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The guide also shows the right coupler to use to link each transducer to an Offner Dynograph® recorder. These small plug-in couplers are an outstanding benefit of Dynograph recorders—they can be interchanged in seconds to record virtually all physiological phenomena.

Would you like a copy of this handy chart? We'll send you one by return mail. Ask for Chart 220-5.
Studies of Small Gap Semiconductors for Infrared Detection

The window in the atmosphere between 8 and 14 microns has stimulated work on devices that will detect longer wave lengths. New semiconductor materials may make practical the detection of longer wave lengths and therefore targets with far lower temperatures.

The atmosphere offers several windows for energy transmission in the infrared spectrum. One particularly good one occurs between 8 and 14 microns where energy is transmitted freely. However, radiation on either side of the window is blocked due to absorption by the molecules in the atmosphere.

All objects at temperatures above absolute zero give off radiations and the lower the temperature the longer the wave length. Therefore, if long wave lengths can be detected by a practical means, targets of much lower temperatures could be recognized.

Infrared detectors use either intrinsic or extrinsic semiconductors. Intrinsic detectors use electron transitions within the atoms that make up the semiconductor material itself. The extrinsic type utilizes electron transitions that occur due to the presence of impurity atoms introduced into the semiconductor material. (See Fig. A.)

While the extrinsic materials permit detection of infrared radiation beyond 6 microns, these materials require cooling to below 40°K. This calls for bulky, heavy apparatus undesirable for airborne applications and difficult to design into multielement detectors.

Until now no one has been able to make an intrinsic conductor that will detect photons in the longer wave lengths. In an intrinsic detector the narrower the energy gap between the valence band and the conduction band the easier it is to excite an electron across the gap. This excitation occurs two ways: by photon excitation and by thermal excitation. The problem is to produce a material with a gap narrow enough to respond to long wave lengths (that is, low energy photons) but wide enough so that practical cooling temperatures will be sufficient to minimize thermal excitation.

Honeywell scientists have performed a theoretical analysis which shows the feasibility of making an 8 to 14 micron intrinsic detector capable of operating at liquid nitrogen temperature, 77°K. (—320°F.)

Honeywell's Research Center
Hopkins, Minnesota

FIG. A

The analysis also shows that by the use of intrinsic material the detectors operating at 77°K could be made so sensitive that the only limitation is imposed by the randomness of the photons coming from the radiation background. Problems present themselves in selecting elements for the semiconductor. For example: while some narrow gap materials meet many of the requirements, their gap is so narrow that the required cooling is impractical. (This is the case with mercury telluride.)

Honeywell's contribution to the development of a suitable detector has been to prepare a compound semiconductor composed of different proportions of mercury, cadmium and tellurium and to develop a theory capable of explaining the behavior of this material.

This compound is difficult to synthesize. Mercury evaporates readily at room temperature yet the compound requires heating to 800°C. At this temperature the pressure of mercury within the capsule is very high.

A number of different compositions have been formulated. Most promising is a compound of approximately 80% mercury telluride and 20% cadmium telluride. With this compound Honeywell scientists, for the first time, have been able to demonstrate photon detection at wave lengths out to 14 microns. Previous workers had been able to demonstrate only thermal effects in these materials.

Further work is under way at Honeywell's Research Center on purification of the material and improvement of its crystal structure. At the same time additional theoretical work is under way to further understand the very complex band structure of small gap semiconductors. If the transitions in these materials can be explained, new insights in semiconductor theory will be attained. This research is partially supported by the Aeronautical Systems Division, Air Force Systems Command.

If you are engaged in scientific work involving small-gap semiconductors and would like to have copies of papers on the subject by Honeywell scientists, you are invited to correspond with Dr. Paul W. Kruse, Honeywell Research Center, Hopkins, Minnesota.

If you are interested in a career at Honeywell's Research Center and hold an advanced degree, you are invited to write Dr. John Dempsey, Director of Research at this same address.
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To make a single amplifier operate in two directions, it was necessary to provide a precise, complex filter system to separate the signals. Signals traveling in one direction occupy a frequency band from 116 to 512 kc., and those traveling in the other direction, from 652 to 1052 kc.

The gain of each amplifier must accurately compensate for its share of cable loss. The total loss varies over the frequency band and, in a transatlantic system, reaches a maximum of 9000 decibels. Since there is no way to adjust an amplifier on the ocean floor, the performance of each one must be pre-established with extreme precision.

A 3600-mile cable link, with its 180 amplifiers, includes 36,000 electronic components. Each component has to be endowed with a reliability far in excess of the requirements of conventional land systems.

