# RARE-EARTH INFORMATION CENTER NEWS

ENERGY AND MINERAL RESOURCES RESEARCH INSTITUTE
IOWA STATE UNIVERSITY / AMES, IOWA

Volume XX | December 1, 1985 | No. 4


## EDITOR'S REPORT CHINA——1985

**Rare Earth Research in China**

According to Mr. Kefeng Tang, secretary of the Chinese Society of Rare Earth, ~3,000 scientists and engineers at ~300 research institutes and ~40 universities are working on rare earths in China. Of these scientists and engineers, ~200 are doing basic research. Most of the rare earth groups working at the research institutes and universities involve only a few people, especially in view of the fact that ~260 of them work at Baotou Research Institute of Rare Earth and another ~100 at the Changchun Institute of Applied Chemistry (Academia Sinica). Other major research institutes are: Beijing Research Institute of Nonferrous Metals and Rare Earth Applications, Central Research Institute of Iron and Steel (Beijing), Ganzhou Resarch Institute of Nonferrous Metals (Jiangxi), General Research Institute of Nonferrous Metals (Beijing), Guangzhou Research Institute of Nonferrous Metals, Hunan Research Institute of Rare-Earth Materials (Changsha), Research Institute of Geology (Academia Sinica), and Shanghai Research Institute of Organic Chemistry (Academia Sinica).

The main reason why there is such a great emphasis on rare earths in China is because, according to their estimates, 80 percent of the world's reserves lie in China with 50 percent in one location, the Baiyunebo mine near Baotou. Thus there is a great deal of effort being put into research and development of new applications of rare earth materials. Research institutes are expected to manufacture and sell rare earth containing products to supplement the income re-

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## Industrial Application Of Physics Prize

John Croat

Robert Lee

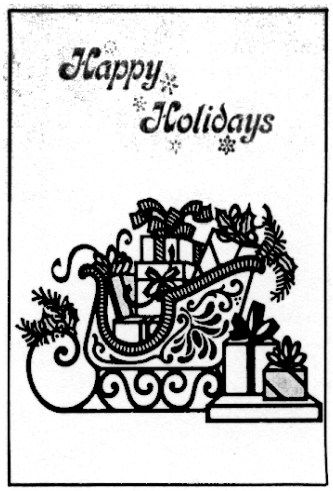
Drs. John J. Croat and Robert W. Lee were corecipients of the American Institute of Physics (AIP) fifth Prize for Industrial Applications of Physics. The prize, sponsored by the AIP Corporate Associates, was awarded October 22, 1985 at the associates' annual meeting in Rochester, New York.

The AIP prize recognizes important industrial applications of physics to publicize the value of physics research in industry, to encourage physics research in industry, and to enhance students' awareness of the importance of physics in industry. Although nominees for the award need not be working in industry, the contribution for which they are cited must have been made while working in industry.

Drs. Croat and Lee were honored for their discovery of a new high-strength permanent magnet alloy, microcrystalline neodymium-iron-boron, and processes for manufacturing permanent magnets from the alloy for commercial purposes. The work was performed at the General Motors Research Laboratories in Warren, Michigan.

## Two ACS Awards

Dr. John Corbett, distinguished professor in the College of Sciences and Humanities of Iowa State University, Ames, Iowa, has won two prestigious awards from the American Chemical Society. On November 7, 1985, he was the recipient of the 41st Midwest Award in St. Louis, Missouri. Next spring at the national meeting of the ACS in New York, he will receive the Inorganic Chemistry Award. These two awards, sponsored by the Edward Mallinckrodt, Jr. Foundation and Monsanto Company, respectively, were awarded to Dr. Corbett for his pioneering work in the field of solid state synthetic inorganic chemistry. In recent years, his research has involved highly reduced metal halides that have metal-metal bonding, such as $Sc_5Cl_8$, $Sc_7Cl_{10}$, $Sc_7Cl_{12}$, $Y_2Cl_3$, and LaCl.



# RE's in the News

## Galfan Comes to North America

The Zinc Institute and the International Lead Zinc Research Organization (ILZRO) have announced the establishment of a North American base for supplying various types of Galfan sheet and wire. Already in use in Japan and Europe, Galfan is a zinc-5 percent aluminum alloy containing 0.05 percent mischmetal. [*J. Less Common Met.* **93**, 253-9 (1983)]. As a coating for steel it has been shown to be superior to the normal galvanizing coating in corrosion resistance and in formability. It is said to be comparable with regard to weldability and painting. Some Japanese producers have claimed Galfan coated steel to be 1½ to 2 times more formable. According to Zinc Institute it was 2 to 3 times as resistant as normal galvanized steel in salt spray, sulfur dioxide, and humidity tests.

The first United States producer is Gregory Galvanizing and Metal Processing Inc. of Canton, Ohio, that has set up a continuous hot-dip coating line to supply Galfan coated strips for commercial evaluation. The Weirton Steel Company in West Virginia has also been granted a license and is planning a Galfan mill.

