LIQUID AIR AS AN EXPLOSIVE.

BY FREDERICK H. M'GAHIE.

In a recent number of the SCIENTIFIC AMERICAN SUPPLEMENT, there appeared an article by me in which the claims of liquid air to employment in the explosive world were examined, with the conclusion that it had little to recommend it. It was pointed out that its theoretical value lay in the fact of its affording a source of highly condensed oxygen, and that, on account of the lower boiling point of nitrogen, liquid air could be profitably concentrated to a point where the percentage of oxygen ran from 50 to 75 per cent. The mixture of this oxygenated fluid with a proper combustible gives a powerful and simple explosive capable of detonation. It was further pointed out that the volatility of the liquid precluded its use in all but the large contracts where a liquefying machine could be installed as part of the contractor's plant. Even here, the practice generally accepted in blasting work as conducive to economical results, that of firing a large number of holes at once, put it out of consideration, since a delay in firing at once a hole, after charging with a liquid air explosive, entailed an amount of evaporation that was fatal. How this limitation entered into the problem was illustrated by the unsuccessful trial of the system at a coal mine in Europe, where prepared cartridges standing fifteen minutes lost all or nearly all of their explosive power.

This oxygenated fluid is receiving another trial in Europe under conditions meeting its limitations as far as possible. The facts have been communicated to me by an eminent expert on explosives who has recently returned from Europe, and will be undoubtedly of much interest to the readers of this paper. Work is progressing simultaneously at both ends of a tunnel that is being put through the Alps. On the southern side the usual explosives for hard rock, blasting gelatine and gelatine dynamite, are being used. On the northern side liquid air is being tried with concessions to its characteristics that afford it every chance of demonstrating any value it may have. In the first place, one hole, or a few at the utmost, are charged and fired at a time. This reduces the time in which the oxygen has a chance to evaporate, the method of charging a hole being in addition very simple and rapid. A cartridge containing the combustible element in a form permitting rapid absorption of the liquid is slipped into the hole, the oxygenated liquid poured into the cartridge, a cap with fuse put in, a light tamp inserted, and everything is ready for lighting the fuse. However, the firing of single holes means increased expense in the item of total idle time of the men during the explosions for a given amount of work. In the second place—and the most important side of the matter—much larger boreholes are being employed than are found advantageous with the nitroglycerine explosives.

The problem in blasting work is generally to dislocate, per pound of explosive, the greatest possible amount of rock in fragments convenient for handling and removal. If the blasted material is to be used specifically for any purpose, blasting conditions must be varied to give it in the desired sizes. Now, the character of the material determines the explosive to be used. In earth work the dynamites are outclassed by black powder, which develops its pressure comparatively gradually and dislocates or disturbs a large amount of earth, while the sharp action of the dynamites leads to compression of the material around the charge and strong wave movements in the total mass, but gives little useful work. In rock of any degree of hardness the reverse is true.

Here the black powder calls for tamping of fissures and boreholes to the extent that they are not the weakest points. The rock is removed in large masses, needing further breaking up. The dynamites do not require such heavy tamping, since they detonate and tend to crush the rock into small fragments. In the range from the soft to the hardest rocks there arises a similar need for variation in the action of dynamites, which is met by the admixture in various proportions of nitroglycerine with inert bodies, combustibles, or oxygen-bearing salts, alone or together. Such admixture not only changes the force but varies the sharpness of the explosive blow. The softer the material in which work is being conducted, the greater the need of an explosive giving a pushing rather than an impulsive shock. An apparently strange fact is that wet guncotton has a greater shattering effect than dry guncotton. Though wet guncotton has the lower explosive force, the detonative wave is propagated more rapidly in it, giving a sharper and consequently more destructive blow. This will illustrate why the various grades of dynamite have different effects. So it may be that liquid air explosives combine power and degree of sharpness of detonation in such a manner as to be well adapted to the hard rock met in this tunnel. The explosive employed should certainly have as high a strength as the gelatine dynamites. Being a mechanical mixture of combustible material, it would seem that it should not detonate as sharply as the gelatine dynamites. These conditions would seem to indicate that the borehole could be economically enlarged. But the results of long experience must settle the matter, especially the question as to what extent can a supposed decrease of blasting expenses under favorable conditions counterbalance the many disadvantages involved in such a volatile explosive mixture. It is apparent that operations must run very smoothly and everything held subordinate to exploding the charges as soon after the holes are ready as is possible. Now, delays must occur, and a weakened charge may produce undesirable effects, such as enlarging the borehole.

