

## PHYSICS

# Same Plastic May Be Made Hard or Soft, X-Ray Shows

**It All Depends on the Orderly or Disorderly Array Of Its Molecules; Compromise Between Extremes Better**

**T**HE SAME plastic may be hard or soft according to the orderly or disorderly arrangement of its molecules. This was disclosed by X-ray investigations made in the Bell Telephone Laboratories by W. O. Baker, C. S. Fuller and N. R. Pape.

The molecules of a plastic are very large, thousands of times larger than those of water or gasoline. They are long and threadlike, being composed of many atoms strung in a row, and so are called chain molecules or polymers.

If the molten plastic is rapidly cooled and quenched, the X-rays revealed that the molecules are in a very disorderly state, as though the rapid solidification had not given them time enough to arrange themselves in a more regular fashion. The plastic is then soft and flexible.

If, however, the plastic is slowly cooled, the molecules do arrange themselves in a quite orderly fashion. They do not all face in the same direction, as in a single crystal, but in groups, the members of which all face in the same directions while the groups face in different directions. The plastic is then hard and strong, but may also be brittle.

Evidently a compromise between these extremes is to be desired. Hardness and strength must be combined with toughness rather than with brittleness. This goal can be attained, the studies showed, by regulating the quenching treatment so as to give the right proportion of ordered to disordered molecules. If a plastic comes out too soft, it can be hardened by moderate reheating and slow cooling.

This last operation brings out a striking difference between plastics and other solids, namely, that the molecules of a plastic even in the solid state can, to some extent, move about into a more orderly arrangement. In most other solids it is believed that the molecules are fixed and do not move from their positions until the melting point is reached.

This limited mobility of the molecules of a plastic even in the solid state, the

investigators believe, is related to the curious property of "lazy" recovery when the plastic is deformed. It does not snap back like a steel spring, but returns slowly and at a decreasing rate—strikingly exemplified by vinyl plastics.

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## AERONAUTICS

## High Flying Airplanes Are Made Safe By Tests

**B**Y SPINNING the rotors of the super-charger and other metal wheels in a vacuum up to 1,000 revolutions per second, or until they fly apart, our bomber planes are being made safe for

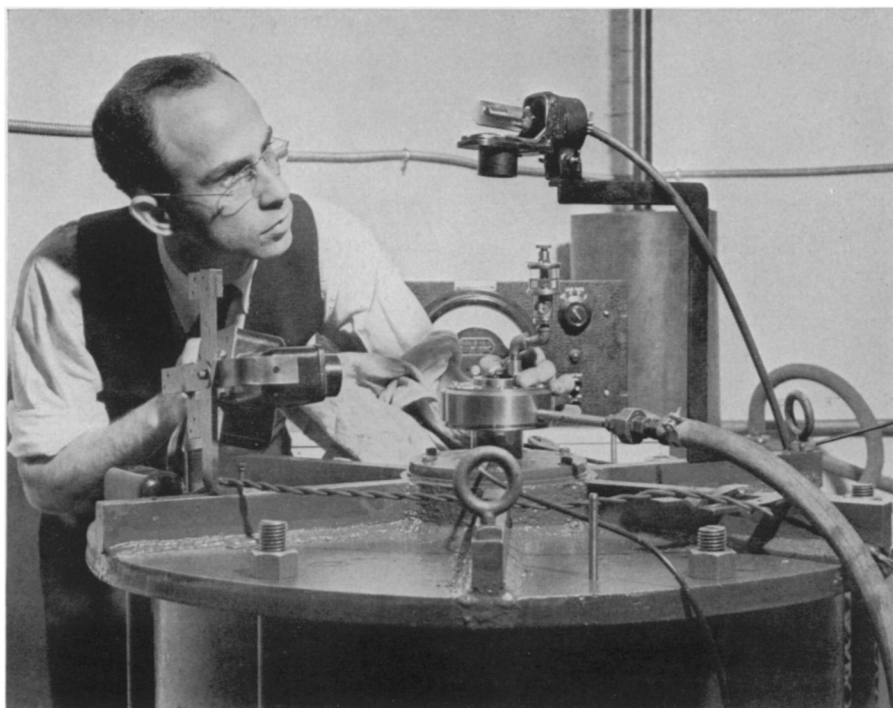
high altitude flying. The tests are being carried out by scientists at the General Electric Research Laboratories.

The wheels, weighing as much as ten to twenty pounds and a foot or more in diameter, are the largest and heaviest ever driven at this terrific speed, the scientists say. Every pound of metal on the rim exerts an outward pull due to centrifugal force of over 100 tons.

When the wheel bursts, the fragments fly in all directions with speeds around 1,400 miles per hour. They have as much energy as the projectile of a small naval gun. The wheel literally explodes.

