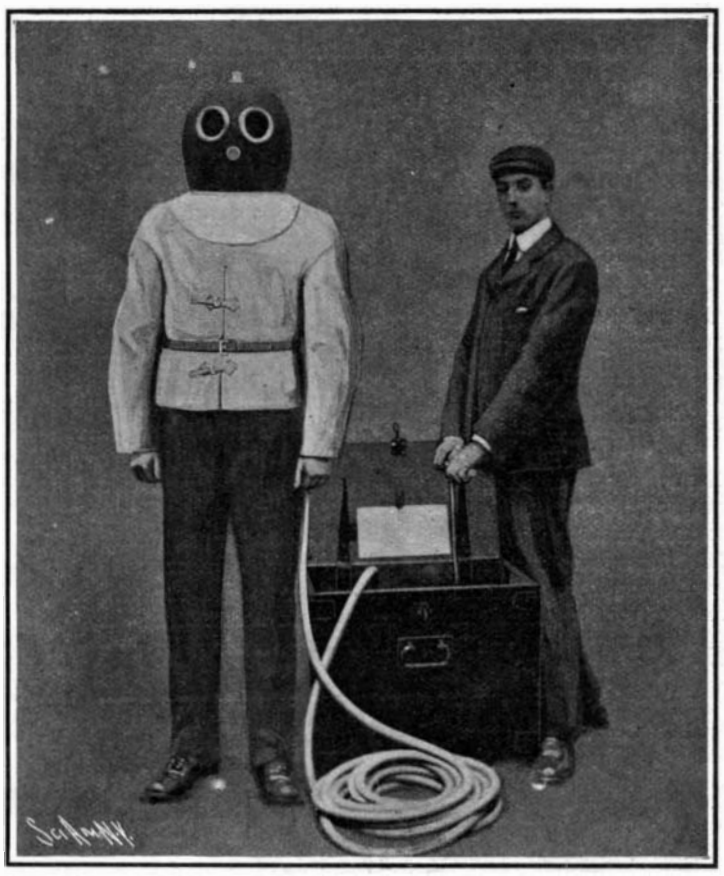
Francisco contained no less than 800,000 linear feet of lumber, to be used for wharf piling. If the piles which it contained were stretched in a row, they would actually extend a distance of nearly fifteen miles. The majority of these rafts have been safely taken to their destinations, although one or two have gone to pieces. Where such accidents have occurred, the mass of timber has covered the ocean for a distance of many miles, and has formed a very dangerous menace to navigation. For this reason an effort has been made by other transportation companies to have a law passed in the States of Washington and Oregon, preventing the building of the sea rafts, on the ground that they are a menace to navigation. Thus far the agitators of this movement have been unsuccessful.

BREATHING MASKS AND HELMETS.

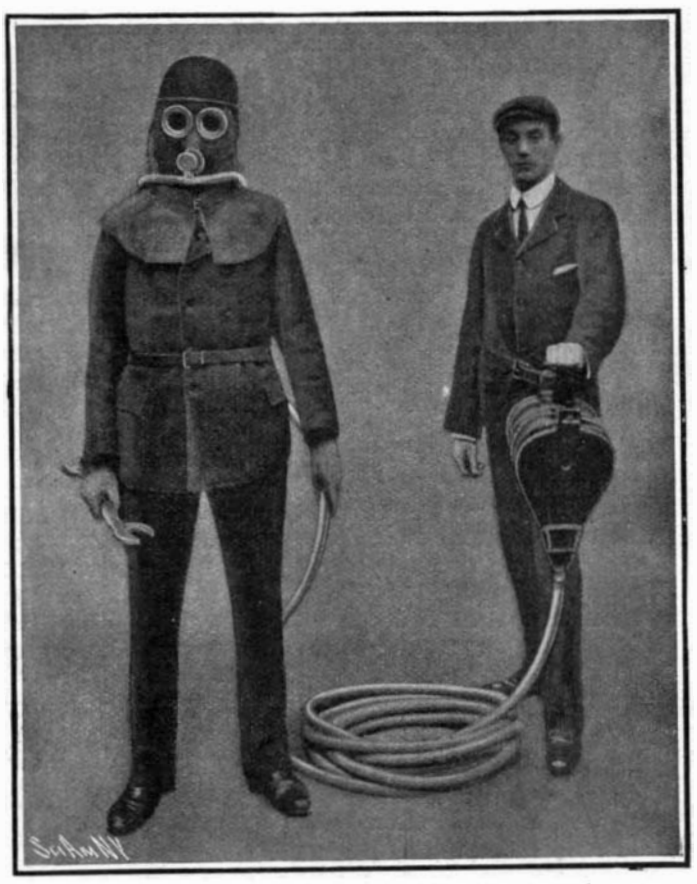
BY W. G. FITZ-GERALD.

