Diacon, who was, however, unable to produce it in the crystalline state. The action of selenium vapors upon cobalt causes the metal to become covered with a gray deposit which is easily detached and corresponds to the formula CoSe; it is an amorphous body. The oxide of cobalt is also transformed to the same compound by the action of hydrogen selenide at a bright red heat. The sesquiselenide of cobalt was the second of the series formed by the experimenter. At low redness, hydrogen selenide reacts upon anhydrous chloride of cobalt and transforms it to sesquiselenide; this body has the form of a gray melted mass, and analysis gives it the formula Co_2Se_3. Another selenide having the formula Co_3Se_4 is obtained in the crystalline state by heating chloride of cobalt to low redness in a tube and passing over it a current of hydrogen selenide drawn through by a current of nitrogen charged with vapors of hydrochloric acid. At the end of the operation a brilliant crystalline mass is obtained, of gray-violet color, which under the microscope appears in fine octahedra, isolated, of the cubic system. The crystals have the formula Co_3Se_4 and are thus isomeric with the mineral linneite, having the same composition. Its density at 15 degrees C. is 6.54. The biselenide of cobalt was next found by the reaction of hydrogen selenide upon anhydrous chloride of cobalt considerably below a red heat, and the latter is transformed into a brittle mass of gray-violet color, having the composition $CoSe_2$. It easily loses selenium by the action of heat. The different selenides mentioned are partially reduced when heated to bright redness in a current of hydrogen and a silver white and brilliant mass is formed, which has the formula Co_2Se, being a subselenide. The experimenter then describes the properties of the new selenides. When reduced to powder they are slowly attacked by hydrochloric acid vapor at low redness, and the strong acid has but little action, even at the boiling point. Bromine water dissolves them easily; when heated in a current of oxygen they give rise to selenious anhydride and oxide of cobalt. Hydrogen, at a red heat, transforms them to subselenide, which by a prolonged action loses a further proportion of selenium. The oxyselenide is another new body formed in the experiments; seleniate of cobalt heated in a current of hydrogen is at first partially dissolved with loss of selenious anhydride and water, then at a higher temperature, below redness, a reduction takes place with the formation of a greenish-gray powder containing variable quantities of selenium and cobalt and also of oxygen. If the reduction takes place at a low red heat a black magnetic powder is formed, which is a mixture of metallic cobalt and its selenide. Lastly, at a white heat a gray and porous mass is obtained, which consists of metallic cobalt containing small quantities of selenium. As a result of these experiments it is found that cobalt will combine with selenium, forming four different bodies according to the conditions of temperature—$CoSe_2$, Co_2Se_3, Co_3Se_4, CoSe. At a high temperature these bodies are transformed by hydrogen into the subselenide Co_2Se. The seleniate of cobalt, reduced by hydrogen, gives oxyselenides or mixtures of selenide and metallic cobalt, according to the temperature.

COKE AS A SUBSTITUTE FOR ANTHRACITE COAL.

BY ALTON D. ADAMS.

