

studied evidence that the subjective concomitant of thought and sensation—consciousness—is also a lawful phenomenon, with its content determined in regular and predictable fashion by the structure and electrochemical activity of the brain. We have, in short, followed the development of a strong case for concluding that the origin and properties of the human organism—physical, behavioral, mental, subjective and objective—are completely and in detail the consequence of the normal interaction of the ordinary laws and particles of physics. In such terms, man is a machine."

Waves and magnetoelasticity

ADVANCES IN APPLIED MECHANICS, Vol. 10/1. G. Kuerti, ed. 112 pp. Academic Press, New York, 1967. Paper \$4.75

by James B. Kelley

This tenth volume in the *Advances in Applied Mechanics* consists of two papers: "Wave Propagation in Real Gases" by Wilbert Lick of the California Institute of Technology and "Magneto-Elasticity and Magneto-Thermo Elasticity" by Gunadhar Paria of the Shri Govindram Seksaria Technological Institute in India. Of the two papers, Lick's is much longer and marks a continuation of work the author has been doing in this general field for the past several years.

As Lick points out in his short introduction, the analysis carried out here is somewhat more sophisticated than the usual linear acoustics theory for a uniform one-dimensional medium with the assumptions of constancy of wave form and entropy. The basic equations are those that describe the conservation of mass, mo-

In 1964 and 1965 Wooldridge received the AAAS-Westinghouse award for science writing, and he demonstrates his ability to express himself clearly and succinctly in this present volume. Whether the reader is convinced that Wooldridge has adequately proved his thesis, one is left with no doubt regarding the author's ability to present his case in an interesting and stimulating fashion.

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mentum and energy and the equations of state relating the different thermodynamic variables.

The problem worked out in detail is the following: a one-dimensional, time-dependent propagation of disturbances through a gas, semiinfinite in extent; the gas is bounded by a piston on the left and is initially in static equilibrium. For time $t > 0$, conditions on certain variables such as velocity and temperature of the piston will be changed to prescribed constant values different from their initial values. Generally, as a result, a wave is propagated to the right in the x direction; the general character of the motion is then studied. Lick calls this problem the "signalling problem."

In the four sections following the introduction, the basic equations, linear theory, structure of steady-state shock waves and the formation of a steady-state shock wave are studied. Such essential factors as viscosity and thermal conductivity, chemical reaction, mass diffusion, radiation and mag-

netohydrodynamics (idealized to some extent, to be sure) are considered in the equations. The presentation is straightforward, the assumptions realistic within the bounds of the conditions set and the solutions handled well. As can be easily imagined, the solutions of the equations are not rigorous—this would be impossible—but involve numerical methods that the author spares the reader.

No presentation of this length could be exhaustive, but Lick has done well in striking the highlights both in his paper and in the list of references of some of the more recent work done in this field. For the researcher in applied mathematics, for seminars or for a specialized graduate course, Lick's paper would be useful.

The problem discussed by Gunadhar Paria, "Magneto-Elasticity and Magneto-Thermo Elasticity," has some special interest to the reviewer because some time ago he helped develop certain nondestructive testing methods for the internal hardness of odd-shaped objects using the phenomenon of magnetostriction. As Paria points out in his introduction, the possibilities for applications of magnetoelasticity and magnetothermoelasticity in modern seismology, geophysics, acoustics, etc., are considerable. Despite the present interest being generated in the field, there is still much to be done.

The development is traditional; it begins with the elastic stress tensor for Hooke's law in an elastically isotropic solid and Maxwell's equations. The Maxwell electromagnetic stress is given in terms of the electric and magnetic field, from which Paria develops the modified Fourier law for heat conduction with terms to indicate the effect of the elastic strain and the electric current on the temperature distribution in the solid. The author points out that relatively few problems in magnetothermoelasticity have been solved, and most of those that have been solved are recent. It is interesting to note that many of those attracted to work in this field have come from outside the US, particularly from India and the Soviet Union.

The problem that Paria considers in some detail is that of magnetoelastic stresses in an infinite medium with a long cylindrical hole. The mathematical presentation is developed in some detail and the basic equations are developed for two dimensions. The solution is carried out for the purely elastic

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case. He then considers radial motion of an elastic sphere in a magnetic field and magnetothermoelastic interactions in an infinite solid owing to instantaneous heat sources, respectively. As in the other paper in this volume, Paria's presentation is straightforward and generally conventional. Again the paper has a value similar to that of Lick's and also performs the worthwhile service of providing a current and good list of references.

For those whose interests are in applied mathematics as well as in applied mechanics this tenth volume in the series should prove a good reference and research document.

