

ated with the US space efforts. In less than 150 pages he leads the reader through what has been accomplished, and then tells him what may be done in the years to come. Kopal presents a strong argument for the idea that manned space observatories can undertake many significant explorations that unmanned observatories cannot. The book, which is well written, should be valuable as collateral reading in undergraduate astronomy courses; it will also be of value for individual perusal by persons who wish to get a survey of the outstanding astronomical problems and the applications of space technology but who lack the background or the interest for a study at the technical level.

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The reviewer is a professor of physics at Syracuse University where he specializes in general relativity.

NEW BOOKS

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Theory of Condensed Matter. (Symp. proc.). International Atomic Energy Agency, eds. (Trieste, 3 October–16 December 1967). 1015 pp. \$20.00

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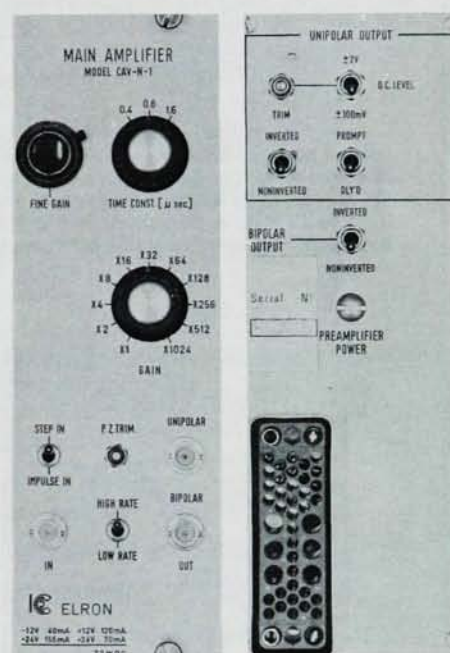
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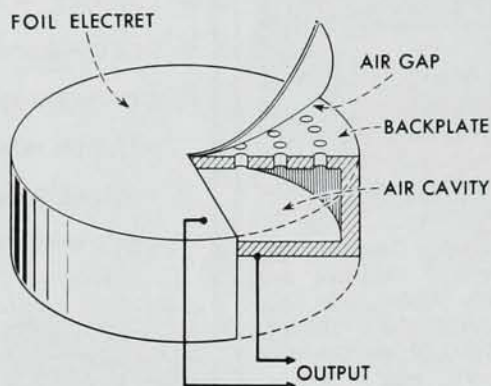
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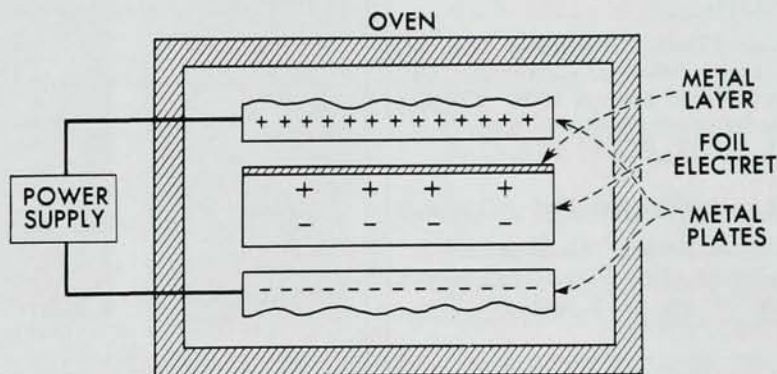
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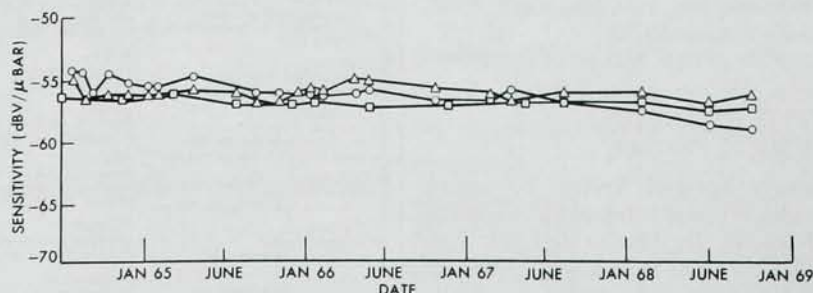
A simple, better microphone



Essentials of the new microphone: The microphone's diaphragm is a charged dielectric foil upon which a thin metal layer has been deposited; it is called a foil electret. The electret touches a metal backplate in several places and, due to surface irregularities, air pockets form between the electret and the backplate. The backplate is perforated so that the air layer can communicate with the larger cavity, increasing the vibration amplitude (and thus the sensitivity) of the system.



