which is but a little over twenty-five years old itself, expects in a few years to net from twenty to thirty thousand dollars per annum from its sewage. The various figures of the farm are not essential, but one may be given as suggestive of the success of the plant. The price received from the walnut crop alone in 1903 was $7,419. The running expenses of the farm for the fiscal year ending January, 1903, including everything, from the salary of the manager down, were about $5,000, so that ninety acres out of three hundred paid all the expenses and left a balance of $2,400.

A LIFE-SAVING MUSEUM.

BY GEORGE E. WALSH

The effort made to establish in New York a museum of safety has attracted the widespread attention of manufacturers, who are interested in the present high industrial death rate that prevails in this country through causes which could be largely removed by the adoption of precautionary methods. We are the foremost nation of the earth in the invention of safety devices and appliances; but our industrial death rate is the highest of all the large manufacturing nations. Either we are careless of the individual life of workmen, or through ignorance or willfulness we do not take the medicine prescribed by ourselves. Our safety appliances are used in manufacturing plants in all parts of the world, but often their use is neglected right at home. Many of the thousands of devices intended to protect workmen from injuries in various dangerous employments are merely of local use, and they are of no general advantage to the industrial world. A more general knowledge of the use and value of safety appliances should result in safeguarding human life in all departments of work. A museum of safety would form a nucleus for working plans and models of all devices intended to protect workmen from their own carelessness or from conditions over which they have no control. Both manufacturers and employes would have object lessons presented to them in such a collection of inventions, and there would be few trades or industries that could not draw some valuable results from the exhibition.

In Germany manufacturers have united in a movement to lower the industrial death rate, while in Holland there has been for some time a museum of safety, which has demonstrated the value of educating the public in the use of safety appliances. Another such museum is located at Milan; but the Amsterdam institution has furnished more data for the general public than the smaller one in southern Europe. Every effort is made to secure working models of new safety appliances for exhibition at the Amsterdam museum, and one can find grouped therein hundreds of practical devices for lessening the industrial death rate. These devices are gathered from all parts of the world, and scores of American inventions are exhibited there, so that a manufacturer or workman from this country can study to the best advantage the improvements made by his own countrymen in this direction.

The Amsterdam museum of safety, after which it is intended to model the New York institution, exhibits specimens of the safety appliances in actual operation. A great many of these devices are intended to prevent injuries that partly incapacitate, but do not kill. Injuries to delicate organs that render the workmen almost useless for further efforts in their trade are so common, that we find among the unskilled class of laborers a fair proportion of old men who were trained in some particular trade, but through gradual injury to eyes, ears, mouth, lungs, or other organ, they were forced to give up their chosen profession and drop back among the unskilled class. Stonecutters blinded by the fine powdered dust of the chiseled stone have to seek some other line of work, and plasterers half blind from some lime or mortar that has spattered in their eyes become almost helpless in their old age.

Fully as pathetic is the disabling of workmen for life by failure to adopt simple mechanical precautions that science has devised for them. Workmen as a rule are less ready to accept new safety inventions for their own protection than employers, who must go to the expense of purchasing the appliances. The education of the workmen to an appreciation of their duty in this matter is one of the objects of the modern safety museum. In factories the whirring machinery appears to the visitor a dangerous power that is waiting for its victims, to grind up or maim for life; but the operators grow so accustomed to the scene that there is no fear or little thought of any possible danger. In some unguarded moment, however, an arm or leg is sacrificed, to warn others of the danger. It is the consensus of opinion of manufacturers that no machinery in operation should be left unguarded and unprotected, and it is possible to prevent nearly all accidents by safety contrivances that will keep heedless or ignorant operators from getting caught. Belts have their guards, so they cannot slip and catch an unfortunate victim; wheels and buzz saws have circular sheaths, so that it is impossible for one to meet accidents with them; piston rods and flywheels of engines have steel wire inclosures, so that the forgetful will not run against them; and nearly all of the moving parts of the machinery are painted in vivid red to attract the eyes. This employment of a color that stands out distinctly to warn the operators is an advance in modern factory and engine-room practice that saves many needless accidents. With every moving part of the machinery painted red, from shafts and flywheels to small valves and slides, the workmen are safeguarded to some extent; but in the up-to-date mill or factory, further devices are employed to keep the operators from getting caught. Extraordinary precautions to make up for man's inherent weakness and forgetfulness are apparent to the visitor in a modern museum of safety.

