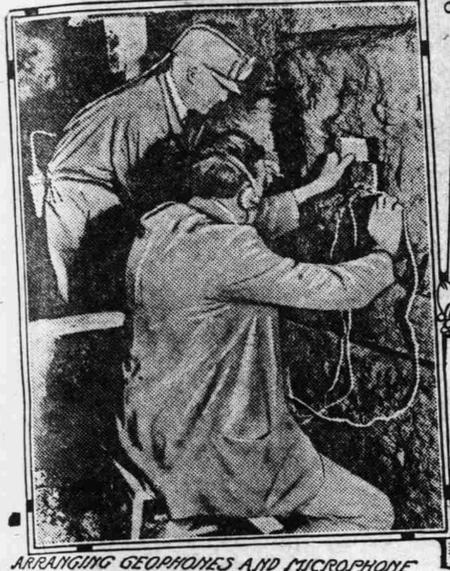




USING GEOPHONES ON SURFACE



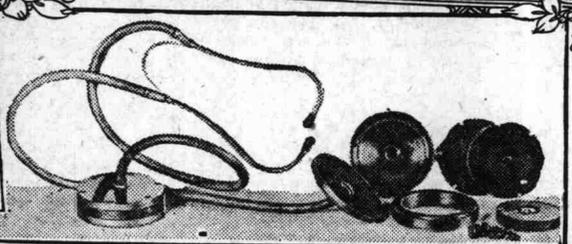
ARRANGING GEOPHONES AND MICROPHONE

Peace Uses For War Inventions

By Robert H. Moulton



LISTENING TO EXPLOSION OF ONE OUNCE OF DYNAMITE 1/2 MILE AWAY



MINE RESCUE GEOPHONE SET

IT WAS a foregone conclusion that many of the inventions born of the needs of war would be turned to peace uses with promise of great benefits. Already the experts of the bureau of mines, who assisted in the war work of perfecting the microphone and geophone to ascertain the exact location of enemy guns, are using these delicate instruments to locate entombed miners, and to make easier, and more accurate various mining operations. The principle of the microphone was applied in ascertaining in a general way the location of a ship at sea. Toward the end of the war the device had been so perfected that it was possible for the microphone listening station to calculate the exact position of enemy guns after hearing the shots. The speed with which sound travels, was, of course, known and served as a basis of calculations at different stations. With these instruments electrically connected it was possible to record the exact time at which the sound reached them and then, by a series of rather intricate calculations based on triangulation, to locate the object.

Geophone is a Seismograph.

The geophone, though small, is essentially a seismograph, since it works on the same principle as the ponderous apparatus with which earthquake tremors are recorded. It consists of an iron ring about three and a half inches in diameter, within the center of which is suspended a lead disk that is fastened by a single bolt through two mica disks, one of which covers the top and the other the bottom of the ring. There are two brass pieces, the top one having an opening in its center to which is fastened a rubber tube leading to a stethoscopic earpiece. These cap pieces are fastened with bolts to the iron ring and serve also to hold the mica disks in place.

We then have really nothing but a lead weight suspended between two mica disks cutting across a small air-tight box. If the instrument is placed on the ground and anyone is pounding or digging in the vicinity, energy is transmitted as wave motion to the earth, and the earth-waves shake the geophone case. The lead, on account of its weight and because it is suspended between the mica disks, remains comparatively motionless. There then is produced a relative motion between the instrument's case and the lead weight. The result is that a compression and rarefaction of the air in the instrument takes place. Since the rubber tube leading to the stethoscopic earpiece is connected with this space in the geophone, this rarefaction and compression is carried to the eardrum. Usually two instruments are used, one for each ear.

How Direction is Determined.

When the two instruments are used, it has been found that the sound is apparently louder from the instrument nearer the source of the sound. It is evident then that by moving the instruments properly a point can be found when the sound will be of the same apparent intensity in both ears. The direction of the sound is then on a perpendicular to the line connecting the centers of the two instruments either in front of or behind the observer. Further observation will show which side. Direction is quite accurately determined in this way. The sound is not actually louder in one ear than in the other, but the ear is capable of distinguishing the difference in time at which the sound arrives in the two instruments. Since this is the case, persons who are slightly deaf in one ear are said still to be able to determine direction with the instruments.