One of the most interesting and curious of all industries is the manufacture of smoke helmets, smoke jackets, artificial respirators, and self-contained breathing apparatus generally, such as are used in mines of all kinds, collieries, gas and chemical works, fire brigades, sewerage works, ships' coal bunkers, the ammonia chambers of refrigerating factories, steel works, breweries, well-sinking plants, and other industrial concerns.

The curious gear is intended to supply the user with factitious but perfectly respirable air, more or less independent of any connection with the outer atmosphere, for about four hours at a stretch. Some varieties, like the Fleuss-Davis patent, have no air pipe or other connections with the base of operations, so that for exploring and rescue work in mines, etc., its scope of usefulness is practically unlimited. The wearer, with his cylinder of compressed oxygen, is perfectly safe in the most deadly gases, and can walk any



Helmet and Jacket Combined; the Tube is Supported by the Belt to Avoid Dragging Upon the Helmet.



The "Complete Mask" Type of Breathing Apparatus of Vulcanized Rubber.

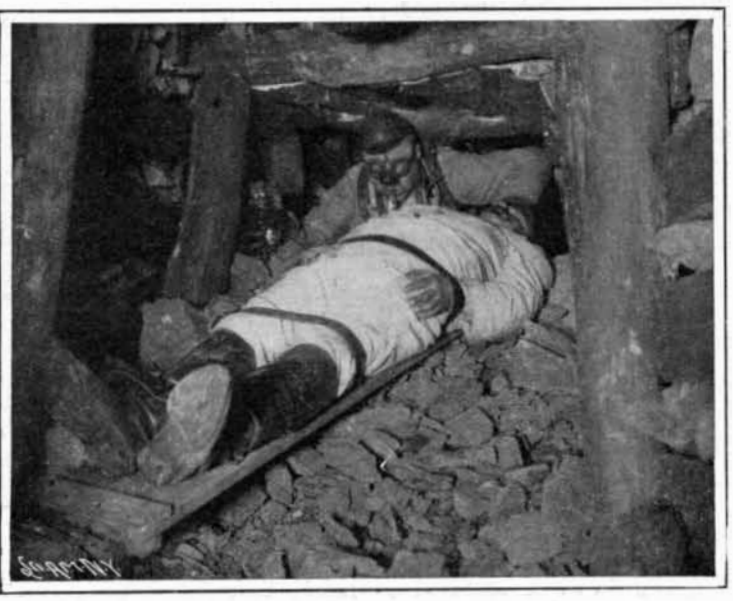
Breathing Device for Use in Coal Mines.

Reviving a Victim Overcome by Poisonous Gas by Means of Supplementary Oxygen Supply.

Type of Helmets Used in German Fire Departments.

Passing an Unconscious Miner Through a Heading Out Into the Open Air.

Penetrating to the Scene of a Disaster in a Coal Mine.



Taking a Victim of a Mine Accident to the Surface, Strapped Upon a Stretcher.

BREATHING MASKS AND HELMETS.

distance and explore the most intricate turnings of a mine with every freedom of action.

The principle of the Fleuss-Davis apparatus is that its wearer breathes the same air over and over again; the carbonic acid being absorbed from it after each expiration, by means of the charge of caustic soda in the breathing chambers, and at the same time the requisite amount of oxygen is restored to it from the steel cylinder carried, thus rendering it pure and fit to be inhaled once more into the lungs. In some cases where this apparatus is to be used in remote places, in which it would be impossible to get the oxygen supply cylinders recharged, a regular plant goes with the apparatus for making oxygen and compressing it to 120 atmospheres. There are no objectionable nose clips and mouthpieces, and the worker's breathing goes on quite naturally.

