

A Wonderful Model of a Copper Mine

By J. W. Grigg

PROBABLY the most elaborate and realistic copper mine model in any museum in the world has just been placed on exhibition at the American Museum of Natural History. It required more than three years' work to complete it. The mine reproduced is that of the Copper Queen Consolidated Mining Company's property at Bisbee, Arizona. It was executed under the direction of Dr. Edmund Otis Hovey, curator of geology, by Mr. Arthur Briesemeister and assistants, and was reproduced from accurate and first-hand study of the mine itself.

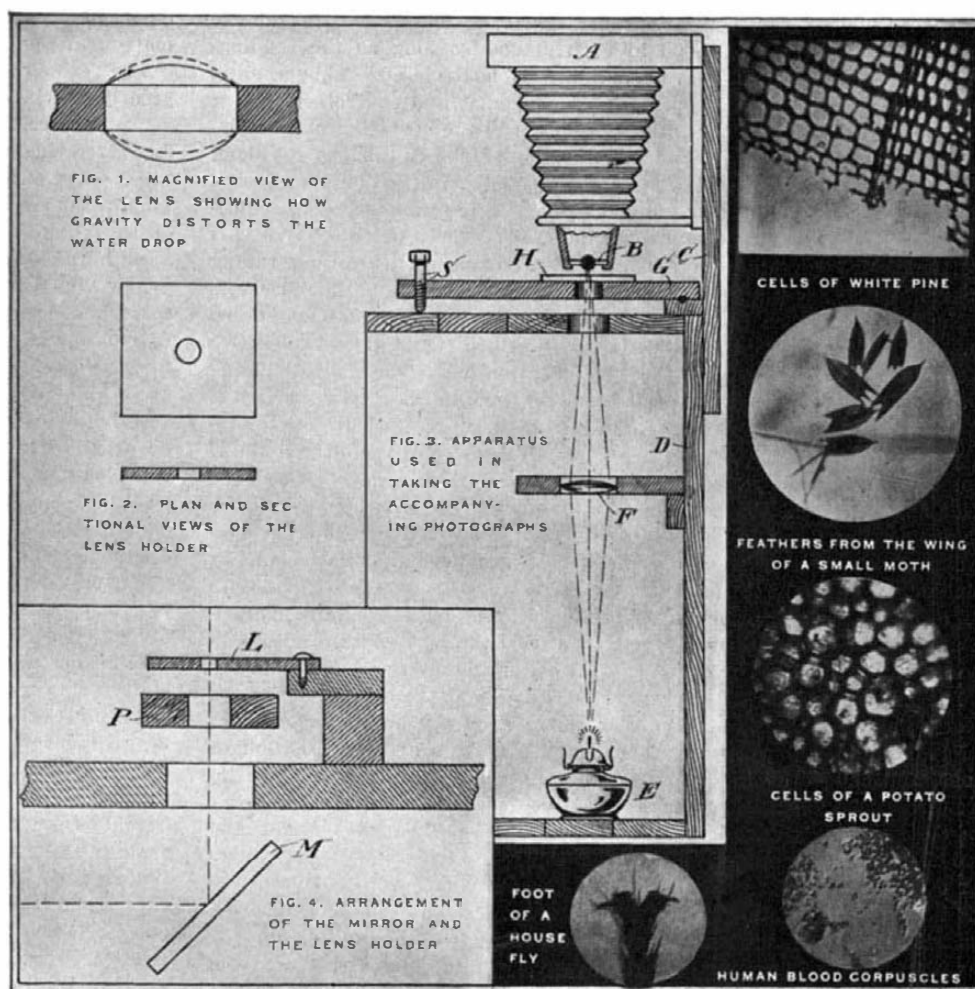
It is another of the many interesting exhibits planned and completed in recent years at the museum in an effort to bring the institution into closer touch with the people, and to make the institution as interesting as possible to the person without scientific training.