During the period of the war, engineers of the mining division of the bureau of mines were engaged in determining the distance that different mining machines could be heard through the clay, shale, coal and the mine cover. Measurements were made also of the energy required in order that they might be heard definite distances through clay, shale and coal, as well as to de-

termine the distances at which the shock waves resulting from the discharge of various explosives could be heard. A brief investigation of the factors influencing the transfer of energy from a mining tool to the clay and coal were also made in order that recommendations could be made as to the type of mining machine which could be used to accomplish the most work with the least noise. In this connection it was found that sounds were transmitted only about half as far in clay as in shale strata and about one-quarter as far in clay as in coal. To give some idea of the sensitivity of the instrument it may be said that pounding with a pick on the bituminous coal can be detected for a distance of 900 feet, and the direction determined, and that pounding with a sledge can be heard as far as 1,150 feet. These measurements were made in the Pittsburgh coal seam in the vicinity of Pittsburgh, where the coal is somewhat harder than in most other bituminous coal beds. The explosion of a one-ounce charge of dynamite was detected a distance of over 2,000 feet through the shale strata.

Sound Tells the Implement.

One interesting feature of the instrument is that the sound transmitted to the ear is characteristic of the implement producing the sound. To illustrate: Twelve mining and carpentering operations were carried out on the coal rib. An engineer of the bureau of mines who had never used the geophone and who did not know what tools were to be operated was able to recognize and name nine of the implements at a distance of several hundred feet through the strata. The other three sounds were accurately described, but the tools were not identified.

Now that the war is over, the bureau has turned to the development of the instruments for peacetime uses. For one thing, it is believed that they will be of great value to mine-rescue crews who may be entering mines for exploration and to locate miners who may have been entombed after a disaster. The tests so far made in the vicinity of Pittsburgh show that a man pounding on the coal rib with a pick, piece of timber or sledge can be detected and located from a point 600 to 1,200 feet distant. This distance depends greatly on the character of coal upon which the man is pounding, and intervening rooms and entries seem to have surprisingly little effect upon the distance or the determination of direction.

Pounding with a sledge can be heard from 200 to 300 feet through the mine cover, depending upon the quietness of the day outside, since any wind greatly interferes with the successful operation of the instruments. It will at once be seen that when mines are not too deep they can be "explored" from the surface and it will thus be possible to find and locate a miner who is pounding. At the experimental mine in Bruceton, Pa., a man has frequently been located through 140 feet of cover within 50 feet of the exact point where he was pounding.

A study is also being made of the distances that pounding on rails and pipes can be heard. Since rails are generally buried in the earth or dust in the entries of a mine, and since this dust dampens the transmission of the sound, the sounds are not transmitted very well. The same is true of pipe lines. However, if the pipe lines are not buried, but are laid on blocks and ties, the pounding can be heard great distances. So far no lines have been found long enough to show the limit of the geophone. It is known, however, that the naked ear can get sounds farther than 2,000 feet.

Used to Guide Tunnel Work.

In metal mines expensive surveys have sometimes to be made in order that the approaching tunnel headings may be brought together accurately. Since direction can be determined so well with the geophones, it is thought that they can be used to guide such work. It would only be necessary to go into each heading and locate the direction from which pounding in the other heading was coming.

Observations made in a metal mine recently showed that direction can be determined much more easily in rock than in coal. This is probably due to the fact that there is some reverberation to the sound from a hammer blow on coal, while on stone the sound is clean cut. It so happened that in this mine a raise was being driven up, about six or eight feet distant from a shaft. Observations were made in the drift of the sound

set up and operated at the survey mark did not break through into the drift, whereas a hole drilled at the point in the drift located by the geophones reached the raise and proved the geophone observation to have been correct within a few inches.

It is also thought the instruments will be of great value in preventing accidents from explosions when breaking through. In this connection an interesting incident happened recently. Observations were being made at a tunnel heading. The pit boss happened along and asked to be allowed to listen. He put the earpieces in his ears and remarked: "Mack is tamping a charge and we'd better move away." He spoke as naturally as he would have done had he been watching Mack, and it is quite evident that he did not realize that the sound was coming through 300 feet of coal, otherwise he would not have given the warning.

Observations were made recently of a mine fire burning from 20 to 40 feet below the surface. A low rumbling noise could be heard as if air were being drawn in along crevices, and occasionally sounds could be heard from the snapping and falling of pieces of coal or rock. As well as can be determined, the fire area was accurately located, but owing to the fact that the fire could not be approached from inside, the data could not be checked absolutely. It is interesting to note that similar sounds could be heard from only one point on the inside of the mine and that point was the one nearest the area as located on the surface.

In addition to the uses enumerated, an engineer of the bureau has discovered that the instruments can be employed advantageously in locating knocks in automobile valves and cylinders. For this purpose it is best to mount the instrument on a short iron rod that can be easily inserted in the machinery. Not only can a troublesome cylinder be located in this manner, but the trouble area in the cylinder also can be found.