He may if he wish carry a special telephonic apparatus and self-contained electric hand lamp, which burns eight hours continuously with one charge. His queer-looking apparatus includes a steel cylinder containing a full charge of oxygen compressed to 120 atmospheres, and also a charge of caustic soda for the breathing chambers.

The question of renewing the oxygen is often a serious one, say in the remote mining districts of South America, where the complicated and tiresome processes, involving the use of chlorate of potash as a generating agent, with retorts, a furnace, purifiers, and the like, would prove costly and difficult for the manufacture of oxygen on a small scale Some shipping companies absolutely refuse to carry compressed oxygen in steel cylinders; but now a new substance, known as "oxylithe," has come along, affording a simple and effective means of producing oxygen gas with the minimum of trouble. The stuff is prepared in small cakes ready for immediate use, and on coming in contact with water it gives off chemically pure oxygen in the same way that acetylene gas is produced from calcium carbide, except that there is absolutely no element of danger in the preparation; thus storage cylinders are rendered unnecessary These breathing apparatus are made in many varieties, according to the type of work for which they are needed. Another consists of a water and air-proof helmet and jacket in one piece. The helmet is very light and strong, and is permanently attached to a jacket of stout yet supple leather, or material consisting of India rubber between two layers of tanned twill.

The helmet has an air inlet connection, to which the air tube is attached; the interior being so constructed that the air pumped in is at once, while quite fresh, distributed over the wearer's face, while the vitiated or excess air is passed through an outlet valve. There are windows of clear mica; and with this type there is absolutely no weight on the worker's head.

The air-supply apparatus can be worked either by hand or foot, and gives an ample volume of air under all conditions. The rubber air tube is of the non-collapsible kind, and is fifty feet in length, with extra lengths as required. It is fitted with a coupling at each end for connecting the helmet and air apparatus; and there is a leather waist belt, fitted with a device for holding the air tube securely in position and preventing it from dragging on the helmet.

Attached to the latter there is a special telephone for connecting with the attendant. Next we have what is known as the "complete mask" type of breathing apparatus. The mask is of strong vulcanized India rubber, so constructed as to be shaped to fit any face comfortably. It has an air inlet valve, and also an outlet valve for the disposal of vitiated air, mica goggles, and a device for quickly securing the mask to the face. If two workers are to be supplied with air at once, this is done by means of a double-acting hand bellows.

A much more powerful air supply, however, can be given if desired by the ordinary air pump used by divers, and this is desirable when the workers in non-respirable air are at a considerable distance from the source of supply. A special respirator is provided for men who work in noxious gases that do not affect the eyes. It consists of a very light mask covering nose and mouth, and intended originally for the use of gas men engaged in tapping mines. Obviously, however, it can be used for other work of a noxious or poisonous nature. The wearer draws his supply of air through a short, light and flexible tube fitted to an inlet valve on one side of the mask, and exhalation is through an outlet valve and tube fitted on the other side. Both tubes pass over the man's shoulders, are held together by a small clip, and are led a few yards outside the mephitic area to the fresh air. In most cases the second tube can be dispensed with; the outlet valve line being quite sufficient to carry away the vitiated air.

Of course this type of respirator can be used only in cases where its wearer is but a very short distance from fresh air. There is hardly a coal mine in the world, a gas or chemical works, fire brigade, or refrigerating plant using ammonia chambers, which is not now equipped with this strange-looking apparatus; and many hundreds of human lives have been saved by its aid. Indeed, on occasion a grave catastrophe has been averted. A case in point was the stopping of the flooding of the Severn tunnel by the famous diver Alexander Lambert—who, by the way, recovered nearly $300,000 in specie from the wrecked steamer "Alphonso XII.," sunk off Grand Canary in nearly 200 feet of water.