The casing and its seal to the cable must prevent minute water seepage at ocean bottom pressures. This could accumulate fatally over the years, and so production tests employing radioactive isotopes are used to search for any such microscopic leakage.

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View of deep-sea amplifier with casing cut away. The casing is of noncorrosive beryllium copper, tested to withstand pressures up to 11,000 psi.
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Along with portions reprinted from Dr. Moore's distinguished text, Principles of Zoology, this book includes two new chapters on genetics and a new chapter on embryology. In addition to presenting the important modern developments in both fields, the text describes the early research work upon which these new discoveries are based.
1963 256 pp. 77 illus. paperbound $1.95

Foundations of Thermodynamics
By Peter Fong, Utica College of Syracuse University
Departing from the approach used in conventional textbooks, Professor Fong expounds a new formulation that gives a physical insight into thermodynamics without the use of elaborate mathematics. Basic concepts are carefully defined, especially those which are pivotal in theory, such as the concept of reversible process.
1963 110 pp. $2.50

An Introduction to Human Physiology
By J. H. Green, University of London at the Middlesex Hospital Medical School
The basic concepts of human physiology are presented as a framework to which additional knowledge may be added by attendance at systematic lectures or through study of larger textbooks, reviews and original papers. The book is designed for use by medical, dental, and nursing students.
1963 176 pp. 214 illus. paperbound $4.85 clothbound $8.00

Foundations of Psychopathology
By John C. Nemiah, M.D., Harvard Medical School and Massachusetts General Hospital
This excellent introduction to the basic principles of psychopathology focuses on clinical phenomena. Such fundamental topics as the dynamic unconscious, psychological conflict, repression, the childhood roots of emotional disorders, defenses, and symptom formation receive thorough coverage.
1961 352 pp. $6.50

Oxford University Press
417 Fifth Avenue
New York, N.Y. 10016

Radiation Accidents and Emergencies
Local emergencies, small accidents, and major catastrophes involving ionizing radiation were the main topics of discussion at a symposium on radiation accidents and emergencies in medicine, research, and industry held in Chicago, 19–20 December 1963. All pertinent aspects of a pure emergency situation were covered—accident dosimetry, handling of spills, medical aspects, mass survey problems, control of post-accident exposures, psychological and legal considerations, public relations, and others.
In most accident or emergency situations (that is, incidents resulting from accidents where prompt action is necessary), the intelligent attention and full capacity of the emergency worker should be directed to the following sequence of action: (i) The saving of lives (rescue operations, protection from further injury, and directing the victims back to active, useful lives); (ii) containment measures and prevention of further injury or threat of injury; (iii) salvage of equipment and materials; and (iv) turning the disaster site over to persons interested in or responsible for restoration.
The type of emergency action taken in an area where radiation has been released will depend on whether or not there is a reasonable expectation that anyone is present and alive. In either case, the course of action to be pursued should be determined by the person designated as responsible for the emergency action (E. Vallario and R. Catlin, U.S. Atomic Energy Commission). The risk to the rescue workers should be weighed against the probable success of the rescue action. Attempts to rescue victims should be regarded in the same context as any other emergency action involving the rescue of victims, regardless of the type of hazard involved. Any rescue activity that may involve substantial personal risk should be performed by volunteers, and all emergency workers should be advised of such risks prior to their participation.
From the legal point of view, Forgotson (Walter E. Meyer Research Institute of Law, Washington, D.C.) pointed out that a particularly complicated situation is presented when, for the purpose of attempting or effecting a rescue of persons involved
in a disaster, or of preventing a disaster, it becomes necessary to expose individuals to doses of radiation in excess of 3 rem per quarter of a year and 25 rem for a single accidental exposure. He discussed the effect of these dose limitations and concluded that, on the basis of Federal Radiation Council publications, exceeding these doses does not constitute negligence per se and, in certain situations, even might not constitute evidence of negligence. (He further discussed a number of liability questions, including the potential liability of a manufacturer or seller of a source. In this connection, he called special attention to the recent product liability case of Goldberg versus Kalsman Instrument Corporation, a case which marked a departure from the way the New York Court of Appeals or any other court has previously handled one of these decisions. In this case, the majority of the court held that someone, namely, the ultimate manufacturer, is left in the role of a virtual insurer for the defective designs.)

The screening of persons exposed to radioactivity for medical attention, decontamination, or release is only a passing phase of the emergency situation although it is most important one. Some controversy exists in the case of a contaminated person who requires medical treatment—which should come first, medical aid or decontamination? This question, of course, does not have a simple answer.

