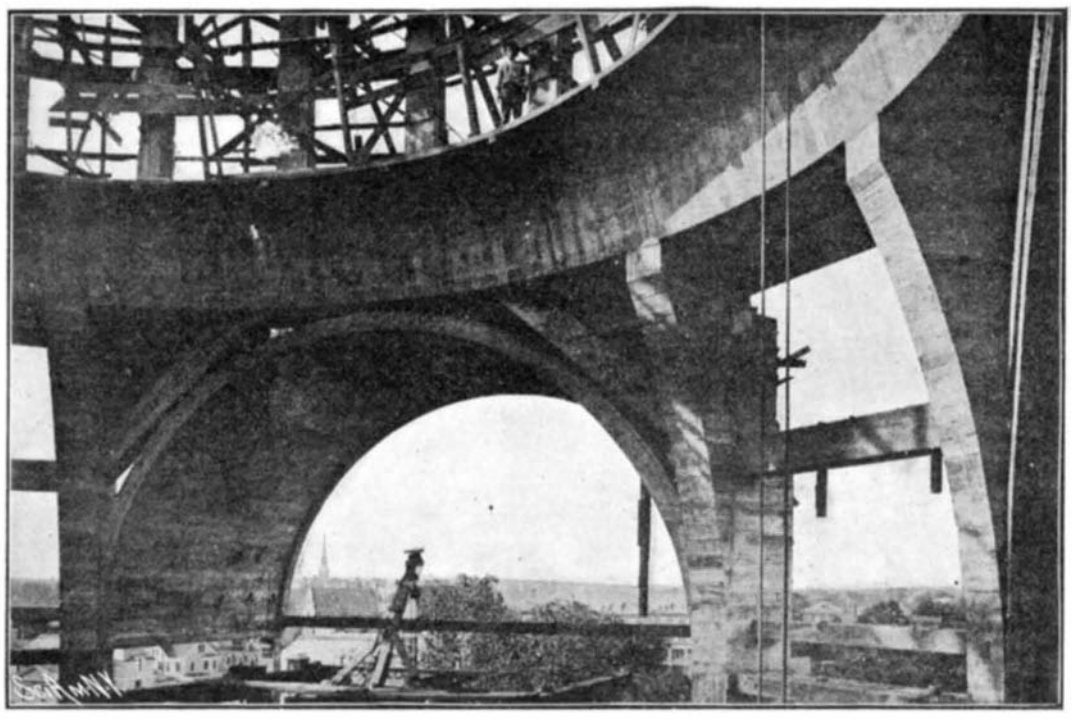
THE NEW CONCRETE CHAPEL OF THE UNITED STATES NAVAL ACADEMY, ANNAPOLIS.

BY DAY ALLEN WILLEY.

One of the most notable of the group of buildings which has been designed for the new Naval Academy at Annapolis is the chapel. Although all of the structures are of impressive size and architecture, the great height of the chapel and its other dimensions will make it one of the most imposing religious edifices in the United States when it is completed. From the ground to the top of the "lantern," which is to surmount it, the distance is 210 feet, while the extreme width of the structure is 130 feet. The building, whose plan is in the form of a Greek cross, measures 83 feet in diameter beneath the dome, not counting the transepts, which when added give a total interior width of nearly 117 feet.

The appropriation of $400,000 for the chapel gave the architect an opportunity to design not only a spacious, but a very ornate edifice. Realizing the effect of a large dome, one was planned which extends to a height of nearly 150 feet above the roof of the main building, with a diameter of 69 feet at its base. The base of the dome is 13 feet smaller than the circle formed by the center of the main building, consequently the construction of the chapel has been attended by some unusually interesting engineering features. If the great weight of the superstructure had been supported by the exterior walls, it would have been necessary to make these of extraordinary thickness or to utilize columns in the interior, which was not considered desirable. As a substitute for interior columns and what might be termed wall support, a somewhat novel method of carrying the load of the dome has been adopted. In it the material known as ferro-concrete has been utilized in a framework, which relieves the exterior walls of practically all stress except that due to their own weight and that of the dome.

