated that none of the details of the disk can be distinguished by the eye. The disk having been set in rotation beforehand, the experiment consists in passing the air through the siren and suppressing it again. Each time the air passes and the vibrations are produced, the disk appears with a stronger light, and at the same time the details are perceived, together with other parts of the siren. On stopping off the air, the whole goes back to obscurity. The effect is the same when the observer stops his ears, and it is not due to reflex action, as has been proved in different ways.

EXAMINATION OF THE EMANATIONS GIVEN OFF BY RADIUM.

The fact that a part at least of the emanation from radium is transformed into helium is brought out in a striking manner by the recent researches of M. Curie and Prof. Dewar, which were presented to the Académie des Sciences.

A sample of 0.4 gramme of bromide of radium, pure and dry, had been left for three months in a glass bulb which communicated with a small Geissler tube and a mercury manometer. At the start of the experiment, a high vacuum had been made in the whole apparatus. During the three months, the radium salt gave off gas continuously at the rate of 1 cubic centimeter per month at atmospheric pressure. Spectroscopic examination of the gas by means of the Geissler tube showed only the presence of hydrogen and mercury vapor. No doubt a small quantity of water had been introduced into the apparatus at the same time as the radium salt, and it became decomposed gradually by the radium. The same sample of bromide of radium was taken to England and used in Prof. Dewar's laboratory at the Royal Institution for measuring the heat given off at low temperatures. In this case the salt had been transported in a quartz bulb provided with a tube of the same substance. A vacuum was made in the bulb and the quartz tube containing the salt was heated to redness, up to the fusing point of the salt. The gases given off by the bromide were collected by a mercury pump, and after passing through a set of U-tubes cooled by liquid air which condensed the greater part, the remainder of the gas was collected in a test-tube over mercury and examined by Prof. Dewar. The gases occupied a volume of 2.6 cubic centimeters at atmospheric pressure. They had brought over a part of the radium emanation and were radio-active and luminous. The light given off by the gases in the test-tube, after three days' exposure with a photographic spectroscope of quartz, gave a discontinuous spectrum. It consisted of three lines coinciding with the three principal bands of nitrogen, 3,800, 3,580, and 3,370. During the three days, the glass tube had taken a deep violet hue, and half the volume of gas had been absorbed.

When a spark was passed through the gas placed in a Geissler tube, the nitrogen bands also appeared in the spectroscope. Upon condensing the nitrogen in liquid hydrogen, a high vacuum was produced in the Geissler tube, and the spark showed the presence of nitrogen alone. The quartz tube containing the bromide of radium, melted and now deprived of all the occluded gas, had been sealed by the oxy-hydrogen blowpipe while a vacuum was made, and brought back to Paris. M. Deslandres examined it with the spectroscope about twenty days after the sealing of the tube. The gas inside the tube, illuminated by an induction coil using two rings of tin foil around the tube as the poles, was found to give the *entire spectrum of helium*. There were no other rays except those of helium after an exposure of three hours with a quartz spectroscope.

A YEAR'S BATTLESHIPS IN ENGLAND.

During the past year fourteen vessels, excluding torpedo craft, were added to the British navy, representing a tonnage of 149,340 and an indicated horse power of 262,800. The list includes five battleships, all of the "Duncan" class. These vessels are of 14,000 tons, and are the fastest in the British navy, their speed being 19 knots. Seven new armored cruisers have been commissioned, with the result that the cruiser squadron has been strengthened, and is now not only the most powerful but the fastest fleet in the world, all of the ships having a full-power speed of 23 knots. The ships commissioned this year include the "Drake" and the "Leviathan," of 14,100 tons, with engines of 30,000 indicated horse power. The five other cruisers commissioned are the "Kent," "Bedford," "Monmouth," "Donegal," and "Berwick," all, with the first exception, built on the Clyde. These vessels are of 9,800 tons and 22,000 indicated horse power. The remaining two ships commissioned during the year were the sloops "Merlin" and "Odin." The armament of the ships may be regarded as indicating the power of attack, and thus it is interesting to note that this year's newly-commissioned ships had in all twenty 12-inch guns, four 9.2-inch weapons, 106 6-inch quick-firers, and 239 smaller weapons.