Speaking on medical effects, G. Voelz (U.S. Atomic Energy Commission, Idaho) stated that "The atomic energy industries to date have not experienced acute accidental exposures from internal emitters (any radioactive chemical entering the body either through the skin, pulmonary, or gastrointestinal tract) resulting in an acute or dramatic radiation injury similar to the direct external radiation exposures which produce the dramatic acute radiation syndrome." The concern regarding internal emitters is related more to the continuing radiation dose which may produce late pathological effects.

Inhalation of radioactive particulates or aerosols by workers has been the most common and important source of internal deposition in atomic energy installations. In the case of contaminated wounds, excision has been practiced most frequently when plutonium-239 was the contaminant. To evaluate the nature and amount of internally deposited radioactive material, G. V. LeRoy (University of Chicago) remarked that, at the outset, it is most important to collect all urine passed by each person from the time he escapes—or is removed—from the site of the accident. Depending on the circumstances, radio-assay of the first urine voided may be of great value in estimating the accidental burden of radioactive material.

The art and science of methods for decontaminating equipment and materials have been vigorously pursued for the last two decades. L. Gemmell (Brookhaven) reviewed older as well as some new techniques, such as shot blasting. Speaking on maximum permissible levels of surface contamination, W. R. Bush (Chalk River, Canada) pointed out that these levels varied by a factor of 1000 for alphas and 100 for betas among the various countries that use radioactive isotopes. He also developed data showing that, for a given surface contamination of a material, the inhalation hazard varied by a factor of 1,000,000, with carbon-14 at the lowest limit and plutonium-239 at the upper limit. J. Maloney (Edgewood Arsenal, Edgewood, Maryland) reported on new effective procedures of major outdoor decontamination under cold weather and winter conditions. (Many portable radiation measuring instruments fail to operate while at low temperatures.)

The spread of alpha contamination, which is caused by a nonnuclear explosion (chemical part) of atomic weapons, has been a subject of concern for many years. The most extensive measurements ever made in this field were reported on for the first time by W. Johnson, Sr. (Eberline Instrument Company). The detonations were designed to simulate conditions of storage, transportation, and handling of plutonium-bearing weapons. Surveys were performed with both alpha and gamma instruments at distances up to 16 kilometers. As one might expect, drastic changes in the contamination patterns were observed from one test shot to another.

The generation and disposal of waste in emergency decontamination is of little consequence in most accidents involving radioactivity (R. O'Brien, General Electric Company, Idaho). This is due in part to the well-established waste disposal channels. In unusual situations such as the...
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SL-1 reactor incident where, after 5 months' decay, about 3500 curies of fission products were distributed as contamination throughout the reactor building and its environs, the use of a local waste disposal site saved more than 300 man-rem of exposure. It is estimated that the cumulative total whole-body dose of 1000 rem was received by those who were involved in the cleanup. The cost of cleanup was $1 million, not counting the cost of volunteer and Army workers.

R. Gallagher (Applied Health Physics, Pittsburgh) reported a wide range of restoration effort for the decontamination of radium spills in medical situations. In one situation an entire building had to be demolished. There is on the average one radium contamination incident a week in the United States.

Unlike many types of accidents, those involving radiation can go undetected for an extended period of time. Such delays can lead to considerable spread of the contamination.

The topic of public relations was assigned to the well-known science reporter, Robert S. Kleckner (Sun-Times, Chicago), rather than to an institutional public relations person.

Kleckner stated that the first step in reporting an accident is to avoid any type of censorship and to get the facts to the people as quickly and simply as possible. If there is a hazard beyond the confines of an installation, it should be stated that this is so and how great it is. The public should be informed about the precautions to be taken. There should be a steady flow of information to the news media until the story has been covered from all angles. There are reassurances even in bad radiation mishaps; the good as well as the bad should be brought out. The American public has never panicked when it knew the truth immediately.

Preplanning and preparedness are the keys to reducing the deleterious effects of accidents. R. Landauer (Cook County Hospital, Chicago) and G. V. LeRoy (University of Chicago) spoke on hospital preparedness but differed greatly on the approach. LeRoy stressed preplanning between a given radiation installation and a nearby hospital for the care of injuries that may occur. Landauer, on the other hand, stressed the need for a simple plan for all hospitals because accidents, especially transport accidents, may occur anywhere.
Emergency situations produce anxieties in those who are directly involved. D. Oken (Chicago), a psychiatrist, talked on mental preparedness of emergency personnel, both as individuals and as groups. Emergency teams must be suffused with a strong *esprit de corps*; members of a group with high morale become capable of carrying out tasks that are personally unappealing or even severely stressful. The group may admit to a certain degree of internal fear, but disparagement of the group itself or self-protective avoidance of responsibilities to one's co-workers is intolerable. Individuals who transgress these limits must be excluded. Panic, however, is rare. Little was seen at Hiroshima or Nagasaki. Emergency teams should be supplied with a maximum of correct information and be trained in the most helpful methods of communicating this to victims. The antidote to scare stories and rumors is information. Even if the news is bad, it is always reassuring to know that you know the worst. On the question of prevention, Oken pointed out that accidents tend to occur in clusters during periods in which other signs of psychological stress are evident—the accident syndrome. Subtle changes in the behavior pattern of an individual may be precursors to a major accident.

