



RARE-EARTH INFORMATION CENTER NEWS

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Left to right: I. S. Mackenzie, A. A. Kassu, M. A. Chaudhry, M. A. H. McCausland, O. Prakash, J. W. Ross, A. Tari (visiting), K. F. Al-Assadi, P. R. Waind, C.-Y. Chen, D. St. P. Bunbury, S. J. Gillott, J. Gillott, G. T. West.

Rare Earth Research at Manchester University Hyperfine Interactions Examined—

The Manchester group specializes in hyperfine interactions in magnetically ordered rare earth metals, alloys and compounds. Its principal experimental techniques are the Mössbauer effect and nuclear magnetic resonance. Argon arc and cold crucible induction melting furnaces together with annealing facilities allow the group to manufacture its own polycrystalline samples, but measurements of hyperfine parameters are also carried out on single crystal material. The measured parameters are interpreted, as far as possible, in terms of basic microscopic theory; theoretical analysis and computation form a major part of the total research effort.

The Mössbauer work includes studies of the temperature and composition dependence of the direction of spontaneous magnetization in binary and ternary compounds of rare earths with 3d metals. Currently, the effect of traces of other rare earth metals on the easy direction of magnetization in $GdFe_2$ is being investigated in detail. Mössbauer spectra of ^{155}Gd and ^{57}Fe are also being studied in $GdFe_2$ in fields up to 6 T, in order to obtain estimates of the contribution of polarized conduction electrons to the hyperfine

fields at both sites. Isomer shifts, hyperfine fields and electric field gradients are being measured for ^{151}Eu and ^{170}Yb in a number of intermediate-valency systems. This work is done over a range of temperatures and applied fields.

The NMR work is done at liquid helium temperatures, using a high-speed spin-echo spectrometer operating at microwave frequencies (4 to 8 GHz). Practically all measurements are on ^{165}Ho , which for several reasons is a convenient probe for use at high

dilution in a wide variety of magnetically ordered systems. Extensive work has been done on hexagonal intra rare earth alloys and in cubic Laves phase compounds RM_2 ($M = Fe, Co, Ni, Al$, etc.). Recent measurements show that the hyperfine parameters of Ho in RAI_2 compounds are strongly anisotropic; they can be predicted with astonishing accuracy by a simple model involving the interplay of crystal field and isotropic exchange interactions. Well-resolved NMR spectra of holmium have recently been obtained in the iron garnets of yttrium, gadolinium and holmium. Here the theoretical interpretation is complicated by the nine-parameter orthorhombic crystal field and by anisotropic exchange, but preliminary calculations are encouraging. As far as the group is aware, this is the only attempt, so far, to relate hyperfine parameters in garnets directly to the microscopic state of the parent ion. One other aspect of the

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BUSINESS NEWS

Rhone-Poulenc Update

As the nationalization of Rhone-Poulenc comes closer to reality, company officials feel that the outward appearance of Rhone-Poulenc will change little. This is based on the belief that the management will remain essentially intact and that the company's major goals will be supported. The emphasis will continue to swing toward specialty chemicals and away from commodities.

Ronson Concentrates Efforts

Ronson has also shifted its emphasis away from its consumer product business in favor of its industrial businesses. One of the results of this emphasis shift has been the sale of England-based Ronson Products, Ltd. to Cavwain, Ltd. Another result of the emphasis shift is apparent at Ronson Metals Corporation's New Jersey Plant. To meet the growing demand, Ronson's mischmetal production capacity has been increased by 20 percent this year and the total plant area has been increased by 30 percent. Future plans include even more manufacturing capacity.

New Owners, New Name

Mitsubishi Chemical Industries, Ltd. has purchased the United States Radium Corporation. U.S. Radium's new name is U.S.R. Optonix.

Rare Earth Society

The first meeting of the Chinese Society of Rare Earth Sciences and Technology was held on December 3-8, 1980 at Beijing University, Beijing, People's Republic of China. 338 representatives of 25 provinces attended the meetings at which 298 papers were presented. The following officials were elected from the 21 member Standing Committee: President: Prof. C. D. Chou, Vice President and Secretary General: Mr. D. Y. Li, Vice Presidents: Mr. H. Lin, Dr. K. H. Hsu, Dr. C. J. Guo, Mr. Y. Z. Liu, Vice Secretaries-General: Dr. J. Z. Ni and Mr. K. F. Tang. Various interests represented by these individuals include industry, metallurgy, chemical engineering, chemistry, geology, applied chemistry and non-ferrous metals. The Society's address is #2 Xin Jin Kou Wai Street, Beijing, People's Republic of China.