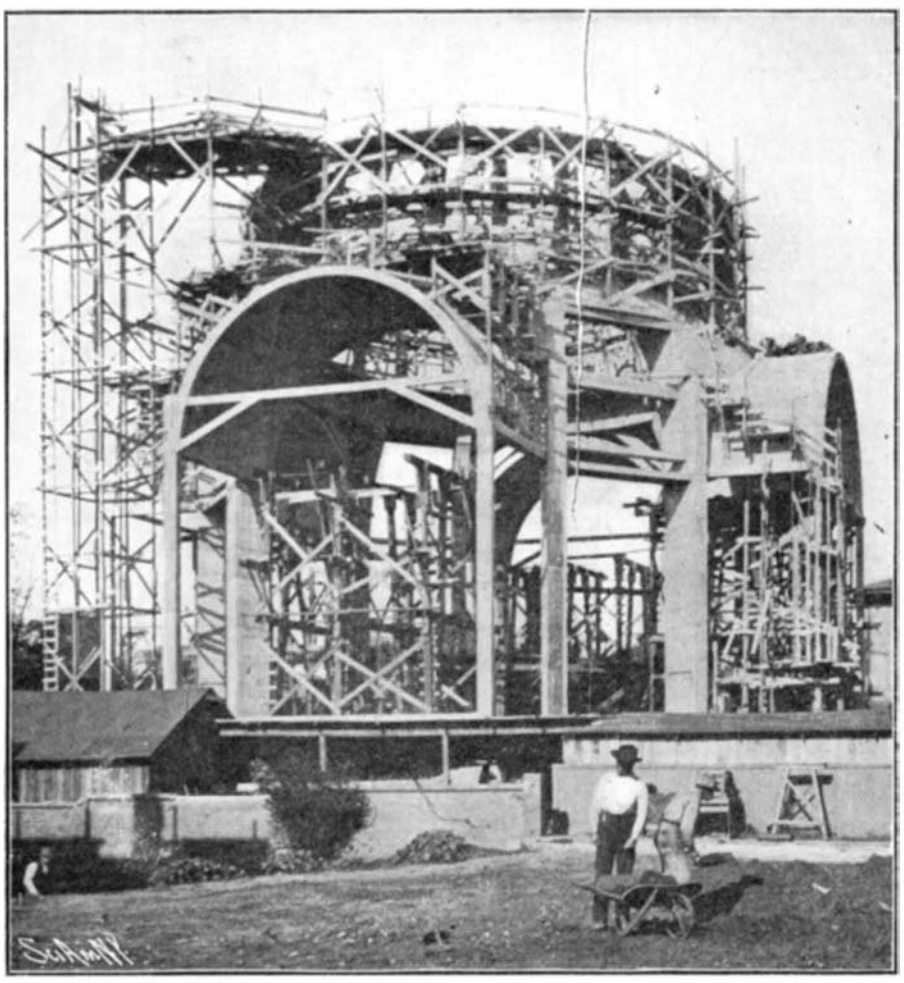
In the space allotted for the exterior walls have been constructed eight concrete pillars, placed at such distances apart that each sustains a load of about the same weight. They are of equal height as well as size, and at the top are set into an enormous ring of the same material, which is really the main foundation for the dome. The dome itself rests upon twenty-four smaller columns of concrete, which are also set in a smaller ring of this material. As already stated, the extreme top of the building consists of a "lantern" of terra cotta, which in itself is about 50 feet high, and represents a weight of no less than 140 tons. It was considered too heavy to be supported merely by the roof and framework, so provision has been made to sustain it independently of the roof by means of another skeleton of ferro-concrete, which assumes the form of a pyramid, the top of the pyramid being directly beneath the center of the "lantern" and upholding it.



