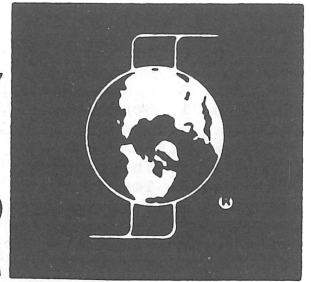


IEEE MAGNETICS SOCIETY NEWSLETTER



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FALL, 1980

RICHARD M. JOSEPHS, EDITOR

• SPERRY UNIVAC

• P.O. BOX 500

• BLUE BELL, PA 19424

DISTINGUISHED LECTURERS

The Magnetics Society is pleased to announce the Distinguished Lecturers for 1981. They are:

1. A. E. Berkowitz, General Electric Corporate Research & Development, Schenectady, NY 12301, "Magnetic Printing."
2. J. F. Dillon, Jr., Bell Laboratories, Murray Hill, NJ 07974, "Magneto-Optics."
3. C. D. Graham, Jr., Department of Materials Science and Engineering, and Laboratory for Research on the Structure of Matter, University of Pennsylvania, Phila., PA 19104, "Squeezing the Hysteresis Loop: Control of Energy Losses in Magnetic Materials & Devices."

The Distinguished Lecturer Program is intended to provide tutorial overviews of topical subjects in magnetics, to expose students to the excitement, challenge, and methods of technical innovation, and to introduce developments in magnetics to the non-technical community. It is an opportunity for local chapters, universities and other technical, educational and business groups to hear outstanding members of the magnetics community. The cost will be borne by the Society.

Any group interested in scheduling a Lecturer should contact the program coordinator, Geoffrey Bate, Verbatim Corporation, 323 Soquel Way, Sunnyvale, CA 94086, (408) 245-4400, X-214.

MULLER REPLACES CHARAP AS REVIEWS EDITOR OF TRANSACTIONS

After serving for five years, Stanley Charap of Carnegie Mellon University has resigned as Reviews Editor of the Transactions on Magnetics. Effective October 9, 1980, Marcel Muller of Washington University has become the new reviews editor replacing Charap.

Marcel Muller is professor of electrical engineering at Washington University in St. Louis. Born in Vienna in 1922, he came to the USA in 1940, and after military service in World War II earned the BSEE and MA (physics) at Columbia University, and the PhD at Stanford. He worked at Varian Associates in Palo Alto (with a year at their Zurich laboratory) 1952-66, first on microwave tubes, and subsequently on quantum electronics, micromagnetism, and solid state microwave devices. At Washington University since 1966, he and his students have done research in magnetics and in semiconductor device theory. He spent the academic year 1976-77 as a Humboldt awardee at the Max Planck Institute for Metallurgical Research in Stuttgart. He is a member of the Optical Society of America and a Fellow of the American Physical Society. He was recently named a Fellow of the IEEE "for development of micromagnetic theory and applications to magnetic materials, and for contributions to noise theory of lasers and masers."

The replacement of Charap by Muller was announced by the Editor-in-Chief of the Transactions, Alan Smith. In making the announcement, Smith pointed out that the Transactions was fortunate to have two men of the calibre of Charap and Muller to serve in this important position. Smith expressed his gratitude for the job done by Charap and requested that the following letter to Charap be made public.

Professor Stanley Charap
Department of Electrical Engineering
Carnegie Mellon University
Pittsburgh, PA 15213

Dear Stan:

The purpose of this letter is to reiterate in writing what I have already said to you over the phone, i.e., to thank you for the conscientious and skillful job you did as Reviews Editor of the Transactions on Magnetics. Also, this letter will be printed in the Newsletter so that the members of the Magnetics Society will be aware of your contribution to the Transactions.

I know that there was a lot of work involved in processing the approximately 250 papers that you handled during your tenure, and I want to thank you on behalf of the Society for all you have done. Although these papers covered a wide variety of topics, you saw to it that each got a fair and technically correct review.

Last but not least, I want to say that at all times it was a pleasure working with you.

Best personal regards,
Alan B. Smith
Editor-in-Chief of the
Transactions on Magnetics

The Reviews Editors of the Transactions on Magnetics handle the review and other details of the processing of all the papers that appear in this journal (except papers that are part of conference proceedings or the Advances in Magnetics series). In a typical year, the Reviews Editors handle papers that result in more than 300 pages of text in the Transactions. It is the responsibility of the Reviews Editors to maintain the high technical quality of the Transactions by overseeing the review process. In order to perform this function, they must select two expert reviewers for each paper. Then, in the frequent case of a disagreement between author and reviewer, they must use their technical judgment to insure fairness to the author while still insuring high technical quality.

The Transactions has two Reviews Editors, and papers are handled by one or the other depending on the subject matter. Ralph Patterson of Hewlett Packard Laboratories takes care of all papers that have to do with memory or recording. The other reviews editor (i.e., previously Charap and now Muller) takes care of all subjects that are not recording or memory. Thus, this editor must cover a wide variety of topics including magnetic materials (hard and soft), eddy current and field calculations, magnetic levitation, magnetic separation, etc.

ADCOM ELECTION RESULTS

September 30, 1980

Dear Members of the Magnetics Society:

The purpose of this letter is to advise you of the outcome of the election of Ad Com members.

