ever, that the healthy competition between the various systems established by the British government's action will achieve this end.

THE BUOYANCY OF SUBMARINE BOATS.

In view of the tragic interest attaching to the recent submarine disasters, the following explanation of the loss of submarine "A8," given by a submarine expert during the investigation by the British Admiralty, commands special attention. The "A8" while traveling on the surface in a calm sea, it will be remembered, suddenly plunged down, and sank with fourteen of the crew.

According to Capt. Bacon, in the ordinary conditions the buoyancy of the submarine was reduced until only about 800 pounds remained, the boat being sunk until only approximately two feet remained well out of the water. In that condition the boat would dive if the horizontal rudders were put down, the nose of the boat depressed, and the speed of 6½ knots maintained. But if the buoyancy of the boat were increased to about 1,120 pounds, and she was still kept trimmed horizontally, the boat could not be made to dive. Before that happened and the boat could be forced under, her tail must rise to the surface. In such a case the propellers and rudders would no longer be immersed, and in consequence the boat would be unable to break away from the surface. If, however, she were trimmed suitably, two or three degrees by the bow, diving could be carried out. The "A8" had 13,440 pounds of buoyancy instead of 1,120 pounds, and was going 10 knots instead of 6 knots. The causes of her diving were therefore not clear. Allowing for the difference of 6½ and 10 knots, and supposing, as was probably true, that all the pressures varied as the square of the speed, the effect of speed would be only as 100 is to 42 buoyancy and one degree by the bow. If the boat steamed ahead and sank, the boat had a tendency to go more and more by the bow, and to steam herself under water. Imagine the boat to be immersed until her hull was nearly covered, whichever way the rudders were put, the conning tower would probably go under water, for the down pressure of the rudders would reduce the buoyancy more than that given her by the conning tower.

Taking for granted that a boat in this condition could be dived at 10 knots, the question was, how could the condition of the boat be changed from one of 13,440 pounds buoyancy and four degrees by the stern to one of 7,840 pounds and one degree by the bow? The only explanation was by water finding its way into the tanks forward in the boat. The two tanks into which the water could possibly get were the foremost main ballast tank and the foremost gasoline tank. If 5,660 pounds of water found its way into these, the buoyancy of the boat would be reduced to 7,840 pounds, and the moment of 75 tons would be introduced, tending to put her down by the nose. This would mean an inclination of 2½ degrees by the bow. Steaming ahead would probably bring her down another two degrees by the bow. The only other weights that could move were the men. There were six men stationed in the boat who were liable to move. Had these gone forward after the boat started steaming, as was usually the case, and sat down by the torpedo tubes, they would have produced a moment of about 12 foot-tons, or an inclination at 7,840 pounds displacement of one degree.

RAMSAY, RADIUM, AND BURKE.

In a well-considered and frankly skeptical and sensible article published in the Independent, Sir William Ramsay has this to say anent Burke's "radiobes":

"During the decomposition of the emanation into helium and other products much heat is evolved, as was shown by Prof. Rutherford; it had been shown before by the Curies that radium continually gives off heat, and Rutherford proved that by far the major part of the heat was due to the spontaneous change undergone by the emanation. Now this energy need not all be manifested as heat; some, at least, may appear as chemical action. A solution of the emanation in water decomposes the water in which it is dissolved into its constituent gases, oxygen and hydrogen. And the rate at which the water is decomposed keeps pace with the rate at which the emanation changes—that is, at the beginning, when the emanation is fresh and there is comparatively much present, the amount of gases evolved is comparatively great; and as the emanation diminishes so the decomposition decreases, less gas being produced in a given time,

"The solution of this gas in water has the curious property of coagulating white of egg or albumen. What is the precise nature of the change produced is unknown. Hence if kept in a liquid containing albumen it forms, no doubt, ultra-microscopic cells, for the gas produced is liberated in molecules, or, it may be, even in atoms. Some solution, injected under the skin of a living being, surrounds itself with a sack, or bag, the walls of which are thick and hard and are absorbed only slowly by the living organism. These phenomena require further study, and I regret to say that I have not had an opportunity of examining them more thoroughly, though I hope to do so.