Among the companies that have expressed an interest in Galfan coated steel are Ford Motor Company (for improved corrosion resistance in automatic transmission cooling lines and for severe forming applications), the Speed Queen Company (for corrosion resistant front panels and bases of automatic washers), the Cyclone Fence Company (for roll-formed fence posts), and Butler Manufacturing (a manufacturer of pre-engineered metal buildings).

## New Ore Source?

U.S. Geological Survey scientists have discovered a potentially significant concentration of placer sand and gravel deposits containing from 3 to 10 percent heavy minerals that are sources for rare earths, titanium, zirconium, and hafnium. Located 5 to 50 miles off the coasts of Virginia and Georgia, the deposits could be mined using relevant technology already used to mine titanium ores offshore in Malaysia and Sri Lanka.

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## Erbium Filters

Erbium has an electronic configuration such that its K-absorption edge filters out a large portion of the useless, low energy x-rays that increase exposure but do little to help take good x-ray pictures. This has been discovered by Doctors Richard Wesenberg and Gary Amundson of Alberta Children's Hospital in Canada who used erbium foil filters and other techniques to minimize the x-ray dose during fluoroscopy [*Radiology*, **153**, 243-7 (1984)].

## Cerac Expands

Cerac, Incorporated of Milwaukee, Wisconsin, U.S.A., has received initial approval for $1.6 million in industrial revenue bonds to finance expansion of the manufacturing plant. Cerac produces rare chemicals, metal alloys, ceramics, etc., many of which contain rare earths. Dr. Ervin Colton, president of Cerac, describes the company as a "chemical job shop" whose sales have grown by 10 to 15 percent per year since 1964. The number of employees has doubled in five years from 30 to 60 and 11 more workers will be hired as a result of the expansion.

## Stronger Magnets

General Motors Company researchers have found ways to further increase the strength of their Magnequench magnets, even before their new plant can start production. Magnequench is a new family of magnets based on iron, neodymium, and boron made by rapidly solidifying a molten stream of alloy on the surface of a rotating quench wheel. The new strengthening method involves the controlled application of heat and pressure to a ribbon in a die, so that the heat-softened ribbon can flow in a direction transverse to the pressing direction.

## New Magnet Market Survey

Gorham International, Inc. has announced plans to conduct a program to assess the market shift and the technical changes that are occurring because of the advent of Nd-Fe-B magnets. Gorham's program will be, according to their news release, useful to magnet users and producers and to new material suppliers. Geographic coverage will include the

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# Rare Earth Organometallics

*Organometallic Compounds of the Lanthanides, Actinides and Early Transition Metals*, edited by D. J. Cardin, S. A. Cotton, M. Green, and J. A. Labinger, gathers into one paperback volume data on the pertinent compounds from the three volume *Dictionary of Organometallic Compounds*. This provides a handy 400 page reference book for the scientist interested in the organometallic chemistry of the selected elements but who does not want a three volume, 3,000 page set of books with which to struggle.

The book is divided into four parts: three indices and the main section. The three indices include a compound name or synonym alphabetical listing, a molecular formula index, and a CAS registry number index.

The main section is arranged alphabetically by the chemical symbol of the elements included. Some general information is given for each element and, if needed, a structure index to the compounds of that element. For each compound the entry includes the molecular formula, the chemical or structural formula, names, and, if available, the CAS registry number. Other information furnished includes physical appearance, solubility, melting or decomposition temperatures, molecular weights, and derivative form in which the compound is usually handled or isolated. The last part of each entry is a list of references for that particular compound. Reference contents are usually indicated using mnemonic abbreviations, i.e., *synth, uv, cryst struc, rev, ir, pmr*, etc.

The book, as well as the full sized dictionary, is published by Chapman and Hall, 11 New Fetter Lane, London EC4P 4EE, U.K. or 733 Third Avenue, New York, N.Y. 10017, U.S.A. It is also available from Methuen, Inc., 29 West 35th Street, New York, N.Y. 10001, U.S.A. The book was published in 1985 and costs U.S. $49.95.

# MEETINGS

## Valence Fluctuations

The V International Conference on Valence Fluctuation will be held January 5-9, 1987, in Bangalore, India. The conference will focus on various theoretical and experimental aspects of valence fluctuations in rare earths and actinide intermetallic compounds. Some of the areas involved are narrow band phenomena; dense Kondo systems; $L_{III}$edge, EXAFS, XPS, Mössbauer, NMR, and muon-spin resonance spectroscopies of mixed valent materials; itinerant magnetism; heavy fermion superconductivity; Fermi liquid nature of mixed valent compounds; and more. The conference will have invited papers and poster sessions.

For more information contact Professor L. C. Gupta, conference secretary, Tata Institute of Fundamental Research, Homi Bhabha Road, Colaba, Bombay 400 005, India. His telephone number is 219111 and his telex is 011-3009.

## 3rd ICPMM

The 3rd International Conference on Physics of Magnetic Materials (ICPMM) will be held in Spala, Poland, September 14-20, 1986. The conference, as usual, will be a joint effort of the Institute of Physics of the Polish Academy of Sciences and of the Research Laboratory of the "Polfer" Plant of Magnetic Materials. A special session will be dedicated to celebrate the plant's thirtieth anniversary.

