

carbonic acid. A little later (1870-1) Rouquairol-Denayrouze conceived his aerophore, which consists of a large sheet-steel tank containing air compressed to 20 atmospheres and carried either on the back or on a rescue car. A tube connects this reservoir with a mouth-piece provided with a pressure regulator, the nostrils of the user being closed by a pince-nez. Shortly afterwards Fayol described various types of respiratory apparatus in which he abandoned the use of compressed air in order to secure appliances little subject to derangement.

"About 1884, Dr. Regnard applied, in an individual portable apparatus, the principle of revivification of the air by means of a reservoir of oxygen and of the passage of the exhaled air into another receptacle filled with pumice-stone saturated with a solution of caustic potash.

"Unhappily, as M. Haton de la Goupillière states, all these appliances had a common failing, due to the infrequency of their use: 'At the critical moment the parts of the apparatus would not work, and the men lacked familiarity with their use.' Furthermore, the respiratory apparatus thoroughly tested from 1873 to 1880 at the mines of Commentry, under the direct inspiration of M. Fayol, little by little passed into disuse. The problem was taken up again in Germany and Austria only during the last years of the nineteenth century. But French inventors and constructors, working quietly, have been producing respirators which, little by little, have won their way by their own merit and without useless proclamations. In particular, Lieutenant Vanginot of the Paris Fire Department, has invented an apparatus of which the earlier forms appeared in 1903 and the most recent in 1907. During these four years this respirator has proved itself in many places, even as far as in Russia and Mexico."\*

#### PRESENT TYPES OF MINE-RESCUE APPARATUS

Although there are many types of apparatus now in use, they can be divided into two distinct groups:

I. Portable apparatus with self-contained gas supply.

II. Apparatus and piping which depend on pumps or bellows for their air supply.

Atmospheric air contains 79.04 volumes of nitrogen, 20.93 of oxygen, and 0.03 of carbonic acid, while expired air contains 79.6

\* *Rescue Appliances in the Mines of France*, by Jacques Boyer, in *Engineering Magazine*, April, 1908.