"Mr. Burke made use of solid radium bromide in fine powder. He sprinkled a few minute grains on a gelatine broth medium, possibly somewhat soft, so that the granules would sink slowly below the surface. Once there they would dissolve in and decompose the water, liberating oxygen and hydrogen, together with emanations, which would remain mixed with these gases. The gases would form minute bubbles, probably of microscopic dimensions, and the coagulating action of the emanation on the albumen of the liquor would surround each with a skin, so that the product would appear like a cell; its contents, however, would be gas, or, rather, a mixture of the gases oxygen and hydrogen. The emanation, inclosed in such a sack, would still decompose water, for enough would diffuse through the walls of the sack, which, moreover, would naturally be moist. The accumulation of more gas would almost certainly burst the walls of the cell, and almost equally certainly in one or two places. Through the cracks more gas would issue, carrying with it the emanation, and with it the property of coagulating the walls of a fresh cell. The result of the original bubble would resemble a yeast cell, and the second cell a bud, or perhaps more than one, if the original cell happened to burst. This process would necessarily be repeated as long as the radium continued to evolve emanation, which would be for the best part of a thousand years. The 'life,' therefore, would be a long one, and the 'budding' would impress itself on an observer as equally continuous with that of a living organism."

LOST ARTS.

Not as much as we used to, but occasionally even yet, one hears of some wonder accomplished by the ancients which cannot be done now.

Not so many years ago it was quite commonly asserted that modern workmen could not quarry, or, having quarried, could not handle stones as large as the monoliths of Egypt; and the writer has heard a public speaker of note assert that it would be impossible to handle, with modern implements, such large stones as were used in the pyramids, or to join them as perfectly as they are joined there; yet, when occasion arose, larger stones than any of these were quarried in Maine, and some of the larger monoliths themselves were transported, not only to the sea, but across it, and erected in England, France, and America; and there are individuals to-day who might, if they chose, cause the transportation to and erection in this country of the largest pyramids, or build new ones ten times larger and more durable. Pyramids are not being generally built, nowadays, because they are not in line with the trend of modern ambition; that's all.

It is very doubtful if a "Damascus blade" would stand half as severe usage as a modern band-saw blade, or even as much as the spring of a forty-cent clock; while the ornamentation of those wondrous blades, so far as the mechanical execution is concerned, can be excelled by apprentices and amateurs of to-day.

Of the "lost art" of hardening copper little is heard of late years, though one occasionally hears a wiseling from the wilds wish that he knew how to do it as well as the ancients; and, while it is perhaps regrettable that he doesn't, his ignorance is his own fault.

Many arts and devices have been abandoned because new knowledge has made them useless, and time spent in rediscovering them would be worse than wasted. The modern youth had much better spend his time studying the art of his contemporaries than that which is "lost."

THE CURRENT SUPPLEMENT.

The Truckee-Carson reclamation project, which will convert 30,000 acres of parched land in Nevada into luxuriant verdure, is fully described by Enos Brown in the opening article of the current SUPPLEMENT, No. 1550. William Barclay Parsons presents his views on rapid transit in great cities. Inasmuch as he was the engineer who gave us New York's Subway, his observations are of considerable importance. The report of the Royal Commission on coal supply has made it clear that in the future England will have to generate power by other means than from coal if she is to keep her place as a manufacturing nation. In a well-considered article Mr. James Saunders shows how tides could be made to turn factory wheels. T. P. E. Butt discourses interestingly on the induction motor as a generator. Mr. Warren R. Smith gives some excellent directions for a number of experiments with dyes. The Plauen viaduct, known locally as the Syrathal viaduct, because it bridges the valley of the Syra, was finally completed during the early part of this year. It comprises the largest arch masonry ring in the world, measuring, as it does, 295 feet 3 inches between the abutments. This stupendous work is very fully described by our English correspondent. Sir William White presents another installment of his treatise on submarines. An article on Sakhalin gives a very detailed account of the island which proved such a bone of contention between the Russian and Japanese plenipotentiaries. Prof. E. P. Schoch presents a thoughtful paper on the physical notions of entropy and free energy and their importance in general chemistry.