It was early in 1910 that Dr. James Douglas of the company informed the museum authorities that he was prepared to furnish the data and the means necessary for the construction of a large scale model of the mine. That summer Dr. Hovey took his assistants to Arizona, where the first thing done was to determine upon the point of view from which the picture of the model as a whole with its proposed painted background should be obtained. Practically the same view is now spread before the observer in the museum.

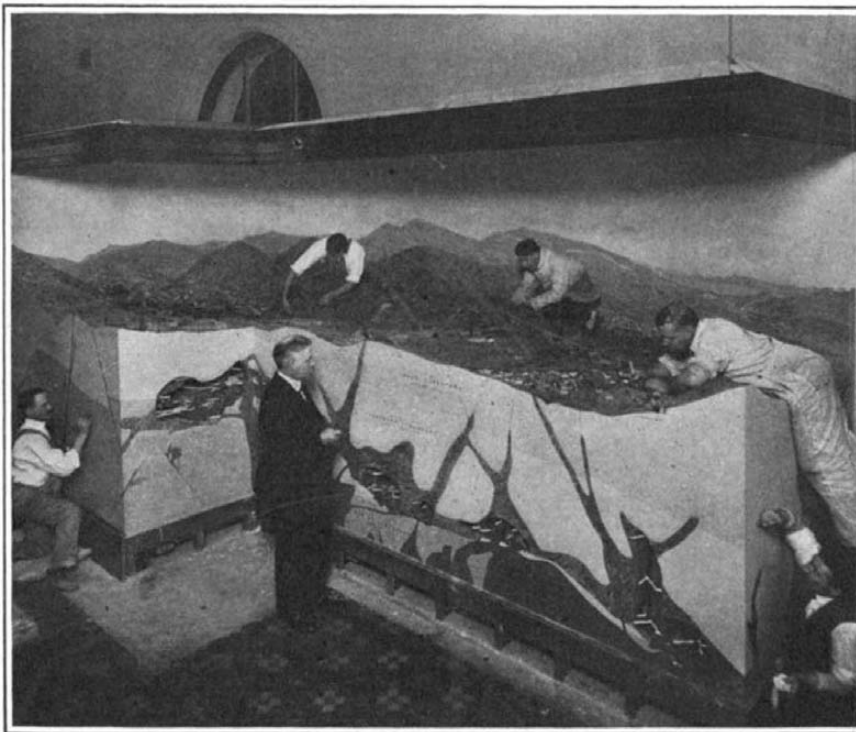
The model is 18 feet 6 inches long by 12 feet wide, representing an area 5,315 feet long by 3,418 feet wide. There are more than 500 structures represented in the model, including loading bins, dwelling houses and other buildings. After experimenting with wood, plaster, and other materials, the metal buildings, which are corrugated iron in the field, were made of brass covered with thin zinc foil scored to represent the corrugations to scale, while the dwelling houses and some small structures were made of cardboard. The head frames, loading bins, railroad tracks, etc., were made of brass.

The museum men in the field made records even of the color of paint on the different buildings, the nature of the material used in construction, the shape and character of the roofs, the position and nature of vines, shrubs, and trees, and in fact all other features that would be useful in making a naturalistic reproduction of the portion to be represented.

Originally it was intended to represent only the surface, with a painted background showing the Mule Mountains, but as soon as the work was actively begun it



Water-drop microscope and photomicrographs made with it.



At work on the copper mine model of the American Museum of Natural History.

was considered of utmost importance that the underground workings should be represented as well. It was decided, too, to make a working model of a single stope on a scale of six feet to the inch to represent details that could not be indicated on the big model.

The representation of the underground work could be accomplished only by excavating the under portion of the model, and to place in the hollows thus formed reproductions of the stopes in solid wood, cut according to detailed plans of the levels as furnished by engineers of the company. Tunnels, raises, winzes, and shafts were likewise constructed to scale according to these plans and inserted in their proper places.