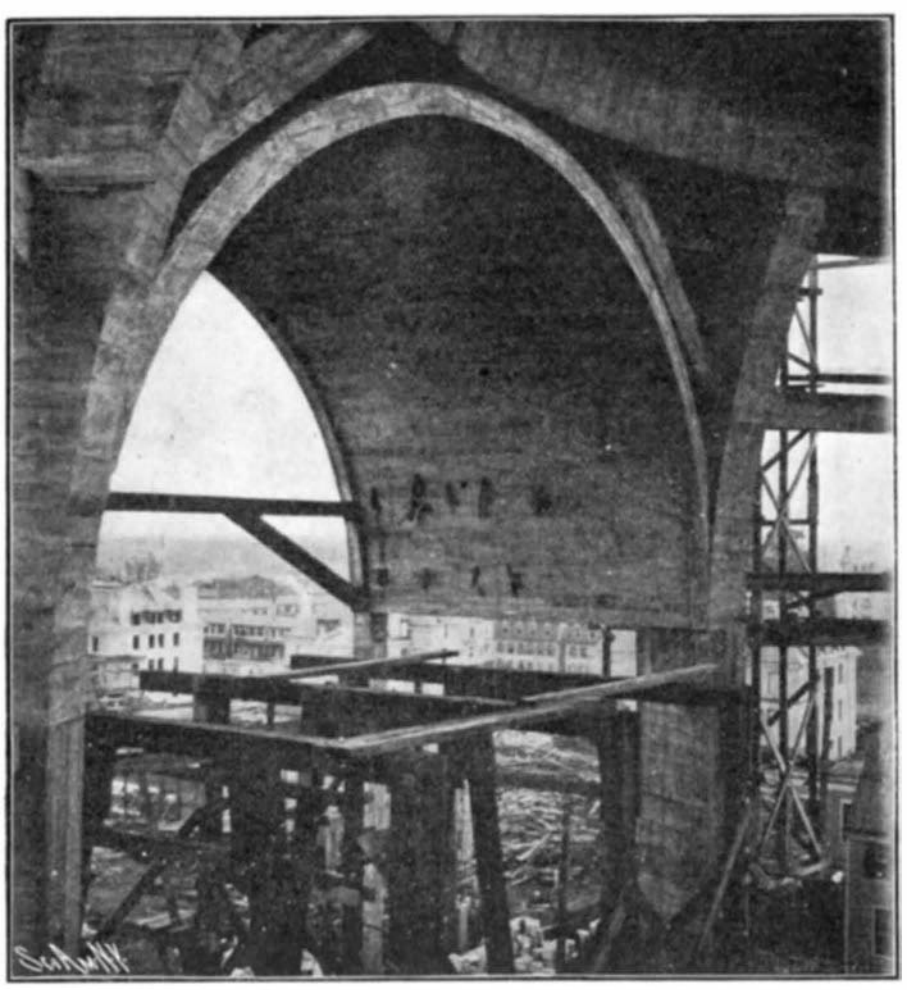
View Showing Transept, Piers, and Foundation Ring of the Dome Tower.

While the problem of constructing pillars of suitable dimensions to sustain the superstructure was in itself difficult to solve, it was necessary to curve the pillars to a considerable extent, in order to set them at the proper angles in the lower ring. For a distance of 55 feet above the ground they are perpendicular, the remainder of the length, 21 feet, forming the curve, which allows the exterior of the chapel to be fashioned in an exceedingly graceful outline. An idea of the massiveness of the columns can be gained when it is stated that each is 2½ feet by 6 feet in section. Through the center extend steel rods, which reinforce the strength of the concrete and give it the necessary resistance to bending. The lower ring, in which the columns terminate, is one of the heaviest portions of the building, but as already stated, it has been molded in a solid piece. The total weight which these columns will sustain when the chapel is completed is over 3,000 tons, each being constructed to carry a load of 383½ tons. Excluding the lower ring, the weight represented by the cupola and the "lantern" above is nearly 1,400 tons. In the main structure the exterior of the arches forming the transepts is also supported by columns of concrete which are 2 feet by 1 foot in dimensions. This formation separates the center of the edifice from the transepts, making of it a huge tower, and practically an independent structure; but as already stated, the exterior walls, except the portion represented by the columns, will sustain merely their own weight, and consequently they can be built much more lightly than if they were essential for support. The outside of the walls will be principally white glazed brick on a foundation of granite, which will give the building a very appropriate as well as a very artistic appearance. Inside, Caen stone will be utilized. The exterior wall will be 18 inches in thickness, with a second wall 12 inches in thickness, separated from it by a space of 12 inches. The concrete columns supporting the center as well as the transepts will be completely hidden from view. The smaller columns in the dome will be covered with ornamental terra cotta to match the treatment of the "lantern." As the various illustrations indicate, the timber work or false work required to furnish the concrete skeleton was very extensive. The dimensions of the wooden mold for the larger ring can be realized in studying the interior of the building. The framework necessitated the exercise of much skill on the part of the designers, representing as it did the exact shape of the skeleton on an enlarged scale. The manner of molding the concrete into shape was the same as is usually employed in what is known as ferro-concrete construction. After a mold was completed, the metal rods were inserted in it in the proper position, then the composition was poured into the mold and left to solidify. The chapel represents the most elaborate form of framework of this kind which has yet been attempted in the United States. The plan followed originated with the French engineers, who were called into consultation, and the work was done under their supervision.

