During the progress of the work special consideration had to be given to some seven acres of swamp which was encountered. The underlying material of the swamp was a plastic clay. The method of treatment was to excavate all the loose top soil, and lay a grillage or foundation of paving stones, of a size which one man could lift, loose or small stony material being filled into the spaces and compacted. The concreting was laid directly on this paving; and the method adopted was so successful that when the concrete was dry a 50-ton locomotive was run over the surface without any detriment.

The filling of the reservoir commenced on October 26, and water was allowed to pass in slowly until the concrete floor and saddles over the pipe lines were covered for the winter. On March 13, there having been prior to this date a shortage of storage in the watershed reservoirs of the Croton, the water was allowed to pass freely into the basin until it had reached a level of 128.45 feet, which occurred on April 3. On April 9, after drawing 40 million gallons to replenish the depleted storage in Central Park reservoirs, the gates were closed, with the water standing at elevation 127.09 feet, which corresponds to 21.09 feet depth of water. On April 30, with an evaporation, etc., of about 0.017 of a foot per day, the reservoir stood at 127.08, thereby showing that the rainfall directly into the basin itself during these three weeks had about equaled the evaporation. The rainfall during this period was about 5 inches, and the evaporation, etc., about 4½ inches, which shows that the basin, considering the fact that it is new and has had but little time for silting action to take place, is a comparatively tight structure. Moreover, it is significant that in a few places, where water was observed seeping through the masonry when the water was first let in, the chemical action going on in the cement, and the silting effect of the water itself, are gradually sealing up even such slight leaks.

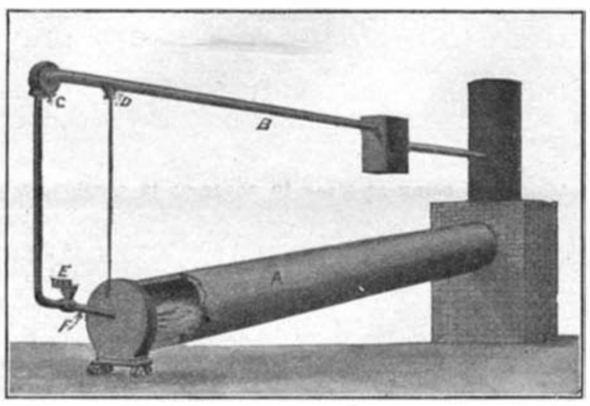
How to Make Concrete.

In determining the proportions of the aggregates and cement for a certain piece of work, it is necessary usually to take samples of the broken stone (or gravel) and sand which are most available to the site, and make measurements of the percentage of voids in the stone which must be filled by the sand, and the percentage of voids in the sand which must be filled by the cement. This is done by taking a cubic-foot box and filling it with broken stone in a thoroughly wet state. The box is then filled with as much water as is required to completely fill it in addition to the stone, which upon being poured off gives the relation between the volume of the voids and the volume of the stone. The required amount of local sand thus determined is then measured out and placed in the box with the stone in a damp state. Water is then used to determine the percentage of voids left in the sand, which gives the approximate amount of cement required, although an excess of cement is almost invariably used. Engineers everywhere differ regarding the best proportion to be used, but in general the above test, roughly made, will determine it well enough. The proportions which are most universally used are as follows: 1 cement, 2 sand, 4 broken stone; where extremely strong work is desired. Tests show that a 6-inch thickness of 1—2—4 concrete properly made is waterproof up to about 50 pounds to the square inch. This concrete is frequently used for facing dams. 1—3—6 is the proportion generally used for the interior of dams and large structures. It is entirely suitable for large foundations. 1—4—8 is frequently used for foundation work, and when properly mixed makes good concrete, although it is about the limit of what is considered good work, and would not be suitable for very important structures. 1—5—10 is equal to any concrete made with natural cement. It is a well-known fact that the volume of concrete when mixed with water is somewhat less than the volume of the aggregates and cement before mixing. The contractors' rule is that the volume of mixed concrete is equal to the volume of the stone plus one-half to one-third the volume of the sand.