The sides of the model were used to give the geological sections along several vertical planes from 4,100 to 5,900 feet above the sea.

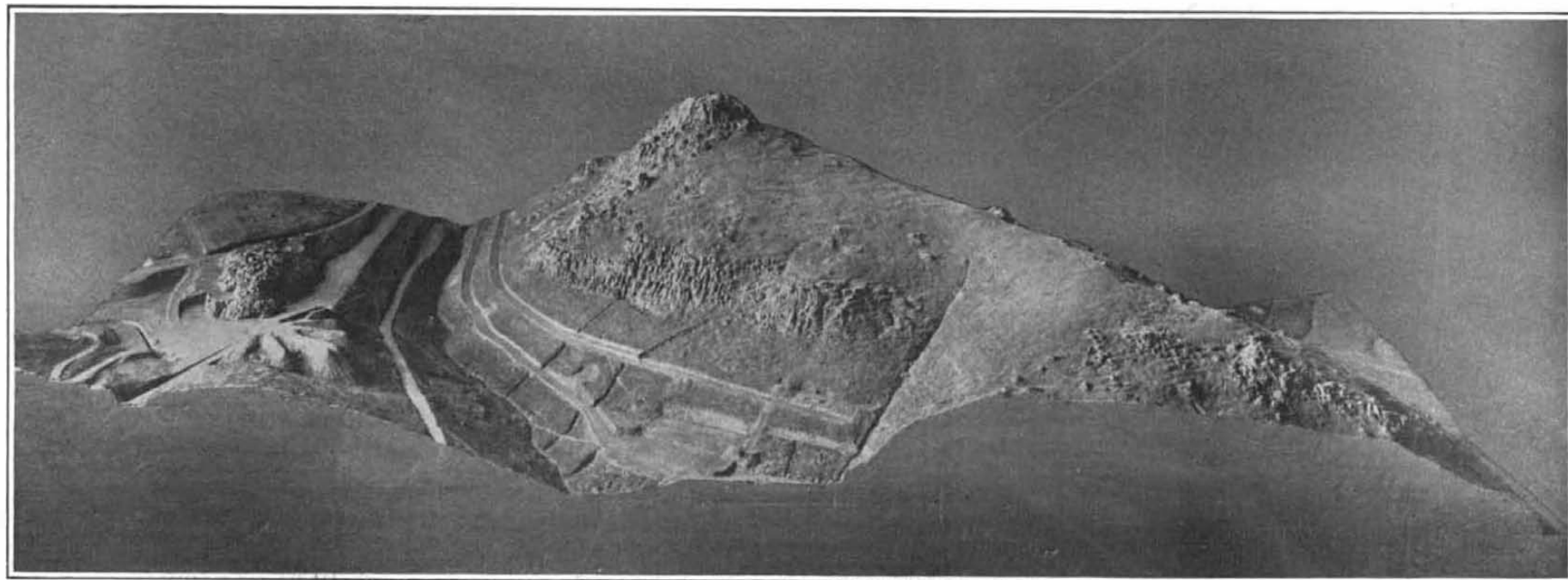
The Water-drop as a Microscope

By James Bailey

THAT a drop of water has the power of magnifying a hundred diameters astonishes most of us, and yet we are familiar with the properties of water, which make it suitable for a lens. We know that, when free, a drop of water assumes a spherical shape, we know that a lens is formed by grinding glass so that it has spherical surfaces, also that water like glass has the power of bending light rays. A free drop of water, therefore, has the two main properties of a lens, i. e., spherical surfaces and refraction. A free drop of water, however, is useless as a lens, but by a suitable holder the lens qualities of the liquid can be maintained and the drop readily handled.