An interesting feature connected with the design of the chapel is that beneath the main floor has been



General View of the Chapel, Showing the Elaborate Scaffolding Necessary to Support the Forms in Which the Concrete was Molded.



Near View of One of the Transept Arches, Showing Junction of Curved Top of Columns with Foundation Ring that Carries the Tower.

The total height of the finished building is 210 feet. The width across the transepts is 130 feet. The diameter of the dome is 69 feet. The total weight of the tower and dome is 3,000 tons.

CONCRETE CONSTRUCTION OF THE NEW CHAPEL, NAVAL ACADEMY, ANNAPOLIS.

provided a large crypt, which will be utilized for the tombs of naval officers, whom it is desired to inter at this historic place. In fact, this feature of the chapel may be compared with that provided at Westminster Abbey in London. The crypt floor will be 12 feet below the main floor, and will be entered both from the interior and the exterior.

A SEEDLESS AND CORELESS APPLE.

(*Continued from page* 100.)

brief. All the credit for the propagation of the apple thus far belongs to Mr. John F. Spencer, of Grand Junction, Col., who, struck with the success of the seedless orange, believed that similar results could be obtained with apples.

After several years' experimental research he succeeded in producing five trees that bore seedless, coreless, and wormless apples, and from this little group there has budded two thousand more trees, which at present constitute the entire seedless apple stock of the world; and from these two thousand trees all the rest of the world must be supplied. It is estimated that these will have produced about three hundred and seventy-five thousand nursery trees by the fall of 1905, and that the following year at least two million five hundred thousand trees will furnish the supply.

There are many striking peculiarities in the development of the seedless tree, as well as in the fruit. As an instance, it may be cited that the tree is blossomless; and while there is a stamen and a very small quantity of pollen, exactly as in the blossom of the ordinary apple tree, yet the blossom or flower itself is missing. The photograph shows the only bloom, flower, or blossom that ever appears on the seedless apple tree.

The only thing that resembles a blossom comes in the form of several small green leaves that grow around the little apple to shelter it. It is this lack of blossom that makes it almost impossible for the codling moth to deposit its eggs, and this practically insures a wormless apple. As it is the blossom of the common apple tree that is attacked by cold and frost, the seedless apple tree is immune, and the late frosts that play havoc with the apple grower's purse by denuding his orchard may now become a thing of the past, and at the same time prevent worry and increase profits.

The seedless apple tree has a hard, smooth bark, and may be grown in any climate; the meat of the new apple, like that of the seedless orange, is very solid, and in both there is a slightly hardened substance at the navel end. Through long development this has almost disappeared in the orange; and while it is more or less prominent in the seedless apple, it has been materially reduced on the last generation of trees, and all sizes tend to show that it will grow smaller with successive generations, as the navel end of the orange has grown smaller.

The apples, which are of a beautiful dark-red color with yellow strawberry dots, are of a goodly size and have a flavor similar to the Wine Sap.

The Current Supplement.

"The Coal and Ore Handling Plant in the Island of Elba" is the title of an article that opens the current SUPPLEMENT, No. 1518. Illustrations, both photographic and diagrammatic, accompany the text. A brief but instructive account of the Wachusett reservoir and dam is published. Mr. Charles H. Stevenson describes general methods of preparing aquatic leathers. Peter Eyermann, one of the staff who had charge of Machinery Hall and allied exhibits at the World's Fair, has designed a locomotive and a steamship which are to be driven by producer-gas. These designs are published in the current SUPPLEMENT with a full description. A. Frederick Collins writes on the De Forest-Ives electric wave-length standard. Ancient and modern methods of measuring time was the subject of the Christmas lectures at the Royal Institution. An abstract of these lectures is published. Edmund Otis Hovey writes on the Seventeenth Annual Meeting of the Geological Society of America. The Bureau of Census has just published a bulletin showing the conditions of irrigation in the United States in 1902. This bulletin is reviewed. An elaborate article on the Transmission of Yellow Fever by Mosquitoes is published. We print the last installment describing the Paris Automobile Show.