The oral presentations will be invited papers covering areas of major interest. Contributed papers will be presented in poster sessions and will cover the following topics: hard magnetic materials based on rare earth elements; amorphous magnetic materials; spin glasses; and films with artificial superstructure.

Because of the limited capacity of the center in Spala the number of participants will be limited to 200. For more detailed information contact Dr. Danuta Zymierska, Secretary of the Organizing Committee, Institute of Physics, Polish Academy of Sciences, Al. Lotnikow 32/46, 02-668 Warsaw, Poland.

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## Magnetic Conference

The second annual international conference and exhibition on neodymium-iron-boron magnets will be held March 2-4, 1986, in Clearwater Beach, Florida. Fifteen invited speakers will cover such topics as: the economics and availability of raw materials, neodymium refining routes and capacities, advances in magnetic production, new applications, market forecasts, the latest patent and licensing situation, and new business opportunities. An exhibition of magnet materials and instrumentation is planned to run concurrently.

The conference is being organized by Gorham International, a contract R&D group that held the first conference in March 1985 in Monterey, California. About 200 attendees from 15 countries were present. The proceedings of the first conference are to be published and the RIC will announce their availability.

For more information on the second conference contact Dr. Hugh D. Olmstead, Conference Director, Gorham International Inc., P.O. Box 8, Gorham, Maine 04038, U.S.A., telephone (207) 892-2216, telex 94-4479.

## Proceedings ICCF-5

North-Holland Publishing has published, in hard cover, the proceedings of the 5th International Conference on *Cyrstalline Field and Anomalous Mixing Effects in f-Electron Systems*. The proceedings were also published as volume **52** of *Journal of Magnetism and Magnetic Materials*. The conference was held April 15-18, 1985, in Sendai, Japan.

Ten of the 119 papers that make up this volume deal with uranium compounds. The balance are on rare earth compounds or theory. The papers presented reflect the rapid progress in theoretical and experimental studies of the *f*-electron systems. According to the editor, T. Kasuya, the crystal field (c-f) is one of the most important parameters in *f*-electron systems. He states that c-f mixing is recognized as important for the origin of the crystal field in connection with various anomalous properties, including the valence fluctuating

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## CONFERENCE CALENDAR

2nd Intl. Conf. on Rare Earth-Iron Magnets
Clearwater Beach, Florida, U.S.A.
March 2-4, 1985
*This issue

5th Intl. Symposium on the Properties and Applications of Metal Hydrides
Maubuisson, France
May 25-30, 1986
*RIC News* **XX** [3] 1 (1985)

17th Rare Earth Research Conference (RERC)
Hamilton, Ontario, Canada
June 8-12, 1986
*RIC News*, **XIX** [2] 3 (1984) and **XX** [1] 3 (1985)

Intl. Conf. on Anomalous Rare Earths and Actinides (I.C.A.R.E.A.)
Grenoble, France
July 7-11, 1986
*RIC News*, **XX** [2] 2 (1985)

3rd Intl. Conf. on Physics of Magnetic Materials (ICPMM)
Spala, Poland
September 14-20, 1986
*This issue

5th Intl. Conf. on Valence Fluctuation
Bangalore, India
January 5-9, 1987
*This issue

2nd Intl. Conf. on the Basic and Applied Chemistry of the *f*-Transition (Lanthanide and Actinide) and Related Elements (2nd I.C.L.A.)
Lisbon, Portugal
April 6-10, 1987
*RIC News* **XIX** [4] 3 (1984) and **XX** [2] 2 (1985)

*New Listing

# RARE EARTHERS

## Mitsubishi

Mitsubishi Metal Corporation of Tokyo, Japan, promoted Mr. H. Sakurai to the post of director of the company's Central Research Laboratory. His former job was as general manager of research and corporate development. Dr. Masayuki Nagasawa was named to replace Sakurai as the new general manager.

## Cabot

Robert B. Herchenroeder has been presented the Cabot Corporation's Thomas D. Cabot Distinguished Inventor Award. The award is given to honor an employee whose technical creativity has contributed significantly to the profitability of the corporation and to establishing technical leadership for the firm.

**China—1985**

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ceived from the central and provincial governments.

When one examines the work going on in China one must remember that the cultural revolution was a great set-back for science and that their modern science and technology is only about 10 years old. From this perspective China has come a long way, but still has a way to go before it is on par with the U.S.A., Western Europe, or Japan. They started to purchase modern scientific equipment about 10 years ago. The earlier items were from the Eastern European countries (primarily East Germany) but today they are coming from the U.S.A., Japan, and Western Europe.

### International Conference on Rare Earth Development and Application

The International Conference (ICRE) was held September 10-14, 1985, in Beijing at the Science Hall of the Friendship Hotel complex. Except for the three plenary lectures that were held the first morning, there were often five oral sessions and three poster sessions being held simultaneously.

