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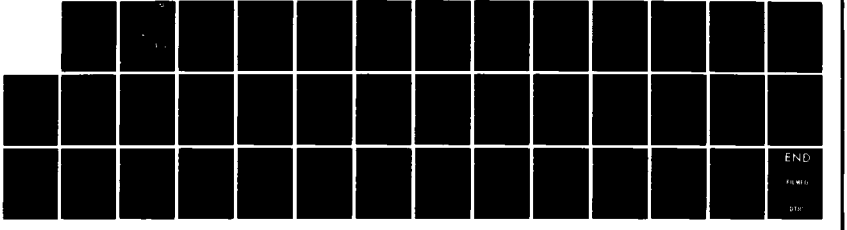

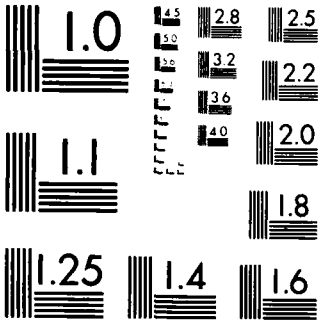

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EUROPEAN SCIENTIFIC NOTES
OFFICE OF NAVAL RESEARCH
LONDON

Commanding Officer ..... CAPT M.A. Howard, USN
Scientific Director ..... James W. Daniel
Editor ..... Larry E. Shaffer

January 1985
Volume 39
Number 1

BEHAVIORAL SCIENCES

Recent Dutch research, using self-report time logs, examines the working behavior of students in science, law, medicine, and other subjects.

BIOLOGICAL SCIENCES

Researchers in the Biophysical Department and Laborabory of the University of Bucharest are doing first-rate work in biophysics. The work focuses on reception and conduction of information in the nervous system, radiobiology and photobiology, membranes and cell biophysics, and the state and role of water in biological systems.

A West German researcher has developed a new interactive model for explaining nonthermal resonance behavior at millimeter-wave frequencies.

COMPUTER SCIENCES

The Second Vector and Parallel Processing in Computational Science Conference provided insights into the European perspective on supercomputing.

ONR, London, report R-10-84 examines developments in the five areas that make up the UK's Alvey program, a 5-year research effort in computer science: computer architecture, very large scale integration, software engineering, expert systems and intelligent knowledge-based systems, and man-machine interfaces.

MATERIAL SCIENCES

MATHEMATICS

MECHANICS

SCIENCE POLICY

SPACE SCIENCE

The 35th Congress of the International Astronautical Federation focused on the technological aspects of both instruments and spacecraft, and on more general mission considerations such as tracking and communication.

NEWS & NOTES

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BEHAVIORAL SCIENCES

UNIVERSITY CURRICULUM STRUCTURE AND STUDENT WORKING BEHAVIOR IN THE NETHERLANDS

by Richard E. Snow. Dr. Snow is the Liaison Scientist for Psychology in Europe and the Middle East for the Office of Naval Research's London Branch Office. He is on leave until September 1985 from Stanford University, where he is Professor of Education and Psychology.

Much research in educational psychology has sought to link variations in teaching practices and materials to variations in learning outcomes. But the teaching-learning relationship is not direct; it is mediated by the amount of effortful work students actually invest in learning, and effort in turn may be influenced by a host of other personal and situational variables. Since these intervening and moderating variables are difficult to identify and measure, clear evidence useful for the improvement of instruction is often difficult to come by.

In recent years, some research attention has turned to the study of student working behavior expressed as time-on-task. Using time as a variable also has its problems. It is an imperfect, surrogate index for the underlying psychology it is taken to reflect; one cannot assume that time spent equals mental effort invested or that comparisons of time within or across persons reflect comparisons of learning processes. On the other hand, time measures offer advantageous mathematical properties and direct practical interpretation, so they deserve serious study. Most of the research on time-on-task has relied on observations in US public school classrooms. Another approach, using self-report time logs, has recently been used to advantage in a continuing series of studies of Dutch university students. Students keep their own confidential logs, turning the records in periodically to the researchers in exchange for a promise of anonymity with respect to faculty members.

Crombag (1984) provides a summary discussion of the work to date. Detailed accounts of the individual studies are available in the technical report series of the Educational Research Center, University of Leiden, The Netherlands, and from Ten Cate (1984), Van Os and Brants (1982), and Vermeer (1977) for some other Dutch universities.

Traditional Dutch university courses consist of a series of lecture classes spread across 10 to 13 weeks, followed by a period of several weeks devoted to examinations. Figure 1 shows the average amount of time spent per week in class and in independent study outside of class by students in an introductory physics course for second-term chemistry freshmen. Figure 2 shows the same course plus three other concurrent lecture courses in the second-term chemistry curriculum; each curve here gives the average total class-time plus independent study time for each course.