All 27 voting members of the Ad Com returned their ballots. These were opened and counted on Sept. 12 by G. S. Almasi and N. J. Mazzeo. Our elected Ad Com members are listed below. Those listed under the date 12-31-83 are newly elected and begin their three year term on January 1, 1981. Our President, Dan Gordon, has asked that I extend to each of these people his personal congratulations on being elected to the Ad Com as well as his appreciation that they have agreed to serve the Magnetics Society for a three year term.

12-31-81

G. Bate
S. H. Charap
R. B. Clover
D. I. Gordon
R. J. Josephs
F. E. Luborsky
J. W. Shilling
E. J. Torok

12-31-82

P. J. Besser
P. P. Biringer
H. C. Bourne
J. M. Lommel
Y. Sakurai
J. J. Suozzi
D. A. Thompson
L. J. Varnerin

12-31-83

W. D. Doyle
F. J. Friedlaender
C. E. Johnson, Jr.
M. H. Kryder
R. O. McCary
E. W. Pugh
A. B. Smith
H. I. Tillinger

The Bylaws require that election of Ad Com officers be by secret letter ballot of all persons who will be voting members of the Ad Com during the coming year. They further specify that returned ballots must be postmarked no later than November 1.

E. W. Pugh, Chairman
Nominating Committee

DUES FOUL-UP

According to Clark E. Johnson, Jr., S-MAG Secretary-Treasurer, an unknown number of 1980 INTERMAG attendees have not had their 1981 S-MAG dues credited to them on their IEEE membership dues invoice. The correct billing says PAID on the Magnetics dues line.

Any member who was incorrectly billed for his Magnetics dues should write "paid by virtue of attendance at Intermag" and draw a line through the \$7, remitting \$7 less, of course.

CHAPTER ACTIVITIES

Pittsburgh

The recently established magnetics chapter within the Pittsburgh Section IEEE had their first elections and the following were elected officers for the year 1980-1981:

Chairman: Shankar T. Lakhavani
Vice Chairman: J. Douglas Adam
Secretary: Kalatur S. Narasimhan
Treasurer: Robert M. DelVecchio

Coming Attractions

February 12: Finite Element Techniques, P. Silvester.

March 12: Magnetic Bubble Memories, M. Kryder.

May 14: The Rail Gun, I. R. McNab.

For further information, please call S. T. Lakhavani at (412) 256-3875.

Los Angeles

January 21: Techniques for Design of Controlled Leakage Inductance. Speaker: Dr. Siegfried Lindena, Consultant.

February 18: Techniques for "Magnetic Application of Metallic Glasses." Speaker: Dr. Carl H. Smith, Application Supervisor, Metglas Products, Allied Chemical Corp., Morristown, NJ.

The IEEE Magnetics Society Newsletter is published quarterly by the Institute of Electrical and Electronics Engineers, Inc., 345 East 47 Street, New York, New York 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. R. M. Josephs, Editor, Magnetics Society Newsletter, Sperry Univac, P. O. Box 500, Blue Bell, Pennsylvania 19424.

March 18: Techniques for Computer Aided Design of Transformers on a TI-59. Speaker: Fred M. Lillenstein, Consultant, Rockwell International.

April 15: Techniques for "Modeling of Pulse Width Modulators." Speaker: Dr. Robert D. Middlebrook, Professor of Electrical Engineering, California Institute of Technology, Pasadena, CA.

For further information call Sam Zwass (213) 391-0711, Ext 6041 or Lloyd Thornblad (213) 327-6670.

S-MAG SCHOLARSHIP PROGRAM

We are pleased to announce the 1982 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, non-profit 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 1982 to a student who will complete high school requirements and who will enter a regionally accredited U. S. college in 1982 to pursue courses of study leading to one of the traditional baccalaureate degrees.

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 winner's choice. The maximum amount that may be awarded to a winner is \$2,000 per year; the minimum will be \$500 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.

Completed entry blanks must be returned to the Program Director by 1 February 1981.

Dr. Richmond B. Clover, Director
Magnetics Society Scholarship Program
c/o Intel Magnetics, Incorporated
3000 Oakmead Village Drive
Santa Clara, California 95051
(408) 987-6043

**CHANGES IN ADDRESS & MEMBERSHIP
APPLICATIONS SHOULD BE SENT TO
THE IEEE SERVICE CENTER,
445 HOES LANE, PISCATAWAY, NJ 08854
AND NOT TO THE EDITOR**

SESSION SUMMARIES, 1980 MMM CONF., NOV. 11-14, DALLAS

Session AD. SPIN EXCITATIONS. H. Alperin.