The conference covered an extremely wide range of topics, starting from the rare earth minerals and ores to their final use, and almost all the science and technology between. The major topics included: geochemistry; ore-dressing; hydrometallurgy; extractive and separation chemistry; analytical, physical, solid state, organometallic, and bioinorganic chemistries; metal preparation and pyrometallurgy; solid state physics; magnetism; luminescence; environmental protection; toxicity; catalysis; and applications in cast alloys, steels, glasses, ceramics, medicine, and agriculture. Since the main emphasis of the conference was on the development and application of rare earths, there was a notable lack (but not an absence) of papers on basic research involving the rare earths, such as valence fluctuation, heavy fermions, superconductivity, etc.

The major differences between the western world conferences (North American and European) and the Chinese conference is the big emphasis on rare earths in steels, cast iron,

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aluminum, medicine, environment, agriculture, and geochemistry at this conference. One afternoon was left free for the attendees to visit the International Fair for Rare Earths and Their Application Products.

About 120 foreigners from 21 countries and ~250 Chinese scientists attended the conference—36 attended from Japan, 29 from America, and 8 each from Great Britain and France. There was a definite lack of scientists from Russia and the Eastern European countries; only 4, 1 each from Bulgaria, Czechoslovakia, East Germany, and Russia were in Beijing.

The Conference Proceedings, entitled *New Frontiers in Rare Earth Science and Applications,* Volumes I and II, edited by G. Xu and J. Xiao, were available at the time of the Conference (see p. 6).

### International Fair for Rare Earths and Their Application Products

The International Fair for Rare Earths (IREF) opened five days before the ICRE and remained open for almost two weeks after the close of the conference. There were 28 Chinese and 2 foreign exhibits (Hitachi Metal Corp. from Japan and Rhone Poulenc Spécialités Chimiques from France). Most of the Chinese exhibits were put together by the provinces, autonomous regions, major cities, some governmental organizations, and corporations.

The fair was a real eye-opener. Everyone was impressed by the large variety of products in which the rare earths were used: aluminum (containing 0.3 percent rare earths) cooking ware; dyed woolens (in which rare earths were used in the dyeing process); Nd-Fe-B permanent magnets; in medical treatments; colored glass, ceramic and porcelain glassware, statues, crafts, etc.; fertilizer for many agricultural products; steels, irons; phosphors; laser materials; hydrogen storage materials; garnets; ferrites, etc. It appeared that any material or process to which they could add a rare earth they were doing so. Many things or processes would not be feasible in the western world because they would be uneconomical compared to other approaches. Some looked interesting and should be explored in a more thorough and scientific manner.

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### Baotou Research Institute of Rare Earth

The Baotou Research Institute of Rare Earth (BRIR) is the largest research organization in the world devoted to rare earths (see p. 7).

The BRIR analytical facilities contain a number of fairly new instruments including: an emission spectrometer, atomic absorption spectrometer, scanning microprobe, inductively coupled plasma spectrograph, and x-ray fluorescence spectrometer. These instruments enable them to carry out most of the analyses needed by other staff. Separation studies are carried out on a laboratory scale using individual separation funnels for liquid/liquid extraction investigations and on a few ion exchange columns for investigating that process.

Corrosion studies involved the use of rare earths in the zinc plating of iron, stress corrosion cracking, and creep-rupture of 18Cr, 18Ni, 2Si steel, and hydrogen embrittlement in ~18 percent Cr steel. In all cases it was found that rare earth additions resulted in an improvement. In the case of Zn plating, they claim to have improved on the commercial "galfan" technique involving rare earths (see p. 2). In the case of hydrogen embrittlement they found an addition of 0.4 percent R (0.2 percent R residual in the steel) resulted in a ten-fold improvement at the same stress level. But in order to get the same stress level the rare earth containing the alloy had to be heat treated at a temperature ~50°C lower than the virgin steel.

Several years ago, BRIR was involved in a study of a 0.3 percent R addition to aluminum to improve the drawability. This addition led to a 20 percent reduction in weight for the same strength level. The rare earth (mischmetal) was introduced by adding $RCl_3$ to the electrolytic reduction cell and coreducing it with the aluminum. The Chinese are utilizing this material in their aluminum pots and pans and electrical conducting wire. (This was quite evident at the Rare Earth Fair; practically every exhibit had aluminum pots and pans.)

BRIR has been appointed as the Chinese center for rare earth information (see p. 7).

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**China—1985**

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### Baiyunebo Mine

The Baiyunebo (White Cloud) mine is located ~140 km (~85 miles) by air north of Baotou on the grasslands of Inner Mongolia. The mine is fairly inaccessible. It takes hours by car over mostly dirt roads that are almost impossible to traverse if it has rained. The mine is closed to most visitors and permission must be obtained frm the Ministry of Metallurgical Industry.

The iron deposit was discovered in 1927 and the rare earths associated with it in 1934. Iron mining began in 1958 and the first rare earths were extracted from the iron ore tailings in 1962. The deposit is unusual in that there is an iron ore (containing both niobium and rare earths) and a rock that is high in niobium and rare earths. There is a sharp interface between the ore and the rock and the two can be separated in the mining operation. The rock is saved and the iron ore is loaded on railroad cars and shipped to Baotou where all processing takes place. The rock is a new mineral that is named after the mine, and consists primarily of CaO and MgO plus niobium and rare earths.