A new form of incandescent lamp in which vaporized petroleum spirit is used has been devised. The principle of the invention is a petroleum spirit vessel placed at a higher level than the burner. From this vessel the gasoline gravitates through a tube to a control valve, which regulates the flow of the volatile liquid into a generator, where it is vaporized through being heated by a separate flame. The gas then passes through a needle valve, receives its correct proportion of air, and is then ignited in a burner fitted with an ordinary incandescent mantle. An intense light is produced. To start the lamp, the vaporizer has to be heated, and this is accomplished by the ignition of a little methylated spirit poured over asbestos contained in a tray placed below the needle valve. The petroleum consumption of the lamp with the maximum light is very economical, one quart of spirit being sufficient to give a light of 150 candle power for sixteen hours. Though the inherent dangers attending the use of petroleum are by no means obviated in this device, it constitutes an excellent lamp for outdoor use.

New Radium Theories.

Two announcements, one by Prof. Monroe Snyder, the other by Prof. E. Rutherford, of McGill University, Montreal, Canada, have recently been made, which are of so startling a nature that, had they come from less trustworthy sources, they would have been immediately discredited.

Prof. Snyder, in a preliminary paper read before the American Philosophical Society, discoursed on his discovery of radium in the photosphere of the sun. Prof. Snyder finds in radium the cause of the heat and luminosity of the celestial bodies. In his opinion, variable stars are caused, not by the revolution of one body about another, but by the regular fluctuation of light, which is due to periodical outbursts of radioactivity. The professor concludes that the sun is a variable star with a period of eleven years, and that the sun spots are one of the demonstrations or results of these outbursts of radium emanations. The problematical rings of light so characteristic of many of the nebulæ are accounted for by Prof. Snyder by treating them as transition stages of radioactivity.

Prof. Rutherford holds that the radioactive substances are the cause of the earth's heat. His theory is promulgated in a recent number of Harper's Magazine. In that periodical, after reviewing Kelvin's mathematical deduction of the earth's age, he formulates his theory. The following are abstracts from his article:

"While the heat supplied by possible chemical combination is quite inadequate to account for the heat of the sun and earth, the recent discovery that the radioactive bodies are able to emit an amount of heat about one million times greater than is evolved in the most violent chemical reaction, throws quite another light on the question. In the course of a year, one pound of radium would emit as much heat as that obtained from the combustion of one hundred pounds of the best coal, but at the end of that time the radium would apparently be unchanged and would itself give out heat at the old rate. It can be calculated with some confidence that, although the actual amount of heat per year to be derived from the radium must slowly decrease with the time, on an average it would emit heat at the above rate for about one thousand years.

"But a still more remarkable fact remains to be noticed. Dr. Barnes and the writer showed that more than three-quarters of the heating effect of radium was due to the radioactive emanation stored in it.

"Sir William Ramsay and Mr. Soddy have recently found that the volume of the radium emanation stored in one gramme of radium is about one cubic millimeter at atmospheric pressure and temperature. The emanation is known to be a heavy gas, and, taking its molecular weight to be one hundred times that of hydrogen, it can be readily calculated that if one pound weight of the emanation could be collected, it would initially radiate energy at the rate of about 8,000 horse-power. This output of energy in the form of heat would fall off with the time, but the total amount of energy liberated during its life corresponds to that required to drive an engine of 10,000 horse-power for five days.

"Since there is little doubt that a quantity of radium, left to itself, would in the course of time completely change into the emanation and other products, we see that at least an equal quantity of energy must be given out by radium during its transformation. According to present views, the emission of heat is a consequence of a breaking up of the radium atom into a succession of radioactive products. The disintegration is explosive in character, and is accompanied by the projection of a flight of material particles with great velocity.

"Since all the radioactive bodies emit particles, each of them probably emits heat at a rate proportional to its radioactivity. The heating effect of uranium is probably only about one-millionth part of that shown by an equal weight of radium.

