IEEE MAGNETICS SOCIETY NEWSLETTER

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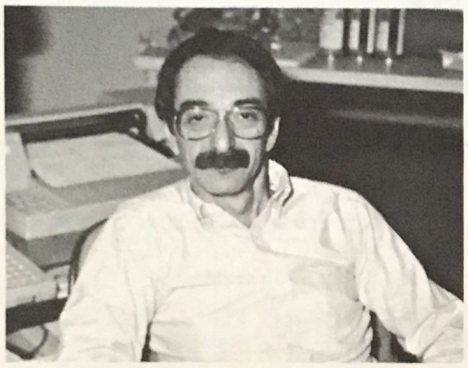
CRAIG PERLOV, EDITOR

COMMENTS

Richy Josephs, President



Richy Josephs

Since last November, S-MAG and several other societies within the IEEE have found themselves on the defensive over their publications policies. I brought this matter to your attention in the past two issues of this newsletter, and I am now relieved to announce that this controversy has been settled. Although there will be some changes in appearance and improvements in the review process, our publication policy will basically remain intact. We will continue to publish original, archival, peer reviewed Conference papers in a single issue of Transactions. The INTERMAG issue will continue to appear; however, there will be no cover photos of Conference city landmarks and no photos of a non-technical nature included in the body of the journal. The review process will be tightened and an attempt will be made to have the author prepared copy become more uniform in appearance. These changes were overdue, and when implemented, will enhance the Transactions.

Specifically, TAB passed the following two motions at its June meeting in San Francisco:

MOTION 1: The current contents of Section 9

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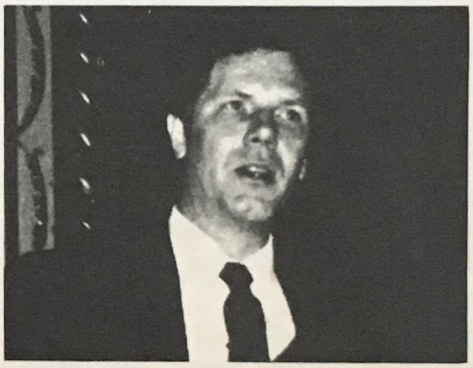
CHAIRMAN'S PREFACE

Ralph Patterson



Ralph Patterson

Intermag '89 was held in Washington, D.C. during March 27-30. Washington cooperated with us by providing wonderful weather that allowed ample opportunity to partake of the city's historical heritage, and that allowed the cherry trees to blossom on schedule.

The conference reflected the continued global strength of magnetic science and technology; 727 abstracts were submitted, the largest number for a U.S. based Intermag. Twenty-six companies exhibited their products at the conference, another record. Authors came from five continents and attendees from six; approximately 50% of the attendees were from outside the U.S.

The keynote speaker was U.S. Representative Doug Walgren (D-PA), a member of the House Science, Space and Technology Committee and Chairman of the sub-committee on Science, Research and Technology. He provided proactive and insightful comments on how we, as scientists and engineers, can affect the government on technological issues. His talk was followed by a spirited and wide-ranging question and answer session.

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COMMENTS (continued)

of the Review Policies for IEEE editors be deleted and that the following definition of an IEEE Transaction/Journal be inserted:

Primary Purpose: To disclose and provide a permanent archival record of *original technical work*, which advances the state of the art or provides novel insights.

Principal Content: Papers of lasting value which are fully and individually peer reviewed according to the Review Policy for IEEE Editors; each paper shall be reviewed in its entirety by appropriate specialists in the paper's subject area.

Intended Audience: Specialists in the field.

Distribution: IEEE member and nonmember subscribers.

Frequency: Regularly issued at least four times a year.

Format: Shall be fully and uniformly edited, including quality graphics and text. NOTE: This still allows the publication of author prepared papers.

Interpretation Note: *Original technical work* referred to above could include review and tutorial papers by experts; could include editorials, instructions, copyright form, list of referees, and other material concerning the publication; shall NOT include paid display advertising; and shall NOT include, except under special circumstances, (e.g., republication of a classic paper in a special issue, see *IEEE Policies and Procedures*, Section 6.6A), papers reprinted from other sources, papers written by paid authors, joint publication of whole issues, and news gathered by other sources.

MOTION 2: To maintain Transactions quality and uniformity, to insure the expected technical value to the subscribers of the Transactions, and to encourage the use of Conference Records for publications of IEEE conference papers, TAB directs all Societies NOT to publish their complete Conference Records/Conference Proceedings as issues of their Transactions. The papers must be selected in accordance with the standard peer review procedures stated in the *Review Policies for IEEE Editors* and meet the requirements of the definition of a Transaction/Journal publication.

At the present time, the entire review process is being scrutinized. This subject is discussed elsewhere in this issue of the Newsletter by Carl Patton, the editor of the S-MAG Transactions. Certainly the expanded use of fax machines will facilitate the process. With regard to the appearance of author prepared papers, a possible improvement would be to specify the font and type size that must be used. This is the practice of the IEEE Nuclear and Plasma Sciences Society.

We are open to suggestions. Please send your input.

The IEEE Magnetics Society Newsletter is published quarterly by the Institute of Electrical and Electronics Engineers, Inc., 345 East 47th Street, New York, NY 10017. The objective of the Newsletter is to publicize activities, conferences, workshops, and other information of interest to the membership of the Society and technical people in the general area of applied magnetics. Copy is solicited from the S-Mag membership, organizers of conferences, officers of the Society and local chapters, and other individuals or organizations with potentially relevant material. Copy should be sent to Dr. C. M. Perlov, Hewlett-Packard Labs, MS-2U, P.O. Box 10490, Palo Alto, CA 94303.

IEEE BOARD OF DIRECTORS CENSURES FEERST

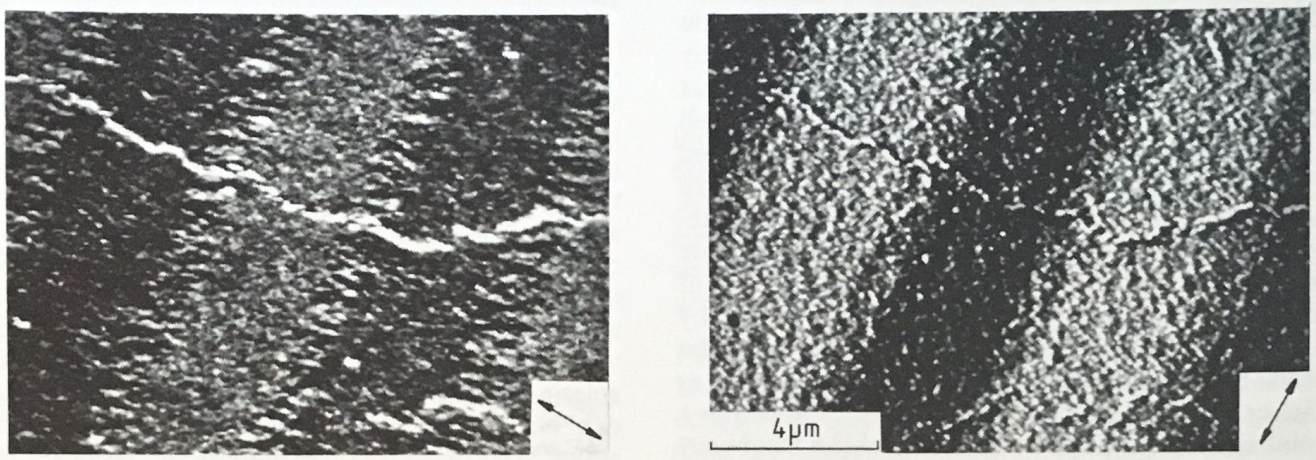
Irwin Feerst has been formally censured by the IEEE Board of Directors. He was found guilty of two violations of the IEEE Code of Ethics, each involving an attempt to injure the professional reputation of an IEEE member.

In one case, it was found, Feerst falsely accused a member of attempted blackmail; in the other, he falsely accused a member of acts of religious discrimination; and in both cases he transmitted his accusations to the members' employers, with the intent of causing damage to their careers, according to an IEEE Hearing Board. IEEE President Emerson W. Pugh has sent an official letter of reprimand to Feerst, informing him that he has been censured.

The procedure for judging cases of misconduct has been on the IEEE books ever since the Member Conduct Committee was established by a Bylaw in 1978. This is the first time a member has been found guilty.

Censure is the mildest of three levels of sanctions that may, according to the IEEE's Bylaws and Policy and Procedures, be imposed. The stiffer penalties are suspension and expulsion. Censure is a public condemnation of a person's actions. It does not affect any of Feerst's rights as a member.

MAGNETIC MATERIAL STUDIES IN THE DEPARTMENT OF PHYSICS AND ASTRONOMY, UNIVERSITY OF GLASGOW, GLASGOW, UNITED KINGDOM



DPC images of a written track in a CoNi metal evaporated tape. The arrows indicate the directions of in-plane induction mapped. (Specimen courtesy of Thorn-EMI; micrograph by George Sinclair.)

Electron microscopy and associated analytical techniques play a major role in the research program of the Solid State Physics Group in the Department of Physics and Astronomy at the University of Glasgow. Our aim is to provide a quantitative description of a wide range of physical properties on a scale which lies usually in the range of 1 to 10nm. Of particular interest to us are magnetic materials, and here the properties we study include the domain structure within the material and the stray field distribution beyond its surfaces together with the local crystal structure, defect structure and elemental composition. We believe that as complete a description as possible of both magnetic and physical microstructures is vital if we are to understand how different growth conditions affect magnetic properties of materials which are to be exploited in specific device applications. Such understanding can then be put to good use in the design of materials with superior properties.

The magnetic activities in the Group are directed by Professors Bob Ferrier and John Chapman and between us, we currently have six post-doctoral workers and research students working on different magnetic projects. Much of the work is carried out on two transmission electron microscopes, a JEOL 2000FX, which can operate in fixed beam or scanning mode, and an extended VG HB5 scanning transmission electron microscope. The latter is equipped with an x-ray detector and an electron spectrometer to provide the analytical facilities we require. Both can be linked to computers for the collection and analysis of data.