Shapiro, Sinha, Lander and Vogt described work on the magnetic phase transition in UAs. Above T_N the critical scattering is highly anisotropic and appears as if it will order at an incommensurate structure, $q \sim .7C^*$ but instead at T_N suddenly orders with a commensurate type-I structure. These results are satisfactorily explained by the strong cubic anisotropy present in the system which arises from bonding effects between the 5f wave functions and the anion p orbitals. Buyers, Murray, Jackman, Holden, Du Plessis and Vogt described recent progress in understanding spin localization and moment formation in metallic uranium compounds UN, US, UTe, UPd₃ from both phonon

and magnon measurements. H. Mook measured the line shapes of the magnetic excitations in single crystal ferromagnetic EuO in the vicinity of T_C and found that the shapes change as q approaches the zone boundary, in qualitative accord with theory. A similar study by Bohn, Zinn, Dorner and Kollmar on a EuS single crystal showed the importance of high-order neighbor interactions in explaining the spin-wave spectrum and also presented evidence for spin-wave excitations well above T_C . The temperature dependence of the magnetic excitations in Gd was reported by Cable, Wakabayashi and Nicklow. Significant differences were found in the behavior of small- q and large- q magnons through T_C compared with theory. Alperin, Melamud and Horowitz measured the spin wave spectrum of $RbMnCl_3$ to find the two nearest-neighbor Mn-Mn exchange interactions to be 0.44 meV and 0.73 meV. The magnetic structure and spin waves were investigated in pure and metal deficient V_2O_3 by Yelon, Werner, Word, Honig and Shivashanker. In the metal-deficient V_2O_3 , magnetic intensity is observed above the metal-insulator (MI) transition at 50K, and the crystallographic distortion is associated with the MI transition and not with the magnetic ordering. In pure V_2O_3 the importance of distant neighbors is shown in fitting the spin wave dispersion. Yang and Cooper presented a calculation of the excitation spectra for a fcc system of Ce^{3+} ions with predominant anisotropic Cogblin-Schrieffer interaction. Some predictions were made that are yet to be tested by experiment. An approach to the problem of the breakdown of the Hartree-Fock scheme for the temperature dependence of the spin excitations in the case of a ferromagnet with uniaxial anisotropy was presented by Rastelli, Tassi, Pini, Rettori and Tognetti and applied to the case of $FeCl_2$. Landee and Willett presented interesting results of magnetization and susceptibility measurements on a single crystal of $CuCl_2 \cdot DMSO$, a salt with nearly perfect Heisenberg-type one-dimensional intra-chain exchange which exhibits antiferromagnetic coupling between chains. De reported on high temperature EPR spectra measurements on the linear chain compound copper calcium acetate hexahydrate.

Session BA. SOLITONS AND ID DYNAMICS. D. L. Huber.

The talks on solitons and ID dynamics proved to be one of the most lively sessions in the conference. The session began with three invited papers. H. J. Mikeska (University of Hannover) reviewed recent theoretical developments on non-linear excitations in one dimensional magnets. He pointed out that there were three classes of systems where solitons are likely to make a contribution to the static and dynamic response: easy plane ferromagnets ($CsNiF_3$), weakly anisotropic antiferromagnets (TMMC), and strongly anisotropic, Ising-like antiferromagnets ($CsCoCl_3$). In the second invited talk J. P. Boucher et al (Grenoble) reviewed the impressive evidence for magnetic solitons in TMMC. Confirmation of their importance comes from both inelastic neutron scattering and nuclear magnetic resonance experiments. In the third invited paper G. Reiter discussed the possibility that the central peak in the neutron scattering cross section for $CsNiF_3$, which had been attributed entirely to solitons, might be due in part to two-magnon processes. This question could probably be settled by additional scattering experiments which separated out the effects due to longitudinal and transverse spin fluctuations. In a contributed paper Loveluck et al (IBM Zurich) reported computer simulations of the dynamics and statics of classical spin chains and their sine-gordon counterparts which shed light on the range of validity of the sine-gordon approximation. Kurman et al (Institute of Physics, Basel) reported on an exact calculation of the out-of-plane response of the anisotropic XY model which shows a separation into "quantum soliton" and magnon parts analogous to the classical chain. The transverse excitations in $CsCoCl_3$ were discussed by Nagler et al (Chalk River) who compared their experimental results with the predictions of a theory by Ishimura and Shiba. Experimental studies of domain wall dynamics in this compound were reported by Satija et al (Brookhaven). Rudkin and Haller reported on the approach to equilibrium in the classical Heisenberg chain. They used computer simulation techniques and obtained qualitative agreement with a recent theory by D. R. Nelson. Experimental results for the low temperature expansion of the linear chain antiferromagnets $CsNiCl_3$ and $RbNiCl_3$ were discussed by J. A. Rayne et al (Carnegie-Mellon Univ.), while results for high frequency raman scattering in $CsNiFe_3$ were presented by Abdalian et al (University of Paris-North).

Session BB. ION IMPLANTATION EFFECTS IN BUBBLE MATERIALS. Ian L. Sanders.

G. P. Vella-Coleiro of Bell Labs proposed that in addition to the anisotropy introduced into a garnet layer due to straining the lattice, ion-implantation also suppresses the growth induced anisotropy. The results indicated that sub-micrometer bubble devices could be successfully implanted for very high density ion-implanted propagation patterns. J. J. Fernandez of Carnegie-Mellon University discussed direct measurements of the planar tridirectional anisotropy in (111) oriented garnets made for the first time using a magneto-optic photometer. M. H. Kryder described magneto-optic observations of the dynamic behavior of charged domain walls, made for the first time without the disturbing effects from an accompanying bubble domain. The results showed that essentially all the damping in ion-implanted devices originates from the bubble and virtually none from the charged wall.

Session BD. TRANSPORT PROPERTIES. S. P. McAlister.