The trend is clear; students spend very little time studying as the lectures proceed, preferring to cram for each exam in turn during the period between the last lecture and the exam. Many courses--across the fields of biology, chemistry, dentistry, languages, law, medicine, and psychology, and across four universities--show much the same pattern. Thus, although the instructor plans each lecture to build on previous learning, students on average ignore this plan; the pattern clearly suggests distributed teaching over the course but massed learning only at its end.

Some courses will yield a different pattern if they are organized to require intermediate student products during the course. Figure 3, for example, shows class attendance and independent study averages in a laboratory course for chemistry freshmen that required periodic written reports from students.

There is also competition for time across courses, and small changes in curriculum organization sometimes can affect appreciably the distribution of student working behavior. As one example, Crombag (1984) cites the data shown in Table 1 for the two largest courses in the first-year law curriculum. Between the two data years shown, the only change in curriculum structure was to reverse the order of the exams for the two courses and to allow more time between them; in 1979-80, the exam for the general introductory course came first with 1 week between exams, whereas in 1981-82 the criminal law exam came first with 2 weeks between. The change produced a marked increase in time spent on criminal law and in the percent of students passing the exam, with a slight decrease in time spent on the introductory course but no decrease in the percent of students passing.

The conclusion that the organization of the curriculum, both within and

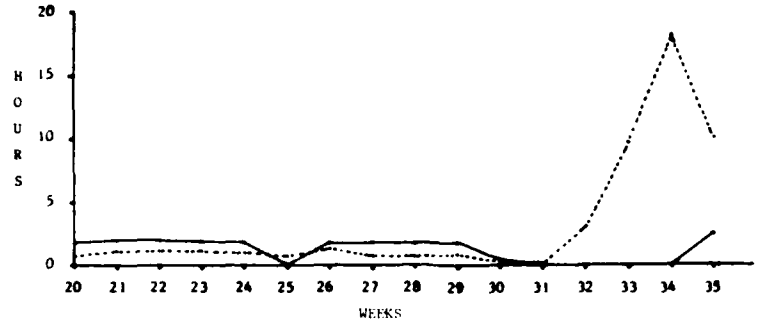

Figure 1. Class attendance time (solid) and independent study time (dotted) in an introductory physics course for chemistry freshman (from Crombag, 1984).

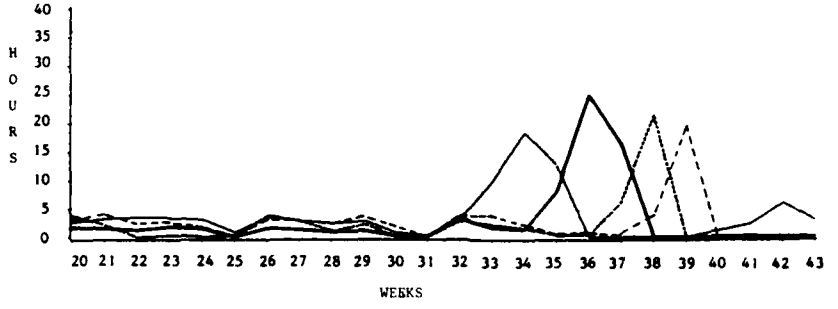

Figure 2. Study load during second term of chemistry curriculum for four courses (from Crombag, 1984).

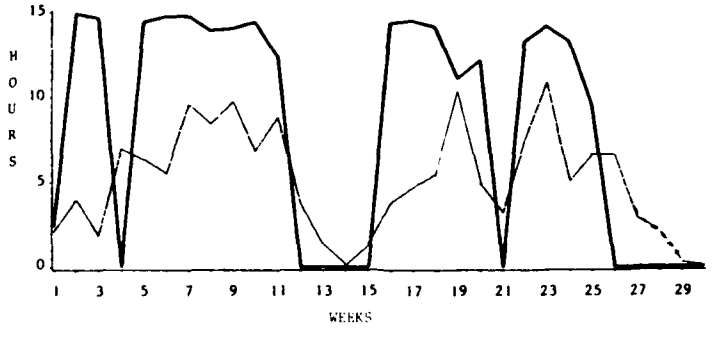

Figure 3. Class attendance time (solid) and independent study time (dotted) in a lab course for chemistry freshmen (from Crombag, 1984).

across courses in a department, is a major determinant of student working behavior is supported by a variety of other analyses. These include studies of detailed hourly time logs over the days of several weeks as well as weekly study logs alone. Crombag and his colleagues argue that what we typically think of as individual student motivation may be much less important than curriculum structure as an influence on student work. Evidence on this point, however, would require analyses of individual differences in independent study time and also the approaches to learning applied by different students in this

time. The Crombag research at least makes the important point that the time implications of different curriculum structures cannot be ignored in studies of student motivation for study.

The Dutch research speaks to a related and also important point. The relationship between class attendance and independent study might be hypothesized to be positive. However, as the total time load for a curriculum increases, competition for time between class attendance and independent study also increases; the relationship between class time and amount of independent study time per class should thus be negative in some range. Precise understanding of this complex relationship could suggest optimization rules for allocating expensive class hours to produce maximal independent study.