There has been much discussion among engineers and others as to the amount of water that should be added to the aggregates and cement for making the best concrete; and while it is not the purpose of this paper to enter into this controversy, it might be said that the modern tendency is toward wet concrete. The old way was to add just enough water, so that when all the concrete was in the form and tamped, it would show moisture on the surface. The tamping is a very important part of the operation, and the quality of the work is dependent upon how well this is superintended, as unless it is well and thoroughly done the concrete is liable to be honeycombed and imperfect, especially near the forms. With the growth of the use of concrete the old method of putting it in the forms nearly dry and depending on tamping to consolidate it has been more or less abandoned, and the more modern way is to put the concrete in quite wet, as less tamping is required and much labor and expense saved. One of the great objections to this scheme is that if care is not taken, the water will tend to wash the cement from the stone and sand; in other words, unmix it. However, it may be said that it is now generally understood that rather wet concrete properly handled makes better work. The amount of water to be added to the aggregates and cement varies from 1 water to 3 cement by measurement to 12 per cent of water by weight. In 1887 Mr. Carey, of Newhaven, England, made the statement that 23 gallons water per cubic yard of cement was the best mixture. Quite frequently salt water is used in mixing concrete in cold weather to prevent freezing, and it seems to have no ill effects on the resulting mixture.—Cement Age.

THE IMPINGING FLAME IN CEMENT BURNING.

The use of the impinging flame in cement burning has come to be recognized as the best method yet devised for increase of output and economy of fuel. This principle, as put into practice under patents granted to Mr. Byron E. Eldred, has attracted the attention of cement manufacturers all over the country. In the Eldred process the air used to support combustion is modified by mixing with it a certain amount of waste stack gases of the kiln. The method of operation is shown clearly in the accompanying diagram. The waste gases are conducted through the pipe, *B*, by the exhaust fan, *C*. Air is then admitted at the opening, *D*, the amount of oxygen desired in the mixture being accurately controlled by means of dampers. The fan, *C*, discharges this mixture into the coal feeding apparatus, *E*, from which it goes through the pipe, *F*, into the kiln, *A*. The point, *F*, is so arranged with reference to the kiln that the hottest part of the tempered flame comes into direct contact with the material. One striking advantage of the process is the easy regulation of the mixture made possible by the manipulation of the damper at the air inlet, *D*. It is possible speedily to adjust the air mixture to meet conditions in the kiln; thus, when rings begin to form, an increase in the quantity of stack gases can



THE IMPINGING FLAME IN CEMENT BURNING.

be quickly made, which causes the removal of the mass. An experienced operator will have no difficulty with the Eldred method in obtaining a direct impingement of the flame and at the same time avoiding difficulties which formerly arose due to contamination of the discharging clinker. In using this process the cement company has been able to increase the output of each of its eight kilns about eight per cent, and to make a saving of about five per cent in consumption of fuel without causing any change in the quality of its product.

Official Meteorological Summary, New York, N. Y., April, 1906.

Atmospheric pressure: Highest, 30.47; date, 3d; lowest, 29.44; date, 25th; mean, 29.98. Temperature: Highest, 74; date, 30th; lowest, 31; date, 1st; mean of warmest day, 64; date, 30th; coldest day, 40; date, 1st, 2d; mean of maximum for the month, 60.1; mean of minimum, 43.3; absolute mean, 51.7; normal, 48.7; average daily excess compared with mean of 36 years, +3.0. Warmest mean temperature for April, 54, in 1871; coldest mean, 41, in 1874. Absolute maximum and minimum for this month for 36 years, 90, and 20. Precipitation: 5.78; greatest in 24 hours, 2.42; date, 9th, 10th; average for this month for 36 years, 3.35; excess, +2.43; greatest precipitation, 7.02, in 1874; least, 1.00, in 1881. Snow: Trace; date, 9th, 23d. Wind: Prevailing direction, northwest; total movement, 9,712 miles; average hourly velocity, 13.5 miles; maximum velocity, 54 miles per hour. Weather: Clear days, 12; partly cloudy, 11; cloudy, 7. Thunderstorms, date, 21st, 30th.

The Current Supplement.