In the event of a radiation accident that cannot be handled by the organization in which it occurs, there are some private organizations that might be called in. In addition to these, the U.S. Atomic Energy Commission has a Radiological Assistance Program. Zintz (U.S. Atomic Energy Commission, Washington) and Brobst (U.S. Atomic Energy Commission, Chicago) reported on the program which is capable of responding to a radiological emergency upon request 24 hours a day anywhere in the United States. During the last 3 years 223 responses to requests for radiological assistance were made. Most of these (40 percent) involved transportation incidents.

The Radiological Health Division, U.S. Public Health Service, has a somewhat broader program, although it too has Radiological Assistance Teams. R. Moore (U.S. Public Health Service, Dallas) and L. Thomas (U.S. Public Health Service, Chicago) outlined the role of the U.S. Public Health Service in the radiation area along with its traditional role of pro-
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3–5. American Assoc. of Pathologists and Bacteriologists, annual, Chicago, Ill. (E. A. Gall, Dept. of Pathology, Cincinnati General Hospital, Cincinnati 29, Ohio)  
4. Arizona Acad. of Science, Tempe. (H. B. Whitehurst, Dept. of Chemistry, Arizona State Univ., Tempe)  
3–8. International Acad. of Pathology, annual, Chicago, Ill. (F. K. Mostofi, Armed Forces Inst. of Pathology, Washington, D.C. 20012)  
5–10. Asia-Pacific Acad. of Ophthalmology, 2nd congr., Melbourne, Australia. (R. N. Mellor, 82 Collins St., Melbourne Cl)  
7–11. Applied Mathematics and Mechanics, Giessen, Germany, (K. Maruhnacht, Mathematisches Institut, Justus Liebig Univ., Giessen)  
9–11. Southwestern Psychological Soc., annual, San Antonio, Tex. (C. C. Cleland, 2104 Meadowbrook Dr., Austin, Tex. 78703)  
9–13. Roentgen Congr., German, Wiesbaden, Germany. (H. Lassen, Deutscher Röntgenkongress, Fichterplatz 20 III, Mainz, Germany)  
10. Natural Phenolic Compounds, symp., Tokyo, Japan. (M. Shimokoriyama, Dept. of Botany, Univ. of Tokyo, Tokyo, Japan)  
12. Industrial Fibers, European inst., Milan, Italy. (F. Tommy-Martin, 40 rue du Stand, Geneva, Switzerland)  
12–13. American Soc. for Artificial Internal Organs, Chicago, Ill. (B. K. Kusserow, Dept. of Pathology, Univ. of Vermont College of Medicine, Burlington)  
12–17. Society of Motion Picture and Television Engineers, semiannual technical conf., Los Angeles, Calif. (J. M. Waner, Eastman Kodak Co., 6706 Santa Monica Blvd., Hollywood 38, Calif.)  
12–18. Chemistry of Natural Products, intern. symp., Kyoto, Japan. (Science Council of Japan, Ueno Park, Tokyo, Japan)  
13–15. Microelectronics, 3rd annual symp., St. Louis, Mo. (T. F. Murtha, P.O. Box 4104, St. Louis, Mo. 63136)  
13–16. American Acad. of General Practice, Atlantic City, N.J. (M. F. Cahal, Volker Blvd. at Brookside, Kansas City 12, Mo.)  
13–16. Industrial Medical Assoc. and American Assoc. of Industrial Nurses, Pittsburgh, Pa. (C. D. Bridges, 55 E. Washington St., Chicago, Ill. 60602)  
14–18. Mathematical Logie, conf., Oberwolfach, Germany. (M. Barner, Mathematisches Forschungs-institut, Hebelstr. 29, 78 Freiburg im Breisgau, Germany)  
15–17. Ophthalmological Soc. of the United Kingdom, annual, Dublin, Ireland. (Secretary, 47 Lincoln’s Inn Fields, London, W.C.2, England)
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16–17. Fiber Soc., spring meeting, Charlotte, N.C. (J. Rebenfeld, P.O. Box 625, Princeton, N.J.)
16–18. Western Psychological Assoc., annual, Portland, Ore. (J. Matarazzo, Univ. of Oregon Medical School, Portland)
17–18. Arkansas Acad. of Science, Conway. (R. R. Corey, Dept. of Botany and Bacteriology, Univ. of Arkansas, Fayetteville)
17–18. Iowa Acad. of Science, Decorah. (D. C. Foley, Iowa State Univ., Ames)
17–18. Resonance Physics, New York State section, American Physical Soc., Corning, N.Y. (J. T. Kerr, Corning Glass Works, Corning)
17–19. Association of Southeastern Biologists, 25th annual, Atlanta, Ga. (W. D. Burnanck, Dept. of Biology, Emory Univ., Atlanta)
18–23. American Ceramic Soc., 66th annual, Chicago, Ill. (ACeS, 4055 N. High St., Columbus 14, Ohio)
19–22. Association for Educational Data Systems, natl. conv., Santa Barbara, Calif. (J. Caffrey, System Development Corp., Santa Monica)
19–22. American Oil Chemists' Soc., 55th spring meeting, New Orleans, La. (AOCS, 35 E. Wacker Dr., Chicago 1, Ill.)
20–22. Radioisotope Conf., 2nd annual, Gatlinburg, Tenn. (R. T. Overman, Special Training Div., Oak Ridge Inst. of Nuclear Studies, P.O. Box 117, Oak Ridge, Tenn.)
20–24. Medical Radioisotope Scanning, symp., Athens, Greece. (E. H. Belcher, Div. of Isotopes, IAEA, Kärntnerring 11, Vienna 1, Austria)

