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<th>Capacity meq/g</th>
<th>Hemoglobin cap. g/g at pH</th>
<th>Particle size microns</th>
<th>Availability</th>
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<td>DEAE-Sephadex A-25</td>
<td>Weakly basic anion exchanger</td>
<td>Cl⁻</td>
<td>3.5 ± 0.5</td>
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<td>0.7;6.5</td>
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<td>CM-Sephadex C-25</td>
<td>Weakly acidic cation exchanger</td>
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<td>4.5 ± 0.5</td>
<td>0.7;6.5</td>
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<td>Strongly acidic cation exchanger</td>
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<td>2.3 ± 0.3</td>
<td>0.7;6.5</td>
<td>0.7;6.5</td>
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The Problem of Second Breakdown in Transistors

The use of transistors is limited by second breakdown, where there is an abrupt reduction in the collector voltage at levels of current below the rated value. In certain cases this can cause destruction of the transistor. New research indicates there are both thermal and electrical causes and some opportunities to push second breakdown limits considerably higher.

Transistors have a characteristic which is not completely understood and which puts undesirable limits on their use.

In all transistors as the collector-to-emitter voltage (V_{ce}) is increased the transistor will reach a point where the collector current I_c increases rapidly. (See Fig. 1)

![Fig. 1](image)

This occurs at first breakdown and as current increases further, voltage will decrease to a sustaining value. This sustaining value is considered the maximum operating value of the transistor.

As current is further increased, the transistor enters a new mode of operation where voltage decreases rapidly. This is termed the second breakdown region. (See Fig. 1)

Obviously, this phenomenon puts an even lower limit on the device and one that if exceeded is potentially destructive.

Many theories have been proposed to explain this second breakdown but none have been found completely satisfactory.

Honeywell scientists in earlier work on first breakdown developed a technique that is useful in studying second breakdown. They experimentally studied the collector junction, or the interface between the P and N regions, to observe whether breakdown occurs in a uniform manner over the entire collector junction or in localized hot spots at random in the junction.

By introducing a variable transverse base current they literally obtained a "contour map" of the breakdown voltages over the entire collector junction surface. These "maps" show that breakdown voltage is not uniform.

An infrared sensor was used to confirm the non-uniform characteristic. It was observed that the infrared emission was not uniform and in fact at breakdown there was a point of intense local heating.

The results of the mapping technique supported by the infrared observations have led to the development of a model with which to analyze second breakdown.

The model treats a transistor as if it were two discrete devices operated in parallel: one device where second breakdown occurs and one where it has not occurred. It is then possible to compare the devices and come to some conclusions as to what the mechanism is that causes breakdown and triggers the negative resistance phenomena. In general, both electrical and thermal effects are important, with the dominant mechanism determined by the transistor design, mode of operation and imperfections present.

Honeywell scientists have concluded that second breakdown in transistors originates in majority carrier current (electron current in a PNP transistor) from the breakdown spot. These majority carriers are generated by the process of avalanche multiplication. During multiplication at the breakdown spot an equal number of electrons and holes are produced. In a PNP transistor the holes enter the collector and the electrons flow through the base region to recombine with holes lost by the emitter. This electron flow has a transverse component which causes a voltage drop which concentrates the emitter current in the vicinity of the breakdown spot. The higher emitter current to the breakdown spot results in a higher electron current through the base. Thus the cycle is regenerative and if the process continues, it will result in the hot spot mentioned earlier.

Continuing work should lead to a computer program to solve equations to predict where and when breakdown will occur and whether by electrical or thermal mechanisms.

The result, it is hoped, would be the ability to design transistors to minimize thermal effects and to eliminate or minimize the electrical effects.

If you are engaged in research on second breakdown you are invited to correspond with Mr. Harold Josephs, Honeywell Research Center, Hopkins, Minnesota. If you are interested in a career at Honeywell's Research Center and hold an advanced degree, write to Dr. John Dempsey, Director of Research at this same address.
similar to the one to be completed at Kitt Peak, funding had not been requested at the time of writing. Design of the European telescope, which continues to benefit from generous cooperation from AURA, is well advanced, to the point where a choice can be made of the supplier of the blank, and the money has been pledged for its construction. In describing the advantages of a fused silica block, spokesmen of the European organization spoke often of the lower coefficient of thermal expansion of quartz, and had not used an imprecise word like "rigidity."