Crombag and his colleagues constructed the negative exponential curve shown in Figure 4 based on data from six first- and second-year curricula in four different Dutch universities. The two points (numbered 7 and 8) from two additional first-year curriculum areas conform well to the same curve. In each instance, the data reflect only the behavior of students who passed their examinations, aggregated over the whole year. Thus in this range the amount of independent study per hour of class attendance decreases as the amount of class attendance increases. A simple transformation of this function to express directly the relation between average class attendance and average amount of independent study yields the optimization curve of Figure 5. This suggests that an average of 325 hours allocated to class time should elicit the maximum of 820 hours of independent study, on average. More or less class time yields less independent study. One could imagine curriculum changes, however, that might drive independent study time up without adding appreciably to class hours. But these changes lie

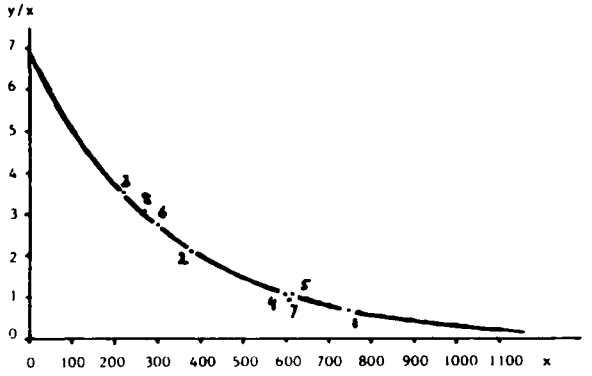

Figure 4. Relationship between class attendance (x) and amount of independent study per hour of class (y/x) (from Crombag, 1984).

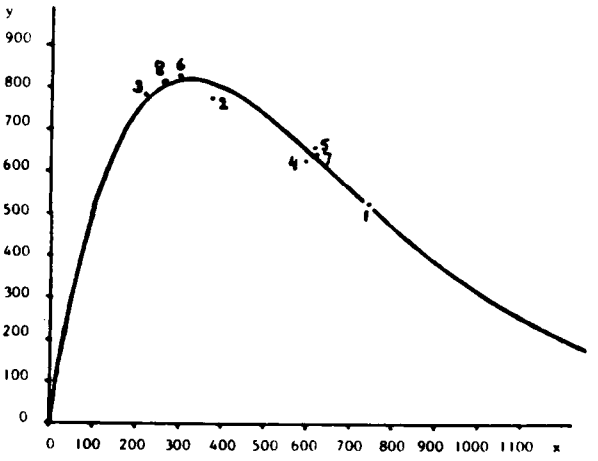

Figure 5. Relationship between average class attendance (x) and average amount of independent study (y) (from Crombag, 1984).

Table 1

Student Work Patterns and Pass Rates for Two Law Courses in Each of Two Years

Course	Year	Total Hours Assigned	Total Hours Realized	% Hours Realized	% Passing Exam
Gen. Intro. to Law	1979/80	275	228	83	56
	1981/82	275	198	72	60
Criminal Law	1979/80	325	159	49	64
	1981/82	325	234	72	78

outside the range of Dutch curriculum structures producing the present curves. From other sources, Crombag estimates that students would need to realize 1300 net hours of work per year to equal the work rate of the average employee in Dutch industry. To achieve this, within the present formulation, class attendance would have to exceed 1000 hours per year, which is quite unrealistic.

Finally, Crombag (1984) notes that in the US, and in some other countries, it is claimed that university student work averages substantially exceed 1300 net hours per year. He calls for cross-national comparisons on this point and offers the curves shown in Figures 4 and 5 as baselines for such research.

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10/11/84

BIOLOGICAL SCIENCES

MEDICAL AND BIOMEDICAL RESEARCH AND TRAINING IN ROMANIA

by Thomas D. Rozzell. Dr. Rozzell is the Liaison Scientist for Biological Sciences in Europe and the Middle East for the Office of Naval Research's London Branch Office. He is on reassignment until August 1985 from the Office of Naval Research, Arlington, VA, where he is Program Manager for Cellular Biosystems.

Researchers at the University of Bucharest are doing first-rate work in biophysics. Romania has a long history of innovative biophysical research; one of the first laboratories in Europe to use radioisotopes in clinical research and investigation was set up there just after World War II. During the last 30 to 40 years, there has been a high level of activity primarily in the following areas of research: reception and conduction of information in the nervous system, radiobiology and photobiology, membranes and cell biophysics, and the state and role of water in biological systems.

While attending the Third International Conference on Water and Ions in Biological Systems, held in Bucharest, I visited the University of Bucharest and discussed programs of training and research in medicine and biophysics.

