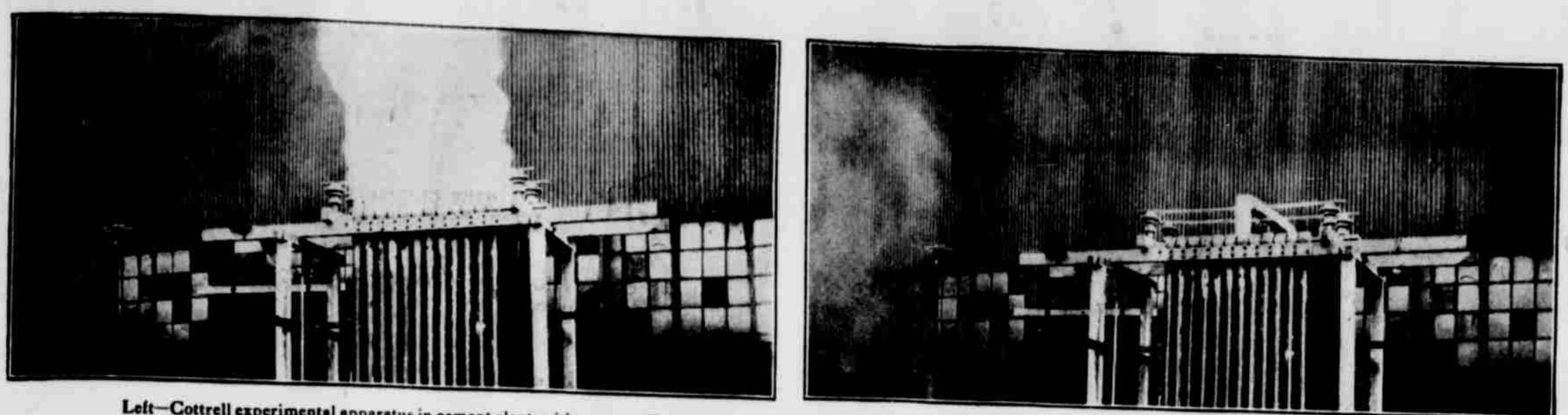

Left—Cottrell experimental apparatus in cement plant, with current off; right—Plant under identical conditions with the current on. Note all absence of smoke or dust fumes.

Turning Smoke Into Money

By ROBERT H. MOULTON

AMERICA sends millions "up in smoke" yearly because of the enormous waste in the fuel used by our industries. On the other hand, there is a man in Washington who has discovered how to turn smoke into money, and he is now busily engaged in teaching the rest of the country how to perform the same trick. He does this by means of devices which, through electrical precipitation, not only reclaim vast wealth from the smoke, dust and fumes of smelters, but at the same time redeem thousands of acres of near-by land. As a matter of fact, the curb which this man has put on the smoke and dust nuisance—his original aim—now actually bids fair to be, in some directions, the primary reason for the running of certain of our industries. The smoke wizard who has accomplished these remarkable things is Dr. Frederick G. Cottrell, chief of one of the government's greatest scientific agencies—the Bureau of Mines. Dr. Cottrell has many claims to the appreciation of his fellow scientists. He is a man who does things and says little. He is that rare thing, an American who cares little for either money or publicity. The clearest proof of the possession of the qualities of the true scientist that Dr. Cottrell has ever given, a demonstration deemed to be a model to be followed by those of his kind, came a decade ago, when he made a discovery of such practical value that it was obviously capable of being made to yield all the riches any man might desire. After having demonstrated its possibilities Dr. Cottrell gave it away. He consistently refused all offers to make a fortune out of his work, and when money began to pour in on him in spite of himself he promptly got his friends together, formed what is known as the "Research Corporation," and turned the financial stream into the corporation, with the provision that the funds were to be used to assist struggling scientists whose hardships he already knew. An ironclad agreement was made that all profits from his work go to the corporation and not to Dr. Cottrell himself.

Rich potash (in bags) reclaimed through dust precipitator at a cement plant.

DR. FREDERICK G. COTTRELL

The first big contribution of Dr. Cottrell to science was the electrical precipitation of particles of liquids and solids, or, in popular terms, the elimination of smoke and rescue of smoke constituents by a process of electricity. Undertaken at first to eliminate smoke as a nuisance, the process showed that the so-called smoke dust precipitated at big plants was worth in some cases more than the product being manufactured.

It was in 1906, while he was working as assistant professor of chemistry at the University of California, that the idea first came to Dr. Cottrell. California at that time was much annoyed over fumes from smelters. There were examples of it close to the university. The fumes were admittedly necessary to the running of the smelters, but were a nuisance to everyone within their radius. There was continued talk about it, but no one suggested a possible remedy, excepting to remove the smelters. Dr. Cottrell said little, but it was noticed that he began spending all his spare time in the laboratory. He worked whenever he got a chance during the day and far into the night. Finally he surprised his friends at the university by telling them that he had discovered an "electrical precipitation process" which would do away with the smoke.