V. K. McELHENY
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Oral Reports

The effectiveness of the "short" paper (10 to 15 minutes) at major scientific meetings might be considerably enhanced if speakers would abandon the classic format of the printed article and, instead, use the following order: (i) background information (if needed); (ii) conclusions of present report; (iii) methods; (iv) results; (v) discussion (if needed); (vi) conclusions repeated.

Conclusions cannot be evaluated properly without consideration of the methods used to collect the data. The reader of a printed paper has the chance to flip back and forth among the pages; the listener at a meeting must depend on his memory. If the listener were to be told first the use that was made of the data, he then could evaluate the methods in this light. I believe that papers delivered orally according to this format would be more interesting and informative and, further, would provoke more useful questions and discussion.

BERNARD K. FORSCHER
Mayo Clinic, Rochester, Minnesota

NIH Career Awards

Before I state my profound disapproval of the attitude expressed by I. D. J. Bross in his letter on NIH Career Awards (19 Mar., p. 1395), I want to establish my credentials. First, I am an active researcher. Although I am an administrator (chairman of a large department) and teacher (43 class hours this April), I manage to spend about half my time in my laboratory. I have published three papers in the last 12 months, and I have two in press. On all I am first or sole author, because I did most of the work described. Second, I am grateful for NIH-NSF support of research, not only because it has multiplied resources but because it has given a healthy independence to every scientist competent to command such support. No man or woman in my department need say "Yes, sir" to me in order to be able to work.

The job of a university administrator is to create an atmosphere in which good people can do good teaching and research, and the job of a university faculty member is to teach, to do research, and to carry some of the administrative burden according to his interests and abilities. Teaching at all levels, undergraduate, professional, and graduate, is a job worth doing and doing well.

There has grown up since the war a new generation of faculty members, nurtured on NIH-NSF support, which regards its own research productivity as its only valid contribution to society. To members of this group, research alone is a positive good, and administration and teaching, because they interfere with research, are evils. A man who holds such views may have his home most appropriately in a research institute; he does not belong on a university faculty. Since universities, imperfect though they may be, are still our chief means of accumulating, preserving, and transmitting knowledge, scientists and supporting agencies should seek to strengthen universities in all their functions. I believe NIH, NSF, and other granting agencies do understand this obligation, and I am sure that most faculty members cheerfully accept it as well. Any scheme of outside support which allows a faculty member flatly to refuse to accept his just share of teaching and administration is destructive of the best interests of both the university and its faculty, and a scientist who accepts such support without accepting his university obligations is a parasite.

HORACE W. DAVENPORT
Department of Physiology,
University of Michigan, Ann Arbor

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100-channel analysis — this provides a high resolution spectrum analysis of charged particles. Scale expansion provides resolution equivalent to 800 channels for storage of a selectable portion of the spectrum. In this capacity the Gammascope will effectively replace the single-channel spectrometer in nuclear medicine, radio-chemistry, and nuclear physics research.

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Multiscaling — the Gammascope provides 100 channels of multiscaling with 8 selectable dwell times from 0.1 to 1000 milliseconds. The single-channel window selects pulses of the desired energy range, which are then automatically stored in successive channels corresponding to a preset time interval. Multiscaling is particularly useful in half-life studies of short-lived isotopes and for investigation of Mössbauer effects.

Mössbauer Analysis — The Gammascope is equipped with an input for an analog signal. In addition, in the Mössbauer mode pulses from the detector can be fed to the single-channel analyzer. The output is used to sample the velocity signal by the analog to digital conversion circuitry, thus providing a count in the channel corresponding to the instantaneous amplitude of the velocity. This mode of operation eliminates the necessity for precise timing by the counting channels and the Mössbauer drive, thus greatly simplifying demonstration of Mössbauer effects.

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creased agricultural production. In searching for impediments to increased agricultural production, Schultz examines and rejects land and capital shortages, limitations resulting from farm size, and allocative efficiency and omits consideration of structures and infrastructures. He concludes that the major impediment is the low rate of return on investment which provides little or no incentive to acquire credit or increase savings.