Second Quarter

Fiscal Year 1982 is nearly half over and over half of RIC's benefactors have responded if you count the fourteen companies listed below who contributed during the second quarter. Of the fourteen, twelve renewed their support while the other two have joined the RIC family for the first time. The total number of companies so far is twenty-eight. The number in parentheses is the number of years that company has supported the Center.

Cerac, Inc., U.S.A. (6)
 Colt Industries-Crucible Inc., U.S.A. (8)
 Companhia Industrial Fluminense, Brazil (9)
 Denison Mines Limited, Canada (10)
 Eastman Kodak Co., U.S.A. (5)
 Ferro Corp., Transelco Div., U.S.A. (6)
 Indian Rare Earths, Ltd., India (13)
 Inland Motor Div., Kollmorgen Corp., U.S.A. (6)
 Nuclemon-Nuclebras de Monazita e Associados, Ltda., Brazil (8)
 Rhone-Poulenc, Inc., U.S.A. (2)
 Rhone-Poulenc Spécialités Chimiques, France (12)
 Stellite Division, Cabot Corp., U.S.A. (1)
 Trans-Tech, Inc., U.S.A. (1)
 U.S.R. Optonix, Inc. (formerly U.S. Radium Corp.), U.S.A. (12)

26th MMM Proceedings

The proceedings of the 26th Annual Conference on Magnetism and Magnetic Materials, held November 11-14, 1980 in Dallas, Texas, have been published in the *Journal of Applied Physics* 52, No. 3, Pt. II, 1617-2585 (1981). Almost 100 of the 320 papers presented deal with rare earth materials on such subjects as transition metal alloys, spin glasses, disordered systems, magnetic properties of amorphous alloys, new amorphous materials and properties, microstructure and relaxation in amorphous alloys, critical phenomena, modulated phases, intermetallics, mixed valence materials, magnetic semiconductors, superconductivity and magnetism, transport properties, resonance and propagation, magneto-optics, magnetic insulators, bubble materials and physics, nonconventional bubble devices, hard magnetic materials and low-cobalt hard magnetic materials.

R. M. Bozorth Dies

RIC has received word of the death of Dr. R. M. Bozorth on January 24, 1981 at the age of 84. Bozorth obtained his Ph.D. from the California Institute of Technology in 1922. In 1923 he joined Western Electric which later became Bell Telephone Laboratories where he worked until his mandatory retirement in 1961. During that time he was considered a primary source of information on magnetism and instigated much systematic magnetism research. In 1951 he published a comprehensive compilation of the research done on ferromagnetic materials entitled *Ferromagnetism* which even today is still considered a classic. Another clue to Bozorth's foresight is the continuing success of the annual Conference on Magnetism and Magnetic Materials. Bozorth organized the original meeting in 1955. Retirement did not diminish his vigor and commitment to his profession as he continued his research through various consulting positions both in the U.S. and abroad.

Re's IN THE NEWS

ODS Superalloys

Inco, Ltd. has announced the availability in commercial quantities of three of its oxide dispersion strengthened (ODS) superalloys, Inconel alloys MA 754, MA 956 and MA 6000. Inco uses a mechanical alloying process to uniformly incorporate yttrium oxide into the superalloys thus circumventing restrictions and trade-offs imposed by mechanical mixing and chemical processes. Possible applications could include combustion chambers or turbine blades in jet engines.

Nova Preparation

The five year old Argus laser at the Lawrence Livermore National Laboratory is being dismantled to make room for the much larger Nova laser. Only two of Nova's laser beams can produce 10 times the energy of Argus and the total Nova system is rated at 200,000 to 300,000 joules or over 100 times as powerful as Argus. The Nova laser is scheduled for full operation in 1985. Nova's laser rods are made of neodymium-doped glass and its major use will be in continuing the research on laser fusion energy production.