The HB5 can be operated in a variety of imaging modes of which the differential phase contrast (DPC) mode is the most useful for magnetic structure investigations. Using this technique in-plane components of magnetic induction integrated along an electron trajectory can be mapped directly. Thus we have a means of providing rapid information not only on domain geometry but also on the induction directions in individual domains and the induction variation within domain walls themselves. Signals recorded simultaneously provide information, in perfect registration, on the physical microstructure.

Our JEOL 2000FX is still being modified to optimize its performance for studying magnetic materials. It is equipped with a special objective lens so that good image resolution is retained (<1nm lattice resolution in fixed beam mode) while the specimen is located in magnetic-field free space. Pat Nicholson has designed a magnetizing stage, built into a specimen support rod, so that we can perform in-situ magnetizing experiments and so study magnetization processes directly. Further developments in progress on the instrument include the addition of suitable detectors for DPC and back-scattered electron imaging. The latter will allow us to extend our research program to "bulk" as well as thin film magnetic specimens.

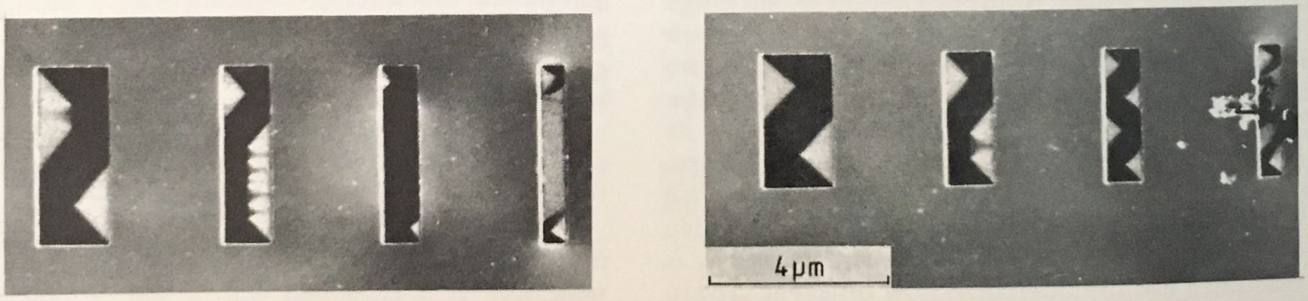
Much of our current research program is concerned with magnetic recording where high resolution imaging techniques have an increasingly important role to play as higher densities of information storage are sought. We collaborate with colleagues in other academic institutes and

(continued from page 3)

with industry in the United Kingdom, Europe and the United States in this work. We examine materials for longitudinal and perpendicular recording and very recently have begun a project involving magneto-optic recording media. As well as studying the magnetic domain structure supported by the material in its as-grown state, we are particularly interested in determining the magnetization distributions in written tracks. An example is shown in the figure above where DPC images of tracks in a CoNi metal evaporated tape written by one of the heads in a helical scan recorder can be seen. From a detailed analysis of images such as these the mean direction of magnetization within a track can be studied as a function of the frequency of the write signal. It is hoped that further analysis will provide information to help understand the noise properties of the medium.

The other major area of interest to us relates to the micromagnetic properties of small particles. To try to better understand these we use electron beam lithography (with the assistance of colleagues in the Department of Electronic and Electrical Engineering at Glasgow University) to define very regular small particles whose size, shape and separation are under the control of the experimenter. An example of a section of a typical array of effectively non-interacting permalloy particles is shown in the figure below. The domain structures in the particles are clearly revealed and it is immediately apparent that they can be divided into two groups depending on whether or not they support flux closure. Detailed examination of a set of such images allows the transition from a multi-domain towards a single domain structure to be studied and information to be obtained on domain wall profiles and energies. Further information, relating to the magnetization reversal mechanism, can be gleaned through use of the magnetizing stage. We are currently extending our work on fine magnetic particles to encompass those produced by chemical means.

We look forward to the future with excitement. New magnetic materials with superior properties are appearing regularly and we believe that micro-characterization techniques will play a vital role in helping optimize their properties.



Foucault images of small regular permalloy particles prepared using electron beam lithography. Note the stray field beyond the edges of the more elongated particles. Stewart Hefferman and Stephen McVitie.

FROM THE EDITOR

Ralph Patterson, who chaired this year's INTERMAG conference, has asked me to announce that he will be resigning his seat on the Magnetics Society Administrative Committee. Ralph has transferred to a division of Hewlett-Packard in San Diego and will no longer be working on magnetics.

The article on Irwin Feerst was excerpted from the "Institute" with permission. In the last issue of the Newsletter, I did not mention that the article by Clark Johnson first appeared in "New Technology Week" and was reprinted with their permission.

CORRECTION

In the previous issue of this Newsletter, it was reported incorrectly that the acceptance ratio for papers by the IEEE Instrumentation and Measurement Society was 85%. Selected papers from their Conference on Precision Electromagnetic Measurements are published in a Special Transactions issue with an acceptance ratio of 51%.

PUBLICATIONS DEPARTMENT REPORT
Carl E. Patton

Robert Johnson

Change in Reviews Editor for Recording

Dr. Dan S. Bloomberg of Xerox Corporation, Palo Alto, California, has asked to step down from his position as a Reviews Editor for the IEEE Transactions on Magnetics. Dr. Bloomberg has served the Magnetics Society, the Transactions, and the magnetics community in his capacity as Reviews Editor in charge of papers in the general area of magnetic recording since April, 1986. Dan has been a diligent and efficient editor. He has contributed significantly to the continued technical quality of the *IEEE Transactions on Magnetics*. His work has been greatly appreciated.

Dr. Robert A. Johnson of the Digital Equipment Corporation, Shrewsbury, Massachusetts, has been appointed as the new Reviews Editor in charge of magnetic recording and related topics. It is a pleasure to have Dr. Johnson join the editorial team of the Transactions.

Dr. Johnson is a senior member of the IEEE. He served as an Associate Editor of the IEEE Translation Journal for Magnetics in Japan from 1985 until 1989, as a Publications Chairman for the 1986, 1987, and 1988 Intermag Conferences, and as Local Chapters Chairman for the IEEE Chapter of the Magnetics Society, and he served as chairman of that chapter from 1986 to 1987.

Dr. Johnson brings considerable technical and editorial expertise with him to his position as Reviews Editor in the general area of magnetic recording. His willingness to join the editorial lineup of the Transactions is very much appreciated.

On the Issue of Peer Review For Conference Proceedings

Several changes in policy and procedures concerning the review process for conference proceedings are under discussion. When finalized, these changes will be designed to insure that conference papers continue to receive the same careful technical review as regular contributed papers to the Transactions.

Peer Review Policy: A major point of IEEE and Magnetics Society editorial policy holds that *all* conference manuscripts submitted for publication *must* be peer reviewed. This means that the inclusion of a presentation in your conference program does NOT guarantee publication of the full paper in the proceedings published in the Transactions. The full manuscript, not just the abstract, must be reviewed by at least one independent technical referee. This review is separate from and in addition to the initial review of the abstract or digest acted upon by the program committee. After this review is complete, it is up to your conference editor(s) to (a) interpret the reviewer's report and (b) decide whether to accept the paper as submitted, to require revisions and then reconsider the paper, or to reject the paper. This policy applies to invited papers as well as contributed papers for the conference. For the Intermag Conference for example, the Call For Papers mailings include the statement "All papers, invited as well as contributed, will be evaluated by peer reviewers to determine their suitability for publication."

Peer Review Mechanics. There are usually severe time constraints placed on the review process for conference papers in order to achieve the timely appearance of the proceedings. It is important that your editors organize these reviews and evaluations so that accepted standards for competent, technical peer review are not compromised:

The conference editors or other individuals in charge of reviewer selection should make sure that reviewers (a) are qualified and technically competent to review the paper they agree to review and (b) have sufficient time to perform a bonafide and thorough review.

Reviewers should not be overloaded. That is, no reviewer should be responsible for the review of more than two conference papers. One paper per reviewer should be the rule.

The conference editors should make sure that reviews are not "rush jobs" and that the standards applied by the reviewers are the same high standards as applied to regular submitted articles to the Transactions.

Under *no circumstances* should a paper author be placed in a position to select the reviewers for his or her own paper, as in the case of session chairpersons charged with the task of selecting reviewers for the session, for example.

In line with the above, it is extremely important for your editors to pay close attention to the details and the mechanics of the review process.

Ideas for Discussion

It is suggested that the Magnetics Society examine the logistics of requiring each conference editorial team to have a representative designated by the editor of the Transactions to monitor conference procedures for peer review and final decisions on acceptance or rejection of papers. The Transactions Representative would have the final say in the case of disputes over the acceptance or rejection of papers.

It is suggested that the Magnetics Society examine the pros and cons of eliminating the "author prepared" option for conference papers, and of going to a fully typeset format for conference proceedings as well as regular articles.

It is suggested that the Magnetics Society examine the possibility of having an additional editor for the Transactions, with the title of "Conference Editor", to manage the conference proceedings portion of the Transactions. In addition to the general management of the conference proceedings portions of the Transactions, the duties of this editor would be as follows:

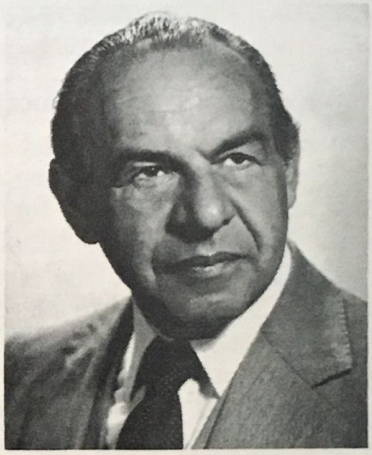
The editor would devise a uniform review form for the use of all conferences publishing in the Transactions.

