

LABORATORY Temperature Controller



Model 5301-E

With an input circuitry designed to accept resistance or voltage generating temperature sensors such as GaS-diodes, thermocouples, Ge & Pt Sensors, Carbon Resistors and Thermistors. The 5301-E, three mode controller offers temperature regulation to better than 0.01°K (or $^\circ\text{C}$) in Vacuum chambers, Cryogenic dewars, Optical ovens, Tensile strength test apparatus, etc. for physics, metallurgy, chemistry and other scientific fields where the control and temperature range requirements are broad or change frequently. Set point readout is either directly in mV or Ohms (4-terminal measurement), with unlimited temperature range. Proportional, rate and reset modes are all internally adjustable, allowing to tune the controller to the thermal time constants of the process. 100 Watts, DC output or up to 5KW with Model 2202.

artronix

INSTRUMENTATION

1314 Hanley Industrial Court, St. Louis, Mo. 63144
(314) 968-4740

Circle No. 39 on Reader Service Card

POWER MODULE



Model 2202

To regulate an AC-line connected load by means of a small DC signal from an automatic control instrument. It supplies large amounts of power for control of resistive heaters, thermo-electric elements, light sources, etc. in temperature controlled ovens, vacuum deposition equipment, infrared heat sources, temperature baths and other applications. The instrument features a pulse-width-modulated zero crossing - fires TRIAC circuit to minimize RF interference, electronic protection against current overloads and voltage transient, and provides linear control to a AC power line up to 25 Amp. (110 V or 220 V).

artronix

INSTRUMENTATION

1314 Hanley Industrial Court, St. Louis, Mo. 63144
(314) 968-4740

Circle No. 40 on Reader Service Card

Considering the increasing complexity of the Royal Observatory's activity since 1835, this accidental difference may have resulted in a better volume. Meadows' summary provides the background for future detailed studies in the Forbes style without diluting the Observatory's exciting history.

Meadows divides the history of the period into four subjects—Observatory staff, positional astronomy, longitude and time, and astro- and geophysics—and analyzes developments in each chronologically. The picture is broadly painted, but the view is clear. From a small observatory run by a small staff, the Greenwich Observatory was transformed into a formidable institution. There is heavy emphasis on the nineteenth century, especially the years of George B. Airy.

Volume 3, by Derek Howse, is a mine of information about the buildings and instruments used at Greenwich. Howse is Curator of Astronomy at the National Maritime Museum, Greenwich, the agency responsible for the old Observatory grounds. As such he was intimately associated with the renovation of Greenwich Observatory buildings to reflect their original use and is very knowledgeable about the Museum's astronomical collections. His presentation includes a description of each instrument, a summary of the method of use, an historical resume of accomplishments achieved with it, and references to contemporary accounts. All the volumes are illustrated, but special care was taken with Volume 3 to portray the instruments.

It is well known that Greenwich in its 300-year history has had an important impact on astronomical developments throughout the world. These books convey some of the excitement of that history.

* * *

Arthur L. Norberg is an historian of astronomy and physics. At present he is coordinating the History of Science and Technology Project of the Bancroft Library at the University of California at Berkeley.

Collective Phenomena and the Applications of Physics to Other Fields of Science

N. A. Chigier, E. A. Stern, eds.
491 pp. Brain Research, Fayetteville, New York, 1975. \$25.00

The papers and abstracts published here are the result of an independent seminar organized by a group of dissident Soviet scientists and cancelled by the authorities; most of the papers had been submitted beforehand. Since no

specific reason was given for the suppression of the meeting, one is left to draw one's own conclusions. The majority of the Soviet scientists involved in the unofficial conference had applied for emigration to Israel, and subsequently lost their employment as scientists. The conference thus represented a means of maintaining their scientific validity after official outlets had been closed. More than 100 scientists from all over the world contributed papers,



Russian dissident scientists (Mark Azbel on right) listen intently at "Sunday seminar" in Moscow apartment, 1975.
(Photo, P. Pershan)

and eight Nobel Prize winners were among the sponsors.

In the preface, Alexander Voronel gives the background of the meeting in a compelling manner: "... after a fortnight's meditation in the cells and prisons around Moscow, it is seen that the solidarity of scientists is greater than the state frontiers that divide us and stronger than direct political pressure ... and that direct contacts of scientists and scientific freedom [can] no longer depend only on the political interests of governments ... a precedent has been created for informal contact between Western and Soviet scientists which can hardly be ignored ..."

The diverse nature of the program included the closely related sciences of physics, chemistry and mathematics (35 contributions) as well as biology (29), cybernetics—modelling—game theory (26), sociology (ten), economics (six) and a so-called "general" section, which consisted of 11 other papers of great diversity—from "Life in the Universe" to "Quest of New Scientific Methods for Archeological Problems." Altogether there are over 100 papers of variable length, averaging about five pages per paper. Sadly, we have only one-page

abstracts from 22 of the Soviet group.