A Linde machine is made use of. Another point of interest is that a heavier cap than usual is required.

However, the phase of the question upon which these experiments bear is not the value of liquid air for general blasting work, but its value for certain classes of work under special conditions. The parties from whom the information came originally claimed success, but, as they were interested in the matter, the statement must be taken with the usual grain of salt. The history of explosives is full of wonderful compounds that perished prematurely through a thorough trial. I have in mind a non-freezing dynamite that was going to revolutionize things a few years ago. It strangely blossomed in summer time, when it proved part of the claims made for it, that of strength. Naturally, since it was a powerful dynamite, the first frosts wilted it badly. In most profane language irate contractors began asking what kind of a non-freezing dynamite was one that froze quicker and more hard than their old friend, and in addition "busted" the cases and became very coy about exploding after being thawed out.

SCIENTIFIC CONGRESS AT COLUMBUS.

BY DR. HORACE C. HOVEY.

Resuming my review of the American Association for the Advancement of Science meeting:

Dr. Howard read a paper about "Gad Flies," in which he detailed the experiments of a Russian entomologist, who killed enormous numbers by means of a kerosene film spread over the pools in which they are known to breed. He claimed that previous to these experiments of Porchincki, he himself had tried a similar method for the destruction of mosquitoes, and had called attention, in 1892, to the fact that many gad flies were thus captured.

A wonderfully interesting communication concerning the blind fish, and other blind cave animals, was read in the section of Zoology, by Prof. Eigenmann, of the Indiana State University, of which it is hoped to give a more full account in a future number of this journal. The A. A. A. S. was so impressed by this able and learned paper as to appropriate the sum of one hundred dollars to aid in Dr. Eigenmann's further investigations into subterranean life, and its bearings on the theory of evolution by environment and compensation.

Dr. Washington Gladden, of Columbus, read a paper concerning the moral tendencies of the system of industry now prevailing, which he also reproduced in his own church the following Sunday. It showed that while we may never secure a perfect morality through improvement in the social mechanism, we may establish social conditions which shall be more friendly to morality than those that now exist. Prof. H. H. Newcomb, of Washington, D. C., discussed "Trusts," showing their dangers and also exposing certain popular fallacies about them that actually hindered reform in the relations of capital and labor. He held that capitalistic combinations perform a useful public service; the field of legitimate inquiry being as to the proper distribution of their beneficial results. Such so-called "trusts" should tend to decrease prices to consumers, increase the demand for materials, augment wages, and ameliorate the condition of employes. Miss Florence Kelley, of Chicago, likewise read a paper bearing on the labor question, in which she narrated her personal experiences in trying to reform flagrant abuses in workshops, factories, and stores and her methods of securing the enforcement of salutary laws. The results appear to have been very beneficial. She is the daughter of Congressman Hon. Wm. Kelley, of Pennsylvania, famous for his expert knowledge of the iron trade.

These are only a few of the two hundred and seventy-three scientific papers discussed, and others might be regarded as equally worthy of mention. The more important addresses and papers will appear in the annual volume of the associational proceedings, while others will be given by abstract. Thus year by year a scientific library has grown up, whose contents have a value that can hardly be overstated, embodying, as they do, the history of learned researches in all departments for the last half century.