The editor would also devise a uniform set of instructions for reviewers, emphasizing the technical and editorial publications standards to which *all* papers published in the Transactions must conform.

The editor would also devise specific procedures to deal with rejected papers, poorly or inadequately reviewed papers, controversial papers, etc.

Your comments on the above suggestions as well as other ideas on the peer review issue for conference proceedings would be most welcome. Please send your comments and suggestions to Carl E. Patton, Department of Physics, Colorado State University, Fort Collins, CO.

MAGNETICS SOCIETY ACHIEVEMENT AWARD 1989 PAUL P. BIRINGER



Paul P. Biringer
Professor of Electrical Engineering
University of Toronto

Paul P. Biringer was born October 1, 1924 in Marosvasarhely, Hungary, where he received his Dipl. Eng. degree from the Technical University, Budapest in 1947. His graduate degrees are from the Royal Institute of Technology, Stockholm, M.A.Sc., 1951 and from the University of Toronto, Ph.D., 1956.

His academic career was interspersed with industrial positions. At A. B. Svetstransformator he designed special transformers. From 1948 he was Research Scientist at the Royal Institute of Technology, where he experimented with high gain magnetic thermo-couple amplifiers to be used in oil heating applications. He invented and designed an automatic torque measuring balance for small motors and started experimental and theoretical work on magnetic frequency changers. While at the Royal Institute of Technology he built and patented a magnetic frequency changer for arc welding. With

K. I. Selin he was involved in the development of multipulse multi-unit saturable reactors to be used for power system stabilization.

In 1952 he came to the University of Toronto, where he started his Ph.D. studies and at the same time joined the General Engineering Co. Ltd. as consultant for induction furnace and heating installations. During this period of time he put into operation the first D.C. controlled magnetic frequency tripler for induction heating. This was soon followed by compensated magnetic frequency tripler for induction furnaces and by the development of dual frequency heating systems, using magnetic frequency doublers. After completion of the Ph.D. degree he joined the University of Toronto, where he became full professor in 1956.

Meanwhile at Ajax Magnethermic Corporation he continued the development of large magnetic frequency changers. By 1976 a 2000 kw installation had been completed close to Pittsburgh. In 1970 he joined Hatch Associates Ltd., a consulting engineering group in Toronto, where he later became Chairman of the Research and Development Group. While at Hatch he participated in the economic and electrical system studies and specified the compensating system for a projected steel complex in Trinidad. A unique electrical compensation system had to be developed to make the project possible. The construction was completed in 1981 incorporating one of the earliest static VAR compensation systems. During the last few years he became interested in magnetohydrodynamic effects, electromagnetic transport and electromagnetic stirring in liquid metals.

Dr. Biringer served on the Educational Activities Board, on the Fellow Committee and was Chairman of the Toronto Section of IEEE. He was a member of the Magnetic Amplifier Committee that became the Magnetics Society. He served on the Administrative Committee of the Magnetics Society, he was Awards Chairman, he served on the Program Committee of Intermag, he was co-Chairman of Intermag in 1975. He is Chairman of the Heating by Induction Department of the Magnetics Society.

His IEEE awards are the Canadian District Prize AIEE 1958, Fellow, 1970, Prize Paper Award - Industry Application Society, 1979, Centennial Medal, 1984, Prize Paper Award–Industry Application Society, 1987. His other awards: Pleyel Award for Research, 1951; Senior Research Fellow-Canadian National Research Council, 1966; Sons of Martha Medal–Officer of the Order of the Sons of Martha--Association of Professional Engineers, 1968; Certificate of Award, American Society of Mechanical Engineers, 1972; Senior Research Fellow, Japan Society for Promotion of Science, 1979; Gold Medal, Hungarian Academy, 1984; Erskin Fellow, University of Canterbury, Christchurch, 1987.

Dr. Biringer is a member of the Electrical Engineering Grant Selection Committee and of the Committee on International Relations of the Natural Sciences and Engineering Research Council (NSERC) of Canada. He is Chairman of National Technical Committee 27 and member of National Technical Committee 68 of the International Electric Commission (IEC). He is also a member of the International Working Group on Arc Furnaces (WG-7) and on Induction Furnaces (WG-12) of IEC.

He has over 130 publications and 40 patents. His other interests are many, including tennis, skiing, archaeology and art. He has an eclectic collection of paintings and art including Innuit and Indian carvings, icons and Ashanti Gold Weights from Africa.

MERIT SCHOLARSHIP WINNER

We are pleased to announce that the winner of the 1988 National Merit Scholarship, sponsored by the IEEE Magnetics Society, is Charles E. Carroll, son of John J. and Karen S. Carroll of Indianapolis, Indiana.

Charles will attend the University of Illinois where he plans to major in chemistry. He hopes to go on for his doctorate and to pursue a career in research.

Charles has won a number of contests in mathematics, science and German. He was one of the top twenty in the country in the ACS National Chemistry Olympiad. Charles enjoys puzzles and play strategy and logic games. He is an avid chess player.

Charles works part-time at a local food establishment. He has been involved in community volunteer activities throughout his high school years. At present, he is working as a volunteer at a home for the elderly. His other interests include the Model United Nations Program and the Young Republicans Club.

INFORMATION STORAGE AWARD
1989 Reynold B. Johnson

Reynold B. Johnson

Reynold B. Johnson is a native of Kingston, Minnesota. He was educated at the University of Minnesota where he graduated in 1929 with a major in Science Education Administration and minors in Mathematics and Engineering. After teaching at the Ironwood, Michigan High School for five years, he joined the IBM facility at Endicott, New York in 1934. Reynold Johnson became the founding manager of the IBM San Jose Research Laboratory in 1952 and five years later of the IBM Advanced Systems Development Division at the San Jose and Los Gatos Laboratories. In 1965 he became an IBM Fellow. After his retirement in 1971 he founded "Education Engineering Associates."

Rey Johnson's move to California in 1952 was coupled with his taking responsibility for developing a new information storage system. He formed and led a new development laboratory in San Jose, California, to carry out this task. He quickly focused on random access magnetic disk storage as the most promising technology. The many difficult technical problems to be solved included methods of putting a uniform coating of magnetic material on metal disks. Development of extremely complex mechanisms for accurately moving and positioning the writing/sensing head, development of air bearings to hold the head close to the recording surface without touching it and programming to control the disk system operation.

The result was the IBM RAMAC, announced in 1957, the first commercial disk file. The RAMAC was an immediate success, establishing IBM's leadership in on-line storage devices. This leadership position has been maintained for the past 30 years, with Mr. Johnson contributing significantly until his retirement in 1971.

Johnson's inventive career began when, as a high school teacher in Michigan, he developed a mark sensor to score tests and was hired by IBM to develop this idea as an IBM product. He subsequently worked on a wide variety of technologies in IBM and has received more than 80 patents in educational technology, keypunch devices, code translations and communications technology in addition to magnetic storage systems. Many of his inventions, such as wire matrix printers, keypunch mechanisms and document moving devices, have been implemented in IBM products and are still in the product line. His central contribution, however, remains the random access disk file, which is one of the handful of most important developments in the history of computer technology. In his efforts to improve price-to-performance ratio, he developed and implemented a multiple head actuator, allowing the same fast access from any disk of a multiple disk spindle.

Johnson's principal contributions in technology were (a) his keen insight that magnetic disk technology would provide the best approach to a random access memory, (b) leadership in the introduction of the first random access magnetic disk storage unit and in later advances, such as a multiple head actuator and (c) personal contributions in the development program as evidenced by his substantial patent activity in the field. His laboratory administration was distinguished by a unique leadership that inspired innovation and creativity by a combination of example and challenge

The magnetic disk technology, pioneered by Reynold Johnson, has had a tremendous impact on business world wide. In addition to the rapid development of the data processing industry, this technology has resulted in significant improvements in the quantity and timeliness of information availability. This, in turn, has had a major positive influence on the entire business community. The Magnetics Society award is a fitting tribute for the man who developed and introduced magnetic disk storage.

I am honored, on behalf of the Magnetics Society, to present Mr. Reynold B. Johnson with the IEEE Award for Information Storage.

MAGNETICS SCHOLARSHIP PROGRAM

We are pleased to announce the 1991 competition of the Magnetics Society Scholarship Program. This program has been established for the children of Magnetics Society members through the annual nationwide scholarship competition conducted by the National Merit Scholarship Corporation. The National Merit Scholarship Corporation (NMSC) is an independent, nonprofit organization whose major purposes are; (1) to identify and honor exceptionally talented high school students and to aid as many as possible in obtaining a college education, and (2) to enable business enterprises and other organizations to contribute more readily and effectively to the support of higher education through scholarship grants.

One Magnetics Society Scholarship will be awarded in the Spring of 1991 to a student who will complete high school requirements and who will enter a regionally accredited U.S. college in 1991 to pursue courses of study leading to one of the traditional baccalaureate degrees.

The Magnetics Society winner will be chosen through the facilities of NMSC from among children of Magnetics Society members who meet the competition requirements established by NMSC. The winner will be chosen on the basis of test scores, academic record, leadership, and significant extracurricular accomplishments.

The Magnetics Society Scholarship will be a renewable award covering up to four years of full-time study or until baccalaureate degree requirements are completed, whichever occurs first. The amount of the stipend accompanying the scholarship will be related to the individual winner's financial situation and the costs of attending the college of the winners choice. The maximum amount that may be awarded to a winner is $4,000 per year; the minimum will be $1,000 per year.

Descriptive material and entry blanks for the Magnetics Society Scholarship may be obtained by writing to the Magnetics Society Scholarship Program Director listed below. Interested children of members should arrange to take the PSAT exam in October of this year if they are high school juniors. Completed entry blanks must be returned to the Program Director by January 1, 1990.