Turning to United States aid programs in less-developed countries, Schultz states that such programs should be founded on the knowledge, availability, acceptance, and use of new agricultural inputs with relatively high payoff as inducements to improve agricultural production. He reiterates the role and importance of investment in labor.

Within modern agriculture, particularly in the United States, Schultz emphasizes the need for providing farm people with the knowledge and means for adjusting themselves and their resources to changing economic conditions emanating from within and outside the agricultural sector. But he finds that the political influence of the Southern Tradition, conflicting views among farm people, confused ideas of their leaders, and vested interests in production-price programs are walls that block progress—but walls which he forecasts will come tumbling down.

The book is provocative and stimulating. However, its reasoning rests heavily on an implicit faith in price-income incentives which alone are not likely to bring the sought-after large increases in agricultural production in less-developed countries. The agricultural problems and their possible solutions at home and abroad are much more complex.

JOHN F. TIMMONS
Department of Economics, Iowa State University, Ames

Monographs in Experimental Botany Series


The book under review, Introduction to Thermodynamics, is the first of a series of monographs in experimental botany. As Spanner states in his preface it is intended as a textbook on thermodynamics for those who are interested in any biological field, even though there is some bias in the book toward botanical problems. Most students in the biological sciences acquire whatever understanding they have of thermodynamics during their study of chemistry. That contact with the subject usually leaves the impression that thermodynamics is a subtle, magical discipline that is invoked to explain phenomena which cannot be described in a more immediate physical context.

It is to the alleviation of this unfortunate situation that the author has devoted this book.

I believe that he has in large measure accomplished the task that he set for himself. The book is sound scientifically and didactically and should provide a good basis for classroom teaching; it should also be useful to the mature research worker who wishes to study on his own.

In content the book is divided somewhat naturally into two main parts. The first part, comprising the first ten chapters, constitutes a rather abbreviated presentation of the basic principles of thermodynamics, a presentation much like that used in the standard undergraduate course in a physical science curriculum. Brevity is the principal characteristic that distinguishes this treatment from others in the textbook literature. The reader whose interest lies principally in the biological application of the subject and whose general background in thermodynamics is adequate might reasonably begin his study with chapter 11, a procedure made practical by the inclusion of a list of symbols and their denotations.

The second part of the book is concerned with the application of thermodynamic reasoning to biological problems. As one might expect, a major portion is devoted to the subjects of membrane equilibria, properties of electrolytes, and water relations. The strength of the author's treatment resides in his insistent use of the chemical potential in an explicit manner. The remainder of the book is concerned with photosynthesis, thermodynamic efficiency, and irreversible processes.

Edward W. Hart
General Electric Research Laboratory, Schenectady, New York

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dode, and with series resistance, was devised. with experimentally determined constants, this circuit can be used to predict current characteristics of the cell voltage as a function of grid spacing at high fluxes. the cells were maintained below 100°C by mounting them on a forced-circulation, water-cooled, pinned heat-transfer surface. beckman presented data on an operating system which produces 50 watts using 36 cm² of close-gridded cell area under various ambient conditions.

T. Noguchi (Government Industrial Research Institute, Nagoya, Japan) discussed the results of fundamental research on refractory systems with a solar furnace. He explained a method of measuring temperature by means of a brightness pyrometer. These measurements established the freezing point of metal oxides by a specular reflection method. The freezing points of zirconia, hafnia, alpha-alumina, and high-purity lanthanide oxides were determined. The data on the 11 lanthanide oxides extended the data which heretofore have been available. Noguchi further investigated the melting behaviors of the ZrO₂-CaO system, and observed an anomaly of the liquidus curve with a composition of 70 percent CaO. Noguchi suggested that the formation of a new cubic-like phase might be expected.

P. J. Sheehan and T. S. Laszlo (Avco Corporation) reported on the results of high-temperature emittance measurements and ablation tests in a solar furnace. Excellent correlations were obtained between the heat flux and the recession rate of the ablating sample. The recession rate was measured by means of a camera viewing the sample surface through a 12-foot light pipe.