Modern inventions for protecting workmen from accidents and injury while in the performance of their ordinary work have lessened the mortality greatly among them in recent years; but there is still plenty of room for further improvement. With the invention of new forms of machines and employments each year, there comes the corresponding need of more devices for protecting operators. But probably the greatest need to-day is a more general use of the safety appliances already invented and in use in a limited way. Thousands of these are neglected in mills, factories, and mines on account of lack of forethought or ignorance. Owners of plants do not always have the time to study the hundreds of devices invented for this purpose, and they are not sure that they would do all that is claimed for them.

With a museum of safety with all the important safety devices exhibited, there would be no further room for ignorant excuses. A day's study of the contents of the institution would reveal to any one the possibilities of safeguarding the lives of operators in any trade or profession. Since the establishment of the Amsterdam museum, it is estimated that thousands of lives have been indirectly saved through the more general adoption of safety devices by manufacturers and mine owners. Until these appliances were exhibited, little was known about them. It has also resulted in the passing of laws compelling employers of labor in certain lines to use safety devices that have been found to give beneficial results. The direct outcome of the founding of such a museum in New York would be far-reaching, and in the end it would tend to lessen the industrial death rate in this country to a considerable degree.

THE SCIENTIFIC AMERICAN REFERENCE BOOK.

It is with a sense of great gratification that we are able to announce that the "Scientific American Reference Book" has been published. The Editor of the SCIENTIFIC AMERICAN receives during the year thousands of inquiries from readers and correspondents covering a wide range of topics. The information sought for, in many cases cannot be found readily in any available reference book or textbook. The publishers of the SCIENTIFIC AMERICAN decided, many months ago, to prepare a work which should be comprehensive in character, and which should contain a mass of information not readily procured elsewhere. It was at first intended to issue a 144-page book; but as the work progressed, and the wealth of material increased, it was seen that the wants of its readers could never be satisfied by a book of this size, and it was extended to 516 pages. This work has been made as non-technical as the subjects treated of will permit, and it is intended as a ready reference book for the home and the office. Among the subjects treated are "The Progress of Discovery"; "Shipping and Yachts;" "Navies of the World"; "Armies of the World"; "Railroads of the World"; "Population of the United States"; "Education"; "Telegraphs," "Telephones," "Submarine Cables," "Wireless Telegraphy," and "Signaling"; "Patents"; "Manufactures"; "Departments of the Federal Government"; "Post Office"; "International Institutions and Bureaus"; "Mines and Mining"; "Geometrical Constructions"; "Mechanical Movements"; "Chemistry"; "Astronomy"; "Weights and Measures." Many of the diagrams and engravings are comparisons made especially for the work. The debt for advice and help has been a heavy one. The compilation of this book would have been impossible without the cordial co-operation of government officials, all of whom have been most kind. There are six colored plates, which give the funnels and house flags of some of the principal steamship lines in American trade, flags of all nations, and the flags and pennants used in the International Code. These plates are printed in eight colors, and are an attractive feature of the book.

A square foot of uncovered pipe, filled with steam at 100 pounds pressure, will radiate and dissipate in a year the heat put into 3,716 pounds of steam by the economic combustion of 398 pounds of coal. Thus, 10 square feet of bare pipe corresponds approximately to the waste of two tons of coal per annum.

SCIENCE NOTES.

A primitive chart prepared by the Polynesians to assist them in their travels from island to island has been acquired by the British Museum. The chart in question refers to the Marshall Islands, and was prepared by the natives. Routes, currents, and prevailing winds are represented by pieces of split cane, straight or bent according to the chart-makers' knowledge of the facts of the case, while the islands are indicated by univalve shells attached to the canes.