During some repairs in the Severn tunnel a year or two ago, a certain door in the drainage quarter had been inadvertently left open, and water was roaring and racing through the shaft. Seizing a Fleuss-Davis apparatus, and fixing it in position on his face and back in a few moments, Lambert crept and swam nearly a quarter of a mile along the shaft, and by sheer strength closed the door, thus enabling the pumps to overcome the tremendous volume of water.

Again, everyone knows how poisonous the atmosphere becomes in a coal mine after an explosion; and less than thirty years ago, before apparatus for artificial respiration was invented, it was impossible for rescuers to venture down to the aid of men overcome by poisonous gases. To-day, however, the moment a catastrophe is known at the pit's mouth, volunteers put masks and helmets in position, jump into the cage and go down into the reeking depths, where no living creature could venture in the ordinary way.

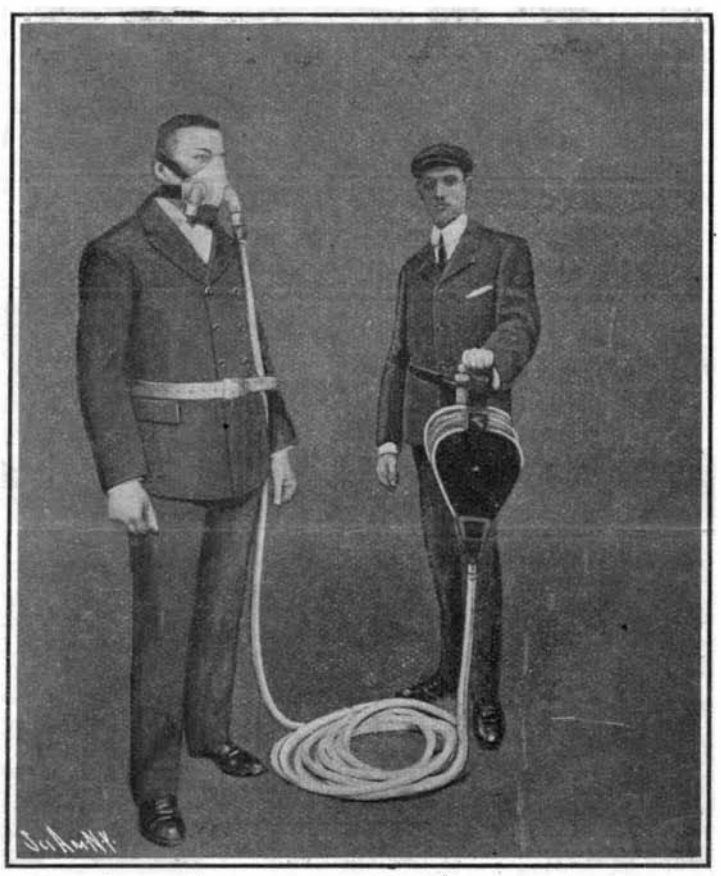
Disasters have also been averted in the sewers of great cities, where hundreds of men are employed; in oil ships, and even in gold and silver mines. Last year fifty-seven men were rescued by these smoke jackets and helmets in the far-famed Broken Hill silver mines of Australia. Here are enormous underground workings supported by wooden pit-props. For some reason or other the Broken Hill is subject to terrible fires, some of which have raged for twelve months without going out.

Last December a fierce rush of flame shot through one of the galleries, entirely imprisoning about sixty workers. The blaze was of short duration, but the galleries were filled with acrid smoke, seemingly as poisonous as the fumes of picric acid. It was evident that the imprisoned men could not live long in such deadly vapors. One hero after another endeavored to get through by holding wet cloths over his face, but after a hundred yards or so he would fall unconscious, and all but lose his life.