H. Masson and J. P. Giradier (Faculty of science, University of Dakar, Senegal) reported on activation by a solar motor of a pump capable of supplying about 40 m³ of water per hour for 4 or 5 hours per day. the water, withdrawn from a well at a depth of 10 m, supplies the approximate daily requirement of a community of 500 persons. the area of the solar collector is 300 m². E. A. Farber discussed the results obtained with a solar hot-air engine (1/3 horsepower, closed-cycle), which is portable and is cooled by a water-cooled radiator. L. F. Yissar (Tucson, Arizona) reported on the performance of a liquid-piston solar prime mover. The mover uses a self-feeding inverted siphon loop with an

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Science, vol. 148
inert liquid piston whose oscillations transmit the power output to a driven device. Solar energy, collected by a flat collector, supplies useful mechanical output.

A. J. Drummond and co-workers (Eppley Laboratory) described the instruments used to measure the components of solar shortwave and terrestrial longwave radiation. Drummond stressed the advantages of coated-receiver (thermopile-type) pyranometers over those employing photoelectric detectors such as selenium and silicon photovoltaic cells. Because the selenium or silicon cells are selective with regard to the wavelength of the incident energy when exposed to sources of varying spectral emission, they require careful calibration to account for the shortwave reflectance of terrestrial surfaces and for radiation from the sun and sky. The pyranometers are particularly useful when accuracy of better than 10 to 15 percent in hourly values and of 5 to 7 percent in daily summations are desired. Drummond considered the major problems associated with the determination of the transfer of longwave (terrestrial) radiation within the earth atmosphere system; he reviewed the principal characteristics of ventilated and unventilated radiometers in common use in recent years. He also described a new instrument, with very short time response, which is used for precise evaluation of shortwave and longwave components and net flux radiation near the ground. The design of the instrument is based on thermopile principles. Drummond pointed out the errors in the measurement of the solar constant outside the earth's atmosphere, and outlined experiments designed to measure the effect of the absorption of the atmosphere on the solar constant over the range of wavelengths of interest.

L. P. Gaucher (Texaco) forecast the pattern of energy consumption up to the year 2200. After accounting for the different sources of energy capable of filling the gap between increasing demands from increases in population and in per capita consumption, he projected that beginning about two generations from now the United States should become more and more dependent upon electrical energy derived from central solar-powered stations. By the year 2200 the stations could account for approximately 30 percent of all of the energy consumed in this country. Gaucher estimated that a satellite solar collector about 35 km in

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diameter would be adequate to supply the energy of \( 48 \times 10^{15} \) Btu (12 \( 10^{15} \) kcal) per year presently required by this country.

The attendees at the meeting were informed of the efforts of Congress-
man Schmidhauser (D-Iowa) to intro-
duce a bill (H.R. 3434) designed to
provide support for research on and
development of means for utilizing solar
energy.

Peter E. Glaser
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Forthcoming Events