Medical Education

Medical and biomedical training has been under way at the University of Bucharest for more than 100 years. Located in the heart of the city, the university has 6000 medical students. Since the course of study is 6 years, this means about 1000 students are admitted each year (the dropout rate is less than 5 percent). This number includes dental as well as general medical students. The medical students are divided into two groups--pediatrics and general medicine. The faculty numbers 120 in general medicine, 80 in pediatrics, and 50 in dentistry. This is a ratio of one faculty person for every 24 students.

The medical students come from many countries of the world; in fact, a number come from the US. About 30 to 40 percent of the students are actually from outside Romania. The school also trains physicians for the military, for unlike the US there is no dedicated school of medicine for the training of military physicians. Approximately one-half of the students are women, and a high percentage of all the graduates go into clinical practice as opposed to research and teaching.

The 6 years of formal coursework are followed by 3 years of clinical work in a hospital that is attached to a university. The students apparently enter medical school a little earlier than US students. The first 3 years of training are devoted to basic subjects, and it is not until the third year that the students begin to get their hands on patients. This is opposite to the general trend in American medical schools, where students actually begin to get some clinical exposure as early as the first semester of the first year.

Of particular interest is the biophysical research conducted in the

medical school of the university. I was introduced to the programs there by Professor V. Vasilescu, MD, PhD, DSc, who is head of the Biophysical Department and Laboratory. Vasilescu heads a team of about 30 researchers, who have been very active and very productive despite a severe lack of modern, state-of-the-art equipment.

The Biophysical Laboratory has had extensive international ties over the past decade or so. A number of the faculty members have taught and consulted in France, England, and the US as well as in the Soviet Union and other East European countries. Representatives of this laboratory have participated in a number of international meetings and particularly those organized by United Nations Educational, Scientific, and Cultural Organization (UNESCO). Certain of the research projects in the laboratory are included in the UNESCO Program for Biophysics, the Third Working Group of which is presided over by Vasilescu.

Essentially all of the support for the research programs is derived from the Ministry of Education. However, there are some "outside" contracts from an organization that appears to be equivalent to the National Science Foundation in the US. These are competitive and awarded annually. The support for research appears to cover salaries and a minimum of equipment, but no travel. While scientists are allowed to go to selected foreign meetings, they must pay their own expenses. I saw only one or two computers in the labs and no photocopying machines. (In fact, it was quite evident that copiers were needed at the conference I attended.) Yet there is obvious dedication and determination, and a lot of good science was evident in the papers that were presented at the conference.

The rest of this article outlines the research programs at the Biophysical Laboratory. Most of these represent research that can be conducted quite well in the absence of highly sophisticated equipment--perhaps not as efficiently, but the work can be done.

Reception and Conduction of Information

Research on reception and conduction of information in the nervous system focuses primarily on the biophysics of the peripheral nerves and the action of certain physical, chemical, and mechanical factors on the reception and conduction of information in the peripheral nervous system of experimental animals. Several significant findings have been reported by the group working in this area:

1. A continuous magnetic field of an intensity reaching values of up to 33,000 Gauss leads to a decrease in the excitability and conduction velocity;
2. Heavy water has an inhibitory action on the myelinated nerve fiber;
3. Very high hydrostatic pressures induce reversible changes in the electric parameters of the conduction of the nerve impulse;
4. The electric current of a very high frequency diminishes the dielectric constant of the nerve depolarized by KCl, a fact that argues for the presence of modifications at the level of the bound water;
5. Various types of radiation have been found to lead to a reversible abolishment of the electrical activity of the nerve.

In recent years, some staff members have begun to do more theoretical studies looking at such things as processing and transmission of information in the nervous system, thermodynamics of membrane permeability, and characterization in terms of energy of excitable systems.

Radiobiology and Photobiology

The radiobiology research is driven by the concern that more and more people are purposely or accidently exposed to radioactive materials. A large part of the research uses the rat as the animal model and ^{32}P as the radiation source. Studies are being made of such things as leukocyte dyramics, enzyme activity, appearance of free radicals, oxygen consumption at rest and during phagocytosis, and chromosomal aberrations. They have found, for instance, that leukocyte dynamics is a function of the amount of radioisotope administered and of its distribution in the organism in the course of time. Studies of the occurrence of free radicals in leukocytes showed that they were found only when the accumulation of ^{32}P in the skeleton was a maximum.

The photobiology research is primarily directed at nucleic acids and should probably be called photochemistry. The researchers have studied the excited state induced in the pyrimidines of DNA by the absorption of ultraviolet rays. Using a number of different photosensitizer substances to stimulate the singlet and triplet states, they have found that pyrimidine dimers are induced only from the triplet state. Absorption and emission spectra at liquid nitrogen temperatures have helped confirm this.

Investigations being performed in the area of cell biology deal with the appearance of giant cells and

chromosomal aberrations following x-irradiation of cell cultures. Interesting results have been obtained also on the ultrastructural and functional alterations in liver mitochondria of rats exposed to gamma rays. Ultrastructural lesions and functional modifications in the mitochondrial membrane, as well as repair mechanisms, have been described in some of the laboratory's publications.