Dr. Bernard R. Cooper
West Virginia University
Department of Physics
Morgantown, WV 26506

STUDENT TRAVEL GRANTS FOR BOSTON MMM

The 1989 Conference on Magnetism and Magnetic Materials intends to award a limited number of grants to support students attending the meeting in Boston. Preference will be given to students who are nearing completion of their graduate studies and who are presenting conference papers. Applications should be in the form of a one page letter with the following information:

- Name, address and phone number of the student, his/her advisor, and FAX/E mail numbers if available;
- Title and a 1-2 sentence description of the student's thesis;
- Title of any paper(s) accepted for the '89 Conference;
- Source and extent of the student's current financial support;
- Itemized budget for attending the Conference (airline travel should be at the most economical fare possible);
- Any previous travel awards received for MMM or Intermag Conferences;
- Endorsement of the student's faculty advisor.

Because of the limitation on funds, it is expected that the costs of attendance will be shared by the student and his/her institution. Applications received after September 4, 1989, cannot be guaranteed consideration. Applicants will be notified by October 1, 1989 of the decision.

The application should be sent to either:

Gordon E. Fish
Allied-Signal, Inc.
Box 1021R-CTC
Morristown, NJ 07962,

or,

Barbara J. Shula
Hewlett-Packard Laboratories
Box 10490
Palo Alto, CA 94303

REFLECTIONS FROM AN OUTGOING DIVISION IV DIRECTOR

Gary A. Thiele

Gary A. Thiele

After two years of serving as your Divisional Director, I would like to share with you some observations from the perspective of an outgoing Director.

Volunteerism is both a strength and weakness of the IEEE. Aside from the IEEE staff in New York and New Jersey, essentially all other positions are volunteer. Elected positions are either for one or two years while appointed positions vary somewhat more in the duration. Thus, people come and go rather quickly and the organization as a whole tends to suffer from short "corporate memory." On the flip side of the coin, the steady stream of volunteers does insure a constant supply of willing workers with fresh ideas and invigorating enthusiasm.

Most volunteer positions require a reasonably modest commitment of time on the part of the volunteer. Exceptions to this are positions at the Board of Directors level which require considerable amounts of time. For example, a Divisional Director is: 1) a member of the Institute Board of Directors (BOD); 2) a member of TAB, OPCOM, the executive committee of TAB, the Technical Activities Board; 3) a member of another board as a liaison between that board and the Board of Directors or a member of a major committee as a BOD representative. Memberships (1) and (2) require at least five trips per year, three of which last for six days. If TAB OPCOM meets outside of North America as it is committed to doing annually and which it did this past autumn, add two weeks to the travel schedule. Membership (3) typically can require three more trips of the one to three day kind depending on the assignment. In addition to this, there are five societies in Division IV which are APS, EMC, MAG, MTT, and NPS. Thus, there are five ADCOMS that look forward to having the Divisional Director at ADCOM meetings. For obvious reasons, I found it impossible to meet this ADCOM expectation and was grateful for the understanding and cooperation of the society presidents on this matter.

In my opinion, as well as that of others, the best interests of the Institute are not served by over burdening its volunteer workers. What can be done about it? I made a preliminary proposal at the June special meeting of TAB OPCOM that there be established the position of Division Director-Elect. This would be the elected position and would automatically lead to the Division Director position after a one year tour as Director-Elect. During this year the Director-Elect would serve without vote, but would liaison with the division ADCOMS. If managed properly, this arrangement could take some of the load off the Division Director, and it would also provide a period of time during which the Director-Elect could get up to speed on the various issues. The way things are done now, the in-coming Divisional Director hits his new duties pretty cold and spends the better part of the first year learning the issues and politics involved. After two years he is gone. Unfortunately, unless one of the continuing directors takes up an interest in the Division Director-Elect proposal, it will die for lack of sponsorship.

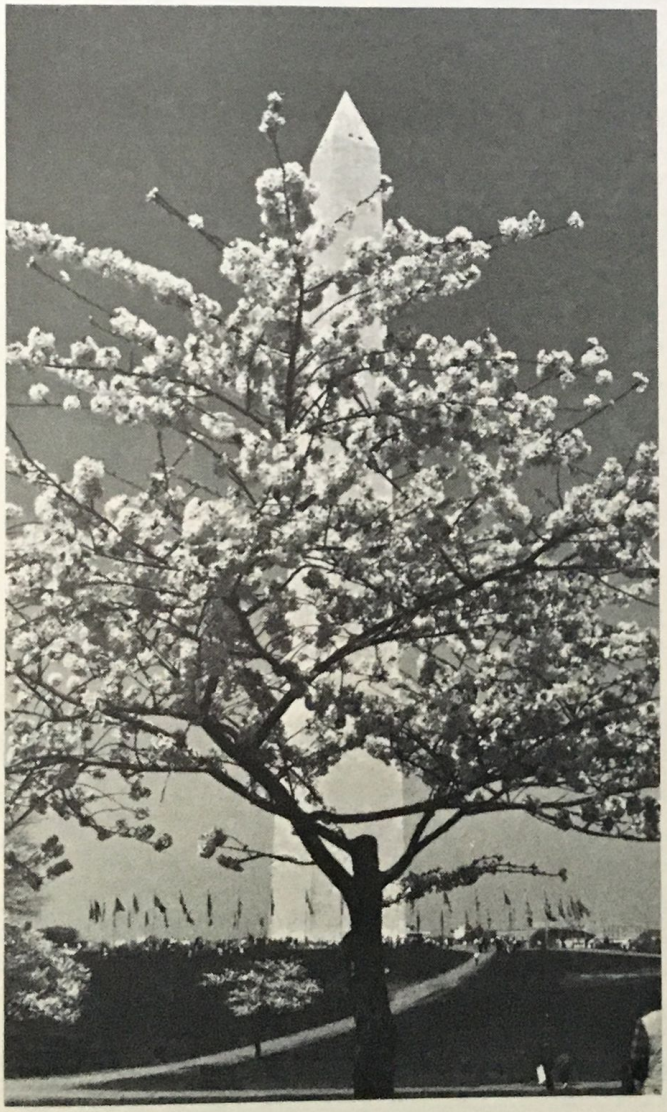
Next, there is the issue of size. The size of TAB (over 50 members) and the BOD (33 voting members) are both too large. It is widely recognized by those of us on TAB OPCOM that TAB is too large, so much so that much of its effectiveness is lost. I look for proposals to down size it. This will be about as easy to do as closing a military base, but it should be done. Furthermore, in my own opinion, the BOD is too large as well, but not to the same degree as TAB. Changes in the Board of Directors are not likely, however.

Finally, some have asked why I'm not seeking higher office. The sole reason is that I need to direct my energies at my career. I have, hopefully, 15 to 20 more productive years ahead of me and now is the time to seek out some fresh challenges. I have enjoyed many aspects of my tenure as your Division IV Director and thank you for the opportunity to serve. I turn over the reins to the capable hands of Len Carlson. Give him your support and cooperation as you have done for me.

Best wishes to all!

CHAIRMAN'S PREFACE (from page 1)

More personally, I would like to thank all the volunteers, without whom the conference could not function. Especially noteworthy was the work of the Program Committee, who had the unrewarding task of winnowing the large number of submitted abstracts down to a number that would fit into the schedule. Likewise, the efforts of the Publication Committee to coordinate authors, reviewers, and deadlines deserve recognition. Their work will result in the archival, refereed record of the Conference in the *Transactions on Magnetics* that will provide a lasting record of the Conference. And, many thanks also to Courtesy Associates for their significant assistance in all aspects of planning and running of the Conference.



INTERMAG '89 SESSIONS

March 28-31, 1989
Washington, DC

SESSION AA

Recording Heads
David Hannon

Session AA, Recording Heads, began with an invited paper by Lazzari, et al, describing a new method to manufacture heads on a silicon substrate. The "horizontal" head does not require lapping and polishing and holds out the hope of integrating the reading and writing circuits into the silicon substrate. Quite acceptable read back pulses were shown from this promising future technology.

Four papers, AA-7 through AA-10, all addressed the most pressing problem of the present, namely, to minimize distortion of the read back pulse arising from domain fluctuations. These papers argue the location and cause of the fluctuations, but the debate goes on.

Paper AA-02 compared NiFe and CoZr tape heads and showed that on metal particle tape the CoZr material (4 piM - 14,500 gauss) has superior performance.

Paper AA-03 described a straight forward method of measuring track widths and paper AA-04 described 3D simulation of side writing.

Turning to magnetoresistive heads, Paper AA-05 gave the important theoretical understanding for the track profile of M. R. heads and, Paper AA-07 outlined the trade-off between stability and output for an MR head.

SESSION AC

Miniature Microwave Control Components
Denis C. Webb

This session consisted of six invited talks which discussed the fabrication and design of miniature microwave ferrite devices and compared the performance of these devices with the obtainable alternate device technologies. Ernst Schloemann (Raytheon) presented fundamental size-performance tradeoffs in lumped-element circulators as well as recent work on planar distributed field approaches, pointing out that significant size reduction is possible with optimum design. In a complementary paper Yalcin Ayasli (Hittite Microwave) described how the circulator function can be realized in MESFET-based monolithic circuits with overall circuit performance comparable to that of circuits

which employ ferrite circulators. Hassan Tanbakuchi (Hewlett-Packard) described a family of magnetically tuned devices–filters, oscillators, and discriminators based on YIG-sphere and YIG-film technology. He also discussed recent work on millimeter wave filters which employ hexagonal ferrites. In the next talk Elias Reese (Texas Instruments) contrasted voltage and magnetically tunable oscillators, pointing out that magnetic-devices have superior linearity, bandwidth and noise characteristics while voltage-tuned devices have superior speed, efficiency and mechanical (size, weight, vibration) characteristics. Their complementary performance seems to assure a role for both in the near future. Doug Adam (Westinghouse) contrasted the performance of magnetostatic wave (MSW) and surface-acoustic-wave (SAW) devices for signal processing. He noted that the most promising MSW applications are those which require only a limited bandwidth, e.g. frequency filtering and frequency selective limiting.

