than its strict scientific sense, and have not attempted to discriminate between the effects produced by thermal, luminous and actinic rays, all of which are contained in ordinary sunlight. They call attention to this fact because their adoption of the word "photophone" has been construed to imply that they believed the audible effects discovered by them to be entirely due to the action of luminous rays. They disclaim such restricted interpretation, and explain their meaning by quoting a paragraph from their previous paper on the photophone, in which they say: "Although effects are produced, as above shown, by forms of radiant energy which are invisible, we have named the apparatus for the production and reproduction of sound in this way, the 'photophone,' because an ordinary beam of light contains the rays which are operative." To avoid future misunderstandings on this point, they have now decided to adopt the term "radiophone," a term signifying an apparatus for the production of sound by any form of radiant energy, and limit the words "thermophone," "photophone" and "actinophone" to apparatus for the production of sound by thermal, luminous and actinic rays respectively.

To determine the effects produced by the different forms of radiant energy, Messrs. Bell and Taintor devised the form of apparatus shown in Fig. 7. A beam of sunlight reflected from a heliostat A, is refracted through an achromatic lens B, so as to form an image of the sun on the slit C, then passes through a second lens D, and through the bisulphide of carbon prism E, forming a spectrum of great intensity upon a screen behind the prism. When this is properly focussed, the disk interrupter F is turned with sufficient rapidity to give 500 or 600 interruptions per second, and the spectrum is explored with the receiver G. With this arrangement and a lampblack receiver, sounds were heard in every part of the visible spectrum (except in the extreme half of the violet), and also in the ultra-red. The sounds increased in intensity as the receiver was removed from the violet towards the red, and reached a maximum far out in the ultra-red. By varying the substance in the receiver different results were obtained, which it would unduly extend this article to reproduce. We will simply note the conclusion that was drawn from the experiments, as follows: The nature of the rays that produced sonorous effects in different subtances depends upon the nature of the substances that are exposed to the beam, and the sounds are in every case due to those rays of the spectrum that are absorbed by the body.

These experiments suggested the idea of constructing an apparatus for spectrum analysis, to which they give the name of "spectrophone," which is shown in Fig. 8. The eye-piece of a common spectroscope is removed, and sensitive substances are placed in the local point of the instrument behind an opaque diaphragm containing a slit. These communicate with the ear by means of a hearing-tube. For the purpose of examining the absorption spectra of bodies in those portions of the spectrum that are invisible, this instrument will doubtless prove a valuable accessory to the spectroscope. When a rapidly interrupted beam of light is passed through any subtance whose absorption spectrum is to be examined, bands of sound and silence are observed on exploring the spectrum, the silent positions corresponding to the absorptions bands. The ear cannot of course compete with the eye in accuracy in examining the visible portions of the spectrum; but for the detection of absorption bands in the invisible parts of the spectrum beyond the red, it promises to be an invaluable adjunct to the spectroscope.

For the engravings illustrating this article, we acknowledge our obligations to the *Journal of the Franklin Institute.*

HIGH EXPLOSIVES.

DYNAMITE OR GIANT POWDER.

No better illustration can be given of this material than by repeating Alfred Nobel's, the inventor's, own descriptive words, which are as follows:

"My invention relates to a new and useful combination or mixture of nitro-glycerine with some absorbent substance, whereby the condition of the nitro-glycerine is so modified as to render the resulting explosive compound more practically useful and effective as an explosive, and far more safe and convenient for handling, storage and transportation than nitro-glycerine in its ordinary condition as a liquid. The invention consists in combining or mixing with nitro-glycerine some porous or absorbent substance, which, being free from any quality which will cause it to decompose, destroy or injure the nitro-glycerine, forms, in combination with it, an explosive compound possessing certain marked properties of great practical utility, which not only increases its efficiency, but also obviates many of the serious practical objections to the employment of nitro-glycerine as an explosive. Some of the peculiar properties of this mixture will be briefly stated: Nitro-glycerine being a liquid, it is usually necessary in exploding it as an explosive for blasting purposes, to place it in cases or cartridges formed of paper, metal, or other substance, which must, of course, be of somewhat smaller diameter than the bore holes, as, if not so enclosed, the nitro-glycerine would permeate the seams of the rock, and prove highly dangerous to the miner, on account of its liability to explode in subsequent drillings; but by means of my invention, the nitro-glycerine, being held in combination with the porous or absorbent substance with which it is mixed, and then assuming the altered form of a powder or paste remains in the bore hole in which it is placed, without leaking through the seams of the rock. Another advantage over liquid nitro-glycerine is, that this mixture can be made to fill the bore hole more closely than a cartridge case will, owing to the irregularities of the shape of the hole, which greatly increases its efficiency. The liability of fluid nitro-glycerine to accidental explosion from agitation or concussion renders its handling and transportation very dangerous. This danger is, however, almost entirely obviated by the use of the compound, because, when mixed with a suitable absorbent the nitro-glycerine is far less sensitive to shocks than when in a liquid condition, so it may be handled in mass either loose or in packages with impunity. This invention then, consists in mixing liquid nitro-glycerine with some solid substance, which will absorb and retain a sufficient amount of nitro-glycerine to form an efficient explosive. The substance which is believed to be the best adapted for this purpose is a kind of silicious earth found in various parts of the globe, and known by the various names of silicious marl, tripoli, rotten stone, kieselguhr. The peculiar variety of this material best suited for this for this use is homogeneous, has a low specific gravity and great absorbent capacity, and is generally composed of the remains of infusoria. So great is the absorbent capacity of this infusorial earth, that, when in a pulverized condition, it will take up three times its own weight of liquid nitro-glycerine, and still retain the form of a powder. Other porous substances, even though they have less absorbent capacity may be used, but in this case the explosive strength of the powder will be diminished, owing to the smaller proportion of nitro-glycerine contained therein. Chalk, for example, will absorb about 15% of nitro-glycerine and retain its powdered condition; and porous charcoal, although of greater absorbent capacity, has less elasticity of particles, so that nitro-glycerine is apt to squeeze out of it. Any of the various vegetables or mineral substances susceptible of pulverization or comminution, and which will retain nitro-glycerine by absorption, may be substituted for infusorial earth. The relative proportion of the ingredients used in making this non-explosive compound will vary according to the absorbent capacity of the substance mixed with the nitro-glycerine, it being preferable in all cases—and this is the only limit—to use so much only of the liquid nitro-glycerine as the absorbent substance will retain without liability to subsequent separation by compression or leakage. Where the absorbent used in a powdered condition is infusorial earth, a thin paste or semi-fluid condition of the mixture is to be avoided."

"The method of manufacturing this explosive compound with infusorial earth is as follows:

"The earth being thoroughly dried and pulverized, is placed in any suitable vessel, and the nitro-glycerine is then gradually introduced, and thoroughly mixed with the powdered earth, which is effected either by stirring with the naked hand or by means of any suitable wooden instrument, worked either by machinery or by hand. Where infusorial earth is used, the proportions may be conveniently varied, from 60 parts by weight of liquid nitro-glycerine and 40 parts by weight of infusorial earth, to 78 parts by weight of nitro-glycerine and 22 parts by weight of infusorial earth; the former proportions forming, at ordinary temperatures, a dry, pulverulent mass, and the latter a pasty mixture. Let it be here observed, that the explosive force of the mixture is increased when a larger proportion of nitro-glycerine is employed, and that, when the mixture is to be used in a cold climate, a larger quantity of nitro-glycerine may be safely employed than when it is to be exposed to a warmer atmosphere.

"For ordinary practical purposes a mixture of 75 parts by weight of nitro-glycerine, and 25 parts by weight of infusorial earth, gives a powder sufficiently dry at ordinary temperatures, and which is susceptible of compression to a specific gravity early equal to that of pure nitro-glycerine. When the in-