The heat of fusion has been studied by A. W. Smith. (Phys. Rev.) In the determination of the constant the ice in small pieces was previously cooled several degrees below 0 deg. C., and after weighing was transferred to the calorimeter containing kerosene oil already cooled to the same temperature. Heat was supplied by means of an electric current, the amount of heat being calculated by measuring both the current through the coil in the calorimeter, and the E. M. F. between its terminals, in terms of a standard cell. The preliminary value given for the constant is 334.25 joules as the mean of eight determinations of the heat of fusion of ice, in each of which about 100 grammes of ice was melted.

On passing a current of hydrogen through a silica tube heated until soft in an oxyhydrogen flame, a deposit of silica, either alone or mixed with silicon, is formed in the tube, the silica being reduced by the hydrogen forming silicon hydride and water vapor, which react together in the reverse direction at a slightly lower temperature. When, however, this reverse reaction is incomplete, some of the silicon hydride is decomposed, yielding silicon and hydrogen. A silica rod loses weight when heated in an oxyhydrogen flame, a rod 970 milligrammes in weight losing 500 milligrammes in 15 minutes. That the above-described deposition of silica and silicon is not due to the volatility of the silica and its partial dissociation is proved by Moissan's work, which showed that silica is not appreciably volatile at the temperature of these experiments. Further, if oxygen or carbon monoxide is passed through the silica tube in place of hydrogen, no deposit forms. The loss in weight of the silica rod when heated varies with the nature of the gas employed as source of heat, being greatest for a mixture of oxygen and hydrogen, and least for oxygen with carbonic oxide.

On immersing in cold distilled water a rod of one of the four non-crystalline tin-aluminium alloys, Sn_5Al, Sn_3Al, Sn_2Al, and $SnAl_3$, the surface of which has been worked with the file, an abundant evolution of detonating gas takes place for two or three minutes at the field surface of the alloy. This phenomenon is not observed with (1) a previously heated or filed tin or aluminium rod, or (2) a rod of the alloy not filed but heated to the same temperature as is produced by the filing. These tin-aluminium alloys must be formed, except at the hardened surface, by the juxtaposition of the molecules of the two metals, so that the filed surface acts with the distilled water like a number of small thermo-electric couples which immediately decompose the water. Boiling distilled water is decomposed by the non-filed tin-aluminium alloy, the heating apparently destroying the combination of the metals at the surface. If a filed tin-aluminium rod is dipped into a faintly acid copper sulphate solution, oxygen is evolved and copper deposited; a non-filed tin or aluminium rod, however, precipitates the copper but gives no gas evolution. Zinc sulphate behaves like copper sulphate, but the development of oxygen is not so vigorous.

Lead-aluminium alloys are described by H. Pécheux in Comptes Rendus. Molten mixtures of aluminium and lead, containing less than 90 per cent of the former metal, separate, on cooling, into three layers, the lower one consisting of lead, the middle one of an alloy containing 90 to 97 per cent of aluminium, while the upper one is aluminium. Of the alloys obtained in this way, those containing respectively 93, 95, and 98 per cent of aluminium have the densities 2.745, 2.674, and 2.600, and have nearly the same color as aluminium; they are malleable and are readily cut with the chisel, showing a silvery surface, but are not so hard as aluminium and are easily bent. That they are not definite compounds is shown by the fact that, when re-melted and cast, they yield alloys containing 92, 94, and 96 per cent respectively of aluminium and having the densities 2.765, 2.691, and 2.671. This tendency to liquate necessitates the rapid cooling of the molten alloys. The alloys do not oxidize in moist air or in the molten state. They are attacked at ordinary temperatures by concentrated hydrochloric or sulphuric acid with evolution of hydrogen, and by hot sulphuric acid which evolves sulphur dioxide and by hot nitric acid with generation of nitric oxide; the latter acid has little action in the cold, and the same is the case with dilute acids, even when heated. Concentrated potassium hydroxide solution and aqua regia act vigorously even in the cold, but distilled water is without action even at the boiling point; hydrogen sulphide blackens to a slight extent the alloys containing 92 and 93 per cent of aluminium.