May
27-29. American Gastroenterological
Assoc., Montreal, Quebec, Canada. (D.
Cayer, 2240 Cloverdale Ave., Winston-
Salem, N.C.)
27-29. American Ophthalmological
Soc., Hot Springs, Va. (S. D. McPherson,
Jr., 1110 W. Main St., Durham, N.C.)
27-29. American Assoc. of Physical
Anthropologists, annual, Pen-
sylvania State Univ., University Park.
(F. E. Johnston, Dept. of Anthropology,
Univ. of Pennsylvania, Philadelphia 4)
27-30. Neuro-Ophthalmology and Neu-
genetics, intern. congr., Albi, France.
(M. Amalric, Congrès Intern. de Neuro-
Ophthalmologie et Neuro-Génétique, 79,
Albi, Tarn, France)
27-30. German Bunsen Soc. for Phys-
ical Chemistry, 64th general assembly;
Innsbruck, Austria. (Deutsche Bunsen-
Gesellschaft für Physikalische Chemie,
Varrentrappstr. 40-42, 6 Frankfurt am
Main, Germany)
27-11. World Meteorological Organiza-
tion, 17th executive committee session,
Geneva, Switzerland. (WMO, 41 avenue
Giuseppe Motta, Geneva)
28-1. Canadian Assoc. of Geographers,
anual, Vancouver, B.C. (Local Arrange-
ments Committee, Dept. of Geography,
University of British Columbia, Vancouver)
30-2. Recent Advances in Adrenal
Steroid Metabolism, symp., Montreal,
Quebec, Canada. (Chemical Inst. of Can-
ad., 48 Rideau St., Ottawa 2)
30-2. Canadian Dental Assoc., conv.,
Quebec. (L. Bernier, 1024, avenue des
Erables, Quebec)
30-2. American Thoracic Soc., Chicago,
III. (F. W. Wunderer, 1790 Broadway,
New York 10019)
30-2. National Tuberculosis Assoc.,
Chicago, Ill. (S. Wicker, 1790 Broadway,
New York 10019)
30-3. Medical Library Assoc., annual,
Philadelphia, Pa. (MLA, 919 N. Michi-
gan Ave., Chicago 11, Ill.)
31-2. Canadian Museums Assoc., an-
nual, Ottawa, Ontario. (Mrs. H. Downie,
Royal Ontario Museum, Univ. of Toronto,
100 Queen's Park, Toronto 5)
31-2. Chemical Inst. of Canada, 48th
conf., Montreal, Quebec. (Chemical Inst.
of Canada, 48 Rideau St., Ottawa 2)
31-2. Spectroscopy, 5th Australian
conf., Perth. (A. J. Parker, Dept. of
Chemistry, Univ. of Western Australia,
Nedlands)
conf., Baden-Baden, Germany. (J. Laar,
Karlst. 21, Frankfurt am Main, Ger-
many)
31-3. Canadian Public Health Assoc.,
annual, Edmonton, Alberta. (E. J. Young,
1255 Yonge St., Toronto 7, Ont.)
31-4. Exchange Reactions, symp.,
Brookhaven Natl. Laboratory, N.Y. (J.
H. Kane, Intern. Conferences Branch,
Div. of Special Projects, U.S. Atomic
Energy Commission, Washington, D.C.)
31-4. Institute of Hospital Administra-
(Secretary, 75 Portland Pl., London, W.1)
31-4. Society of Physical Chemistry,
15th annual, Paris. (G. Em-
schwiller, Société de Chimie Physique, 10,
rue Vauquelin, Paris 5)
31-4. Group for Advancement of
Spectrographic Methods, 27th congr.,
Paris, France. (1, rue Gaston Boissier,
Paris 15)

June
1-3. Tissue Culture Assoc., Miami
Beach, Fla. (M. M. Sigel, Univ. of Miami,
Department of Microbiology, Coral
Gables, Fla.)
1-4. Nordic Medical Rehabilitation
Congr., Oslo, Norway (Chief Physician B.
Rogan, Socialmedisinsk Avdeling, Aker
Sykehus, Oslo, Norway)
1-4. Water Studies, 18th intern. conf.,
Liege, Belgium. (Belgian Center for the
Study and Documentation of Waters, 2,
rue A. Stievart, Liege)
1-8. Fruit Virus Diseases, 6th European
symp., Belgrade, Yugoslavia. (Prof. Sutic,
Institut za Zastitu Bilja, T. Drajzcra 7,
Belgrade)
2-3. Diagnosis and Semiology of Ce-
rebral Vasculor Diseases, European symp.,
Modena, Italy. (Segreteria della Clinica
Oculistica, Policlinico Universitario, Mo-
dena)
2-3. Endemical Struma, symp., Prague,
Czechoslovakia. (K. Silnik, Národní 8,
Prague 1)
2-3. Quality Control of Engineering
(Production Eng., 10 Chest-
erfield St., Mayfield, London, England)
2-4. International Federation of Con-
sulting Engineers, annual, Copenhagen,
Denmark. (Consulting Engineers Council,
1155 15th St., NW, Washington, D.C.
20005)
2-4. Canadian Phytopathological Soc.,
anual, University of Guelph, Guelph,
Ont. (R. Stace-Smith, C.D.C. Research
Station, 6660 NW Marine Dr., Van-
couver 8, B.C.)
2-4. Nordic Congr. of Surgeons, Oslo,
Norway. (F. Hauge, Sophies Mindle,
Trondheimveien 132, Oslo)
2-5. Acoustical Soc. of America, 69th
meeting, Washington, D.C. (ASA, 335
E. 45th St., New York 10017)
3-4. Endemic Goiter and allied condi-
tions, symp., Prague, Czechoslovakia.
(J. Blahů, Výzkumný Ústav Endocrinol-
ogický, Národní tr. 8, Prague 1)
3-5. Canadian Soc. of Plant Physi-
ologists, 6th annual, Univ. of New Bruns-