20-24. Fluid Dynamic Aspects of Space Flight, Marseilles, France. (Fluid Dynamics Panel, NATO, 64, rue de Varenne, Paris 7, France)


20-25. American Acad. of Neurology, 16th annual, Denver, Colo. (AAN, 4307 E. 50 St., Minneapolis 17, Minn.)


21-23. Engineering with Nuclear Explosives, 3rd "Plowshare" symp., Davis, Calif. (Plowshare Symp. Committee, Lawrence Radiation Laboratory, Bldg. T-105, P.O. Box 808, Livermore, Calif.)


22-24. Institute of Electrical and Electronics Engineers, 16th annual southwestern conf., Dallas, Tex. (F. E. Brooks, Jr., Military Electronics Div., Ling Temco Vought, P.O. Box 6118, Dallas 75222)


23-25. Ohio Acad. of Science, Cleveland, Ohio. (J. H. Melvin, 505 King Ave., Columbus 1, Ohio)


24. Mississippi Acad. of Sciences, Columbus. (C. O. Sheely, Mississippi State Univ., State College)


24-25. Chemistry of Microbial Products, symp., Tokyo, Japan. (H. Umezawa, Inst. of Applied Microbiology, University of Tokyo, Hongo, Tokyo)


24-25. South Dakota Acad. of Science, Sioux Falls. (T. Van Bruggen, Dept. of Botany, Univ. of South Dakota, Vermillion)

26. Georgia Acad. of Science, Athens, (T. W. Kethley, Georgia Inst. of Technology, Engineering Experiment Station, Atlanta 13)


26-30. Cereal Chemists, 49th annual, Toronto, Ont., Canada. (N. G. Irvine, Grain Research Laboratory, 190 Grain Exchange Bldg., Winnipeg 2, Canada)

26-30. AAAS, Southwestern and Rocky Mountain Div., Lubbock, Tex. (M. G. Anderson, P.O. Box 97, University Park, New Mexico 88070)


27-29. American Assoc. for Thoracic Surgery, Montreal, Quebec, Canada. (AATS, 311 Carondelet West, 7730 Carondelet Ave., St. Louis, Mo. 63105)


28-30. Dallas-Southwest Industrial Trade Fair, Dallas, Tex. (C. L. Wells, P.O. Box 26010, Dallas 26)


30-1. Institute of Hospital Administrators, annual, Edinburgh, Scotland. (IHA, 75 Portobello Place, London, W.C.1, England)

30-1. Zonal Centrifugation Systems, Oak Ridge, Tenn. (F. C. Von der Lage, Office of Industrial Cooperation, Oak Ridge Natl. Laboratory, P.O. Box X, Oak Ridge, Tenn. 37831)

30-2. Agricultural History Soc., annual, Cleveland, Ohio (A. G. Bogue, History Dept., Univ. of Iowa, Iowa City)

30-2. American Phys. Assoc., 22nd annual, Los Angeles, Calif. (ACPA, Parker Hall, Univ. of Missouri, Columbia 65202)
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