The theory of the lens is quite simple. Consider the holder shown in Figs. 1 and 2, and neglect the effect of gravity for the present. The water or liquid used is prevented from falling out of the holder by adhesion. The surface tension of the liquid causes its surfaces to act like thin sheets of rubber fastened to the upper and lower edges of the holder. These edges being true circles, any pressure from within distorts them into spherical shells as shown by the dotted lines in Fig. 1. If the space between these is filled with water a lens is formed. The effect of gravity is to lower both surfaces and to distort them from the true spherical shape as shown by the solid lines. This corresponds to the actual condition and approximates the shape of the liquid lens as used. It can be easily shown that this distortion increases with the diameter of the holder, and as more liquid is added to

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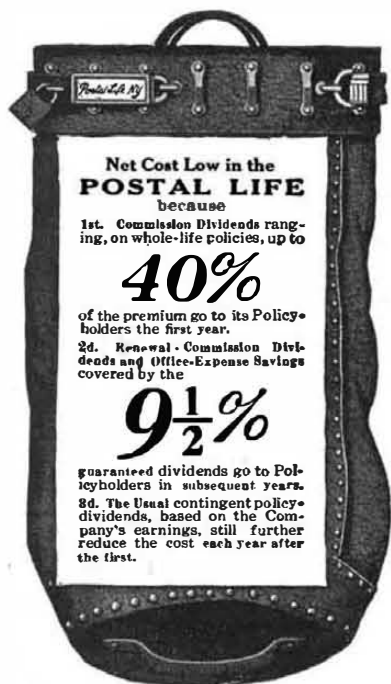
Model of an Arizona copper mine in the American Museum of Natural History.

The surface of the ground was modeled in clay on a wooden core. Many photographs had to be taken on the spot in Arizona so that every detail could be accurately reproduced.

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(Concluded from page 290.)

as is laid down in the above clause would be taken, in our opinion, if the roads were treated with incombustible dust.

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In closing this brief account of the present position in the United Kingdom with regard to the use of stone dust in mines, a few particulars of the Experimental Explosion Station at Eskmaels, in Cumberland, may be given, also some details of the constitution of the committee in charge of the experimental work.

The experiments were commenced by the Mining Association of Great Britain, at Altofts Colliery, Normanton, Yorks, in 1908. The result of these experiments was to prove beyond all doubt the truth of the theory that coal dust suspended in the air was capable of being ignited without the aid of any inflammable gas, and was, therefore, capable of propagating an explosion through the dusty galleries of coal mines.

The official record of these experiments, and of the conclusion based upon them, is contained in the *Proceedings* of the Mining Association of Great Britain, for the year 1910. In that year, the Mining Association approached the Royal Commission on Mines with the view of ascertaining whether the government would be prepared to continue the experiments at the public cost, and offered to lend to the government the experimental plant and apparatus that they had accumulated at Altofts. This proposal was communicated to His Majesty's government, which ultimately undertook to find the funds necessary for the purpose. An executive committee to carry out the experiments was appointed by the Secretary of State for the Home Department, consisting of Sir Henry Cunynghame, chairman; Mr. R. A. S. Redmayne, Capt. A. H. P. Desborough, Prof. H. B. Dixon, and Mr. W. C. Blackett. The members of the Royal Commission on Mines, together with the Coal Dust Committee of the Mining Association already referred to, were constituted as a Consultative Committee. The first meeting of the Executive Committee was held at the Home Office on May 11th, 1911.

The site at Altofts being no longer available, it became necessary to seek a new one. An endeavor was made to secure a suitable locality which should be at a fairly equal distance from the various coal fields in England, Scotland, and Wales, which should be remote from dwellings, and at the same time should be near a railway so as to afford convenient access for heavy material. After the examination of numerous sites a piece of land on the sea was chosen, near Eskmaels, in the county of Cumberland, adjoining the gun-range of Messrs. Vickers. The works are surrounded by sand hills. The space available for a gallery measures 600 yards in length from the eastern side of the seashore. The large gallery (7 feet 6 inches) has been removed from Altofts, and has been placed east and west, so as to point seaward, and it now extends to a length of 800 feet.