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Laboratory benches in space

SCIENTIFIC SATELLITES. By William R. Corliss. 822 pp. NASA, Washington, D. C., 1967. Paper \$3.00

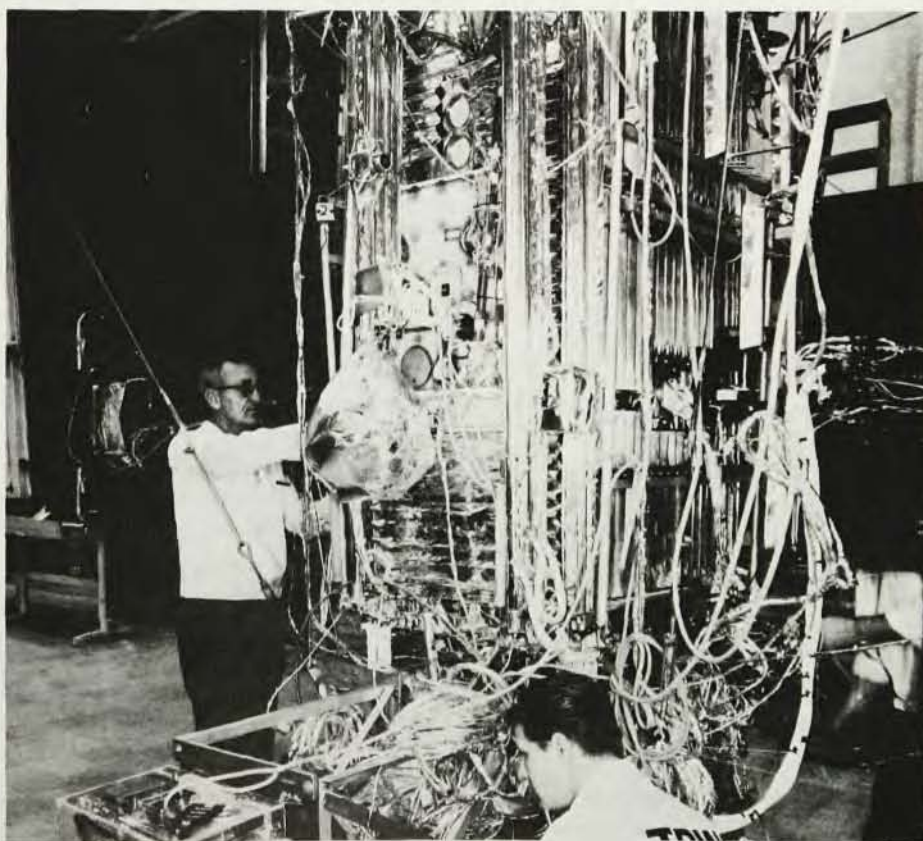
by George F. Pieper

The exploration of space by unmanned scientific satellites has come a long way since the Russians launched Sputnik I over a decade ago and the US experienced frustration and failure in getting its own space program started. We have discovered the solar wind and mapped the earth's radiation belts and magnetosphere; we have determined the earth's shape to a high degree of accuracy; we have measured radiations from the sun and stars in wavelength regions not accessible on earth . . . and the list goes on through aeronomy, geomagnetism, cosmic-ray physics, cosmology and the other disciplines that make up the space sciences. The scientific results are generally well documented in the literature. Not so well documented are details of the equipment used to sense the physical phenomena under study, to process their signals and record their data and details of the spacecraft on which the scientific experiments have flown. William R. Corliss, a specialist in space propulsion and a professional science writer with an MS in physics, has addressed himself to this problem.

Corliss's book (which is under NASA sponsorship) is a storehouse of information. Following brief reviews of the objectives, status (already

somewhat out of date), and history of satellite science, he plunges into details of satellite dynamics, communications and data handling, tracking, guidance, attitude control, satellite testing, launch-pad activities and data reception and launch vehicles. Throughout this part of his book, which covers 324 pages and culminates in a long (128-page) chapter on the design of scientific satellites, Corliss works entirely in terms of ten subsystems (such as power-supply subsystem, attitude-control subsystem and structure subsystem) that make up the spacecraft system and the interfaces between the subsystems and the launch vehicle and earth-based facility systems. Especially valuable is the depth of illustrative detail. Pages 141-143 show the 32-word OSO II data frame and wheel- and sail-commutator channel assignments; pages 222-225 give the chronology of IMP B between 13 August, 1964 and its lift off to become Explorer 21 at 2245 UT, 3 October, 1964. These and dozens of other similar illustrations taken from actual cases should give the reader a firm feeling for the solid reality of spacecraft technology if he does not already have it from his own experience.

The third major part of *Scientific Satellites* is a 262-page review of instruments and experiments in the fields of astronomy, solar physics, biology and geophysics. Included between solar physics and geophysics is the field that has come to be called solar-terrestrial relations. Missing is satellite meteorology, defined admittedly arbitrarily by Corliss as an "application." The same writing technique is used here as earlier in the book, with general descriptions of experiment types and illustrative detailed descriptions, drawings and pictures of particular experiments. For example, ten pages are given to the four experiments that will fly on Orbiting Astronomical Observatories A2, B and C. The book closes with a good 38-page bibliography and a splendid 98-page appendix listing "all the unclassified scientific satellites known to the author." Included in brief form is just about everything Corliss was able to find out about these satellites including orbital data, project-management responsibilities, descriptions of subsystems and a list of experiments with experimenter and institution. The list covers foreign as well as US satellites and includes what details are known about the



TECHNICIANS MAKE FINAL ADJUSTMENTS in NASA's Orbiting Geophysical satellite (OGO-E). Cables monitor performance in simulated space conditions.