Deposits of anthracite coal, thus far worked in the United States, are of smaller extent and much more concentrated geographically than are those of the bituminous varieties. Statistics of coal production show the influence of these conditions, in an annual output of bituminous fully three times as great as that of anthracite coal for the entire country. The average value of the bituminous coal at the mines is only about one-half as great per ton as that of the anthracite. Moreover, the annual supply of bituminous coal is capable of a much larger increase, without raising the price per ton, than is the case for anthracite. Over a large part of the country the uses to which the two varieties of coal are applied are in large measure distinct. Anthracite generally has the decided preference for residences and in city buildings, while bituminous coal is much more extensively used in industrial operations. Railway locomotives consume large amounts of both hard and soft coal, some roads using one and some the other variety, but the anthracite is much the more satisfactory, because of the great reduction of smoke and cinders where it is used. The limited area and amount of anthracite coal deposits, the difficulty of the mining operations, over those of soft coal, and industrial conditions that frequently result in strikes on the part of the miners, all tend to render the supply of anthracite coal to some extent uncertain. Considering the comparatively high price of hard coal and the elements of uncertainty in its supply, it seems that some substitute for it, free from these objections and also from the disadvantages of soft coal, would be of great advantage to the public. It is evident at the start that any substitute for anthracite that is to have extensive use must be derived from bituminous coal, since natural gas is only available over a limited area and is failing in quantity, while the supply of petroleum is too small in total amount and its price too high, to admit of its general application to fuel purposes. As is well known, soft coal suffers by comparison with hard, because the former is not as readily burned in ordinary stoves and furnaces, and unless special precautions are taken gives off on combustion a dense black smoke. If these undesirable properties can be removed from soft coal or its products, without too much expense, a cheap and desirable substitute for hard coal may be provided. The different results attained in the combustion of anthracite and bituminous coals are mainly due to their chemical compositions. Good anthracite coal consists, on an average, of about 88 per cent fixed or solid carbon, 4 per cent volatile matter, in the form of hydrocarbons, and 8 per cent ash. An average value for the composition of bituminous coal is approximately 60 per cent fixed carbon, 32 per cent volatile matter and 8 per cent ash. The main difference between hard and soft coal, is thus the presence in the former of a much larger proportion of fixed carbon and but a fraction of the volatile hydrocarbons that are found in the latter. It is the presence of this large per cent of hydrocarbons in bituminous coal that interferes with its satisfactory combustion in ordinary stoves and furnaces, besides producing the black smoke and soot that are mixed with the air in most places where soft coal is extensively used for fuel. The fact that the hydrocarbons found in soft coal can be driven off by heat, leaving the fixed carbon in solid form, is taken advantage of for two distinct purposes, the production of coke for metallurgical uses, and the supply of illuminating gas. The distillation of bituminous coal in each case produces both gas and coke, but where the main object is to obtain coke, the gas is usually wasted, while in the manufacture of illuminating gas the by-product coke is somewhat inferior in quality for metallurgical uses. A good grade of coke is a very satisfactory fuel for general use in almost all kinds of stoves and furnaces, as well as for special purposes in the industrial arts. As coke is even more nearly composed of pure carbon and ash than is anthracite coal, its employment entirely avoids the smoke nuisance. A sufficient supply of good coke at competitive prices would render private consumers, large city buildings, and such railways as require a smokeless fuel, to a large extent independent of anthracite coal. Such a coke supply would not do away with the use of anthracite coal, but would divide the market with it, and expand in use whenever the production of hard coal was restricted by any unusual cause. While there is an almost unlimited field for the solid product of the distillation of bituminous coal, the gas developed seems equally certain to find a demand beyond any probable production for many years to come. It is quite certain that the present use of illuminating gas for fuel and power is held in check by the comparatively high prices of energy from this source. A large reduction in the present rates for gas would result in a great increase of its use for heat and power.

One ton of fairly good gas coal may be taken to yield, when treated in retorts, 10,000 cubic feet of gas and 1,300 pounds of coke on an average. About 300 pounds of coke, when used as fuel for the retorts, are required to distill one ton of coal, so that the net products of gas and coke are 10,000 cubic feet of the former and 1,000 pounds of the latter per ton of coal. In addition to the coke and gas, each ton of average coal yields about 120 pounds of tar and 200 pounds of ammonia liquor. The accounts of quite a large number of gas companies show that more than one-half of their total outlay for coal is recovered by the sale of coke, tar and ammonia. Allowing that only one-half of the cost of the coal consumed is received for the residual products of gas manufacture, the net outlay for coal to produce a thousand cubic feet of gas is obviously very small. For example, if gas coal costs three dollars per ton, and one-half of this amount is recovered for the by-products, the net charge for coal against the 10,000 cubic feet of gas obtained from one ton is $1.50, which corresponds to fifteen cents per 1,000 cubic feet.

The wide difference between this last figure and the current charges for gas includes the cost of enrichers, the various items in manufacture, such as labor, interest, depreciation, repairs, distribution charges and profits. If the gas is not enriched, the entire cost of oil, some of the plant equipment and a part of the labor item are saved. The result is a gas of about ten per cent smaller heating capacity than the enriched product usually distributed, but of a much larger reduction in cost. It seems evident from these facts that a large plant, producing coke and simple coal gas, would be able to offer both the gas and coke at prices decidedly lower than are charged by existing plants that operate primarily for the manufacture of enriched illuminating gas, a product that necessarily can find only a comparatively limited demand, at the rates for which it must be sold. Such cheap gas and coke would supply much of the demand now met by anthracite coal.