The final talk in the session by Daniel Ryder (Tufts) described progress in deposition of barium hexaferrite films from solution. When perfected, this technique is an excellent candidate for producing films for miniature microwave and millimeter wave devices. The session gave an excellent overview of the status and future role of several important microwave devices.

SESSION BA

Recording Systems and Noise

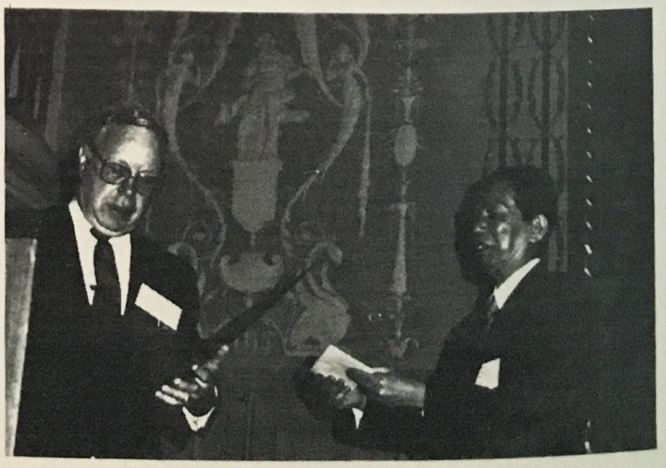
Steve Brittenham

This session covered a variety of familiar topics and some novel ones as well. Familiar topics included transition noise, track edge effects, perpendicular recording applications, and the effects of thin film disk alloys on electrical performance. A study of air circulation within a hard disk drive and a downward compatible floppy disk configuration capable of handling 16 Mbyte disks were described. And a magnetooptical means for reading back digital information recorded on video tape was presented.

Two papers discussed specific applications for perpendicular recording. In BA-02, Dr. Yamamoto described that for a 3.5", 25 Mbyte floppy disk image file, where error rates of 10^{-5} are acceptable, perpendicular recording is feasible. Conversely, for a kbpi, 2200 TPI rigid disk system, Dr. Beaulieu (paper BA-01) detailed the aggressive 1.3 um servo tolerance needed by his perpendicular recording system to demonstrate the significantly better error rates required in data storage applications.

Two IBM Almaden papers described track edge effect. Dr. Lambert (paper BA-05) summarized previous discrete track techniques for characterizing both media noise and TF head effect, then described the necessary considerations when studying track edge noise. In paper BA-06, Dr. Su wrote with a TF inductive head and read back with an MR head to relate read back waveform baseline shifts to track edge effects; the results were used to suggest head and media modifications to reduce this shift. Transition noise also was a popular subject. In paper BA-08, Dr. Ferrier captured transition regions using Lorentz microscopy techniques, then used Fourier transforms to relate transition noise quantified by spectrum analyzer measurements to the resulting micrographs. Dr. Zhu (paper BA-09) extended transition noise simulations described at previous Intermag conferences by including exchange coupling and dispersion of the easy-axis angles. And in paper BA-10, Dr. Shiroishi characterized the electrical performance of various alloys and deposition thicknesses.

Three different systems issues were addressed. In paper BA-03, Dr. Sakai described a configurable servo system with an analog configuration that is compatible with traditional 1, 2, and 4 Mbyte floppy disks and a hybrid analog/digital configuration that support a higher 16 Mbyte format. And as an alternative to helical scan video recording, Mr. Maurice (paper BA-11) offered a multi-track magneto-optical read back scheme for an 8 mm magnetic video tape. As a final system consideration, Dr. Yamaguchi (paper BA-04) used pictures of air flow patterns to illustrate the use of partitions to optimize velocity profiles and flow rates within a two disk, 3" rigid disk drive.



SESSION BB

Magnetic Measurements - Magnetometers
Gerald F. Dionne

The session opened with an invited review of current magnetometry by M. M. Acuna of Goddard Space Flight Center, who focused on vector flux-gate and scalar proton precession magnetometers, and pointed out how advances in materials and digital electronics will continue to make these instruments important for a variety of industrial, geophysical, biological, and navigational applications in both terrestrial and space environments.

Two papers on magnetic field controlled sensors were presented by authors from Kyushu Institute of Technology. The first, by T. Sonoda, described an innovation based on a "zero magnetic field concept", and the second, by K. Kudo explained the operation of a double ring-core bridge-type sensor with proposed sensitivity comparable to a SQUID magnetometer.

A ring-core in combination with MOS-FETS was shown by H. Sakamoto of Kyushu University to provide the basis for a simple instrument of sensitivity sufficient to measure the magnetic field of the human heart.

W. Z. Fam of the Technical University of Nova Scotia described an elegant Poynting vector probe that features both low cost and ease of construction, in addition to high accuracy for direct measurement of load losses in high-voltage power transformers and shunt reactors.

A torsion pendulum concept applied to the magnetic anisotropy characterization of powdered barium ferrite was described by H. J. Richter of Aachan University of Technology. The results indicated that the method is sensitive to the effects of chemical substitution on the particulate media and could be useful in detecting inhomogeneities and different phases.

W. F. Arvin of Quantum Magnetics, Inc. described a free-precession magnetic detector (FPMD), a sophisticated optically-pumped Zeeman effect magnetic sensor that uses the free-precession of potassium 39 atoms in a three-step procedure to provide submilligamma sensitivity.

The operation of a low-power portable (battery operated) magnetometer that employs an eddy current sensor and features 1nTs sensitivity was explained by R. Rabinovici of Ben-Gurion University of the Negev.

J. Pressesky of Seagate Magnetics described the principles of a nondestructive technique for determining the spatial distribution of longitudinal coercive fields in thin-film recording media by in situ measurements.

The generation of zero-level fluctuations in magnetic head type torque sensors and methods to reduce them was discussed by I. Sasada of MIT/Kyushu University.

In the final contributed paper, D. Son of Physikalisch-Tech. Bundesanstalt described a novel flux-gate magnetometer based on measurement of the observed core material coercive field shift that is caused by the external field and is normally present in the course of magnetometer operation.

SESSION BD

Domains and Domain Walls
Philip E. Wigen

The papers in this session can be divided into three categories. The first was related to Barkhausen jumps in stainless steel sheets and pipes. The second series had to do with micromagentic evaluation of various domain patterns and switching mechanisms associated with small particles and the third class of papers were associated with the problem of Bloch points within Bloch walls.

In the first two papers the Barkhausen noise in the magnetic hysteresis loop was used as a means of nondestructively testing ferromagentic materials such as pipelines or steel sheets was reviewed. It was reported that the Barkhousen noise could easily be related to the stresses in the material.

In papers 3 through 8, micromagentic evaluations of various magnetic domain patterns and switching mechanisms were considered. The papers included the evaluation of the equilibrium magnetic domain organization in a film patterned after Permalloy properties being 500 A thick and 5.4 x 200 microns in size.

Another paper considered numerical micromagentic calculations to evaluate the switching behavior modeled after barium ferrite particles showing the curling mode generated by a soft spot in the center of the platelette by the demagnetization was the most favorable switching mechanism. A third paper in this area considered a numerical calculation of magnetization reversals and hysteresis loops for small prolate spheroids and the calculations were compared with experimental results. In another paper the fundamental theorem of Brown applied to spherical particles was extended to that of right circular cylinders and a critical size condition was evaluated in which the magnetization reversal process would either occur by domain rotation or by a curling mode. The conclusions are that the acicular particles used in the present day recording media reverse by the curling mode.

In a slightly different application, one paper considered the forces applied to a very fine magnetic needle that could be used as a scanning detector in which the forces on the tip of the needle were evaluated again using a micromagentic calculation. An experimental paper reported the magnetic domain response of a very thin film inductive head in which the drive field and the drive frequency were changed. The changes in the domain pattern could be represented as phase boundaries associated in the amplitude vs frequency of the drive.

The final 2 papers of the session considered the problem of the motion of Bloch points within a Bloch wall. Bloch lines in a Bloch wall are unstable, but in the presence of a Bloch point it was possible to reverse the chirality of the Bloch line and the pair of Bloch lines would then become stable. In the final paper, an experimental setup to measure of the displacement of single Bloch wall under dynamic conditions was reported and the results were found to be useful for developing an interpretation of Barkhausen noise in terms of the wall dynamics.

SESSION BQ

Superconducting Materials and Measurement

S. Schultz

In paper BQ-01 Gallo, et al presented extensive magnetization and EPR measurements of Gd_2CuO_4 and other R_2CuO_4 single crystals as a function of field angle and temperature. These data reveal two characteristic transition temperatures, one attributed to an AF ordering, the other to a spontaneous canted spin reorientation.

BQ-02 did not appear. BQ-03 investigated the effects of the amount of time spent at the sintering temperature in the $(Bi_{0.7}Pb_{0.3})_{1-y}SrCaCu_{1.8}O_x$ system. They found that in order to get the highest T_c phase, it is necessary to sinter for 10 days at 845°C.

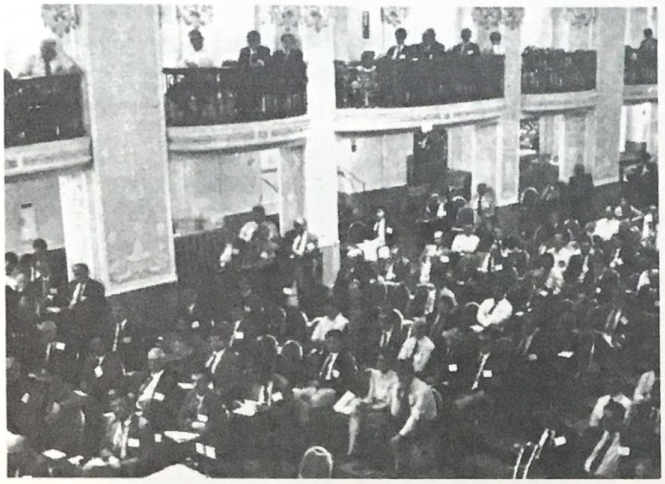
BQ-04 studied the time dependence of the dc magnetization in a Gd (1:2:3) and Dy(1:2:3) powder in the temperature range where the rare earth orders antiferromagnetically. They found that above the ordering temperature the diamagentic susceptibility shows a time dependence.