In a general way his idea was to remove the suspended particles from the gases by the aid of electrical discharges. His process was to operate by passing the gases, carrying the suspended, finely divided particles, between two systems of electrodes, one of which was made to carry a negative electrical charge, while the other carried a positive charge.

The electrodes were to be charged by being connected with a source of high voltage electricity, consisting of a high voltage transformer for increasing the electric potential up to a working voltage of from 20,000 to 100,000 volts. A rectifier for changing alternating current into direct current and a switchboard were to provide the necessary control equipment. Dr. Cottrell figured that the suspended particles, while passing between the electrodes, would become electrically charged and would be driven into pipes by the forces of the electric field. The original laboratory experiments conducted by Dr. Cottrell were made with the apparatus shown in the accompanying photographs, which clearly show the effect of turning the electric current on and off in a precipitator in which sulphuric acid mist had been generated.

Dr. Cottrell had no money at the time he perfected his invention. He was distinctly "hard up" in those days, but he was certain he could eliminate the smoke nuisance if given a chance. It happened about this time that at Riverdale, a town not far away, there was a huge cement factory, which had likewise become a nuisance in the community because the dust from it found its way into the blossoms of orange groves near by and interfered with the development of the fruit.

The orange growers took the matter into the courts and spent hundreds of thousands of dollars pressing and winning their cases. The company then tried the expedient of buying up the land at $1,000 an acre, but found it couldn't stand the pace. More than $1,000,000 had been spent by the company in litigation and still there was no relief in sight. In desperation the firm sent for Dr. Cottrell, the fame of whose experiments had reached it from the university.

How dust from cement manufacture collects on vegetation and destroys life.

Dr. Cottrell told the firm that he believed his process would solve its difficulty, but that it would cost a considerable amount of money to install it. He was told to go ahead and never mind the expense. The process was installed and it worked like a charm. It did away with the dust nuisance completely, and it was not necessary for the community to sacrifice either its cement plant or its oranges. The electrodes in the smoke stacks of the cement plant yielded every day 100 tons of minute particles which would otherwise have been spread out on the community. Although the plant had a capacity of 5,000 barrels of cement a day and business was good, Dr. Cottrell suggested that the concern might find it profitable to examine the dust which his process collected. The firm did so and found that it contained large quantities of potash, and potash is the basis of one of the most valuable fertilizers in the world. Since that time the company has manufactured chiefly potash, obtained from the smoke dust by the Cottrell process, and is only making cement as a by-product. Thus a new and profitable means of getting potash has been discovered. This is certainly a romantic development of modern industry, where an apparatus installed to save the life of the factory turns out to be the center of the operations, around which the entire plant is adjusted, the incidental profits being sufficient to make the former operation of the factory of secondary importance.

The success of the experiment at Riverdale attracted the attention of a smelter at Vallejo Junction, located a few miles from the former place, which was at that time the subject of injunction proceedings brought by the farmers of the surrounding country. Three separate stacks of the smelter contributed to the alleged nuisance, the most serious offender of the lot being one which handled the gases from the lead blast furnace and discharged several tons of lead fume daily into the air.

While this particular trouble was overcome by the installation of a bag house before work was begun with the electrical precipitators, there still remained a stack which, besides discharging the gases from the roasters, furnished dense white clouds, consisting chiefly of sulphuric acid, arsenic, and lead salts, and to which the bag house was not applicable because of the corrosive action of these gases on the bags. There was still another stack which carried the mists escaping from the pots of boiling sulphuric acid used in dissolving the silver out of the gold and silver alloy coming from the cupels. The electrical precipitators installed at this smelter by Dr. Cottrell proved eminently satisfactory and was the first commercially successful use of the method applied to this type of smelter. The precipitators have now been in regular daily operation for more than 12 years at a cost for labor attendance and repairs of less than $20 a month. As a matter of fact, the plant made enough bluestone to utilize all the weak acid recovered, so that the saving on the purchase of the latter paid for the entire cost of operating at least five times over.

While the solution of the coal smoke problem lies in better combustion, and while what is here needed is not so much a method of collecting smoke as one for preventing its original formation, Dr. Cottrell expresses the opinion that in some special cases, and probably for some time to come, precipitation methods may prove a stepping stone and a useful adjunct. As an example, he points to power plants which have a very high power demand for a short period during the day, as compared with the rest of the time. Under such conditions it is impracticable to prevent the production of a certain amount of black smoke during the high power period without providing a much larger furnace and boiler equipment than is required for the average load. The installation of precipitation apparatus would prove more economic than the addition of boilers and furnaces that would otherwise be required.

The waste in metallurgical smoke—which means gases, vapors, and fine dust—that issues from blast, smelting and roasting furnaces runs into hundreds of millions in money. To prevent that waste was really the problem to which Dr. Cottrell addressed himself.

It is thought Dr. Cottrell's device will be generally applied throughout industry in the near future, but none of the earnings will benefit Dr. Cottrell—the money will all go to aid other struggling scientists.