A smaller gallery, 3 feet in diameter and 400 feet long, has been fixed alongside the large gallery for the purpose of making comparative experiments, and the number of recording instruments for following the course of the explosions has been accordingly increased.

The writer's thanks are due to Prof. Harold Dixon, F.R.S., a member of the Home Office Committee, in charge of the experimental work, and also to Dr. Wheeler, the chemist in charge of the tests at Eskmaels, for their co-operation in obtaining photographs and information for use in this article.

The Water-drop as a Microscope

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the lens, thus limiting the diameter of the hole, which can successfully be used to hold the drop, and the magnifying power of the lens possible with any given holder. The magnifying power may, however, be increased by using a smaller holder, since

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the surfaces of the drop will be sharper and the effect of gravity is lessened. Very small holders are to be avoided, especially in photographic work, as they let through too little light. Of course it is necessary to use the holder in a horizontal position.

The simplest and best type of holder is that shown in Fig. 2. It consists of a piece of metal about 1/32 inch thick having a straight round hole bored through it at the center. It is of paramount importance that the upper and lower edges of this hole be true circles. The easiest way to insure this is to drill the hole with a first-class twist drill, and then polish both top and bottom surfaces on a flat oil stone. If iron is used it should be blued afterward by heating, to prevent rusting. The best results with this type of holder are obtained with a diameter of from 1/16 inch (having a maximum magnifying power of 100 diameters) to 1/8 inch (having a maximum magnifying power of 60 to 70 diameters).

To fill the holder, a stick with a very long, slender point is best. Dip this stick in the liquid, shake off any surplus, place the point against the inner surface of the holder and allow the desired quantity of liquid to run in. Considerable care must be exercised to prevent any liquid from running over the surface of the holder, thus destroying the circular contact. No trouble will be experienced in this respect unless too much liquid remains on the stick, or its point is allowed to slip over the surface of the holder.

Fig. 3 shows the apparatus used in taking the accompanying photographs. It consists of a camera A, whose lens has been replaced by a wooden frame supporting the holder B, so arranged that the holder may be easily removed for replacing the liquid lens. The camera is supported on an upright C, fastened to the box D. Within the box D is a lamp E and the camera lens F so placed as to concentrate the light on the liquid lens in B. The adjustable platform for bringing the slide H into focus consists of the board G pivoted at one end and supported by the screw S. Focusing is accomplished by turning the screw S, which should be capable of a vertical adjustment of at least 1/2 inch, and should make it possible to bring the slide H nearly into contact with the liquid lens. The box D and the platform G have holes in them directly under the liquid lens to let through the light from the lamp.

The image of the specimen is projected by the liquid lens against the ground glass of the camera and sharply focused by turning the screw S. When this has been done, the camera is loaded in the usual way. An exposure of 5 minutes with an ordinary kerosene lamp burning half height will probably suffice.

In photographic work, instead of water, it is best to use a glycerin lens, as a glycerin lens will not change its focal length by evaporation, and is not easily shaken by small jars.

For use as a microscope, the apparatus shown in Fig. 4 is sufficient. M is a mirror, L is the lens holder, P is the adjustable platform for holding the slide, and is made like G in Fig. 3. The mirror is tilted so as to reflect the light from any source up through the slide. If much field is desired, the eye must be placed quite near the liquid lens.

With this simple apparatus the hairs on the edge of a fly's wing, the teeth on the edge of a blade of grass, wood cells, etc., are distinctly visible; in fact, this simply constructed liquid lens microscope is sufficiently powerful for the needs of most amateur naturalists.

Commissioner Ewing and the Patent Office Building

IN a statement before the Committee on Public Buildings and Grounds of the House of Representatives, Commissioner Ewing has many interesting things to say about the Patent Office building. In the first place, he points out that the Secretary of the Interior occupies about three fourths of the room in the basement and about one half of the rooms on the main floor, and suggests that if the Secretary of the Interior were removed out of the



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