BQ-05 reported DC magnetization on high T_c powders and interpret their results as consistent with s-wave pairing. Their ac susceptibility data are interpreted using Bean's model and yield the temperature dependence of the shielding currents.

BQ-06 reported on a magnetic field sensor using a super conducting magnetic multivibrator fluxgate design incorporating a high T_c Y(1:2:3) core. They have a sensitivity of <1 Oe, and a response to 20 mHz. Both second harmonic type, (AC source), and voltage output multivibrator type, (DC source), sensors were described.

Paper BQ-07 was a study of the composition variation of a sputtered file of Y(1:2:3) as a function of substrate temperature, gas pressure, and substrate position. They found that the sticking probability of Cu decreases with the substrate temperature and gas pressure, and that the sticking probability of Ba decreases with the gas pressure.

BQ-08 studied the linear and the non-linear dynamics (via AC susceptibility) in a high T_c granular superconductor. They interpret their data as evidence for a low field super conducting glass state which cannot be explained over the entire critical temperature range by either the Bean or the critical state models.



SESSION ED
Magnetoelasticity and Multilayers
J. D. Livingston

Six papers in this session dealt with magnetoelastic effects in amorphous metals. Lachowicz and Siemko reported on the stress dependence of saturation magnetostriction, an effect that is most significant in low-magnetostriction Co-rich alloys. In one such alloy, magnetoelastic anisotropy first increased and then decreased and became negative with increasing stress, resulting in rotation of domains, first towards and subsequently away from, the ribbon axis. Squire and Gibbs measured the ΔE effect on Fe-rich amorphous ribbons with oblique easy axis, and modeled their results with a distribution of initial moment directions and anisotropies. Clark and Wun-Fogle measured magnetostriction by comparing permeability curves under constant stress and constant strain, and presented data for transverse-annealed ribbons and wires. Amorphous wires, produced by quenching in rotating water, have a complex stress-reduced domain structure. Three papers discussed measurement of magnetostriction and induced anisotropy, stress effect on hysteresis loops, magnetoresistance, and domain observations on such wires.

Rounding out the session were one paper reporting attempts to measure volume magnetostriction in terfenol (Fe-Dy-Tb) and two papers on magnetic multilayers. Grundy, et al reported structural properties and moment, anisotropy, and coercivity of Co/W and Co/Cr multilayers, and Motomura and Urai reported similar measurements of Fe/Ni and Co/Ni multilayers. The latter authors also measured magnetoresistivity greater than for the pure metals, and related this to interdiffusion across the multilayer interfaces.

SESSION EQ
Recording Heads
David Heim

A generally high level of interest was shown in this session. The papers were concentrated in the area of thin film inductive heads (9) followed by MR (5), MIG (2), and ferrite (2). Koyanagi, et al, presented a FEM analysis of stress distributions in film heads. Scholz and Schulz modeled the dependence of film head efficiency on yoke shape. Nishimura, et al, presented data on the heat treatment of CoZrRe films for film heads. Koshimoto, et al, obtained good agreement between data and a simple model for side reading from film inductive heads. Modeling of cross talk in multitrack film heads was presented by Sasaki and Sawada. Chapman presented a new approach to making horizontal film inductive heads. Film heads for perpendicular recording were discussed by Hesterman and Gill (new design to reduce stray field induced erasure) and Zhang-an and Zheng (influence of pole dimension on performance). A composite film/ferrite head was described by Moriceau and Jouve. Modeling results for a new horizontal MR head structure were discussed by Chapman, et al. Tsang showed quiet response curves in unshielded MR sensors with patterned exchange. The stray field response of shielded MR heads was explored by Smith. Performance data for unshielded MR tape heads biased by a TbCo exchange layer were presented by Cain and coworkers. Kanai, et al, showed experimental data linking the shape of the shielded MR head track profile to the sensor magnetic state. MIG heads were the subject of the papers by Nakao, et al, (data on bit shift characteristics and secondary gap effect) and Koeppe and Dryder (correlation between Kerr images of the gap region and the presence/absence of the secondary gap effect in the measured, isolated pulses). The field distribution of infinite pole tip inductive heads was discussed theoretically by Minuhin (finite gap depth effects) and Tomsia (approximations for head fields).

SESSION GB
Magneto-optic II: Recording Materials
Roy Callaby

One of the interesting features of this session was the fact that the majority of papers presented dealt with environmentally stable layers such as Co/Pd, Co/Pt and Garnets. There were two

papers on garnets. H. Kano of Fujitsu Labs reported on rf diode sputtered Bi,Ga:Dy1G films and disks. Using a garnet film thickness of .23um, with an aluminum reflector thickness of 0.1um, they were able to obtain a CNR of 60 dB. W. Eppler of CMU showed the Bi substituted Gd1G films deposited by rf magnetron sputtering on to glass substrates is suitable for magneto-optic recording.

All four papers on multilayer films of Co/Pd and/or Co/Pt films referred to the original work by P. F. Garcia of DuPont who showed that perpendicular magnetic anisotropy could be obtained using a multilayer structure. W. P. Zeper of Philips Research Lab., showed that square hysteresis loops could be obtained with 4 A thick layers of Co (i.e., 2 atomic layers) together with Pt layers greater than 12 A. They prepared a disk using e-beam coating techniques and measured a CNR of 49 dB and estimated that CNR values above 60 dB could be obtained. Two papers from Nagoya University reported on Pd/Co multilayer films–K. Nakamura used magnetron sputtering and showed that the film behavior could be explained by an interfacial alloy model whilst S. Tsunashima showed that stress induced anisotropy due to lattice misfit could be one of the origins of the perpendicular anisotropy in Pd/Co multilayer films. Y. Ochiai of Sony looked at both Pd/Co and Pt/Co multilayer films and considered that the perpendicular anisotropy was due to interfacial stress and crystallographic anisotropy. The first three authors all noted the fact that the Kerr rotation of these material increases very much as the wavelength of the light is reduced towards the U. V. compared with TbFeCo materials which peak in the infra red. A fifth paper on CoPd by R. J. Gambino of IBM examined the exchange coupling of this material with TbCo magneto-optic films. He showed that these layers exchange couple only when the CoPd is deposited first and then the exchange field only orients the first 8nm of the CoPd layer. W. Reim of Siemens examined Kerr rotation and reflectivity of FeCo films with different reflector layers. They found that Al reflector layers were not as good as Au layers at 780nm and Ag reflector layers were better at short wavelengths. The remaining two papers dealt with RE/TM coatings. D. K. Hairston of CMU showed that the polar Kerr effect decreased as heavier rare earth elements from Gd to Er were used whilst the perpendicular anisotropy was highest with Tb. M. Nakada of NEC Labs found that the Kerr rotation enhancement in Nd-Dy-FeCo was caused by the film microstructure.

SESSION GP
Soft Magnetic Materials and Devices
P. P. Biringer

This was a session of new ideas and innovations. It was a pleasure to see and have explained by the authors the large number of original approaches. A new electric power sensor was shown by Yoda, Kurashima, Endoh and Wakatsuki of Fukitsu Ltd. All elements, including the transformers were included in the small housing. Good accuracy was shown in the power frequency range of approximately 40-100 Hz. A very original current detector based on skin effect was shown by M. Yamaguchi. It was developed by him and his colleagues at Tohoku University. Accurate results were obtained up to 300 kHz. A variable reluctance sensor using a multiplicity of wound ferrite cores for eccentricity sensing was shown by M. G. Lemarquand, Universite de Savoie, Annecy. A new magnetic position sensor was developed by I. J. Garshelis and W. S. Fiegel of magnetoelastic Devices Inc. A good application for liquid level sensing was shown. Another interesting development was shown by Mr. E. W. Hill of the University of Manchester. This was a Vector Sensor with trimmable sense axis direction. A very original shielding technique was described by Mr. A. Haga of Tohoku Gakuin University. He uses u-shaped magnetic materials to achieve good shielding. The length, the number and dimensions of the shielding material are dependent on the strength of the field to be shielded.

SESSION HC

Field Calculations: Hysteresis and Eddy Currents

D. A. Lowther

The session consisted of two distinct parts; that concerned with hysteresis modeling and that with eddy current problems. This was made very obvious by the fact that over 85 people were present for the work presented on hysteresis, whilst only 47 remained for most of the eddy current session. This is probably indicative of the wide range of applications requiring a solution to the hysteresis problem.

Much of the work presented described developments in methods, rather than any new approaches to the problem. Drs. C. D. Boley and M. L. Hodgdon continued their efforts to produce an analytical model of hysteresis, whilst Dr. I. Mayergoyz, along with G. Friedman and C. Salling continued with their work in using the Preisach model. This latter method was also discussed in a paper by Drs. G. Kadar, E. Kisdi-Ksozo, L. Potocky, M. Zatroch and E. Della Torre. The results shown were interesting although it does seem that, as might be expected for modeling a system with memory, the method is computationally expensive. It is this expense which has led to the work of Boley and Hodgdon as well as the paper presented by Drs. D. C. Jiles and J. B. Thoelke, which attempt to use an analytical expression to represent hysteretic behavior. However, it seemed unclear as to whether these last approaches could handle minor as well as major loops. In general, all the papers provoked much interest and resulted in both questions and stimulating discussions.