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- **SUBSTANCES SEPARATED**: Proteins, including C-reactive proteins, glycoproteins, mucoproteins, nucleic acids, nucleo-proteins and thyroxin-binding proteins; hemoglobin and haptoglobins; globulins, histones, human and bovine growth hormones, ovine follicle stimulating hormone, human chorionic gonadotropin, enterotoxins, Hageman factor, α-crystallin, collagen, diglyceride and prolactin; amylase, aminopeptidase, phosphatases; β-galactosidase, carbonic anhydrase, carboxypeptidase, dehydrodipalmitoyldehydrogenase, glycyogen phosphorylase, lipase, lactase and malt dehydrogenase, Phosphorylase, ribonuclease, sialidase, transaminase and transpeptidase.

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8-9. System Safety, symp., Seattle, Wash. (H. E. Wessman, College of Engineering, Univ. of Washington, Seattle)


8-12. German Soc. for Medicinal Plant Research, 13th conf., Hamburg, Germany. (H. Friedrich, Deutsche Gesellschaft für Arzneipflanzenforschung, Bei den Kirchhöfen 14, 2 Hamburg 36)

8-12. American Assoc. on Mental Deficiency, 89th annual, Miami Beach, Fla. (I. Goldberg, Dept. of Special Education, Teachers College, Columbia Univ., New York, N.Y.)


9-11. Canadian Federation of Biological Societies, annual, Ottawa, Ont. (A. H. Neufeld, Faculty of Medicine, Univ. of Western Ontario, London)


9-11. Canadian Inst. of Food Technology, annual conf., Winnipeg, Manitoba. (J. M. Sisler, 300 Norquay Bldg., Winnipeg)

9-11. Genetics in Ophthalmology, congr., Brno, Czechoslovakia. (Secretariat, c/o Eye Clinic, Pekarska 53, Brno)

9-11. Heat Flow below 100°K, and Its Technological Applications, symp., Grenoble, France (Centre de Recherches sur les Tres Basses Temperatures, Boite Postale 319, Grenoble)

9-11. German Metallurgical Soc., general assembly, Salzburg, Austria. (Deutsche Gesellschaft für Metallkunde, An der Alteburger Mühle 12, Köln-Marienburg, Germany)

9-11. Association of Physiologists, 33rd, Louvain, Belgium. (A. Fessard, Assoc. des Physiologistes, 45 rue des Saints-Peres, Paris 63)


9-12. Canadian Assoc. of Physicists, annual congr., Vancouver, B.C. (R. E. Bell, Dept. of Physics, McGill Univ., Montreal, Quebec)


11-12. Nutrition Soc. of Canada, 8th annual, Ottawa, Ont. (K. K. Carroll, Col- lip Medical Research Laboratory, Univ. of Western Ontario, London, Ont.)

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12-20. National Speleological Soc., annual conv., Bloomington, Ind. (D. R. Martin, 2711 Oak St., Terre Haute, Ind. 47803)
13-15. Medicine and Religion, 1st natl. symp., Estes Park, Colo. (Office of Postgraduate Medical Education, Univ. of Colorado Medical Center, 4200 Ninth Ave., Denver 80220)
14-16. Cooper Ornithological Soc., Univ. of British Columbia, Vancouver, Canada. (J. Davis, Hastings Reservation, Carmel Valley, Calif.)
14-16. American Neurological Assoc., 19th annual, Atlantic City, N.J. (M. D. Yahr, 710 W. 168 St., New York 10032)
14-17. American Proctologic Soc., annual, Minneapolis, Minn. (N. D. Nigro, 320 West Lafayette, Detroit, Mich. 48226)
14-17. Spectroscopy, annual Mid-America symp., Chicago, Ill. (L. R. Pearson, American Can Co., Research Center, Barrington, Ill.)
14-18. Canadian Medical Assoc., annual, Halifax, N.S. (A. D. Kelly, 150 St. George St., Toronto 5, Ont.)
14-18. Molecular Structure and Spectroscopy, annual symp., Columbus, Ohio. (K. N. Rao, Dept. of Physics and Astronomy, 174 W. 18 Ave., Columbus 43210)
14-18. Vacuum Metallurgy, intern. conf., Brussels, Belgium. (R. Winand, Service du Prof. Decroly, Metallurgie-E lectrochimie, Universite Libre de Bruxel-
Dissymmetries