"Although the radioactive substances are found in the greatest quantity in pitchblende, radioactive matter has been found to be distributed to a minute extent throughout the atmosphere and the earth's crust. Much of our information in this important field has been due to the splendid work of Profs. Elster and Geitel, teachers in the High School of Wolfenbüttel, Germany.

"The emanations of radium and of other radioactive substances are present everywhere in the atmosphere. Every falling rain-drop and snowflake carries some of this radioactive matter to the earth, while every leaf and blade of grass is covered with an invisible film of radioactive material.

"These emanations are not produced in the air itself, but are exhaled from the earth's crust, which is impregnated with radioactive matter. The air in confined spaces like caves and cells is, in most cases, very radioactive on account of the presence of emanations which have diffused from the soil. The radium emanation has been found in the water from deep wells and springs, in surface and lake water, in escaping natural carbonic acid, and in the oil from wells. Elster and Geitel have shown that the soil itself is radioactive to varying degrees, the activity being most marked in clayey deposits.

"Since the radioactive substances present on the earth are continuously expelling α particles, heat must be evolved in amount proportional to the quantity of active matter present and to the intensity of its radiations. The question then arises, is the amount of radioactive matter present in the earth sufficient to heat it to an appreciable extent? I think that, even with our present knowledge, this question must be answered in the affirmative.

"Taking the value of the conductivity of rock used by Lord Kelvin, and knowing the average temperature gradient, the amount of internal heat lost per second from the earth by conduction to its surface can readily be calculated. Since one gramme of radium emits enough heat each hour to raise one hundred grammes of water through 1 deg. C., a simple calculation shows that the present loss of heat from the earth is equivalent to that supplied by the presence of about two hundred and seventy million tons of radium. This amount may seem very large compared with the small quantities of radium hitherto separated, but is small, for example, compared with the annual output of coal from the world. It can readily be deduced that this amount of radium, if distributed uniformly throughout the earth's crust, corresponds to only five parts in one hundred million million per unit mass. This is a very small quantity, and calculations based on the observations of Elster and Geitel show that the radioactivity observed in soils corresponds to the presence of about this proportion of radium. In some soils it is greater, in others less, and in this calculation no account has been taken of the deposits of uranium and thorium materials. A large amount of observations of the materials of the earth for radioactivity will be required before such a conclusion can be considered to be established, but the magnitude of the radioactivity observed is certainly suggestive.

"In this calculation it is not assumed that the radioactivity of the soil is due to radium alone. Other kinds of radioactive matter are undoubtedly present, but, for simplicity, the results are expressed in terms of that amount of radium in the soil required to exhibit the observed radioactivity.

"If radioactive matter is distributed throughout the whole earth to the extent that experiment indicates, the heat evolved by the radioactive matter would compensate for the heat lost by the earth by conduction to the surface. According to this view, the present internal heat of the earth tends to be maintained by the constant evolution of heat by the radioactive matter contained in it. The calculations of the age of the earth made by Lord Kelvin, which were based on the theory that the earth was a simple cooling body in which there was no further generation of heat, cannot apply, for the present temperature gradient of the earth may have been nearly the same for a long interval of time."

Automatic Fire Alarm to be Operated Over Telephone Wires.

Patents have been recently granted to W. L. Denio, of Rochester, N. Y., on a telephone fire alarm system.

This device secures its energy from the central office, so that there is no local battery to get out of order. It consists of one or more signal boxes installed in any building having a telephone. One signal box is sufficient for ordinary purposes, but if one box is placed on each floor, a fire starting on that floor would send a signal through that box, which would indicate that particular floor, so that no time would be lost by the fire department in locating the exact seat of the conflagration.

Leading from the signal box is a circuit on which glass-protected push buttons are located at convenient points, also thermostats on the ceiling. This signal box consists essentially of an electro-magnet arranged to be energized by the closing of the circuit by a thermostat or push button, which magnet unlocks a vibrating pendulum driven by an escapement wheel and a spring, actuating a revolving star-pointed contact wheel, operating to send in the signal indicating the floor on which the fire occurs. For instance, the wheel in the signal box on the fourth floor would be four points, one on the fifth floor five points, and so on.

The signal box is so constructed that the signal will be repeated a sufficient number of times to insure the central exchange operator's getting it correct. The star-