Membranes and Cell Biophysics

Research on membranes and cell biophysics is the area that seems to be the most active in the laboratory and certainly is the closest to the interest of the director, Vasilescu. The researchers have done a considerable amount of work on the tranquillizer Thalidomide and its effects on certain biophysical, biochemical, and structural parameters of the cell. Cytospectrophotometric techniques in the visible range are used to study changes in the lymphocyte nucleus induced by the drug in combination with ultraviolet radiation.

Combined techniques of cytospectrophotometry and fluorescence microscopy have shown the presence of certain modifications in the lymphocyte nucleus, in cases of chronic lymphatic leukemia, which could not be found by classical histological and histochemical methods. An autohistoradiographic study has been used to investigate and confirm the biochemical stability of DNA in the spermatozoa, a stability that was proved by the absence of a turnover of labeled DNA precursors in the DNA molecule of sperm.

The laboratory team has successfully worked out and applied a number of very tedious cell-measuring techniques. Such techniques as voltage-clamp, current-clamp, and double air space are routinely used and apparently very well. These are important techniques for studying the structure and function of cell membranes and the effects of the permeability of membranes to a number of ionic species or to physical agents. A minicomputer in the Biophysical Department has been used to simulate ionic currents in nerve impulses and is being used to conduct modeling experiments.

State and Role of Water in Biological Systems

Research on the state and role of water in biological systems is an area in which the Romanians have certainly been in the forefront internationally for a number of years. They have spent considerable effort in elucidating the state and role of water in a host of biological systems. They have used freeze drying, nuclear-magnetic-resonance spectrometry, and tissue deuteration techniques--all quite successfully. Much emphasis has been placed on the so-called "bound-water" and its role in nerves and other types of cells. A lot of their research in this, as well as in the other areas, has been conducted in close collaboration with US scientists, a number of whom were supported by the ONR, Arlington, biophysics program.

Conclusion

In summary, this small group of very dedicated scientists in the University of Bucharest School of Medicine is doing some first-rate research in biophysics. They have published almost 300 papers in the last 20 years, which is a very good record by any measure. Unfortunately, a large number have been in Romanian journals and therefore not often seen by the outside world. The majority have, however, been published in international journals, and several books have been written or edited in English. The Romanian Biophysical Society, whose headquarters are in this department, is very active and is known worldwide. Established in 1961, the society is under the direction of Vasilescu. It has organized 15 National Biophysics Symposia, two National Conferences, one International Summer School of Biophysics, and three UNESCO International Conferences on Water and Ions in Biological Systems. The proceedings of all these meetings were published and widely distributed. Since international scientific cooperation is one of the main activities of the Romanian Biophysical Society, it is worth noting that Vasilescu, the current president, is on the Coordinating Group of the UNESCO European Expert Committee on Biophysics and at the same time is the Romanian Commissioner in the Council of Commissioners of East European countries for cooperation in biophysics.

10/19/84

NEW THEORY OF EM INTERACTION DEVELOPED BY GERMAN RESEARCHER

by Thomas C. Rozzell.

The Bioelectromagnetics Society/Union Radio Scientifique Internationale (BEMS/URSI) Open Symposium held in Florence, Italy, in August 1984 was well attended by Europeans and Americans alike. However, since it came less than

2 months after the annual BEMS meeting in Atlanta, it did not contain a spectacular amount of new material. But there were a few notable exceptions. This article focuses on a new theory of electromagnetic (EM) interaction developed in West Germany and formally presented for the first time in Florence.

Background

Over the past decade, there have been several reports of unusual biological sensitivity to electromagnetic fields at millimeter-wave frequencies between 40 and 100 GHz (Webb, 1969; Devyatkov et al., 1974; Grundler and Keilmann, 1978 and 1983). These findings are unique for several reasons--particularly because of their consistency and reproducibility. Large users of EM energy, such as the US Department of Defense, have been concerned because of the biological effects that occur at very low threshold levels and that appear to give resonances with narrow linewidths at fixed frequencies. These findings, if found to be detrimental, could affect the operational requirements of a number of military and industrial systems currently in use or being planned. I reported last year on a special symposium in Hersching, West Germany, that dealt exclusively with millimeter-wave research (*ESN* 38-3: 119 [1984]). I recommend that article as background reading for those interested in better understanding the nature of the biological problems presented by this type of EM energy.

Much of the impetus for millimeter-wave research has resulted from predictions by the UK's H. Frohlich, who postulated the existence of nonlinear vibrational modes in large, complex macromolecules such as DNA (Frohlich, 1968 and 1972). However, Fritz Keilmann (Max Planck Institute), whose research with yeast cells gave reproducible evidence of nonlinearity, does not appear to be satisfied that Frohlich's model adequately explains the very low energy transitions that lead ultimately to higher order biological responses. Keilmann is, therefore, developing a completely new interactive model that he feels will be more comprehensive and will explain better the nonthermal resonance behavior that has been observed at millimeter-wave frequencies. It was this model that he presented in Florence and that I will attempt to outline in general terms.