SCIENCE NOTES.

A Dublin firm has produced a typewriter writing Irish characters.

It is said that the trials of the flying machine which has been under construction for some time by Denny Brothers have been satisfactory, showing that the principle is all right but the motive power is inadequate. The machine is 40 feet from tip to tip of the wings, and the weight, including that of the two aeronauts, is about 600 pounds.

The density of population in foreign countries has recently been computed. Great Britain takes the lead with 132 inhabitants per square kilometer, which is equal to 0.3861 square mile; then comes Japan, 114.4; Italy, 106.6; the German Empire, 104.2; then comes Austria, 87; Hungary, 59.6; France, 72.2; Spain, 35.9; the United States, 8.4; Russia, 5.9.

Twenty thousand dollars has been collected for a statue of Virgil at Mantua, Italy, his birthplace. This city formerly had a statue of him, but it was destroyed in 1397, so that for over five hundred years the great Latin poet has been without a monument. A portrait of him was discovered in Tunis two years ago, so that the monument of Mantua ought to be a correct representation of the author of the "Æneid."

Dr. H. S. Gaylord, of the University of Buffalo, states that cancer is caused by an animal parasite which has been identified and isolated. He has been investigating the cause of cancer for two years as head of the New York State Pathological Laboratory. He has inoculated animals with cancer germs, and cancer afterward developed in the animals. Cultures of these organisms have been injected in the abdominal cavities of other animals and they recovered, having apparently grown in the serum of the animal.

An instance of the inexplicable conservatism and arrogance of the Turkish customs authorities was recently evidenced by the prohibition of the importation of typewriters into the country. The reason advanced by the authorities for this step is that typewriting affords no clew to the author, and that therefore in the event of seditious or opprobrious pamphlets or writings executed by the typewriter being circulated it would be impossible to obtain any clew by which the operator of the machine could be traced. A large consignment of 200 typewriters was lying in the custom house at the time the above law was passed, and as there is no apparent possibility of the authorities repealing their ridiculous decree, the machines will have to be returned. Efforts are being made by the various embassies to induce the authorities to assume a more reasonable attitude. The same decree also applies to the mimeograph and other similar duplicating machines and mediums.

The American branch of the Society of Psychical Research of Boston has issued a circular for the sentiment of people regarding a future life. They are desirous of obtaining statistics on this subject. The questions which they ask are, first, would you prefer to live after death or not; second, do you desire future life whatever its conditions may be? If you do not prefer to live after death, what would the character of the future life be to make the prospect seem tolerable? Would you, for example, be content with a life more or less like your present life? Can you state what elements in life were felt by you to call for its perpetuity? Third, can you state why you feel this way, as regards questions one and two? Fourth, do you now feel the question of a future life to be of urgent importance to your mental comfort? Have your feelings on questions one, two and four undergone change? If so, when, and in what way? Sixth, would you like to know for certain about the future life, or would you prefer to leave it a matter of faith?

Ordinary gypsum is brittle, porous, hygroscopic and by the absorption of water becomes a good electrical conductor, but in the hardened condition it is useful for parts which do not require to withstand powerful tension or high and sudden changes of temperature. Gypsum may be hardened by the following methods: (*a*) The powdered gypsum is intimately mixed with 2 to 4 per cent of powdered marshmallow root and with 40 per cent water kneaded to a paste. After an hour the mass is so hard that it may be filed, cut, or bored; an addition of 8 per cent marshmallow root powder makes it thicker. Marshmallow root powder may be replaced by dextrin, gum arabic or glue. (*b*) Gypsum, 6 parts, is mixed with freshly slaked lime, 1 part, and when the required shape is made it is moistened with a concentrated solution of magnesium sulphate. (*c*) The gypsum, after burning, is digested with 10 per cent solution of alum and after drying again burnt; on the addition of water the gypsum crystallizes to a marble-like mass, the so-called marble cement.—Pharm. Centralh., 41, 779.