IR & D Award

W. E. Spicer has been named as the 1981 *Industrial Research & Development* Scientist of the Year in recognition of his leadership in pure/applied science. Spicer is chiefly



known for his contributions to the development of photo-electron spectroscopy for studying the electronic structures of solids including many rare earth materials. He also developed an x-ray image intensifier that is in widespread use today in the medical world.

Spicer received his Ph.D. from the University of Missouri in 1955 and went to work for RCA where he developed his theory on photo emission. In 1962 he joined Stanford and has since combined photo emission and synchrotron radiation techniques to atomically study the top layers of solids. Spicer is currently a consulting director of the Stanford Synchrotron Radiation Laboratory.

Manchester Univ.

(continued from page 1)

NMR work concerns the dynamics of the coupled electronic and nuclear spin systems in magnetically ordered media. This entails extensive measurements of spin-lattice and spin-spin relaxation rates as functions of applied field, temperature and composition. NMR measurements will shortly be extended to temperatures well above 4.2 K in order to test theoretical models under conditions of significant magnetic disorder.

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K. A. Gschneidner, Jr. . . . Editor
Bernie Evans . . . Staff Writer

Industrial Applications

A book entitled *Industrial Applications of Rare Earth Elements* has been edited by K. A. Gschneidner, Jr. and published in 1981 by the American Chemical Society as ACS Symposium Series No. 164. Length of the volume is 297 pages and cost is \$35.00. The book contains 16 chapters and is based on a symposium held August 25-26, 1980 in Las Vegas, Nevada which was sponsored by the Division of Industrial and Engineering Chemistry of the American Chemical Society. Topics covered in the book include an overview of the discovery, commercial separation, history of rare earth applications and the rare earth market today; and current applications of rare earth metals, alloys and compounds in nodular iron, steel, glass, catalysts, phosphors, bubble domain memory materials, hydrogen storage, oxygen sensors and PLZT electrooptic ceramics and devices. This book will serve as an excellent starting point and reference material for anyone interested in the current and future trends of rare earth applications.

1981 IR 100

Four of the top 100 significant new technological developments of 1981 as determined by *Industrial Research & Development* either contain or are applicable to rare earth materials [23, No. 10, 103-68 (1981)]. These new developments are described in the following paragraphs.

In the electrical and electronic devices category, C. T. Luddy of the General Electric Company has come up with a brushless DC motor that weighs only 31 pounds but generates 141 horsepower at 20,000 rpm. Samarium cobalt permanent magnets are partly to blame for the increased efficiency ratings of the motor. Possible applications would include starter-generators for aircraft and variable speed drives for electric vehicle technologies.

An automated bubble memory film characterization apparatus has been developed by R. Henry of Quadra-Bubble Memory Technology. Using a laser and a computer, the device is able to determine the magnetic parameters of a bubble memory film in less than a minute. That is one-fiftieth of the time needed by conventional microscope

Valence Fluctuation

The proceedings of the International Conference on Valence Fluctuations in Solids held in Santa Barbara, California on January 27-30, 1981 have been published as a book entitled *Valence Fluctuations in Solids*, L. M. Falicov, W. Hanke and M. B. Maple, eds., North-Holland Publishing Company, Amsterdam and New York (1981). This volume is 466 pages long and costs \$75.50 (Dfl. 155.00).

The Conference followed much the same lines as the conference held in 1976 with the general consensus being that the theorists have been able to make some forward progress in understanding the fluctuating valence problem while the experimentalists still seem to be on somewhat of a rampage. The list of rare earth materials that are considered to exhibit valence fluctuation has grown dramatically which would tend to indicate that substantial progress has been made in both understanding the phenomenon and perfecting the techniques to measure it. Eighty-eight papers were presented in the oral and poster sessions. Discussions that followed oral presentations are included in the published proceedings.

techniques. The apparatus could be used for quality control in production of rare earth iron garnet films for magnetic bubble applications.

K. A. Wichersheim and R. V. Alves of the Luxtron Corporation have combined the phosphor and fiber optic technologies to get a temperature measurement system capable of operating in electrically, thermally and chemically harsh environments [see also—*RIC News XVI*, No. 1, 4 (1981)]. With rare earth oxysulfide phosphors the device can rapidly measure the temperature from -50 C up to 250 C within 0.1 C. A microprocessor converts spectral line intensity ratios into temperature data.