The current Supplement, No. 1584, is opened by B. S. Bowdish with an article on the Rapid Growth of Birds. An article on Artificial Gems will be of interest to the jeweler. Mr. James P. Maginnis continues his discussion of Reservoir, Fountain, and Stylographic Pens. A fourth installment of Valuable Alloys is published. Interesting to the naturalist is an article on the domestic life of animals. The well-known meteorologist, Prof. Cleveland Abbé, writes on the relations between climates and crops. A most ingenious piece of mechanism is described in an article entitled "A Speed and Mileage Recorder for Automobiles and Railroads." The Tangent Galvanometer and Its Construction is described.

THE ADVANTAGES AND LIMITATIONS OF REINFORCED CONCRETE.

(*Continued from page 383.*)

with the older materials. This condition must be charged in large measure to the fact that proprietary concerns have been chiefly instrumental in promulgating the use of the new material. Their purpose has not been that of true engineering to adopt the material only for such uses as it is particularly fitted, but that of the sales agent, to dispose of as much material as possible by forcing its use in every conceivable way. The natural result has been to see reinforced concrete used in many places where plain concrete would have served well enough, and in other places where every consideration called for the use of steel. The remedy for this evil will come with the passing of concrete-steel work into the hands of engineers whose only object is to employ the material best fitted for their purpose, be it whatever it may; and this transition has already begun. Another evil rising from the same cause and destined to be remedied in the same way is the tacit acceptance of empiricism as a rule of design. Already the theory of reinforced concrete is engaging the time and attention of many competent engineers, and a mass of reliable test data is being accumulated which will soon relegate empirical rules for reinforced concrete to the position they have long occupied in designing steel structures.

These strictures against empiricism will doubtless meet with opposition from some quarters, but they are entirely warranted. There is no place in engineering for guess-work whenever scientific determination is possible. It is becoming increasingly plain, moreover, that it is possible in reinforced concrete work. The common assumption of certain builders, that the laws, formulas, and methods of calculation used for ordinary materials cannot be applied to such a combination of two materials as is reinforced concrete, comes very close to being utter nonsense. The sooner such assumptions are banished from reinforced concrete work, the better it will be for the engineer and the building public; any attempt to weave a net of mystery about the new material is entirely wrong.

What Science Loses by the Earthquake.

Science has lost almost irretrievably in the destruction of one institution, not to refer to others, in which the most ardent hopes of the future were centered. The history of the California Academy of Sciences has many counterparts in other institutions devoted to pure science. It was begun forty years ago, and after a career of stress and poverty, at last as a beneficiary of the Lick estate, emerged into the full sunshine of wealth, and with splendid equipment was doing invaluable work in investigation and discovery. The latest expedition to be sent out by the institution is even now at work preparing a catalogue of the flora and fauna of the Galapagos Islands, where a company of scientists are exploring that remote group, and filling a gap which thus far has remained a blank page to science. In the department of entomology the academy has done immense service to general knowledge. Its collection of specimens was one of the finest in the world, and can never be replaced, and its museum of natural science, fossils, Indian curiosities, reptiles of California and Lower California, Aztec and Mexican, birds, together with a complete collection of the flora of the Pacific coast, included much that can never be replaced and many things that are lost to the world forever.

The Astronomical Society of the Pacific lost its valuable records and many rare manuscripts, as did the Geographical Society of the Pacific. The University of California, with its great museum temporarily housed at the Affiliated Colleges, suffered no loss from either shock or flames. Every public library in San Francisco fell a victim to the catastrophe, the largest being the Free Public with three branches containing 150,000 volumes; the Mechanics', with 80,000; the Mercantile, with 60,000; and the San Francisco Law, with 41,000; and the library of the California Historical Society, with its priceless manuscripts and unreplaceable records. There were in the city many noted private and professional libraries, which were all destroyed; no one had time to save books. Millions of volumes were reduced to ashes. Of schools and colleges destroyed, the most noted was St. Ignatius, a college of the Jesuit Fathers, located on Van Ness Avenue and the first established in San Francisco. The society also lost its magnificent church, built in the style of the Spanish Renaissance and richly decorated. College and church cannot be replaced for less than a million and a half dollars. Twenty-eight public schools of all classes were burned.