Among the synthetic polymers, polyamides (nylons) have not been until recently, investigated by means of the light scattering technique. The first paper on the subject appears to be the one by Fendler and Stuart (1), who observed anomalies due to polyelectrolyte character of perlon when dissolved in formic acid. This point as well as other macromolecular properties of nylon have been elaborated upon recently by several workers, all of whom employed Brice-Phoenix light scattering spectrophotometers and differential refractometers in their studies.

POLYELECTROLYTE EFFECTS IN NYLON SOLUTIONS

The first evidence of polyelectrolyte character of polyamides in formic acid came in 1923 from viscosity measurements. The change on the polyamides results from the protonation of the polymer amide groups. The presence of these charges and the interactions they cause lead to the interference phenomena in the light scattering experiments. This makes determination of molecular weights and molecular parameters unreliable.

In a series of papers (2, 3, 4, 5), Saunders (Chemstrand Research Center, Inc., Durham, N. C.) explored in detail the influence of the solvent composition and ionic strength on polyelectrolyte behavior of nylon 66 (polyamide). In study (4) the solvent used was formic acid-water-sodium formate. The change in intrinsic viscosity and second virial coefficient in 98% formic acid were small concentrations of sodium formate higher than 0.2 M. Light scattering data led to an estimate of the molecular weight that was independent of the sodium formate concentration. When the concentration of 0.5 M, the polyelectrolyte effects were completely repressed and the polymer-solvent interaction could be varied by changing the amount of water in mixture with formic acid. Concentration of formic acid varied from 98% to 75%. The molecular weight, as derived from light scattering measurements, was independent of the amount of water, but the second virial coefficient decreased with the increase in water content. Nylon 66 was soluble when the water content exceeded 30%.

REFRACTIVE INDEX INCREMENT

The refractive index increment was also much dependent on the change in the degree of ionization of the polymer and ionic strength of the solution. This finding was confirmed in another study by Saunders (3), in which the effects of potassium chloride random coil statistics in solution. The molecular parameters of nylon 66 were studied in detail also by Elias and Schumacher (6) at Eidgenössisches Technische Hochschule in Zurich, Switzerland, who used several other solvents (sulfuric acid, m-cresol, dichloroacetic acid) in addition to those utilized by Saunders.

Chiang of the Hercules Powder Co., Wilmington, Del., (7) emphasized that only very high values of the second virial coefficient observed for nyons in different solvents introduce an uncertainty larger than usual in the estimate of the molecular weight by extrapolation of the light scattering data to zero polymer concentration. For practical purposes, therefore, it is desirable to suppress the polyelectrolyte effects in the way indicated by Saunders.

Another suitable solvent for nyons is 2,2,3,3-tetrafluoropropanol. Beachell and Carlson of the University of Delaware, Newark, Del., (8) reported that polyamides when dissolved in this solvent exhibited strong polyelectrolyte effects which could be suppressed by addition of 0.1 mole/liter of sodium trifluoroacetate. This was a rather surprising result since the solvent has little tendency to protonate nylon. Very recently (9) Saunders observed that in completely dry tetrafluoropropanol no polyelectrolyte behavior of nylon 66 was noticeable and, therefore, this solvent is a nonionic one for nyons. Treatment of water, however, brought about strong typical polyelectrolyte effects which could be repressed by addition sodium trifluoroacetate. Molecular weights obtained under these conditions were identical to those measured in the solvent system formic acid-water-sodium formate.

REFERENCES


Inquiries concerning the Brice-Phoenix Light-Scattering Photometers should be sent to the PHOENIX PRECISION INSTRUMENT COMPANY, 3803 North 5th Street, Philadelphia, Pa. 19140.