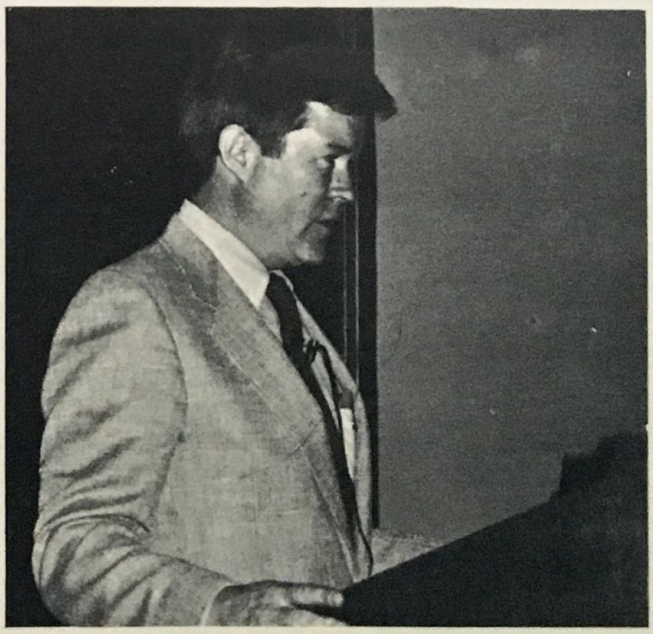
The major part of the session, although less well attended, covered a range of problems involving eddy currents and techniques for solving them. Drs. J. Weiss and V. K. Garg described a system for analyzing time dependent, i.e., transient, problems including a specification of the terminal conditions in terms of voltages. Drs. M. T. Ahmed, J. D. Lavers and P. E. Burke presented a solution method using boundary integral methods coupled to surface impedances to represent the conducting regions and, in a second paper, discussed similar methods for handling the multiple conductor induction problem. Coupled problems including eddy currents and thermal effects were described by Drs. P. Molfino and M. Repetto, in particular with reference to the design of Tokamak coils. Continuing the combination of several methods or problem areas, Dr. O. A. Mohammed developed an optimization process for the design of magnetic devices. This involved the definition of a design space by performing several finite element analyses with varying geometries, and then using a dynamic programming approach to optimization. Finally, a hybrid boundary element/finite element method was proposed by Drs. P. S. Shin, K. A. Connor and S. J. Salon for dealing with waveguide problems. Whilst the attendance for this part of the session was low, the quality of the papers was very good but left the feeling that there is still much work remaining to be done in this area!

SESSION HQ

Magneto-Optic III

Craig Perlov

This poster session was a potpourri of twelve papers largely on magneto-optic media. Perhaps the most innovative was paper HQ-09 which presented a new medium design for direct overwrite. This is a three layer medium with a soft magnetic shield between the memory layer and the bias layer. At high write power a "paramagnetic hole" is created in the shield layer and permits field from the bias layer to enter the memory layer. The other papers generally fell into one of two categories. There were material studies of magnetic properties and computer simulations. There were two papers on new garnet materials (HQ-01 and HQ-02) which show large Faraday rotation. Anisotropy in rare earth- transition metal alloys was discussed in HQ-03, 06 and 08. The computer simulations included an extension of the mean field analysis work (HQ-04) and some interesting thermal computations (HQ-12, 13).



SESSION JA

Particulate Recording Media: Barium Ferrite

M. P. Sharrock

This session was devoted entirely to the physical and magnetic properties and the recording performance of barium ferrite platelets, a relatively new particulate recording material.

D. E. Speliotis of Advanced Development Corp., presented data showing that in rigid disk formats barium ferrite can have high-density performance comparable to that of thin-film coatings and superior to that of cobalt-modified acicular oxides. The desirable recording properties of barium ferrite were stated to correlate with parameters that can be measured from remanence hysteresis loops.

R. G. Simmons of IBM described correlations between recording properties and the physical and magnetic parameters of longitudinally oriented barium ferrite coatings on rigid disks. The results confirmed the applicability of barium ferrite to rigid disks and showed the relevance of existing recording theory to its behavior. The effects of substrate properties of film quality were also described.

E. F. Wollack of 3M discussed the effect of coercivity on high-density output in longitudinally oriented barium ferrite tapes. The output for a helical video recorder increased with coercivity, but that for an experimental recording apparatus, having a different head-to-tape interface, showed essentially no dependence.

Y. Okazaki of Sony reported that perpendicularly oriented barium ferrite tapes are suitable for magnetic contact duplication in the R-DAT format. The transfer process for high-density digital signals becomes more efficient with increasing perpendicular squareness, but very high squareness values (>0.8) produce waveforms that may not be compatible with head-written longitudinally oriented tapes.

T. Suzuki of Toshiba also discussed the use of perpendicularly oriented barium ferrite tapes for R-DAT contact duplication. As in the previous paper, the high-density duplicated output was found to increase with perpendicular squareness. The digital error rates, however, were lowest for an intermediate squareness value, about 0.66, because higher values produced a sufficient perpendicular magnetization component to cause phase mismatch in the signal processing.

M. Kishimoto of Hitachi Maxell described the temperature dependence of the effective magnetic anisotropy, obtained by torque measurements, for a perpendicularly oriented barium ferrite coating. Together with the temperature dependence of the saturation magnetization, this was used to derive the crystalline anisotropy constant as a function of temperature. The similar temperature dependences of the effective anisotropy field and the coercivity were presented as evidence of coherent rotation at temperatures from 78K to 400K.

A study presented by D. E. Speliotis of Advanced Development Corp., however, found the coercivity and anisotropy field to have different temperature dependences in barium ferrite powders. This led to the conclusion that the switching mechanism changes between coherent and incoherent modes as a function of temperature.

D. G. Agresti of the University of Alabama described Mossbauer spectroscopy studies of Co-Mo substituted barium ferrite; this material is intended to serve as a model for the Co-Ti substituted barium ferrite commonly used in recording media because it gives very well resolved spectra. A five-site fit to the spectra was used successfully over a range of Co-Mo content, with the result that substitution is seen to occur primarily in the 12K site.

F. Schumacher of Aachen University of Technology described the effect of acid etching on the coercivity and switching mechanism of unsubstituted barium ferrite particles. The dependence of the switching field on the angle of the field application was used to determine the switching mechanism, which in some particles could be made closer to Stoner-Wohlfarth behavior by etching.

SESSION JB
Coding and Channel
N. H. Yeh

There were ten papers presented in this session including one invited talk. S. Olcer analyzed the maximum-likely sequence detection of normal and extended class IV partial response signals and found the former has more robustness in off-track performance. R. Wood described a modified linear canceller for use with (1,k) code. The performance is approaching a Viterbi detector with, however, a much simplified implementation. J. W. M. Bergmans presented a method based on echo cancellation technique to characterize the linear and non-linear distortions in a recording channel. K. Fisher and Y. Lin both modeled and analyzed non-linear channel distortions. K. Kato studied the channel requirement in perpendicular recording systems with a MIG head of significant secondary gap effect. A. D. Weathers compared SNR and peak shift of "Controlled modulation Code" with conventional (d,k) codes. K. French and L. Fredrickson both described methods to construct RLL codes with error correction capabilities. Finally, A. M. Patel gave an invited talk on the two-level coding scheme used for error control in IBM 3380 J and K disk drives. The first level code provides fast correction for one-symbol errors and the second-level code may correct up to two symbols for additional protection.

SESSION KA
Perpendicular Recording Media
Jack H. Judy

Tagawa and Nakamura from Tohoku University presented results of a computer simulation analysis of perpendicular magnetic recording based on a new model using a finite element method with a magnetization reversal model of curling. Their simulation explained their experimental results on head-media magnetic interactions. Suioka, Sai and Ashar from IBM used a large-scale (5000x) single pole head to simulate perpendicular recording on Ba-ferrite media with a Permalloy underlayer to show that the 2-D magnetization at the track edge is as sharp as the transition edge. Mapps, Mahvan, and Akhter of Plymouth Polytechnic used ultra-sensitive thermal evolution mass spectroscopy to measure a linear increase of Ar and a monotonic decrease of N; the N appears to be the cause of an increase of the coercivity in sputter CoCr films with increasing bias. Jang, Kim, Lee from KAIST and Kang from Seoul University showed that a maximum anisotropy field and HCP c-axis alignment were found for a RF magnetron sputtered $Co_{78}Cr_{22}$ film which was used as a 500 A seed layer to enhance the recording performance of double-layer CoCr/NiFe media. Lodder and Zhang from the University of Twente found that the perpendicular coercivity of iron particles in alumite media decreased with increasing packing fraction and reversed by incoherent curling rotation. Takahashi and Naoe from Tokyo Institute of Technology described the operation mechanism of a novel toroidal plasma type magnetron sputtering technique for depositing CoCr films in which an intense toroidal plasma is formed between an inner and outer cylindrical iron pole piece covered with Co and Cr. Kitakami, Ogawa, Yamagata, Fujiwara from Hitachi Maxell and Kugiya, Suzuki from Hitachi showed the same large improvement of the reproduced output of evaporated CoCr thin film (200nm) media by using either a Permalloy film (500 nm) or Co film (10 nm) underlayer separated from the Co-Cr film by a Ti film (10 nm). Rogers, Chapman, Bernards from Glasgow University and Luitjens from Philips showed by high spatial resolution x-ray microanalysis a 5% enrichment of Cr causing a reduction of the exchange coupling in the grain boundaries of high coercivity $Co_{73}Cr_{27}$ thin films deposited at 90 C on polyester substrates by RF sputtering. Sugita, Tohma, Honda, Kawawake, and Echigo from Matsushite showed that higher productivity can be obtained by ion beam bombardment of polyimide substrates before continuous vacuum evaporation of perpendicular CoCr films which exhibited as strong adhesion and high output as films made after either glow discharge and Ti underlayers. Tateno, Iwasaki, Naruse, and Chubachi from Sony showed that perpendicular Co thin films evaporated with O_2 at high deposition rate (3000 A/sec) and high incident angle (20-40 degrees) gave high coercivity (1400 Oe), anisotropy field (5.5 KOe), and output (wavelength of 0.5 micrometer) 13 db higher than metal powder tape. Akiyame, Sumide, Nakagawa, and Naoe from Tokyo Institute of Technology used the facing target sputter technique to deposit well-oriented perpendicular CoCr films continuously on heat-resistant polyethylene naphthalate (PEN) tape by first depositing 200 A through a narrow slit and then depositing through a wide slit at 500

A/min. Mapps, Mahvan, and Akhter from Plymouth Polytechnic showed that the surface coercivity and squareness of bias-sputtered perpendicular CoCr films measured by the magneto-optic effect are significantly different than the bulk properties measured by a vibrating sample magnetometer because of the presence of closure domains on the surface and Cr segregation inside.