After the iron ore dressing process, the rare earth content is ~30 percent and it is upgraded in three steps to 60 percent rare earth. The rare earths are present both as bastnasite (a fluorocarbonate) and monazite (a phosphate). Three different processes have been used to convert the rare earths into a usable form as the chloride. These include pyrochlorination, pyrocalcination with sulfuric acid, and decomposition with alkali. These operations are carried out in the No. 2 Rare Earth Plant of the Baotou Iron and Steel Company (BISC).

The No. 1 Rare Earth Plant of the BISC manufactures rare earth alloys (primarily a ferrosilicide) for additives for steel and cast iron.

The No. 3 Rare Earth Plant of BISC uses the rare earth concentrate from plant No. 2 to make commercial grade (95 to 99 percent pure) and high purity (>99 percent pure) individual rare earth elements. Liquid-liquid and ion exchange techniques are used in the separation and purification processes.

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### Physics Department—Peking University

The work carried out at the Physics Department of Peking University is more basic oriented, but some applied studies are being carried out. My discussions involved: spin glasses in $ZnAl_xFe_{1-x}O_4$ and in rare earth-iron (-cobalt and -nickel) alloys (Wen-Sheng Zhou); Ti or Ce substituted for Nb in $Nb_3Sn$ thin film superconductors (Chuan-Yi Li); and $RCo_5$, $R_2Co_{17}$, and $Nd_2Fe_{14}B$ permanent magnet alloys (Wen-Wang Ho and Wen-Sheng Zhou).

### Changchun Institute of Applied Chemistry

The Changchun Institute of Applied Chemistry (CIAC) was founded in 1948 a few years after the liberation of northeast China from the Japanese. It is one of the more important chemistry institutes supported by Academia Sinica. CIAC is divided into four departments: Polymer Chemistry and Polymer Physics, Physical Chemistry, Inorganic and Analytical Chemistry, and Structural Chemistry. There are ~1,050 people working for CIAC, of which ~650 are scientific and technical. This institution also grants advanced degrees and currently has 140 M.S. and 10 Ph.D. students.

Dr. Paul Caro (National Center for Scientific Research, Paris, France) and Mr. Ed Morrice (consultant and former U.S. Bureau of Mines, Reno employee) toured the institute with me. We visited the Structural Chemistry Department and discussed their work involving NMR, conventional single crystal structural work, gas chromatography-mass spectrometry, and IR studies of rare earth complexes with crown ether and polymers.

We spent more time discussing and viewing the facilities in the Inorganic and Analytical Chemistry Department. These included fused salt electrochemistry (including the preparation of the light lanthanide metals and Al, Mg, Fe alloys with the rare earths by electrowinning); crystal growing of rare earth crown ether complexes and double (alkali and rare earth) phosphates; and spectroscopic and magnetic susceptibility studies of these complexes and phosphates.

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### Department of Chemistry—Peking University

I spent a few hours of my last day in China vising Professor K. H. Hsu (G. X. Xu) at the Department of Chemistry of the University of Peking. This department is located on the beautiful main campus of the University of Peking. Dr. Hsu has a large group working for him: 5 associate professors; 7 assistant professors (lecturers); and 22 graduate students, most of whom are studying for their M.S. degrees. His group is involved with the solvent extraction of rare earths and with theoretical calculations of the electronic structure, chemical bonding and coordination chemistry of rare earth complexes using *ab initio* molecular orbital methods.

### Epilogue

The Chinese were friendly, helpful, and generous—indeed gracious hosts. Those of us attending ICRE were appreciative of their hospitality and we thank them for their efforts.

The Chinese were quite proud of their scientific and technical accomplishments and I believe justifiably so. They will make a big impact in the rare earth field in the future.

## Fritz London Memorial Award

The 12th Fritz London Memorial Award was presented in 1984 to Dr. Olli V. Lounasmaa (Helsinki University), Dr. Werner Buckel (University of Karlsruhe), and Dr. David J. Thouless (University of Washington). The award is presented every three years "in recognition of outstanding contributions to research in low temperature physics."

Lounasmaa was honored for his systematic development of cooling techniques that combine dilution refrigeration with nuclear demagnetization to reach temperatures of 0.06 microkelvin. He was active from 1962 to 1972 measuring the specific heats of various rare earths with 16 papers on the subject. Lounasmaa received his Doctor of Philosophy from Oxford in 1958 and has been director of the Low Temperature Laboratory at Helsinki University of Technology since 1965.

## Chinese Conference Proceedings

When attendees of the International Conference on Rare Earth Development and Applications arrived in Beijing in mid-September they found a two-volume, 1,535 page proceedings of this international conference.

Edited by Drs. G.-X. Xu and J.-M. Xiao, the proceedings, entitled *New Frontiers in Rare Earth Science and Applications,* were published in 1985 by Science Press, Beijing. Outside of the People's Republic of China it can be purchased for U.S. $180.00 from Academic Press, Incorporated, Orlando, Florida 32887, U.S.A. In China, the proceedings can be obtained from Mr. Xhao Shixiong, editor of the First Editorial Department, Science Press, 137 Chaoyangmennel Street, Beijing.