APPLE TIME.

The crisp, frosty days of autumn are a sure indication that the apple season is in full swing. Those who can pick the fruit are fortunate, for the apple fresh from the tree, at this time of the year, is unrivaled in flavor and temptingly tart and juicy. But the privilege of gathering apples is no longer limited to those who live in the country, for nowadays many families, who own cars avail themselves of the opportunity of motoring to the suburbs, where they may either gather a generous supply from unclaimed trees, or purchase the privilege of picking better varieties from the orchard of some thrifty farmer. After a few of these trips the housewife will find that she has obtained enough apples to supply her family with a variety of preparations for the winter's use. So many things may be done with apples that one becomes enthusiastic at the thought; they may be canned, dried or made into fruit butters and jellies, fruit sirup and fruit leather. Even the pulp which remains may be fed to the cattle, hogs or sheep, so there is no waste whatever in the whole process.—Christian Science Monitor.

NESTED IN TOWER TWENTY YEARS.

There is an old English sparrow that has nested in the eaves at Tower C, at East Somerville (Baltimore and Maryland yards), for the last 20 years.

Fifteen years ago he was caught and marked with a band of silver wire just to see how long he would live.

A new tower is being built at Tower C, and as the new tower is of brick and so constructed there is no nesting place in the eaves, and when the old tower is torn down the old sparrow will be deprived of a home.

Consequently one of the towermen caught the old sparrow (he is very tame), and took him to Wakefield and kept him in the garage several days, thinking he would nest there.

IMPROVED UNIFORM INTERNATIONAL SUNDAY SCHOOL LESSON

(By REV. F. B. FITZWATER, D. D., Teacher of English Bible in the Moody Bible Institute of Chicago.)
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LESSON FOR NOVEMBER 16

WITNESSES OF CHRIST'S GLORY.

LESSON TEXT—Luke 9:28-36.
GOLDEN TEXT—This is my beloved Son; hear ye him.—Mark 9:7.
ADDITIONAL MATERIAL—Matt. 17:1-8; Mark 9:2-8; II Peter 1:16-18.
PRIMARY AND JUNIOR TOPIC—Peter and John with Jesus on the mountain.
SENIOR AND ADULT TOPIC—The glory of Jesus Christ.

While it is true that in this lesson the disciples are witnesses of Christ's glory, the full truth is that the manifestation of Christ in glory was to give to the discouraged disciples a foregleam of the Messianic Kingdom. The hopes of the disciples were crushed when Christ announced his death on the cross. They were unable to see how victory could issue from death.

Jesus took with him Peter, James, and John, and went into the mountain to pray. His chief aim in retirement was to get the disciples apart into a state of receptivity so that he might show them the method of the Kingdom. Before going to the mountain he declared that there were some standing in his presence who would not taste of death till they should see the Son of Man coming in his Kingdom (Luke 9:27; Matt. 16:28). That their drooping spirits might be revived and their confidence restored, he is transfigured before them. Two men from the upper world are sent to converse with him about his approaching death in Jerusalem (v. 31)—the very thing about which the disciples refused to talk. Then, too, God's own voice was heard in words of approval of Christ's course, directing them to hear the Master. Surely they cannot doubt his ability now to carry into execution his kingdom plans. The purpose, then, of the transfiguration is to give the disciples a foregleam of the coming Kingdom, to enable them to see the Kingdom in embryo. That this is true is not only shown by the context and circumstances, but by the inspired interpretation of one who was with him and knew all that happened. Peter said, "For we did not follow cunningly devised fables when we made known unto you the power and coming of our Lord Jesus Christ, but we were eye witnesses of his majesty, for he received of God the Father, honor and glory when there came such a voice to him from the excellent glory. This is my beloved Son in whom I am well pleased; and this voice we ourselves heard come out of heaven, when we were with him in the holy mount. And we have the word of prophecy made more sure; whereunto ye do well that ye take heed, as unto a lamp shining in a dark place, until the day dawn, and the day-star arise in your hearts (2 Peter 1:16-19 R. V.). To those who believe in the inspiration of the Bible these words are final. Let us therefore note the outstanding features of the Kingdom as displayed in the transfiguration.

I. Jesus Christ the Glorified King on Mount Zion (v. 29).

The glorified King on this Mount was intended to symbolize the Messianic Kingdom when Christ returns to the Mount of Olives in Jerusalem (Zech. 14:4-17). This is still in the future, and will be literally fulfilled.