Interactive Model

Keilmann bases his model largely on the well-accepted concepts underlying electron spin resonance spectroscopy and borrows heavily from the work of El Sayed (1974), McGlynn et al. (1969), and others. He disregards free radical formation but takes into account molecules or intermediate complexes that have two or more unpaired electrons which, in addition to exhibiting paramagnetic resonance in high magnetic fields, offers the possibility of microwave transitions in the absence of an external magnetic field.

Keilmann begins by looking at triplet molecules which possess three substates--X, Y, and Z. These substates differ in energy, if the molecular symmetry is not cylindrical, because of the mutual magnetic interaction of two unpaired electrons. Any two of the substates are connected by magnetic dipole transitions, as pointed out by El Sayed (1974). In organic molecules with dominant spin-spin interaction, the transition frequencies, V_{ij}, are low (on the order of 3 GHz). However, these transition frequencies can be over 40 GHz in molecules with tight orbitals. As an example, in benzenesulfonitrene it is 43.5 GHz (McGlynn, 1969). Some types of transition metal ions of porphyrin-type molecules have strong spin-orbit interactions that give rise to frequencies above 200 GHz. Keilmann feels that such metallo-proteins might be critical because of the central role of metal ions in enzymatic functions.

In cases where thermal equilibrium occurs at room temperature, the triplet substates are essentially equal in number. When nonthermal substate populations occur, they relax toward equilibrium through "spin-lattice" processes without giving off radiation. The time of these relaxations is known to be on the order of 1 second at temperatures below physiological levels. Not much is known about the time for these relaxations at these higher levels--except that they should be shorter.

Nonthermal populations of triplet substates characteristically appear when triplet molecules are formed. They may form by one of two mechanisms: optical or chemical. The former involves the radiationless decay of a photoexcited singlet molecule. This type of transition is substate-selective according to rules of symmetry, in that substates that tend to conserve angular momentum are preferentially populated. Analogous rules of selection are in force for the formation of triplet molecules by the chemical route.

There is also substate selectivity in the opposite case, that of annihilation of triplet molecules--for example, when there is a subsequent chemical reaction or a return to ground state

through emission of a photon (phosphorescence).

Since these types of transitions occur with rather fixed and critical lifetimes, Keilmann is suggesting that microwaves could alter the triplet reaction rate if they impinge on these molecules and if they are of a frequency that permits exact "resonance" with the triplet energies. It is possible that the rates are important in metabolic processes but may not be life threatening to an organism. Thus it is perhaps easy to speculate that such interaction mechanisms might give rise to some of the resonant effects that Keilmann and others have seen experimentally.

Finally, Keilmann claims that his model predicts a rather specific behavior of the observed bioeffects in the presence of external DC magnetic fields of approximately 100 Gauss. He feels that both resonant microwave fields and DC magnetic fields might, through consideration of these highly specific interactions, offer possible analytical and diagnostic applications in that they could serve as a "fingerprint" to identify the target molecule in the biochemical pathway.

Conclusion

Is Keilmann on to something? I don't know; that remains to be seen. He indicates that in the coming months he is going to attempt to fine tune this model and conduct experiments that he hopes will strengthen it. He will publish it soon in the *IEEE Transactions of Microwave Theory and Techniques* so that others can consider experiments to test it. He is also going back over past experiments and reanalyzing them in light of this new thinking.

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10/18/84

COMPUTER SCIENCES

CONFERENCE ON VECTOR AND PARALLEL PROCESSING HELD AT OXFORD

by C.J. Holland. Dr. Holland is the Liaison Scientist for Applied Mathematics/Computational Science in Europe and the Middle East for the Office of Naval Research's London Branch Office. He is on reassignment until December 1985 from the Office of Naval Research, Arlington, VA, where he is the Deputy Division Director of the Mathematical Sciences Division.

The Second Vector and Parallel Processing in Computational Science Conference was held in Oxford, England, from 28 through 31 August 1984. The meeting presented an excellent opportunity to discover the European experience with supercomputing.

Since the first conference in Chester, England, 3 years ago, researchers have gained considerable experience in working with vector and parallel processors and in designing algorithms that are particularly efficient for them. Additionally, manufacturers have developed both their architectures and user interfaces and have improved their support for such machines. New manufacturers, especially the Japanese, have also entered the scene. Europe itself is not a major manufacturer of parallel and vector processors; the only significant commercial production is the International Computers Limited (ICL) Distributed Array Processor (DAP). But European researchers are significant users of supercomputers, with about one-third of the approximately 100 supercomputers (as of the end of 1983) residing in Europe.