The proceedings contain the welcoming address, three plenary lectures, and about 300 invited and contributed papers and poster presentations. The two volumes are divided into the following 16 subject areas: (1) geochemistry and ore-dressing; (2) coordination, organometallic and bioinorganic chemistry; (3) structural and quantum chemistry and spectroscopy; (4) solid state chemistry and physics; (5) extraction chemistry and hydrometallurgy; (6) analytical chemistry; (7) applications in catalysis; (8) environmental protection, toxicity, and applications in medicine; (9) luminescence and phosphors; (10) magnetism and intermetallics; (11) hydrogen storage materials; (12) preparation of metals and pyrometallurgy; (13) applications in steel; (14) applications in cast iron and nonferrous metals; (15) applications in glass and ceramics; (16) miscellaneous applications. Subjects 1 through 8 are in volume 1 and 9 through 16 in volume 2.

## Physics of Magnetic Materials

The invited papers presented at the 2nd International Conference on Physics of Magnetic Materials (2nd ICPMM) held September 17-22, 1984, in Jadwisin, Poland, have been published in 1985 as a book by World Scientific Publishing Company and can be obtained for U.S. $54.00 from 242 Cherry Street, Philadelphia, Pa. 19106-1906, U.S.A. or P.O. Box 128, Farrer Road, Singapore 9128. The editors of the proceedings, entitled *Physics of Magnetic Materials,* are J. Rauluszkiewicz, H. Szymczak, and H. K. Lachowicz. One hundred of the 177 contributed papers presented at the conference were selected to be published in *Acta Physica Polonica,* **A68,** Nos. 1, 2, 3 (1985). A list of the contributed papers is included in the book.

The 580 page book contains 22 papers and 3 abstracts. More than half of the papers deal with rare earth alloys or compounds. Among the compounds discussed are $Gd_{3-x}v_xS_4$ (v = vacancy), garnets of various compositions, $RCo_5$, $R_2Fe_{14}B$, $(R,Y)M_2$ (where M is a 3*d* metal), $R(Al,M)_2$ and $YbCrO_3$. Among the alloys are 3*d* metals, ion-implanted with rare earths, and amorphous alloys or metallic glasses of rare earths with many elements.

Ever increasing interest in the physics of magnetic materials, stimulated by the industrial applications of the research findings and new materials, make this book appealing to solid state physicists, material scientists, and electrical engineers. It presents both theoretical and practical aspects of many magnetic systems.

## HF LASER

The hydrogen-fluorine (HF) chemical laser, as developed by the Air Force Weapons Laboratory and the Missile Research and Development Command, utilizes an HF flame to excite HF molecules to an elevated vibrational state. The lasing occurs when they are allowed to expand rapidly. A combustion chamber is required to form the gases and a nozzle is needed for control of gas flow during expansion.

Nickel metal had been used as nozzle material but had some restrictions. It was found that resistance to the HF flame depended on the formation of a protective fluoride film. The film must be dense and continuous; have a high melting point with a low vapor pressure; and form no low melting eutectic with the substrate.

After testing a variety of materials, lanthanum hexaboride ($LaB_6$) was found to be the most promising. Experiments showed that adding carbon to the $LaB_6$ improved the thermal shock resistance with negligible effects on the corrosion resistance. Further studies on combustion chambers made of $LaB_6$/10-25 vol.%C and nozzles of $LaB_6$/10%C, lanthanum boride mixed with molybdenum silicide, and $(Sr_{0.7}La_{0.3})B_6$/10%C are being conducted.

## Lasers Celebrate 25th Anniversary

It has been only 25 years since T. H. Máiman published [*Nature,* **187,** 493 (1960)] a description of the first laser. The succeeding years have seen an explosion of knowledge unmatched by almost any other scientific finding. The power of that first laser was approximately 1 kW; the Nova laser complex (using Nd-glass lasers) can produce up to 100 TW, an increase of 11 orders of magnitude. Lasers are of interest to rare earthers since many of the lasing ions are rare earths and many of the hosts are rare earth compounds. Some of the more important commercial lasers are Nd ions in a variety of hosts. The July 25, 1985 issue of *Nature,* **316,** 291, 300, 307-330 (1985) is devoted to the history, development, and current research programs of lasers and their applications.

## ICCF-5

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(VF) state. It is important to treat various effects of c-f mixing from a unified standpoint and to understand each anomalous property, including the crystal field, from a unified view.

Heavy fermion superconductivity is the most widely discussed area related to the anomalous mixing effects. Two symposia were held as part of the conference, one on "Tunneling and Point Contact Spectroscopy to Probe Gap Character in Valence Fluctuation and Superconductor Reliability and Interpretation," and one on the "Fermi Liquid Aspects in Kondo and VF Systems and their Relation to the *f*-band Model and Fermi Surface." Each symposium was comprised of four invited papers.

