at Columbia University, New York City.

This perversely vertical vibration, at right angles to a steadily blowing wind, is but one instance of many other examples of the same sort which until now have defied mathematical analysis. Other instances, Dr. Levinson mentioned, are the flapping of a flag in a breeze, the vibration of a violin string when bowed, the singing of wires in the wind, the sound issuing from a bottle when one blows across the mouth. They are called "relaxation oscillations."

They occur also in electrical systems containing radio tubes, and this case was investigated mathematically some 20 years ago by the Dutch engineer Van der Pol, and again in 1927 by a French engineer, Lienard. But this is a very restricted field.

Much more general equations have now been developed by Dr. Levinson, applicable to a great variety of mechanical and other situations. In particular, he has found the conditions under which these relaxation oscillations will be kept within narrow safe limits. Also he has found the conditions under which only one of several possible modes of oscillation will occur.

Such a system will never be at rest, he declared, but the engineer can so design the structure that the oscillations can never become very great.

Science News Letter, April 25, 1942

RESOURCES

Germany Well Supplied With Necessary Minerals

Enemy Does Lack Copper, Tin, Tungsten, Nickel And Petroleum But Shortage Won't Cause Collapse

HITLER'S troops are "surprisingly well supplied" with necessary minerals, metals and fuels, despite war losses, a report made public by the Department of the Interior states.

The report, which summarizes Germany's war materials acquired during the past eight years through purchase, aggression and internal effort, was prepared by Charles Will Wright, foreign minerals specialist of the Bureau of Mines.

"In the case of aluminum and magnesium, the metals so essential to the manufacture of airplanes and incendiary bombs, Germany was out-producing the United States, Great Britain and Canada up to 1941," according to Mr. Wright.

"By the end of 1941, it was expected that the combined aluminum output of the three allied countries would pull ahead of the German-dominated nations, and that the Allies' 1941 figures would be nearly doubled by the end of 1942. In the case of magnesium, it is believed that American and British output is now equal to German production, while American output alone by 1943 will be more than four times Germany's expanded 1941 production."

Mr. Wright warns, however, that mineral production for non-defense purposes in the United States still goes on, even since Dec. 7.

He asserts that "Just when the United States and Great Britain will be able to exceed the German production of these war machines (tanks, submarines and munitions) depends largely on their ability to increase and maintain mineral production and the extent to which civilian consumption is curtailed to permit more rapid advances in the manufacture of required war materials."

The report admits Germany lacks "copper, tin, tungsten, nickel and petroleum.

"But," it continues, "there is no immediate prospect of a collapse of the military machine because of shortages of any of these materials."

According to Mr. Wright, German possession of the Near Eastern oil fields would assure ample petroleum oil for all essential needs if transport and reconstruction problems were solved.

Mr. Wright notes that despite purchase and tremendous internal effort, "Germany's greatest increase in mineral supply . . . has been through the occupation first of Poland, then Norway, then France, the Balkans, and later of the Ukraine and Donetz Basin."

"Reports indicate that no time is being lost by the Germans in these occupied countries in organizing mineral production in order to get the utmost benefit out of these new sources of supply."

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● RADIO

Saturday, May 2, 1:30 p.m., EWT

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

Miss Katharine F. Lenroot, chief of the Children's Bureau, U. S. Department of Labor, will discuss the Pan American Child Congress for which she is chairman of the organizing committee.

Tuesday, April 28, 7:30 p.m., EWT

Science Clubs of America programs over WRUL, Boston, on 6.04, 9.70 and 11.73 megacycles.

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

CHEMISTRY

Liquids and Gases Not Entirely Formless

"GHOSTS" of ice lurk in water, and all liquids have some slight residual structure which is like a memory of a former crystalline solid state. This latest finding of science was told at the University of Minnesota by Dr. John G. Kirkwood, professor of chemistry at Cornell University. Dr. Kirkwood spoke under the auspices of the Society of the Sigma Xi, the national fraternity for promotion of scientific research.

When a solid melts, the long-range crystalline order, that extended throughout the mass of the solid, disappears completely, but some trace of the short-range local organization persists, he explained. Each molecule in the liquid tends to retain some of its former neighbors.

That liquids are mobile and solids are rigid, does not adequately describe the distinction, Dr. Kirkwood declared. For glass is to be regarded as an undercooled liquid that failed to crystallize on solidifying. Yet it has great rigidity while crystalline solids may show plastic flow.

The real distinction, he said, is the degree of orderliness in the arrangement and distribution of their molecules. In the crystalline solid, the degree of order is high and extends over wide domains. In the liquid, it is slight and confined to local groups. Nevertheless some remains, both in liquids and gases.

This residual orderliness in liquids is revealed by X-ray scattering, the same technic that has so precisely determined the crystal structure of solids.

Dr. Kirkwood has reduced "degree of local order" to a mathematical expression, the "radial distribution function." X-rays determine the value of this function, and conversely, if the function is known, some of the properties of the liquid can be predicted.

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