14–19. **Multivariate Analysis**, intern. symp., Univ. of Dayton, Ohio. (P. R. Krishnaiah, Aerospace Research Laboratories, Wright-Patterson Air Force Base, Ohio)


15–18. **Biophysics and Physiology of Biological Transport**, symp., Rome, Italy. (L. Bolis, Via Alcamo 19, Milan, Italy)

15–19. American Soc. of **Pharmacology**, 6th annual, Kingston, R.I. (L. R. Worthen, College of Pharmacy, Univ. of Rhode Island, Kingston)


16–19. International College of **Surgeons**, European Federation, congr., Helsinki, Finland. (P. Vara, Haartmaninkatu 2 A, Helsinki)


16–24. International Council of **Nurses**, 13th congr., Frankfurt am Main, Germany. (German Nurses Federation, Cronstenstr., 25, Frankfurt am Main)


17–19. **Pediatrics**, 13th congr., Prague, Czechoslovakia. (J. Houetek, Sokolova 2, Prague 2)

17–19. American Assoc. of **Physics Teachers**, summer meeting, Knoxville, Tenn. (M. Phillips, Physics Dept., Univ. of Chicago, Chicago, Ill.)


20–23. American Soc. of **Agricultural Engineers**, 58th annual, Univ. of Georgia, Athens. (J. L. Butt, P.O. Box 229, St. Joseph, Mich.)


21–24. American Nuclear Soc., 11th natl., Galtinburg, Tenn. (ANS, 244 East Ogden Ave., Hinsdale, Ill.)

20–24. **Air Pollution Control Assoc.,** 58th annual, Toronto, Ont., Canada. (M. Katz, Dept. of Natl. Health and Welfare, 45 Spencer St., Ottawa, Ont.)


20–25. American **Physical Therapy Assoc.,** Cleveland, Ohio. (L. Blair, 1790 Broadway, New York 10019)


21–23. Society for the Study of **Development and Growth**, annual, Carleton Col-
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le, Northfield, Minn. (J. A. Schiff, Dept. of Biology, Brandeis Univ., Waltham, Mass.)
21–24. Canadian Soc. of Animal Production, annual, Vancouver, B.C. (J. A. Newman, CSAP, Experimental Farm, Lacombe, Alta.)
21–24. Automatic Control in Peaceful Uses of Space, intern. symp., Stavanger, Norway. (J. A. Aseltine, Aerospace Corp., P.O. Box 95085, Los Angeles, Calif.)
21–24. Fuel Cells, intern. symp., Brussels, Belgium. (Mr. VanOothenenhouse, S.E.R.A.I., 1091, chaussée d’Alsemberg, Brussels 18.)
21–25. Canadian Anaesthetists’ Soc., annual, Charlottetown, Prince Edward Island. (S. M. Campbell, 178 St. George St., Toronto 5, Ont.)
21–25. Carbon, 7th biennial conf., Case Inst. of Technology, Cleveland, Ohio. (W. W. Lozier, Union Carbide Corp., Carbon Products Div., P.O. Box 6116, Cleveland, Ohio 44101)
21–26. AAAS Pacific Div., Riverside, Calif. (R. C. Miller, California Acad. of Sciences, Golden Gate Park, San Francisco 18)

The following societies plan to meet in conjunction with the AAAS Pacific Div.:
American Meteorological Soc. (J. E. Miller, New York Univ., New York)
American Nature Study Soc. (B. O. Bergh, Univ. of California, Riverside)
American Phytopathological Soc., Pacific Div. (C. E. Horner, Oregon State Univ., Corvallis)
American Soc. for Horticultural Science, western regional (C. K. Labanauskas, Univ. of California, Riverside)
American Soc. of Ichthyologists and Herpetologists, western div. (R. Rosenblatt, Scripps Institution of Oceanography, La Jolla, Calif.)
American Soc. of Limnology and Oceanography, Pacific Div. (J. G. Patullo, Oregon State Univ., Corvallis)
American Soc. of Plant Physiologists, western section (M. Mazelis, Univ. of California, Davis)
American Statistical Assoc. (E. King, Pacific Telephone Co., Los Angeles, Calif.)
Biometric Soc. western North America Div. (F. S. McFeely, Montana State College, Bozeman)
Botanical Soc. of America, Pacific section (J. R. Stein, Univ. of California, Berkeley)
Ecological Soc. of America, western section (H. G. Baker, Univ. of California, Berkeley)

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