This session was largely devoted to reports on transport measurements on amorphous magnetic alloys (usually films). Most speakers were able to identify the various contributions to the observed properties, for example, the different contributions to the anomalous Hall effect, using standard ways of analyzing their data. Noteworthy contributions also came from Ramanam and Berger, who described work on the excess resistivity of pure cobalt caused by ferromagnetic domains, and by Tsang and Baberschke who showed the existence of the "reverse" Kondo effect in the system Au-Gd.

Session D-P. RESONANCE AND PROPAGATION. A. Morrish.

The thirteen papers presented in this poster session attracted much interest (one paper listed in the program, DP-11, was withdrawn). Indeed, the prejudice held by some that poster sessions contain mainly so-so papers can be firmly laid to rest; this session clearly was one of the best at the conference. The spectrum of topics was wide, but magneto-elastic interactions and surface phenomena were two topics that emerged in several papers. For example, K. B. Hathaway and J. R. Cullen (NSWC, Silver Springs) observe a large softening of the elastic moduli in $Tb_0.3Dy_0.7Fe_2$ that leads to a substantial velocity splitting between the parallel and perpendicular polarization and which is a function of field. Then, C. Lingner and B. Luthi (Frankfurt) find analogous field orientation dependences of the velocity of surface acoustic waves in $SrSb$ and $CeAl_2$. Next, R. Yeh, H. Reimann, H. Dotsch, and P. E. Wigen (Ohio State) detect a fine structure in the magneto-elastic waves in bubble garnet films. Further, at microwave frequencies (24 GHz), K. Myrtle, B. Heinrich, and J. F. Cochran (Simon Fraser) conclude that an absorption in thin single crystals of nickel is the result of excitation of a sound wave via the magnetoelastic interaction. The FMR of a film with alternate layers of Ni and Cu 10 and 20 Å thick, respectively, was reported by J. F. Dillon, E. M. Gyorgy, L. W. Rupp, Y. Yafet, and L. R. Testardi (Bell Labs). Although the resonance behavior is influenced by the copper, the precise mechanism seems unclear. L. C. Hsia, P. de Gasperis, C. Boghese, and P. E. Wigen (Ohio State) find that the number of Fe^{4+} ions in Ca-doped YIG can be altered by introducing oxygen vacancies. They then determine the change in magnetic properties and conclude that electron hopping and vacancy are involved. Two papers by C. Vittoria, F. J. Rachford, and P. Lubitz (NRL, Wash.) contribute to the knowledge of FMR in magnetically unsaturated samples. Several papers were concerned with magnetostatic modes. In one, H. Reimann, L. C. Hsia, and P. E. Wigen (Ohio State) find that the uniaxial anisotropy of a bubble film plays a vital role in the spectra observed. The coupled integral equations that describe the magnetostatic surface modes in films with non-uniform in-plane bias have been developed by F. R. Morgenthaler (MIT). Finally, properties of magnetostatic devices were described in three papers by J. C. Sethares, M. R. Stiglitz (Hanscom AFB) and I. J. Weinberg (Lowell U.), by W. R. Brinlee, J. M. Owens, C. V. Smith, and R. L. Carter (U. Texas, Arlington), and by J. P. Parekh and H. S. Tuan (SUNY, Stony Brook).

Session EA. MAGNETIC PROPERTIES OF AMORPHOUS ALLOYS. R. W. Cochrane.

Session consisted of (1) invited paper and (9) con-

tributed papers treating both macroscopic and microscopic properties of amorphous metallic alloys: specific heat, magnetization, hyperfine field and even the generation of ultrasonic waves by microwaves. The subject of the invited paper was a review of measurements of the specific heat of amorphous metals from 0.5 to 100K. Focusing on metal-metalloid alloys, Prof. David Ohn (Univ. of Delaware) showed how the usual lattice, electronic and magnetic contributions could be separated. Of interest was the systematic variation of these terms and metalloid composition; ρ gives significantly different phonon and electronic terms than does B for the same amount of transition metal. On the theoretical side, Prof. T. Egami (Univ. of Pennsylvania) introduced a model of a spatially correlated mean field theory to account for the unusual susceptibility behaviour near the ferromagnetic transition - critical index γ as high as 1.7 over a wide temperature interval. This theory is a non-local Landau-Ginzberg for which the correlation length of the molecular field is equal to the spin correlation length and hence temperature dependent.

Session EC. RECORDING HEAD DESIGN AND MATERIALS.
K. Lee for G. Hughes.

