

## PHYSICS

# British Scientists Study Action of Exploding Bomb

## Pressure Part of Wave, They Report, Which Causes Most Physiological Damage, Does Not Turn Corners

**B**ANG! goes the bomb dropped from an enemy airplane!

And in less time than it takes to tell, a gaping crater yawns where a few seconds before there was a building.

This has been happening so much in London during the war, that one might think no Englishmen would care to examine the process too closely. Yet, with real scientific spirit of inquiry, British physicists in the laboratories of the Department of Scientific and Industrial Research have taken advantage of their opportunity to study the physics of an air raid.

More than curiosity is behind such an investigation, for the more they know of what actually happens, the better will they be able to protect from the effects.

Recently arrived in this country is a report which J. D. Bernal, professor of physics at Birkbeck College, London, made to the Royal Institution of Great Britain on this subject. American engineers charged with building for defense will study it with interest.

"Weight by weight," he points out, "high explosives have very little more energy than coal or petrol, but whereas in a car 10 gallons of petrol may be used up with a running motor in five hours, the same amount of high explosive, roughly that contained in a German 50 kg. bomb, will liberate its energy in

$1/20,000$ th of a second. Its power, therefore, will be enormously greater.

"Another consequence is that the mechanical effects of explosives are far more important than the thermal. A high explosive is an extremely efficient way of converting energy into mechanical work and wasting very little of it in heat. Unfortunately, in wartime at least, its mechanical effects are nearly all destructive."

When an explosion occurs, there is a sudden increase in the pressure on everything around it, which, as a result, can transmit the waves from the explosive much faster than they can ordinary sound waves. Sound in air travels about a thousand feet a second. Compressed by a nearby explosion, however, it can go 20 times as fast. In water, the speed may change from 6,000 to 12,000 feet a second, says Prof. Bernal.

The shock wave, it is found, has a number of lengths. First is a sharp, high-pressure part, which has very short wavelength, then, on the tail, is a suction part, of very long waves.

"Consequently," it is stated, "a shock wave passing through an aperture or round an obstacle is changed in character. Roughly speaking, the pressure part goes straight and casts shadows, whereas the suction part travels round corners without any difficulty. Thus, be-

hind a wall, the pressure part of the wave may be cut down to about  $1/10$ th without making any difference to the suction part. This is very useful, as it has been shown that it is the pressure part of the wave that is responsible for most physiological damage. To have even a small garden wall between oneself and the bomb is practically to be secure from direct effects of the blast."

The effect of the blast wave has been found that of a simple blow on the body, the lungs being bruised through the chest wall. "Fortunately," Prof. Bernal states, "lungs will stand a great deal of bruising without permanent injury and though quite a number of blast cases have occurred, most of them have recovered. Now that the nature of the injury is known they can be treated as non-infected pneumonias which, in practice, means only rest in bed."

Most bombs penetrate into a building, or the ground, before exploding. When one goes very deep into the earth, the explosion forms a spherical compression chamber and the gases are forced up through a crack in the ground. But nearer the surface a plug above the chamber is raised in bits, and the fragments fall back into the true crater, thus making an apparent crater which is much more shallow.

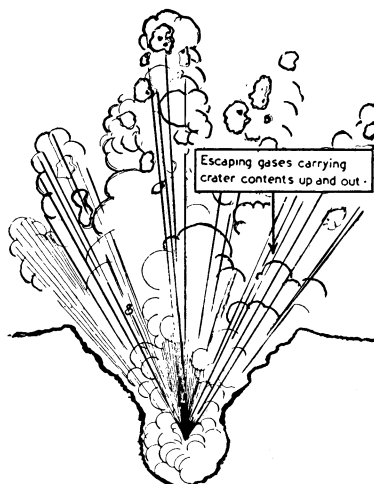
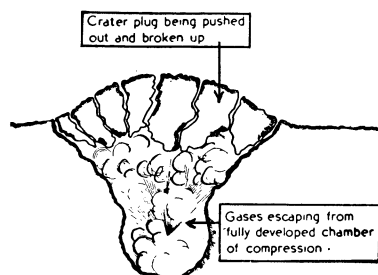
*Science News Letter, August 2, 1941*

To provide each person in a family with 18 to 20 quarts of tomato juice or canned tomatoes, a farm garden should allow 15 to 20 tomato plants per person.

The United States can make soap out of any kind of grease, but without some tropical vegetable oils and imported essential oils we would have the coarse, unlathering soaps of earlier times.

### WHAT HAPPENS

An aerial bomb penetrates some 10-20 feet before exploding, then, after about  $1/500$ th second, a spherical compression chamber is formed by the rapidly expanding gases. After  $1/10$ th second, these start to raise the plug of the crater, as shown on the



left. After another  $1/10$ th second, the fragments are being thrown high in the air, indicated in the middle diagram. The final stage is shown on the right. The debris from the explosion partly fills the true crater. These diagrams were used by Prof. Bernal to illustrate his report to the Royal Institution of Great Britain.