Evidently the visiting scientists and their hosts of Columbus were on the best of terms. Everything was done to make the forty-eighth meeting of the A. A. A. S. memorable for hospitality as well as for scientific interchange of experience and discovery. Besides the more general entertainments, nearly every section and affiliated society had its supper, or trolley ride, or other excursion. Those who had never previously seen the flames of the natural gas region were astonished and dazzled. Others rambled through the woods and fields for plants, or insects, or other specimens of natural history. The geologists took a day for the coal mines of Corning and Hollister, where they found mines worked by electricity and lighted by the same means, visited a subterranean forest of the Carboniferous Age, said to be the finest of its kind, and enjoyed the novelty of dining by electric light 200 feet underground and a mile from the daylight. These mines are owned by the Sunday Creek Coal Company and the Courtright Coal Company. The visitors noted with interest the beautiful plant impressions, the ferns, calamites, cordaites, and Sigillaria tessellata. There are 500 oil wells also in the Corning field, the oil being all derived from the Berea grit, at a depth of about 1,200 feet. The gas wells near Thurston are 2,000 feet deep and derive their gas from the Clinton-Medina formation.

A grand excursion was made at the close of the meeting to Sandusky, Kelley Island, and Put-in Bay, at which place they explored the unique and marvelous Strontia Cave, the only one of the kind known. The arches are hung with prismatic crystals of "celestite." The place was found by Mr. Gustave Heinemann, in 1897, while opening a well. Besides exhibiting his grotto, he makes money by selling specimens of the sparkling strontia. Commercially this mineral is worth $12 a ton, and is used to clarify beet sugar, and likewise in pyrotechnics, giving a vivid crimson color to fireworks.

An excursion to Macinac and the lakes was enjoyed by a number. An anthropological party visited Fort Ancient, an extraordinary prehistoric stronghold, located on the old Lebanon and Chillicothe turnpike, between Columbus and Cincinnati. It is my intention, however, to give a future article expressly on this extremely interesting and mysterious fortification.

Three cities contended for the distinction of entertaining the meeting in 1900, namely, Denver, Philadelphia, and New York. The latter won the day. The date was set in June, from the 25th to the 30th, in order to favor members who may wish to attend the Paris Exposition. The president for 1900 is Prof. R. S. Woodward, of Columbia University, an alumnus of the Michigan University, distinguished for his services in astronomy, geodesy, and mathematics. He has for many years been the treasurer of the A. A. A. S., and is the president of the American Mathematical Society, and also a fellow of the National Academy of Sciences. A pleasant incident of the closing meeting was the gift of $1,000 from Mr. Emerson McMillin, of New York, but formerly of Columbus. This places him as the fourth patron of the association.

AUTOMOBILE NEWS.

Chief Croker, of the New York Fire Department, has decided to use a gasoline automobile for going to fires. He finds that the two horses which he keeps to take him to fires are unequal to the duty imposed upon them. The new carriage weighs about 400 pounds.

An automobile has made the ascent of Mount Washington, 6,300 feet above the sea level, in two hours and ten minutes, the distance being ten miles. This included delays in replenishing the water tank. The time was, however, about half that required by the teams that make the trips with carriages. The carriage was driven by F. O. Stanley, of Newton, Mass.

According to The Wheel, there are probably over a dozen French firms who have been able to cope with the enormous demands made upon them for automobile vehicles. They have accomplished this by laying down costly plants equipped with American machine tools and attracting the best mechanics into their shops by paying them high wages. Each of these concerns is turning out motor carriages of the standard types by the score. They continue to work from set patterns and are not disposed to change them. Others who possess fairly satisfactory vehicles cannot manufacture them on a commercial scale either because they lack sufficient means or are unable to get a sufficient number of hands. As in this country, there is also another class of small makers; these are the men who are inventing and perfecting motor carriages, and who build one from time to time.

A recent consular report from Consul-General Goodnow gives an amusing view of Chinese character. He says that it is impossible to sell anything to Chinese which they have not seen. Automobiles are the point in question. They have never seen them, and they cannot imagine what they can be like. Naturally, the average Chinaman has seen so few new things that it is not easy for him to exert his imagination. Makers of automobiles will find that it is useless to attempt to sell carriages to Chinese or foreigners by means of descriptions or catalogues. It is proposed that ambitious dealers make a present of an automobile to some well known person in Shanghai, making him promise to use it constantly and prominently, so that the Chinese may become accustomed to the startling innovation. The place is an ideal one for motor carriages, the roads are macadamized and the climate very fine.