SCIENCE NOTES.

The pedagogical dictum, "from the concrete to the abstract," finds universal acceptance in this age of laboratory education. The idea of teaching through hand and eye in manual training is being put into practice more and more, owing to the great success that has been achieved by the pioneer institutions in this line. Why should not the same principles of co-ordinate activity govern in the teaching of algebra? Can we not clear up some of the most troublesome points by making visual, concrete representations of negative numbers, and of equations?

After covering an ebonite dish containing 0.03 gramme of radium bromide with an aluminium plate 0.1 millimeter in thickness, M. N. Orloff has noticed on the surface of the aluminium turned toward the radium protuberances similar to small drops of melted metal, but not differing in appearance from that of the neighboring surface of aluminium. These protuberances are radio-active and produce a photographic image through black paper in a few minutes. They appear to have emitted invisible radiations during a period of six months without noticeable abatement. The inference is that there is a formation of a stable alloy, due to the accumulation of particles proceeding from the atomic system of the radium around slight nuclei of aluminium.

The Chemiker Zeitung describes the researches of Dr. H. Thorns on the obnoxious products of tobacco smoke, nicotine, and its products of decomposition, ammonia, methylamine, pyrrol, hydrogen sulphide, cyanhydric acid, butyric acid, carbonic acid, carbon oxide, watery vapor, pyrogenous essential oil, tarry and resinous products, among which the presence of a small quantity of phenol has been ascertained. He recommends the filtration of the smoke through cotton soaked in ferric salts. The preparation is obtained by dissolving one part ammoniacal sulphate of iron in four parts of distilled water and 1-10 to 1-5 of a part of glycerine, soaking of the wadding and its desiccation, which ought to leave 50 per cent of the salt. By this process the fumes of the essential oil, of the hydrogen sulphide, the cyanhydric acid and about half of the nicotine and its products of decomposition, as well as the greater part of ammonia, are got rid of, while not depriving the smoke of its aroma.

A Unique Process of Irrigation.—The Italian professor, Cusmano, has originated a process which assures an ample supply of water to plants growing in regions where the dry season is of long duration. Use is made of the Barbary nopal, the *Opuntia vulgaris*, a fig tree which is widely acclimated and bears figs that are excellent reservoirs of moisture. In spring a ditch, 30 centimeters deep and about 2 meters in diameter, is dug at the foot of the tree that is to be protected from the drought. This ditch is filled with the figs cut into pieces about two fingers thick; to make a dense layer, they are beaten down and stems are added as the mass piles up. This mucilaginous pulp, covered with a layer of earth, stores up much water and gives it out gradually, thus watering the tree a long time. Prof. Cusmano asserts that after four months of drought he has found pulp still fresh, capable of supporting vegetation, and the foliage was in perfect condition.

M. Berthelot has directed his researches to the white glass of ordinary test tubes, which commences to soften at 550 deg. C., and to the Jena glass, which softens only at 700 to 750 deg., and has communicated his conclusions to the Académie des Sciences. Glass kept for a long time at a temperature a little lower than its fusing point becomes opaque, and is devitrified. Softened silica is also at length modified. It is affected more rapidly when heated by the acetylene blowpipe, of which the temperature is sufficiently high for volatilization. The permeability of glass as well as that of softened silica is like that of membranes manifesting osmotic properties. It does not result from the existence of visible holes and fissures. The penetration especially occurs when the silica and glass are softened by heat and thinned by a pressure of interior gases greater than that of the atmospheric pressure. The intervention of this permeability in the current phenomena of chemistry and physics has so far scarcely been suspected. Hereafter, the penetration or dissipation of gases, interior or exterior to vessels regarded as sealed, such as hydrogen, oxygen, nitrogen, helium, and the emanations of radio-active bodies, must be surmised whenever vessels of glass, silica, earthenware, or porcelain, have been raised to a temperature near their point of softening, which occurs in organic analysis, in the reduction of metals by means of hydrogen, in the measurement of high temperatures by means of gas thermometers, and in the determinations of the density of vapors.