This session consisted of one invited paper and nine contributed papers with topics varying from thin film head modeling results to magnetic properties of recording head materials. The session was very well attended, with an average attendance of about 100 people at each talk. All the papers were well presented and interesting. The four that seem to be noteworthy are as follows: Paper EC-1 (Film Head Design Criteria) was presented jointly by W. Cole and P. Chang, both of IBM. They presented modelling results which provided Guidelines for achieving specific performance figures of merit in DASD systems using thin film heads. Particular attention was directed to resolution, asymmetry and TMR versus pole-tip and gap dimensions. Comparisons with experiment were presented. Paper EC-3 (Origin of Barkhausen Noise in Small Permalloy MR Sensors) was presented by C. Tsang of IBM. He presented results of direct, simultaneous experimental measurements of both the MR response and domain (Bitter) patterns on small ($12\mu\text{m} \times 24\mu\text{m}$) permalloy stripes. The authors were able to identify two classes of noise: the abrupt reduction of the domain wall population and domain wall state transitions. Paper EC-4 (Applicability of the Planar Hall Effect) was presented by J. H. J. Fluitman of Twente U. of Technology, The Netherlands. He discussed experimental and theoretical results pertaining to a Hall effect magnetic recording sensor. He discussed sensor geometry, sensor response (sensitivity) to different external field directions. Paper EC-10 (Magnetic Properties, Aging Effects and Application Potential for Magnetic Heads of Co-Fe-Si-B Amorphous Alloys) was presented by K. Shiiki of Hitachi, Japan. Zero magnetostriction alloys of $(\text{Co}_{0.94}\text{Fe}_{0.06})_x\text{Si}_y\text{B}_z$ (e.g., with $x = 74$, $y = 4$, $z = 22$) were prepared by single roller quenching. Video tape heads were fabricated and shown to have output signals approx 4 dB at 1 MHz and approx. 1-2 dB at 4 MHz higher than that achieved by a commercial Mn-Zn ferrite head of approximately the same construction. Considerable data on the permeability was presented.

Session ED. SURFACES, ADSORBED LAYERS AND SMALL PARTICLES. Stephen Gregory.

This was a small session. The major area of interest was the study of ferromagnetic layers on "non-magnetic" substrates - copper, usually. In particular, the question of "magnetically dead" layers near the surface was discussed. Future meetings will continue to reflect interest in both well-characterized layer structures and small particles as sample preparation techniques evolve.

Session FA. APPLICATIONS OF MAGNETISM IN BIOLOGY AND MEDICINE. S. J. Williamson.

The symposium on Magnetism Applied to Biology and Medicine consisted of four invited talks followed by three contributed presentations. J. P. Wikswo, Jr. (Vanderbilt University) reported his group's achievements in detecting the magnetic field associated with the action potential in isolated nerves and muscle. An amplitude on the order of 100 pT was observed near the sciatic nerve of the frog and the Purkinje conducting muscle of the heart. The magnetic technique based on a superconducting detector (SQUID) provides a non-invasive method for determin-

ing the intracellular currents of the depolarization and repolarization fronts of the propagating action excitation. J. H. Tripp (Case-Western Reserve University) described magnetic field measurements near the human chest which reveal a feature in the magnetocardiogram between the P and QRS waves that can be attributed to the action excitation of the His-Purkinje fibers, which lead to the ventricles. The magnitude and waveform were found to be fairly accurately described by predictions of a model in which the depolarization front in each fiber is represented by a current dipole. T. Katila (Helsinki University of Technology) presented his group's measurements of the magnetic field of the human eye, which is associated with currents produced by the trans-retinal voltage. A dc field pattern shifts with movement of the eye (magneto-oculogram), and a transient response can be evoked by a rapid change in luminance (magneto-retinogram). C. M. Bastuscheck (New York University) summarized progress in the development of an ac susceptibility based on the SQUID for measuring the susceptibility of compact organs in vivo. The required sensitivity was achieved for studies of the liver where large excesses of iron are stored as a consequence of diseases such as Cooley's anemia and hemochromatosis. T. D. Sterling (Simon Fraser University) pointed out in a contributed talk that the use of magnetite dust as a magnetic tracer in studies of clearance from the human lung may pose a health risk to the subject. On application of a magnetic field, particles may more easily cluster in regions of the respiratory system which have more sputum, as found in smokers' lungs, and this clustering could lead to a lower clearance rate. Experimental studies reported by L. Robinson (Rhode Island Hospital) provide evidence that application of a magnetic field on the order of 50 mT to a suspension of $5\mu\text{m}$ size particles in a sputum-equivalent medium does indeed lead to clustering. The final presentation by M. D. Graham (Coulter Biomedical Research Corporation) summarized studies of the relative efficiency of high-gradient magnetic separation of erythrocytes from whole blood. When diamagnetic oxyhemoglobin is first reduced to deoxyhemoglobin the separation is more consistent and complete than when first oxidized to methemoglobin. This difference is attributed in large measure to differences in the effectiveness of the reduction and oxidation reactions.

Session FC. RECORDING MEDIA. Tu Chen.

In this session G. Bate of Verbatim Corp. gave an extensive review of recent advances in articulated recording media. He stated that the industry today still is using mainly the oxide particle media. The annual consumption of the oxide last year was 18,000 metric tons. He stated that the recently intensive development of metallic particles as a substitute for the oxide looks promising. However, the cost per pound of the metallic particles ranges between \$150 to \$2500 at present and possibly \$40 to \$200 by 1984 and is too expensive to economically substitute for the oxide particles. (In the discussion period for this paper, a person from Pfizer Corp. indicated that they will introduce metallic particles for \$30 a pound. If this is the case, it will make the metallic particle more attractive to replace the oxide.) For perpendicular magnetic recording media, Kobayashi from Fujitsu Lab. Ltd. presented that the addition of Rh in sputtering of Co-Cr alloy film can increase the preferred orientation as well as the coercivity of the film. Recording using ring type head on the film was demonstrated for the flux reversal of up to 25,000 FRPI using gap length of $0.9\mu\text{m}$ and track width of $70\mu\text{m}$. A. Baltz of Sperry Univac presented that chromating of the iron powder improves surface smoothness, increases magnetization, reduces oxygen in the powder and made it more stable against oxidation.