II. The Glorified Saints With Christ (vv. 30, 31).

1. Moses, who was once denied an entrance into Palestine, appears now in glory, representing the redeemed of the Lord who will pass through death into the Kingdom. Many thousands of the redeemed have fallen asleep and at the coming of the Lord shall be awakened to pass into the Kingdom.

2. Elijah, now glorified, represents the redeemed who shall pass into the Kingdom through translation. Many shall be living upon the earth when the Lord shall come, and shall without dying be changed and thus pass into the Kingdom (1 Cor. 15:50-53; 1 Thess. 4:14-18).

3. They talk of the very thing which the disciples refused to believe, namely, the death of Christ.

III. Israel, in the Flesh, in Connection With the Kingdom, Represented by Peter, James and John (v. 28).

Israel shall be called from their hiding place among all nations of the earth and shall be gathered to Jesus Christ the King, as the central people in the Kingdom (Ez. 37:21-27).

1. Peter proposes to build three tabernacles (v. 33). The Feast of Tabernacles looked forward to the glorious reign of Christ. Peter caught a glimpse of the significance of the transfiguration. His proposition showed that he thought of the Feast of Tabernacles, and therefore of the Millennium.

2. The divine voice (v. 35). At this time God himself uttered his words, assuring them that this one in glory was his son Jesus Christ.

IV. The Multitude at the Foot of the Mountain (vv. 37-43).

This is representative of the nations which shall be brought into the Kingdom which shall be established over Israel (see Isaiah 11:10-12). The people here were grievously oppressed by the devil. There are times when the devil is especially active in his oppression of men. About the time of Christ's first coming he did his best to harass men. Just before Christ's coming again he will be especially active, for he knows that his time is short.

BOY SCOUTS

(Conducted by National Council of the Boy Scouts of America.)

SEA SCOUTS FROM ENGLAND

"That the splendid work done by British sea scouts during the war period is appreciated by England is shown by the special arrangements which have been made for their benefit with the White Star line," writes James E. West, chief scout executive. "Every White Star liner, whether making port in New York, Boston or Halifax, carries two or three British sea scouts who are shipped as 'cadets,' are regular members of the crew and are getting an unforgettable and fascinating experience of real seafaring. "Some of these boys learn to love their good ship and the life of the sea so well that they continue in the service, sail the seven seas, make strange ports, and eventually become mates, officers or skippers."

In New York, Dr. J. J. Macdonald, an American scoutmaster, is always ready at the pier to greet these British boys, and to take charge of them as long as they remain on shore.

W. ARMSTRONG PERRY.



He is to Head the Pioneer Scouts of the Big Brotherhood.

THE KING AND THE BOY SCOUTS.

On the day that King George gave his great garden party to those who had distinguished themselves in patriotic work during the war, there were included only two organizations of young people. These were the boy scouts and the girl guides.

The king particularly asked that the boys and girls themselves should be present to the number of 150, as representatives of the rest. Picked, as they were, one from every county in the British isles, they naturally presented a very smart lot.

The king talked for quite a while in praise of the work of scoutmasters. Results were what he judged by, not the steps. Results are the only test, and the results reflected with greatest possible credit on the workers. He said that he had personal experience of this, because, on account of their capability, scouts had come now to be used for all large functions at the palace.

And he went on to say this of scouting: "The beauty of a scout is that you never have to tell him what to do, and you can rely on his doing it. A scout never makes a mistake. I have never known a scout to make a mistake."

SCOUTS LIKE WOOL CAMP DUDS

Bodily moisture can evaporate through woollens much more easily than through cotton or linen cloth, which keeps the moisture in its texture until it is thoroughly saturated. And it is the dampness next to the skin that causes colds and chills—so stick to woollens.

But, see that you wash 'em right! You kill their betterness right off if you let little bits of soap get in between the fibers and thus clog up the channels through which the moisture is supposed to go.

A good way is to soak the garments in lukewarm suds, then squeeze out the water by pulling the woollens through the hands. And don't twist or wring, if you don't want to invite stretching or shrinking.

Just get out as much of the water as you possibly can and hang the "duds" up to dry.

WHAT THE SCOUTS DO.

At a victory celebration for the soldiers at Geneseo, N. Y., the boy scouts were asked to take care of two airplanes and guard them through the long night.

Some happy scouts are those of Los Angeles Troops 1 and 2. A short time ago they went over to Hollywood and were the guests of Mary Pickford, the movie star, who not only gave them a royal reception, but also presented them with \$25 for troop equipment.