In the metals and alloys division General Electric strikes again with a chromium-aluminum-yttrium alloy developed by J. R. Rairden, R. W. Smith and M. G. Benz. The alloy is used as a corrosion resistant overlay coating that extends the lifetime of jet engine turbine blades by a factor of three while only costing in the range of 5 to 10 percent more than competitive coatings.

Meeting of Interest
Braunlage, Harz, West Germany. The topics of the School are divided into four general sections: 1. systematics, 2. structural chemistry of the lanthanide complexes, 3. electronic, spectroscopic and magnetic properties of the lanthanides, and 4. lanthanides as geochemical indicators. A tentative list of the plenary lecturers is as follows: systematics: Prof. L. Brewer, Prof. S. P. Sinha; structure: Prof. G. J. Palenik, Prof. L. Niinisto; spectroscopy: atomic: Prof. H. Odabasi; absorption & fluorescence: Prof. W. T. Carnall, Prof. S. P. Sinha; electronic properties & cohesion: Prof. H. L. Skriver, magnetic properties: Prof. J. Yakinthos, Prof. J. Rossat-Mignod; shift reagents: Prof. A. V. Xavier, geochemical characteristics: Prof. J. C. Duchesne, Dr. Möller.

There is no registration fee for the School. A fee of U.S. \$690 is charged to cover the costs of accommodation and all meals in Hotel Maritim, and copies of the long Abstract and the printed proceedings of all plenary lectures and panel discussions. The proceedings will be published in the NATO Advanced Study Institute Series by D. Reidel Publishing Company and additional copies will be available at a cost of U.S. \$25.00. A limited number of grants for partial coverage of travel and/or living expenses is available to the participants from the NATO countries. Participation is limited to 90

Spectra Symposium

An International Symposium on Rare Earth Spectroscopy has been scheduled for August 30-September 3, 1982 at the University of Wrocław, Wrocław, Poland. Topics of the Symposium include spectroscopic methods in structural study of lanthanide compounds, intensities of $f-f$ transitions, $f-d$ transitions, hypersensitivity, environment effects, luminescence of lanthanide ions, non-radiative processes in luminescent materials, energy transfer (cross relaxation, up conversion, photon-assisted energy transfer, concentration quenching), and rare earth lasers.

Contributed papers will be presented either orally or in poster sessions and the deadline for submission of abstracts is Spring 1982. English is the official Symposium language.

Invited speakers include F. Auzel, G. Blasse, W. T. Carnall, G. R. Choppin, J. G. Conway, C. K. Jørgensen, B. R. Judd, A. K. Kaminskii, J. A. Koningstein, S. F. Mason, R. D. Peacock, Yu. E. Perlin, R. Reisfeld, S. P. Sinha and M. J. Weber.

For more information or if you wish to attend, contact Dr. J. Legendziewicz, Institute of Chemistry, Joliot Curie 14, University of Wrocław, 50-383 Wrocław, Poland by December 15, 1981.

Durham Conference
vayukil, G. H. Lander, J.-C. Spirlet, O. Vogt and M. Zuchermann. Deadlines for the conference are December 21, 1981 for the receipt of abstracts and March 1, 1982 for registration. Registrations should be sent to Dr. B. K. Tanner, REAC-82 Secretariat, Physics Department, University of Durham, South Road, Durham, DH1 3LE, United Kingdom.

3rd I-MMM

The 3rd joint InterMag-Magnetism and Magnetic Materials Conference is set for July 20-23, 1982 at the Hotel Sheraton Mt. Royal in Montreal, Quebec, Canada. The conference will address all areas of both experimental and theoretical basic science, applied science and engineering pertaining to magnetism. The program will consist of invited and contributed papers. The deadline for abstracts is March 26, 1982. The published proceedings will be divided between the *IEEE Transactions on Magnetics* and the *Journal of Applied Physics*. Registration fee is U.S. \$125.00 with reduced rates for students and retired individuals. For more information if you are not already on the InterMag or MMM mailing list write to P. E. Wigen, Physics Department, Ohio State University, Columbus, Ohio 43210.

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