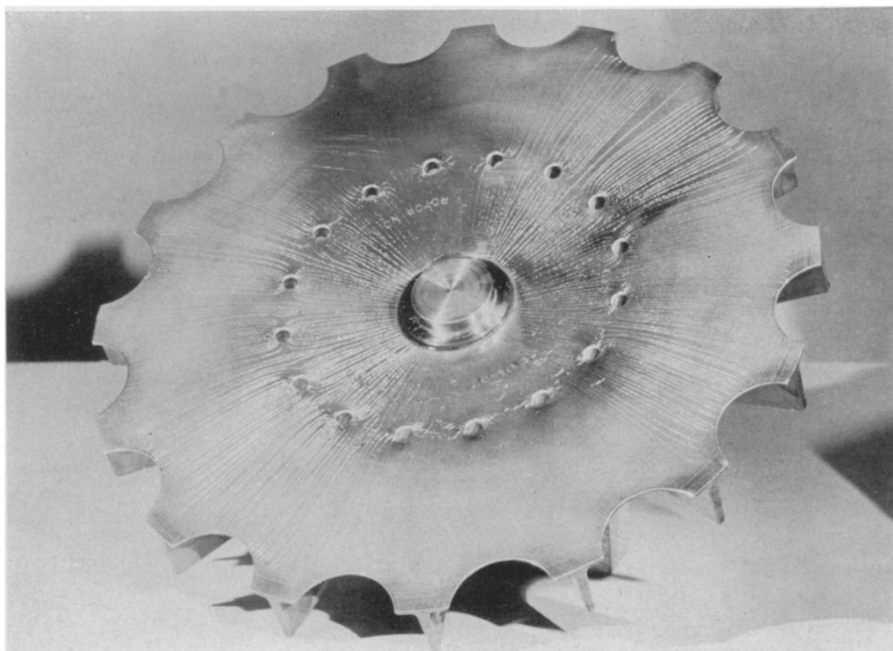
As may be imagined, the chamber in which the wheel is spun, is built with massive steel walls. These are sometimes lined with lead bricks to reduce damage to the fragments so that the nature of the fractures may be examined.

This chamber is exhausted of air to a pressure one ten-thousandth that of the outside air. The vacuum is necessary because otherwise the air resistance would be so great that thousands of horsepower would be necessary to overcome it. With the wheel in an almost non-resistant vacuum, a one-horsepower turbine,



### FOR TEST SPIN

*This machine spins wheels at high speeds up to 1,000 revolutions per second. The wheel is suspended in the tank, from which the air has been exhausted, shown at the bottom of the picture. On top of the tank is a small compressed air turbine that spins the wheel. Frank D. Quinlan, of the General Electric Research Laboratory, is looking at an electric eye which receives flashes of light from the spinning wheel by means of which the speed of rotation is determined.*



#### TEST RESULT

*This shows what the machine on the facing page does to a rotor for an airplane's supercharger. The white lines on its surface are cracks in a brittle varnish with which the wheel was coated. As the wheel spun, centrifugal force caused it to expand. The cracks are at right angles to the stresses produced and are more numerous where the stresses are greatest.*

driven by compressed air, is all that is needed.

Tests below the breaking speed are made by coating the wheel with a brittle varnish. As the wheel speeds up, centrifugal force causes it to expand. The varnish cracks in a direction at right

angles to that of the stress, and the greater the stress the more numerous the cracks. By examining the pattern of these cracks, the direction and magnitude of the stress at every point can be determined.

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#### PSYCHIATRY

## Strict Pre-Induction Tests Avoid Mental Breakdowns

### Psychiatrist Credits Greater Importance of Individual In This War For Low Incidence of Neuroticism Today

**S**TRICT physical and mental examination before induction will enable the United States to avoid mental and nervous breakdowns among its armed forces, Dr. Robert Dick Gillespie, psychiatric specialist of Britain's Royal Air Force, told the New York Academy of Medicine in the Salmon Lectures.

There are remarkably few cases of psychoneuroses among members of the Royal Air Force because of the extreme care used in selection, Dr. Gillespie said.

Only the mentally and emotionally stable get past the weeding out process.

Everyone who flies for the RAF and most of the ground force has the "professional attitude" toward his work, whether he is a pilot or an air gunner, a mechanic or a rigger, he explained. His patriotic devotion is reinforced by his pride in his particular technique and his devotion to his job.

Dr. Gillespie credited the "greater importance which is attached to the indi-

vidual" in this war as one reason why there are fewer neurotics than in the last war. Even among the infantry today a man tends "to be more and more a technician, and less of a foot flogger."

Dr. Gillespie told of a hospital specially built for the care of psychoneurotic victims in the RAF that had to be closed after a few months and directed to other work because there were not enough patients to fill it.

Surprisingly enough, Dr. Gillespie continued, the war has given birth to two institutions, shelter life and community centers, which are highly successful as preventives of psychoneuroses.

"We have learned that shelter life with its common sharing of danger has helped people to withstand peril better than isolation in small groups, which often contributes to the development of psychoneuroses," he said. "The feeling of being with others during an air raid, even in an insecure shelter, brings courage."

Shelter life and community centers fill a need for companionship, Dr. Gillespie went on. In large cities, before the war, we had the paradox of want amid plenty, social want in the midst of social possibilities. Now persons return from safe areas to the shelters in large cities declaring, "I'd rather be bombed than bored."

Dr. Gillespie warned against apathy both among soldiers and civilians as "one of the most significant symptoms of psychoneuroses." This apathy, he said, is usually the result of the continual thwarting of simple desires—in the case of the soldier, the repeated thwarting of the instinct of self-preservation. In the case of the civilian, it is the thwarting of the desire for activity.

"Activity of some sort is a necessary condition of happiness," he said, "and for many people a necessary preventive of psychoneurotic or anti-social behavior. It is important for psychiatrists to recognize the apathy of restlessness which may precede psychoneurosis."

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## ● RADIO

*Saturday, December 6, 11:45 a.m. EST*

On "Adventures in Science," with Watson Davis, director of Science Service, over Columbia Broadcasting System.

Sidney D. Kirkpatrick, editor of Chemical and Metallurgical Engineering, will discuss magnesium from seawater.

*Listen in each later Saturday at 1:30 p.m.*

*Monday, December 8, 9:30 p.m., EST*

Science Clubs of America programs over WRUL, Boston, on 6.04 and 11.73 megacycles.

One in a series of regular periods over this short wave station to serve science clubs, particularly in high schools, throughout the Americas. Have your science group listen in at this time.