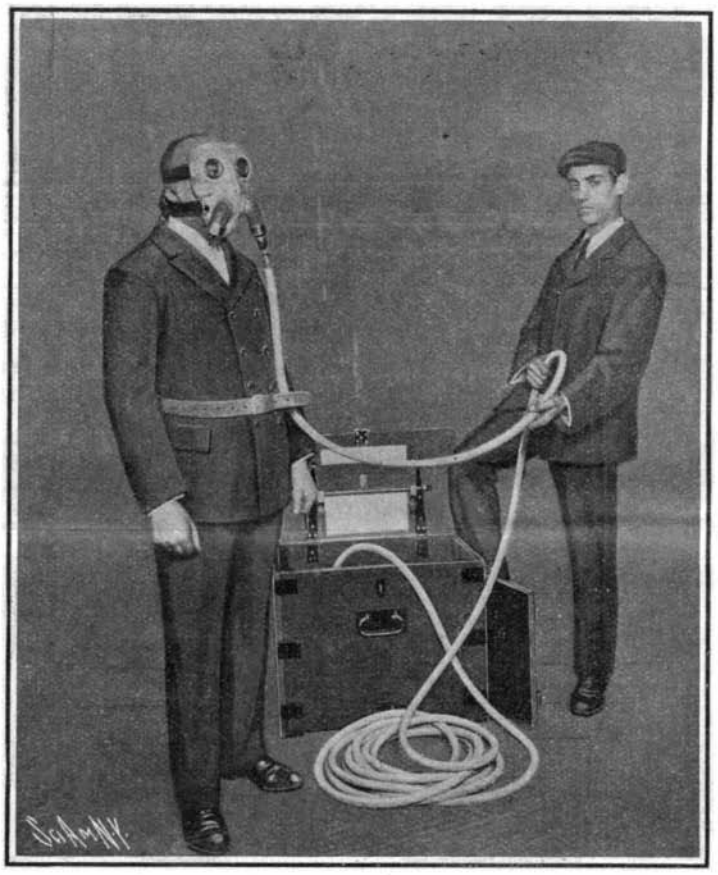
Finally half a dozen artificial respiration apparatus were brought from the town, and like a flash men had donned them, and were racing in security through the dense poisonous smoke wreaths. They soon came upon the bodies of their comrades, some of them propped against the side of the workings, and others tossed this way and that on the mud floors as though in sleep. All but three or four of the men were got out alive, and a short but energetic treatment soon restored them to consciousness.

As to the work of the fire brigades of the world with these smoke helmets, smoke jackets, and respirators, this is too well known to be more than mentioned here. A passing word must be said, however, about the duties of men who work in the ammonia chambers in refrigerating factories; without this strange-looking gear such labor would be absolutely impossible. Then there are many trades and industries, like the making of cordite and other high explosives, as well as the manufacture of grindstones, which imperatively call for the use of such protection for the hands employed.

As said before, in cases where the wearer must penetrate for longer distances into a non-respirable atmosphere, the supply of oxygen must be self-contained in the apparatus. We illustrate herewith several German devices of this character. The oxygen is usually compressed and carried in light metal cylinders, being discharged as required through a suitable valve to the mouth piece. The apparatus sometimes also includes an extra supply of oxygen for use in reviving persons overcome through the inhalation of noxious gases. The illustrations indicate the terrible difficulties with which the rescuers must often contend in coal or other mines, after an accident of the kind to which such mines are liable. One of the engravings shows the type of helmet, not with a self-contained oxygen supply, which has been adopted in many German fire departments.



Special Device for Working in Non-Respirable Gases Which, However, Do Not Affect the Eyes.



A Mask Without Helmet, of Vulcanized Rubber. This Device Can Be Adjusted with Great Rapidity.

BREATHING MASKS AND HELMETS.

Charles D. Walcott, the New Secretary of the Smithsonian Institution.

On January 23 the Regents of the Smithsonian Institution unanimously elected Charles D. Walcott to fill the place of the late Samuel P. Langley as Secretary of the Smithsonian Institution.

Mr. Walcott was born at New York Mills, N. Y., on March 31, 1850, and became an assistant in the New York State surveys in 1876. He was appointed assistant geologist in the Geological Survey in 1879, and took up a study of the Cambrian rocks, the oldest known on the globe. His paper presented before the Geological Congress in London in 1888 was epoch-making concerning studies of these formations.

In 1894 Mr. Walcott became director of the U. S. Geological Survey, succeeding Major J. W. Powell.

To Mr. Walcott is due much of the success of the reclamation service, and under his direction this service has grown and increased until it now employs more than five hundred civil engineers and assistants in constructing works in all parts of the arid West, under an expenditure of upward of $1,000,000 a month.