SESSION KB

Magnetic Measurements-Magnetostriction, Microscopy, Magneto-optics

Charles Krafft

Papers in this session were in three general categories, magnetostriction measurement, microscopy, and magneto-optic measurement techniques. The first three papers described new techniques to measure magnetostriction. L. Kvarnsjo and G. Engdahl described an apparatus they used to make dynamic measurement of the magnetic and mechanical behavior of giant magnetostrictive materials. The apparatus uses an electronically controlled mechanical load to stimulate passive, time dependent, and active loads. D. Markham and N. Smith demonstrated a simple technique to measure magnetostriction in permalloy bars. The bars are used in MR heads. The sample is supported at its ends and deflected in the middle. The change in magnetoresistance is recorded as a function of hard axis field and related back to the magnetorestriction in the film.

K. Arai, M. Yamaguchi, and C. Muranaka reported on a magnetostriction measurement technique in which the film to be measured is deposited onto a piezoelectric substrate. A voltage is applied to the substrate to keep its length constant as a field is applied. This technique eliminates the need to know the elastic constants of the thin film.

The first microscopy paper was an invited talk given by J. Mamin that described magnetic force microscopy. The apparatus is similar to a scanning tunneling microscope except that a Ni or Fe tip is used. Since a significant portion of the tip interacts with the sample, different magnetization components can be detected by adjusting the probe angle. They achieved submicron resolution domain images on samples that required minimal preparation.

R. Brizzolara and R. Colton described a novel device for sensing the magnetostriction-induced length change in materials. By using the tunneling current in a tip similar to that used in the STM, they are able to detect changes in the length of the sample as small as 10^{-9}m and project an order of magnitude better ultimate sensitivity. The instrument can also be used to sense magnetic field by detecting the length change of a magnetostrictive metglas ribbon that is in an unknown field. Minimum field value detected was 60 microOersteds.

The next paper, by J. Unguris and co-workers described the use of Scanning Electron Microscopy with Polarization Analysis (SEMPA) to analyze chevron-shaped permalloy memory elements. They detected both the magnitude and the direction of the magnetization with 40 nm spatial resolution and +/-10 degree direction resolution.

The next paper, by C. Gudeman, D. Peter, J. Best, and D. Cheng described a magneto-optic Kerr BH looper that is used to map the easy axis, and several other parameters of soft magnetic films. The field from the air core coils is rotated electronically and a radial plot of the Kerr signal is generated and analyzed using the Stoner-Wohlfarth critical switching curve. This is a rapid, digital technique with 1 degree accuracy that is insensitive to stray fields, and subscribes to the no moving parts philosophy. K. Abe et al described a microKerr apparatus that has a 2 micron diameter beam size. The field is generated using a Weiss magnet that is under the microscope stage. This apparatus is used to measure the coercivity in thin film disks non-destructively. T. Numata and co-authors described a non-destructive technique to test steels. An AC magnetic field is applied to the test specimen and the leakage flux is detected optically by observing the effect on the domain structure in a magnetic garnet film that is placed on top of the specimen.

A. Hoare presented a paper on the application of the transverse susceptibility technique to measure the anisotropy energy and the orientation distribution function in fine particle systems.

In the final paper, H. LeGall reported on a non-destructive technique to measure the permeability of up to 5" diameter soft magnetic films. The film is included in the core of a coil and the films influence on the coil inductance is accurately measured.

SESSION KD
Bubble, Bloch Line, and
Other Solid State Memories
F. J. Friedlaender

There were eleven papers in this session.

Five papers dealt with Bloch line memories or memory concepts, two papers were on the subject of bubble memories. Then there were two additional Bloch line papers, dealing with device physics and mathematical modeling.

The final two papers on a magnetoresistive memory drew the largest audience which obviously was interested in how far the ideas presented at previous conferences had advanced.

In the first paper, Maruyama et al presented details of Bloch line propagation by means of a field access scheme. Bias field margins for successful propagation were given for positive as well as negative bias field operation. The frequency dependence of the bias field margin was also discussed.

In the second paper by K. Mizuno et al field access operation of a test structure was discussed. It consisted essentially of a single stripe domain along which Bloch lines were propagated. Two papers were presented by the LETI (Grenoble) group. The First (Zimmerman et al) gave details on the initialization of a Bloch line memory. Again margins of operation were given for the specific structures that were studied and detailed conclusions were presented. The second LETI paper (Arnaud et al) discussed vertical Bloch line propagation by means of bias field pulses (again, field access "gyrotropic force" propagation). Details of the propagation process were given, as obtained in part by the direct observation by stroboscopic means of wall displacement.

Matsuyama et al described the major line bubble propagation in a Bloch line memory. Again detailed bias field margins for different operating conditions were presented.

Y. Hosoe et al presented garnet film requirements for a 64 Mbit bubble device. Different substrates (GGG and OG) were proposed to obtain 0.4. - 0.45 um bubbles needed for a 64 Mbit memory in an ion-implanted device. Details of film parameters for different garnet compositions were presented.

A paper by Jo & Kryder discussed bubble collapse in ion-implanted propagation tracks.

Bettinger et al reported on state changes due to Bloch line creation and annihilation in bubbles propagating in a circular path. Bias field pulses were applied to cause the state changes.

Hayashi and Inoue presented computer calculations in an improved Bloch line model for low-Q garnet films.

The last two papers (Pohm et al and Yoo et al Iowa State University) dealt with the magnetoresistive memory being developed by Iowa State and Honeywell. A 10^8 bit/cm^2 array was presented and analyzed in the first paper. In the second paper a detailed analysis of the switching process in individual memory elements (sandwich-structured) was presented for both transverse and longitudinal elements.

CONFERENCE CALENDAR

International Perpendicular Magnetic Recording Conference '89, August 29-31, 1989, New Takanawa Prince Hotel, Tokyo, Japan. Contact Prof. Masahiko Naoe, Dept. of Physical Electronics, Tokyo Institute of Technology, 2-12-1 O-Okayama, Meguro-Ku Tokyo 152, JAPAN.

5th International Conference on Magnetic Fluids, September 1989 Riga, Latvia (USSR). Contact Professor E. Blums, Institute of Physics, Latvian SSR Academy of Sciences, 229021 Riga, Salaspils, USSR. Cable: Riga Atom USSR, Telephone 947188 (Riga)

7th COMPUMAG Conference on the Computation of Electromagnetic Fields, September 3-7, 1989, Tokyo, Japan. Contact Compumag Secretariat, Nuclear Engineering Research Lab The Faculty of Engineering, The University of Tokyo. Tokai, Ibaraki, 319-11, JAPAN.

EMMA '89, September 4-6 (MRM) and 6-9 (EMMA), Rimini, ITALY. For information please contact Dr. L. Pareti, Local Chairman, EMMA '89, ISTITUTO MASPEC, Via Chiavari, 18/A, 43100 Parma, ITALY, Phone 521-95811

34th Conference on Magnetism and Magnetic Materials, November 28-December 1, 1989 Sheraton Hotel, Boston, MA. For more information contact Diane Suiters, Courtesy Associates, 655 15th St. N.W., Suite 300, Washington, DC 20005 (202) 639-5088.

Image Storage and Retrieval Technologies, February 11-16, 1990, Marriott Hotel, Santa Clara, CA. Contact H-P David Shieh, IBM T. J. Watson Research Center, P.O. Box 218, Yorktown Height, NY 10598.

INTERMAG Conference, April 16-20, 1990 Metropole Hotel, Brighton, UK.

8th International Conference on Video, Audio and Data Recording, April 23-26, 1990, Birmingham, UK. For information contact Conference Services, IEEE, Savoy Place, London, WC2R OBL, Telephone 01-240-1871 x222.

35th Magnetism and Magnetic Materials Conference, October 29-November 2, 1990 Town and Country Hotel, San Diego, CA.

MAGNETICS SOCIETY CHAPTERS

Chairman: H. S. Gill (415) 857-5251

CHAPTER	CHAIRMAN	PHONE	DAY & TIME	LOCATION
Santa Clara Valley	Chandler Baldwin	408 298-8400	3rd Tuesday, 8:00 P.M.	H-P auditorium 5301 Stevens Creek Blvd. Santa Clara, CA
San Diego	C. S. Chi	619 455-9910	3rd Thursday, 7:00 P.M.	UC San Diego, CMRR
Pittsburgh	James Benford	412 226-6301	2nd Thursday, 7:00 P.M.	U of Pittsburgh
Twin Cities	Bharat Pant	612 541-2666	2nd Thursday, 7:30 P.M.	No fixed location
Milwaukee	K. A. Vollbrecht	414 259-5567	Feb., March, Sept., Oct.	
Houston	S. A. Long	713 749-2511	Not very active. Difficult to bring together people with diverse professional interests.	
Japan	Koosuke Harada	092-641-1101		
Boston	Shyam Das	508 841-3369		
Philadelphia	Bryen E. Lorenz	215 499-4040		
Washington, D. C.	E. Della Torre	202 994-5517	Two meetings a year. Difficult to bring together people with diverse professional interests.	
United Kingdom	N/A*			
Rochester, NY	N/A			
Princeton	N/A			
Los Angeles	N/A			

* N/A = Not Available

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