This conference was hosted by the UK's Atomic Energy Research Establishment (AERE), Harwell, with Professor L.M. Delves of the University of Liverpool as chairman. It was a rather large meeting of approximately 300 attendees (up from 250 at the first meeting) with about two-thirds of the participants from the UK. The remaining participants were primarily from other European countries, Japan, and the US. There were 12 invited talks, 26 contributed talks, and two poster sessions. The proceedings of the conference are scheduled to be published in a 1985 issue of the North-Holland journal *Computer Physics Communications*. Dr. Iain Duff and Dr. John Reid of AERE-Harwell will be the editors of the proceedings.

The conference was excellent in terms of both organization and quality of presentation. Talks were equally divided between hardware, software, languages, numerical methods, and applications. There were talks and poster papers on experience with most of the existing commercial supercomputers--the versions of the Cray and Cyber, the Denelcor Heterogenous Element Processor (HEP), the ICL DAP, the Fujitsu VP-100/VP-200, and the Hitachi S810/810-20. And there was discussion of some prototype machines--the Manchester data-flow machine, the Japanese SIGMA-1 data-flow machine, the Goodyear Massively Parallel Processor (MPP), the Erlangen General Purpose Architecture (EGPA) pilot pyramid machine, and the IBM Yorktown Simulation Machine for logic simulation.

In this short overview of the conference, I will concentrate on those talks which discussed experience with non-US machines, either commercial or prototypes. I will also report on a talk describing European experience with the Denelcor HEP since there is only one HEP in Europe, and its dedicated use for real-time simulation is unique.

European Supercomputer Sites

Duff gave an overview of European supercomputing sites (a detailed report is available from AERE-Harwell; see Duff, 1984). In early 1984 there were approximately 36 supercomputers in Europe; this number may not include sensitive defense installations. The distribution consists of 23 Crays, eight Cyber 205s, one Denelcor HEP, and five ICL DAPs. One may argue about the inclusion of the HEP and the DAP in the supercomputing list, but these computers are capable of supercomputing performance on many problems.

Duff discussed the principal uses of supercomputers. The following list gives those applications estimated to include the equivalent of at least one Cray or one Cyber (the numbers indicate years of Cray-1 time): nuclear weapons research, 4.0; seismic, 3.7; weather forecasting, 2.6; aerodynamics, 2.2; theoretical physics, 2.0; oil reservoir modeling, 1.7; nuclear power, 1.5; and structural analysis, 1.1.

European supercomputing sites are concentrated in the UK, France, and West Germany. The UK has the largest total with 15, consisting of eight Crays, two Cyber 205s, and five ICL DAPs. Germany and France both have nine supercomputers. The sites in Germany consist of five Crays, three Cybers, and one HEP, while France has eight Crays and one Cyber 205. Finally The Netherlands has one Cray and one Cyber 205; the only supercomputer in Scandinavia is a Cray in Sweden. A detailed list of supercomputing sites is given by country in Table 1.

British Experience

The British played a dominant role in the conference, as should be expected from the above discussion of supercomputing usage and the location of the conference. Many of the talks centered around experience on the ICL DAP, with an additional talk on the Manchester Data-Flow Machine.

ICL DAP. Britain's early commercial candidate in the supercomputing field was the ICL DAP. As Table 1 indicates, this machine has not been sold outside Britain and is perhaps unfamiliar to many in the US. The ICL DAP has 4096 processors arranged in a 64 by 64 matrix. The DAP does not operate as a stand-alone computer but is linked to an ICL 2972 or 2980 mainframe machine. The clock cycle time is 200 nanoseconds, and at each clock cycle a single bit operation is performed on each of the 4096 processing elements. Each processor has 16k bits of fast storage and is connected to its four nearest neighbors. Each processor has a 1-bit accumulator, a carry register, and an activity switch. The latter function allows the processors to be deactivated, which can be a useful facility when solving partial differential equations in a nonsquare domain. In the US, the Goodyear MPP employs a somewhat similar architecture. The MPP, a single machine, was designed for US National Aeronautics and Space Administration, primarily to do real-time image processing of satellite data.

Six of the DAPs have been built, with five being distributed to universities and government labs in Britain; the other one is at ICL. The UK's Science and Engineering Research Council has encouraged use of the DAPs. A DAP Support Unit was created at Queen Mary College, University of London, to do algorithm and software support for the DAP. Consequently, the British have considerable experience with these machines.