Session FD. TRANSITION METAL ALLOYS. G. Williams.

This session opened with an invited paper by M. B. Brodsky (Argonne) on enhanced magnetism in metal film sandwiches. Thin layers of Pd or Cr were effectively stretched by depositing Au on either side of them, and experimental data obtained using a variety of techniques were interpreted as indicating large enhancements of the transition metal susceptibility. These effects stimulated considerable interest and a lively discussion period. The contributed papers in this session covered various traditional aspects of transition metal magnetism. Several papers discussed the onset of magnetic ordering in exchange enhanced systems such as Pd Mn and Pd Ni, and explored the

role played by local environmental effects in Pd Ni, Ni Pt and Ni Pd. Local environment effects were also the theme of a number of experimental and theoretical contributions on first transition series impurities in Co Ga and Mo Nb hosts. Pair interactions were further cited as the cause of differences in behaviour between Fe and Co impurities in Cr (with respect to their coupling to the spin density wave below T_N). Of the two remaining contributed papers one examined the low temperature, isolated impurity behavior of Cu Cr, while the second reported on the structure and magnetic ordering occurring in intermetallic compounds of Gd with Rh and Pt.

Session GA. NEW AMORPHOUS MATERIALS AND PROPERTIES. K. Fukamichi.

Many transport properties at low temperatures in amorphous magnetic metals were reviewed, and the analogies with and the difference from the Kondo effect was discussed by Y. Imry (invited). Direct measurement of the shift of Curie temperature for (FeNi)Zn alloys under the hydrostatic pressure was reported by Shirakawa et al. Surface crystallization and ferromagnetic surface layer were reported by H. N. Ok and Bhagat, respectively. Co-Ti alloys with zero magnetostriction were demonstrated by Aboaf et al. Magnetostriction and magnetization of many Co-base alloys were discussed by O'Handley et al using Friedel's virtual-bound-state model. Magnetic properties of Fe-Be-B alloys were presented by two groups (Hasegawa, Severin and Chen), and compared with those of Fe-B alloys.

Session GP. RARE EARTH-TRANSITION METAL INTERMETALLICS; OTHER METALS AND ALLOYS. J. E. Keem.

At this poster session significant interest was shown in the paper by C. Meyer et al concerning Mössbauer and magnetization studies of the meta-stable compounds $TbFe_2$, $NdFe_2$, and $PrFe_2$; also a very nice study of d-band magnetism (GP-8 by D. Gignoux et al) received a lot of attention because of the breadth of types of magnetism exhibited in Y_4Ni_4 compounds as a function of x. The report by Eibschutz et al on ferromagnetism in Fe_xTa_{2-x} ($x = 1/4$) indicated a wealth of magnetic properties available in this two dimensional system.

Session H-B. LOW COBALT HARD MAGNETIC MATERIALS PANEL. K. S. V. L. Narasimhan.

Three types of magnet categories exist: namely, magnets that can contain lower amounts of cobalt (Fe-Cr-Co), magnets that contain high amounts of cobalt but with superior energy products that minimize the amount of cobalt of an actual magnet in a device (R_2Co_{17} type, R = rare earth) and finally magnets that do not contain cobalt (MnAlC, ferrite). G. Y. Chin of the Bell Laboratories highlighted the two distinct methods of achieving coercivity in the Fe-Cr-Co alloy - the thermomagnetic heat treatment method and deformation aging method. Anisotropic magnets containing 2 to 10% cobalt were made with a BH_{max} of 5.3 MGOe. The challenging areas appear to be in the techniques of improving the rate of spinodal decomposition in the low cobalt containing alloys and the attainment of higher coercive force. R. W. Lee of General Motors Research Laboratories detailed the two methods of achieving BH_{max} of 30 MGOe in the R_2Co_{17} type magnets. The precipitation hardening approach and the approach of the nucleation of domain walls in a homogenous material. The future of R_2Co_{17} magnets for automotive market would depend on the use of other abundant light rare earths besides Sm. It was suggested that a better understanding of the role of Mg addition in generating large coercive force in $MnCo_5$ might help in achieving high coercive force in the R_2Co_{17} magnets. M. A. Bohlmann of Indiana General described the formation of anisotropic MnAlC magnet by hot extrusion. The future of these magnets, although good, depends on the methods of improving the deformation process, die design and wear. T. G. Reynolds of Ferroxcube described the current status of ferrite magnet. The future of attaining high energy product (~ 4.5 MGOe) depends heavily on the control of grain size of finished magnet. S. Rinaldi indicated that ferrite magnets with proper substitutions have a potential BH_{max} of 7 MGOe. J. Livingston of General Electric reviewed the coercivity mechanism in all of the above magnetic materials. In certain of the Fe-Cr-Co alloys wherein the neighboring ferromagnetic regions are coupled by exchange forces, the mode of magnetization reversal is not understood and required further study.

Session HD. ELECTRONIC STRUCTURE. A. K. Rajagopal.