The 478 page book, published in 1985, can be obtained for U.S. $132.45 from Elsevier Science Publishers, P.O. Box 1663, Grand Central Station, New York, N.Y. 10163 or for 384 Dfl from Elsevier Science Publishers, P.O. Box 211, 1000 AE Amsterdam, The Netherlands.

## Magnetic Superconductors

The proceedings of the 6th Taniguchi International Symposium, held November 14-18, 1983 in Kashikojima, Japan, have been published as volume 52 in the Springer series in solid-state sciences. The 204 page book was published in 1984 by Springer-Verlag. The cost of the book is U.S. $23.50 and can be obtained from Springer-Verlag New York Inc., 175 Fifth Avenue, New York, N.Y. 10010, U.S.A. or Springer-Verlag GmbH and Co., KG, Postfach 105280, Tiergartenstrasse 17, 6900 Heidelberg 1, West Germany. The editors of the book were T. Matsubara and A. Kotani.

A brief overview of magnetic superconductors is given by the editors with the remainder of the book divided into four sections dealing with ferromagnetic, antiferromagnetic, organic, and exotic superconductors. The section on ferromagnetic superconductors includes discussion of superconductivity in heavy fermion systems.

$ErRh_4B_4$ and $HoMo_6S_8$ are described as ferromagnetic superconductors while $CeCu_2Si_2$ is an exotic heavy fermion superconductor. $RRh_4B_4$ compounds with R = Nd, Sm, or Tm and $RMo_6S_8$ compounds with R = Gd, Tb, Dy, or Er are discussed in the antiferromagnetic section.

**RIC News**
Vol. XX No. 4 December 1, 1985

Published
quarterly in March, June
September and December
by
Rare-Earth Information Center
Energy and Mineral Resources
Research Institute
Iowa State University
Ames, Iowa 50011

Second-class postage
paid at Ames, Iowa

**Postmaster:** Send address changes to
RIC News, Rare-Earth Information Center,
Energy and Mineral Resources Research
Institute
Iowa State University, Ames, Iowa 50011

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## Chinese Info Center

The Chinese Society of Rare Earth has announced the establishment of the China Rare Earth Information Centre (CREIC) at the Baotou Research Institute of Rare Earth. They hope to operate in the same spirit as the Rare-Earth Information Center (RIC) here in Ames and help spread news relevant to the rare earth field across China and around the world. The centre published the first issue of the *China Rare Earth Information* in September 1985. Mrs. M. Wang is the editor for the newsletter. She is also vice director of the Technical Information Department of the Baotou Research Institute of Rare Earth. The information newsletter is published in English and subscription is free.

Anyone interested in receiving the newsletter should write to CREIC at the following address: China Rare Earth Information Centre, Baotou Research Institute of Rare Earth, Baotou, Inner Mongolia, People's Republic of China.

We at the RIC in Ames, Iowa, wish them the best and hope their success far exceeds their most optimistic expectations.

## 50 Years of RE Ferromagnetism

Fifty years ago, Georges Urbain, Pierre Weiss, and Felix Trombe published a short paper [*Compt. Rend. Acad. Sci.* **200**, 2132-4 (1935)] in which they described the ferromagnetic behavior of gadolinium metal. This discovery of ferromagnetism in rare earths has generated many new exciting scientific developments, a much better understanding of magnetism, and ultimately, the commercial utilization of the rare earth-cobalt and rare earth-iron-boron permanent magnetic materials.

### In the News

(Continued from page 2)

U.S.A., Japan, Western Europe, and People's Republic of China. The study was scheduled to start in October 1985 and completion was expected in early 1986. Complete details on the program, including fees and sign-up procedures, are available from Dr. Hugh D. Olmstead, Gorham International Inc., P.O. Box 8, Gorham, Maine 04038, U.S.A.

## *Baotou Research Institute of Rare Earth*

In May 1985 the Ministry of Metallurgical Industry announced the formation of the Baotou Research Institute of Rare Earth (BRIR). This Institute was previously known as the Baotou Research Institute of Metallurgy, which was established in 1963. The name change was made to reflect the emphasis the People's Republic of China is putting on rare earths and the proximity of the Institute to the Baiyunebo ore bodies.

It is the largest rare earth oriented research facility in the world, employing about 1,000 people, with ~260 scientists and engineers and ~165 technicians. BRIR is headed by Director Z. An with P. Ma, S. Wang, and S. Ding as vice directors.

BRIR has 14 departments: ore-dressing, hydrometallurgy, pyrometallurgy, niobium exraction (the niobium concentration is also high in the Baiyunebo ore), rare earth applications, new materials, smelting, chemical analysis, physical testing, automatic control, radioactive isotopes, new equipment design, rare earth technical information, and machine shop.

In the past 20 years, BRIR has attained 400 awards in scientific research, 113 of which have been considered to be very important and 73 have won prizes in state competition. These have led to greater exploitation and comprehensive utilization of the Baiyunebo ore and helped in the development of the Chinese rare earth industry.