Simplified cross-sectional diagram showing how microphone "electrets"—permanently charged dielectric foils—are made. The metallized foil is heated to about 200°C while between a pair of charged metal plates which create an electrostatic field of between 10 and 100 kV/cm. Charges, identical in sign to the adjacent plates, migrate from the plates to the electret, where they remain after cooling. This method of foil electret preparation was announced by Bell Laboratories in 1962.



Sensitivity of electret microphones using fluorocarbon foils is nearly constant. Extrapolated lifetime is about 100 years.

A new kind of condenser microphone with several valuable features has been invented by Gerhard M. Sessler and James E. West of Bell Laboratories. It has the excellent sound fidelity of former types of condenser microphones, but does not need a d-c supply, and has much lower electrical impedance; this permits good low-frequency response without the need for special circuits.

Like previous designs, the new microphone depends on a varying capacitance—produced as sound vibrations impinge on one flexible plate of a capacitor. But there's a difference: here, the flexible plate is a "foil electret"—a thinly metallized sheet of fluorocarbon or polycarbonate. The electret contains a permanent static charge. As the electret moves, it varies the electrostatic field across the air gap (drawing). This produces a varying voltage at the output. Thus, the microphone needs no d-c supply.

In any capacitor, the thinner the dielectric, the higher the capacitance. Dielectric films can be made 0.00012 to 0.001 inch thick. So, the capacitance of the electret microphone is about triple that of conventional types of condenser microphones, and the impedance is comparably lower. This simplifies accompanying circuitry.

The microphone is inexpensive, exceptionally rugged, and immune to wide temperature fluctuations.

As the graph (left) shows, the microphone's sensitivity remains essentially constant for very long periods. This is due to an inherent compensation only possible with thin-film electrets: as the charge on the electret decays—and measurements indicate that it will take about 100 years to fall 50 percent—electrostatic attraction between electret and backplate is reduced. This diminishes the restoring force on the electret, allowing it to vibrate at greater amplitude. Electrical output remains, therefore, nearly constant.

As with all promising devices the electret microphone is being evaluated by our development and systems engineers. Because of its simple construction and low cost it may well find application in future telephones.



Bell Telephone Laboratories
Research and Development Unit of the Bell System

Champ Cristallin et Luminescence: Applications de la Théorie des Groupes à la Luminescence Cristalline. By Daniel Curie. 361 pp. Gauthier-Villars, Paris, 1968. 68F

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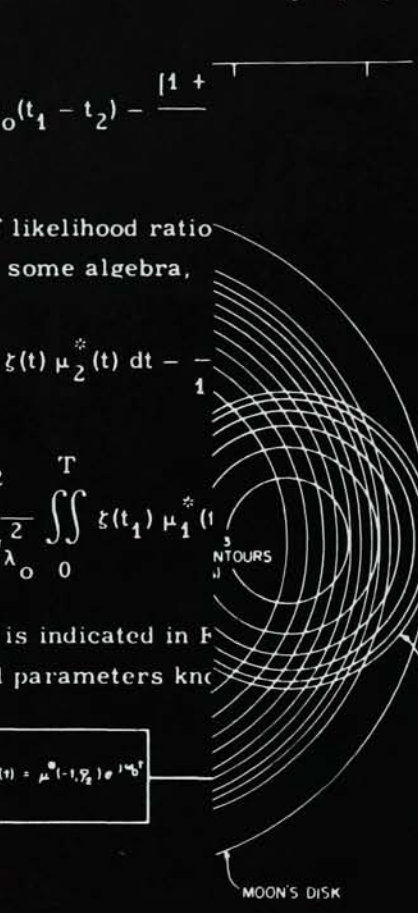
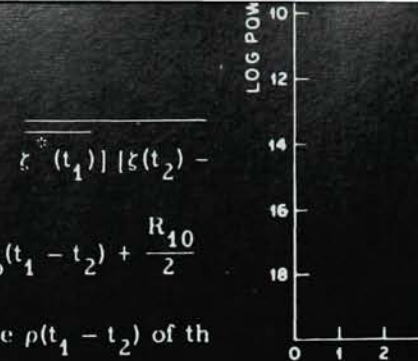
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