The awareness, although not recent, has grown rapidly in the last few years that a number of structures in apparently diverse intellectual disciplines appear to be quite similar, and that if an advance is made in one area, it will be useful in another. The present book provides a group of interesting contributions that help to highlight these similarities, or at least to suggest them; as such, they represent an amelioration of the often too rigid interdisciplinary barriers. It should present a welcome starting point for the mathematically inclined in the physical sciences who enjoy utilizing their skills in unfamiliar areas. One is apt to find, however, that unsolved problems in one area are also unsolved in others.

FREDERICK W. CUMMINGS
*University of California
Riverside*

Astrophysics of Gaseous Nebulae

D. E. Osterbrock

251 pp. W. H. Freeman, San Francisco,
1974. \$17.00

In preparing this book, Don Osterbrock has made a fresh approach to the problems associated with gaseous nebulae. We astrophysicists can reorganize our files of dog-eared Xerox copies and reprints of essential papers on the spectra of gaseous nebulae and follow his organizational scheme.

The author starts out with the basic concept of a pure hydrogen cloud and posits a totally photoionized hydrogen sphere, or HII region. Chapter by chapter, he builds upon his simple physical model, adding singly and doubly ionized helium, then ionized heavier elements in turn. He discusses thermal equilibrium, and the emission spectrum—with its dependence on density, temperature and abundances—is calculated. Theory is compared with observations, and the effects of internal dynamics are discussed. Consequences of dust in the ionized nebula are also considered.

Gaseous nebulae are extremely varied in shape, size, color and even origin, yet their characteristic emission-line spectra tie them together into a field of most interesting astrophysics. However, it is still a challenge to understand these spectra totally, though they seem so simple. Very bright green lines of doubly ionized oxygen, deep-blue lines of singly ionized oxygen, and deep red neutral-oxygen, singly ionized nitrogen and sulfur lines usually dominate the nebular spectra, but all lines are due to forbidden transitions that cannot occur in more dense laboratory vacuums.



Trifid Nebula. Photo by T. R. Gull records hydrogen-alpha and nitrogen emission lines.

Explaining the basic physics of gaseous nebulae was a major challenge to astrophysicists in the first half of this century. As the physical processes have become better understood, the astrophysics of gaseous nebulae has in turn been put to work as an important tool in studying galactic structure by extinction measurements of hydrogenic lines, in measuring abundances of the various elements and in understanding the ultraviolet spectral energy distribution of very hot stars that ionize diffuse and planetary nebulae. Analysis of the emission spectra of supernova remnants has aided researchers to confirm that the remnants are being driven by a central source expanding at shock velocities into the surrounding neutral medium. Today astronomers use theoretical concepts developed over the years to determine electron temperatures and densities and elemental abundances of gaseous nebulae. Observations indicate possible abundance differences between ionized-hydrogen regions with increasing distance from the nuclei of spiral galaxies. The conditions within quasars and nuclei of emission galaxies are studied using emission-line spectra. Even though the sizes and mechanisms of excitation are very different, it is astounding to realize that the spectra of some high-excitation planetary nebulae and the nuclei of Seyfert galaxies have many similarities.

The approach of this book is unique. Osterbrock presents just what he promises to discuss: the astrophysics of gaseous nebulae. Diversions—such as pretty color pictures of the heavens or totally mathematical discussions—are not to be found. The book treats astrophysics in an informal but logical, straightforward manner. Aside from the usual typographical errors that always occur in first editions, the book is well prepared. Particularly attractive is the outline summary at the end of each chapter, with references to the source papers summarized in the text. This feature makes the book a useful guide not only for the graduate stu-

COMPUTER PLOTTING



Model 1653

A high speed, 22 inch recorder designed to operate on-line to scientific and general purpose computers in graphic output applications.

- Plug-to-plug compatibility (hardware and software) with all standard 300 steps/sec. plotters used in the computer field (CALCOMP and COMLOT).
- Z-fold paper (367 ft. long) folding conveniently into notebook size.
- 0.01 inch step (0.25 mm optional) with 300 steps/sec. operation.
- Single step resolution with one step repeatability.
- Pen point exposure for manually setting origin.
- Simple control panel layout with single function switch.
- Integral chromed steel stand with paper storage.

Price: \$3,300.00

artronix

INSTRUMENTATION

1314 Hanley Industrial Court, St. Louis, Mo. 63144
(314) 968-4740

Circle No. 41 on Reader Service Card

PHYSICS TODAY / APRIL 1976