## THANK YOU *Laurence Quill*

We wish to take this opportunity to thank Dr. Laurence L. Quill for his donation of books and pamphlets to the RIC Library. Dr. Quill says in his letter, "Most pleased I am to donate these books in honor of and in memory of Frank Spedding for whom I had the greatest respect and whom I considered a good friend." The books on the rare earths and actinides are greatly appreciated for their historical value and make available many books that are no longer in print.

# GEOCHEMISTRY

*Rare Earth Element Geochemistry,* edited by P. Henderson, reflects the developments that have added to our knowledge of the chemistry and especially geochemistry of the lanthanides. Advances in the methods of analysis for rare earths and their isotopes have led to a rapid growth in our knowledge of fundamental geochemistry. Much of this work has been in the field of igneous petrogenesis, meteorite composition and origin, and on element mobility in the earth's crust. A noticeable lack of work on metamorphic rocks and processes, ore formation, rock alteration, and mineral authigenesis is mentioned.

The 510 page book was published in 1984 and can be obtained in the U.S.A. and Canada for U.S. $84.75 from Elsevier Science Publishers, P.O. Box 1663, Grand Central Station, New York, N.Y. 10163 or for 220 Dfl from Elsevier Science Publishers, P.O. Box 211, 1000 AE Amsterdam, The Netherlands.

The 13 chapters in this book and their authors are: (1) General Geochemical Properties and the Abundances of the Rare Earth Elements, P. Henderson; (2) Mineralogy, A. M. Clark; (3) Cosmochemistry: Meteorite Studies, W. V. Boynton; (4) Petrogenic Modeling, L. A. Haskin; (5) Abundances in Upper Mantle Rocks, F. A. Frey; (6) Characteristics of Igneous Rocks from the Ocean Basins, A. D. Saunders; (7) Igneous Rocks of the Continental Crust: Predominantly Basic and Ultrabasic Rocks, R. L. Cullers and J. L. Graf; (8) Igenous Rocks of the Continental Crust: Intermediate and Silicic Rocks—Ore Petrogenesis, R. L. Cullers and J. L. Graf; (9) The Mobility of Rare Earths in the Crust, S. E. Humphris; (10) Aqueous and Sedimentary Geochemistry, A. J. Fleet; (11) Radiogenic Isotopes, C. J. Hawkesworth and P. W. C. van Calsteren; (12) The Economic Importance of the Rare Earths, C. R. Neary and D. E. Highley; and (13) Analytical Chemistry, P. Henderson and D. E. Highley.

Most of the chapters adopt a quantititave approach and will be useful to most researchers, especially beginners.

# WHAT A QUARTER!

The RIC has never experienced such a quarter for sponsorships to date. We added 13 new members to our family of sponsors. We also received renewals of support from 17 of our regulars, including 7 who have contributed for more than 15 years. We also had one company renew after an absence of almpst 10 years. We wish to thank each and every sponsor and extend an invitation to all other companies who have any connection with rare earths to join our growing family.

The 31 companies that confirmed their sponsorships during the second quarter, with the number of years they have been sponsors in parentheses, are listed below:

Allied Automotive, U.S.A. (1)
Arnold Engineering Company, U.S.A. (1)
Atomergic Chemetals Corporation, U.S.A. (14)
Baotou Research Institute of Rare Earth, People's Republic of China (1)
Cabot Corporation, U.S.A. (3)
CERAC, Incorporated, U.S.A. (10)
Davison Specialty Chemical Company, Subsidiary of W. R. Grace & Company, U.S.A (18)
Electron Energy Corporation, U.S.A. (1)
BF Goodrich Company, U.S.A. (1)
Haber, Incorporated, U.S.A. (2)
Hoeganaes Corporation, Subsidiary of Interlake, Incorporated, U.S.A. (1)
Indian Rare Earths Limited, India (17)
Iron Ore Company of Canada, Canada (2)

(Continued in next column)

(Continued from previous column)

P. T. Koba Tin, Indonesia (1)
London & Scandinavian Metallurgical Company, Limited, England (2)
Mitsubishi Chemical Industries Limited, Japan (12)
Molycorp, Incorporated, U.S.A. (18)
Nippon Yttrium Company, Limited, Japan (7)
The Ore and Chemical Corporation, U.S.A (2)
Research Chemicals, Division of NUCOR Corporation, U.S.A. (18)
Rhone-Poulenc Spécialités Chimiques, France (16)
Ronson Metals Corporation, U.S.A. (18)
Sassoon Metals & Chemicals, Incorporated, U.S.A. (1)
SG Magnets Limited, England (1)
Sherritt Gordon Mines, Limited, Canada (2)
Shin-Etsu Chemical Industry Company, Limited, Japan (16)
Sumitomo Special Metals Company, Limited, Japan (1)
Thomas and Skinner, Incorporated, U.S.A. (1)
Transelco Division, Ferro Corporation, U.S.A. (10)
Varian Associates, Incorporated, Specialty Metals Division, U.S.A. (1)
Walker Magnetics Group, Incorporated, U.S.A. (1)

# New Telex Number

The telex number for reaching the Rare-Earth Information Center has been changed to 269 266. Please change your records. This number is also found in every issue of the *RIC News* in the mail block that appears on p. 7 of this issue.

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