Meservey et al (HD-1) used spin-polarized electronic tunneling to measure the magnetic moment of very thin layers (fraction of atomic layer in Fe and 3 layers in Ni) of ferromagnetic metals (Fe, Ni, Co, Gd, and Tm) deposited on normal metal substrates (Al or Cu). These results were found to be in agreement with anomalous Hall effect experiments of Bergmann. It was also found that where available, the results were not in contradiction with those of photoemission experiments, where magnetism of the first few layers of magnetic metals are probed. J. F. Cook (HD-11) has found that calculations of temperature dependent dynamic susceptibility for itinerant ferromagnets based on simple extrapolations of zero-temperature itinerant theory up to one-half of the Curie temperature can account for the experimental findings for Nickel's spin wave dispersion. Also he points out a discrepancy between neutron and photoemission experiments regarding the temperature dependence of spin splitting of electronic energy bands. This is important because the two experiments are entirely different in their character and a difference between them opens up many questions.

ALTEN GILLEO DIES

M. A. (Alten) Gilleo, a well-known member of the magnetic bubble community, died on Nov. 14, 1980, after a brief illness. At the time of his death, he was manager of the Electronic and Optical Physics Department of the Materials Laboratory of Allied Chemical Corp., Morristown, NJ.

M. A. Gilleo received his Ph.D. in Electrophysics in 1952 from the Mass. Inst. of Tech., and from 1952-58 he was a Member of the Technical Staff at Bell Laboratories where, with S. Geller, he did pioneering work on the magnetic properties of Yttrium-Iron-Garnet (YIG).

After various positions with Lockheed, Teledyne, and Monsanto, he joined Allied as a manager in 1969. His research spanned many fields including magnetic bubble, laser, and surface-acoustic-wave materials, and laser isotope separation. He was a regular contributor to the Conference on Magnetism and Magnetic Materials (MMM), and he was treasurer of the New York Conference local committee in 1979. Active until the end, he was co-author of a paper at the MMM-Dallas conference which was presented four days before his death.

Devlin Gualtieri
Allied Chemical
Electronic & Optical Physics
- MRC
Morristown, NJ 07960

EDUCATION SOCIETY POSTER

The Education Society will once again be making up and distributing a poster highlighting universities doing research in the area of applied magnetism. The scope of this poster this year will be expanded to include universities in Europe and Japan as well as North America. Any school wishing to be listed on the poster or wanting more information should contact Dr. Edward Della Torre, Department of Electrical and Computer Engineering, Wayne State University, Detroit, Michigan 48202.

MAGNETIC RECORDING TUTORIAL SESSION

Dr. Edward Della Torre, Chairman of the Education Committee of the Magnetic Society, announces that his committee will sponsor an evening tutorial session on magnetic recording at the next INTERMAG Conference to be held in Grenoble in May 1981. Professor Jack Judy of the University of Minnesota is acting as coordinator of this session and he is putting together a program of outstanding practitioners in this area.

PROC. OF 1ST U. K. CONF. ON PERM. MAGNETS

The proceedings are available of the 1st U. K. Conference on Permanent Magnets which was held in June,

1980. The conference was attended by over 250 people. The proceedings are published by:

The Magnet Centre
Physics Division
Sunderland Polytechnic
Chester Road
Sunderland

at a price of 30 dollars. For further details, contact A. G. Clegg at the Magnet Centre. The contents are listed below.

Contents

Permanent Magnets - an introduction.
Dr. A. G. Clegg, Magnet Centre, Sunderland Polytechnic.

Hard Ferrite Permanent Magnets.
Mr. M. Armstrong, Swift Levick & Sons Ltd., Sheffield.

The Manufacture of Sintered Samarium Cobalt Magnets.
Dr. R. E. Johnson, Preformations (Magnets) Ltd., Swindon.

The Manufacture of Sintered Permanent Magnets.
Mr. J. B. Spencer, B.O.C. Magnets, Rainham, Essex.

The Manufacture of Bonded Magnets.
Dr. P. S. Nyholm and Mr. A. J. Wetherilt, Preformations (Magnets) Ltd., Swindon.

Magnetic Quality Control Techniques using "Programmable Calculators."
Mr. P. Dibbo, Darwins Magnets International Ltd., Sheffield.

Some aspects of workholding and lifting using Permanent Magnets.
Mr. R. Scholes, James Neill & Co. Ltd., Sheffield.

The design of Cobalt Samarium Magnet Systems.
Mr. C. J. Fellows, Preformations (Magnets) Ltd., Swindon.

Computer aided design of Permanent Magnet Motors.
A. E. Corbett, Engineering Dept., University of Warwick. C. S. Roerig, Moore Reed & Co. Ltd., Andover, Hants.

Ceramic Magnets in Industrial Motors.
Mr. C. P. Southworth, Mullard Ltd.

Permanent Magnets in Alternators and Special Drives.
Dr. H. R. Bolton, Dept. of Electrical Engineering, Imperial College, London.

INTERMAG CONF., GRENOBLE, FRANCE, MAY 12-15, 1981

The next International Magnetism Conference (INTERMAG) will be held at the Alpes Congrès Conference Center in Grenoble, France, from Tuesday, May 12 to Friday, May 15, 1981. This conference is jointly sponsored by the Magnetism Society of IEEE, the Société Française de Physique and the Société des Electriciens, des Electroniciens et des Radioelectriciens. Holding the conference outside the USA continues a long-time triennial cycle which emphasizes the international community in applied magnetism. The choice of Grenoble recognizes the important contributions of French science and technology to the subject, and in particular those contributions of the laboratories and University of Grenoble, now the site of several multinational centers of research. The meeting will be open to all persons subject to payment of a registration fee.

The purpose of the INTERMAG Conference is to provide a forum for presentation of new developments in applied magnetism, related magnetic phenomena, and information storage technologies. The program will consist of both invited and contributed papers, technology assessment sessions, and workshops for less formal discussions of current topics. Contributed papers are solicited in all areas of applied magnetism and related magnetic phenomena. Topics of wide interest in recent years have included all aspects of magnetic recording, various memory technologies (magnetic bubble and others), microwave magnetism, transformers, permanent magnet materials and technologies, control and power conversion and conditioning, magnetometry and transducers, magnetic printing, magnetism in life sciences, magnetic separation, magnet-field calculations and magnetic materials properties

and processing. The list is intended to be suggestive rather than restrictive.

Individuals who are not on the Conference mailing list may obtain Conference information from the Conference Chairman, J. M. Lommel, General Electric Corporate Research and Development, P. O. Box 8, Schenectady, NY 12301, USA. Abstracts (prepared in the prescribed form) should be submitted by December 15, 1980 to the Program Co-Chairman, R. Krishnan, Laboratoire de Magnétisme, CNRS, 1 Place Aristide-Briand, 92190 Meudon-Bellevue, France.

An exhibit of equipment, components, materials and technical information is being arranged. Firms wishing to participate are urged to contact the Local Arrangements Chairman, D. Randet, LETI, Centre d'Etudes Nucléaires, B. P. No. 85, 38041 Grenoble CEDEX, France.

ADVANCES IN MAGNETIC FILTRATION, MAY 18-19, 1981, UNIV. OF SALFORD

A two day international symposium will be held in association with the IEEE Magnetism Society from 18-19 May 1981 at the University of Salford. The symposium chairman is Professor R. R. Birss (Salford) and the symposium convener is Dr. M. R. Parker (Salford).

The program will be available in January 1981. Further queries may be addressed to Mrs. L. Roberts, Symposium Secretary, Room 110, University of Salford, Salford, M54WT. Telephone 061-726 5843, ext. 449.

MAGNETIC RECORDING COURSE

The George Washington University's Continuing Engineering Education program will offer a course in Magnetic Recording on

February 2-3-4 in West Berlin
March 9-10-11 in Washington, D. C.

The lecturer will be Finn Jorgensen of DANVIK whose recently updated Handbook of Magnetic Recording is the text for the course.

For additional information, contact

Finn Jorgensen
DANVIK
P. O. Box 475
Goleta, CA 93117
805-694-4641

or The George Washington University
School of Engineering & Applied Science
Washington, D. C. 20052
202-676-6106, 800-424-9773, Telex 64374

CONFERENCE CALENDAR

1981 IEEE Power Engineering Society, Feb. 1-6, 1981, Atlanta, Georgia.

4th International Seminar On Magnetism, April 7-10, 1981, Hertzsdorf, GDR.

INTERMAG, May 12-15, 1981, Grenoble, France (see announcement).

Advances in Magnetic Filtration, May 18-19, 1981, Univ. of Salford (see announcement).

5th Rare Earth-Cobalt Magnet Workshop, June 7-10, 1981, Roanoke, Virginia.

Workshop on Applied Magnetic Recording, June 16-17, 1981, San Francisco.

1981 Power Electronics Specialists Conf., June 29-July 2, 1981, Boulder, Colorado.

1981 Cryogenics Engineering Conf., Aug. 10-14, 1981, San Diego, CA. Contact Dee Belsher, NBS, Boulder, CO 80303.

COMPUMAG Conf. on the Computation of Magnetic Fields, Sept. 13-17, 1981, Chicago, Illinois. Contact R. D. Smith, 362/C-132, Argonne National Lab., Argonne, Illinois 60439.

JOIN THE MAGNETICS SOCIETY TODAY

Membership in the IEEE Magnetics Society entitles you to receive, for the low Society fee, the IEEE Transactions on Magnetics, and the quarterly Magnetics Society Newsletter. You are kept informed of latest developments, meetings, and conferences in your areas of interest, and are entitled to purchase informative conference records and other helpful educational aids at greatly reduced rates for members.

Use the convenient coupon to become a member of the IEEE MAGNETICS Society. If you are not a member of the IEEE, but would like to join, please check the appropriate box on the coupon. Descriptive materials and an IEEE membership application will be sent to you upon receipt.

Society Fee: \$7.00 for IEEE members of all grades except Student.

Student Fee: \$3.00. These rates apply to payments received September 1 through February. On payments received March 1 through August 31, remit one-half of the above rates. (Payments received September 1 through December 31 apply through December 31 of the following year.)

MEMBERSHIP APPLICATION IEEE MAGNETICS SOCIETY

Send to: IEEE Service Center, 445 Hoes Lane,
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(Please show this message to a colleague in magnetics who could benefit from membership in the Magnetics Society.)

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The Society sponsors the INTERMAG Conference and co-sponsors the Conference on Magnetism and Magnetic Materials, which jointly cover the whole subject of magnetism.

Fill out the application blank today. If you prefer, you may contact: E. J. Torok, Membership Chairman of the Magnetics Society, Sperry Univac, ULT25, P. O. Box 3525, St. Paul, Minn. 55165.

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