The architecture of the DAP makes it particularly well suited for simulation since it can generate 4096 random numbers simultaneously. Delves, of the University of Liverpool, discussed applications of Monte Carlo calculations on the DAP. A simulation for neutron diffusion occurring in reactors was discussed which gave a speedup of over 100 times the existing codes on the host ICL 2980 computer. Professor G. Pawley of the University of Edinburgh discussed simulations of a three-dimensional Ising

Table 1

European Supercomputing Sites
(Adapted from Duff, 1984)

Institute	Location	Supercomputer
United Kingdom		
Atomic Energy Res. Estab.	Harwell	CRAY S2200
Atomic Weapons Res. Estab.	Aldermarston	CRAY 1A CRAY X2200
European Center for Medium Range Weather Forecasts	Reading	CRAY 1A CRAY X2200
University of London Computer Centre	London	CRAY S1000
University of Manchester Regional Computer Centre	Manchester	CYBER 205
Meteorological Office	Bracknell	CYBER 205
Royal Aircraft Establishment	Farnborough	CRAY S1000
Royal Armaments Research and Development Establishment	Fort Halstead	CRAY S1000
Edinburgh University Regional Computer Centre	Edinburgh	2 DAPs
International Computers Ltd.	West Gorton	DAP
National Physical Laboratory	Teddington	DAP
Queen Mary College	London	DAP
Wallingford Hydraulics Research Establishment	Wallingford	DAP
West Germany		
Ruhr-Universität Bochum	Bochum	CYBER 205
Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt	Oberpfaffenhofen, Munich	CRAY S1000
Universität Karlsruhe	Karlsruhe	CYBER 205
Kernforschungsanlange-Jülich	Jülich	CRAY X2200
Max-Planck-Institut	Garching, Munich	CRAY-1A
Prakla-Seismos	Hannover	CYBER 205
Universität Stuttgart	Stuttgart	CRAY M1200
Wissenschoften Rechenzentrum Berlin	Berlin	CRAY M1200
France		
Commissariat à l'Énergie Atomique	Villeneuve St. Georges Vaujours	CRAY S2300 CRAY S2200
Compagnie Générale de Géophysique	Saclay (Massy)	CRAY S2300
Compagnie Internationale de Services en Informatique	Saclay	CRAY S2300 CRAY S1000
Computer network run by Control Data (CYBERNET)	Marne la Vallee	CYBER 205
École Polytechnique	Saclay (Palaiseau)	CRAY S1000
Électricité de France	Clamart	CRAY S2000
ELF-ACQUITAINE	Pau	CRAY M2300

Table 1 (Cont'd)

Institute	Location	Supercomputer
The Netherlands		
Stichting Academisch Rekencentrum Amsterdam	Amsterdam	CYBER 205
Shell	Rijswijk	CRAY S530
Sweden		
Saab-Scania	Linköping	CRAY S1000

model and quantum chromodynamics calculations.

Professors R. Wait and I. Martindale of Brunel University discussed iterative solutions of equations generated by three-dimensional finite element methods on the DAP. This is much harder than the two-dimensional problem, for which the architecture of the DAP is particularly well suited.

The present DAPs are far from the modern state of the art in fabrication--it is unlikely that any more of the current version of the DAPs will be made. There is considerable speculation as to ICL's next commercial move in this field. J. Roberts of the UK's Royal Signals and Radar Establishment discussed the plan of the British military for a highly compact and highly programmable processor--based on the architecture of the DAP--for real-time signal processing applications arising in speech recognition, electronic support measures, and image recognition.

Manchester Data-Flow Machine. Professor J. Gurd discussed the Manchester prototype data-flow computer system which has been operational at the University of Manchester since October 1981 (*ESN* 36-12:323-325 [1982]). Data-flow machines are specialized parallel architectures intended to support particular applications. In a data-flow machine, the asynchronous execution of the multiple processors is driven by the flow of the data. Each processor remains idle until all the data necessary for it to execute have arrived; then those processed data are passed on to other processors. The Manchester system implements a tagged token data-flow model of computation. The model imposes a tag field on data values in order to maximize asynchronousness of instruction execution. One key issue is to determine to what extent this overhead is necessary and how to minimize the overhead yet maintain acceptable asynchronousness.

German Experience

Dr. David Snelling of Denelcor discussed the use of the Denelcor HEP at the Flight Simulation Group at Messerschmitt Bölkow Blohm (MBB) in Munich. This is currently the only non-American sale of the machine. (Four have been sold to the US Army's Aberdeen Proving Grounds, and one is being leased to the Los Alamos National Laboratory.) At MBB, the Denelcor HEP is used for running real-time simulators designing aircraft. This work requires that the model be altered several times daily. These changes can be made more simply with the HEP than they could be with simulators built around arrays of analog computers and systems designed around multiple minicomputers. (I expect to discuss this operation in more detail in *ESN* later this year.)

A paper by Professors W. Handler, A. Bode, G. Fritsch, W. Henning, and J. Volkert (Universität Erlangen-Nürnberg) discussed a class of multiprocessors, the EGPA, which they are developing. The architecture is a grid-like array of microprocessors which operate asynchronously and are coupled via memory with a restricted number of neighbors. For supervising and for data transport there is a hierarchy of processors above the array. An experimental pilot-pyramid had been developed using the above ideas. The experimental system consists of four processor-memory modules at the lower level (the worker processors), with mutual memory access between neighboring processor-memory modules. An additional processor-memory module supervises these four worker processors with access to the memories of the worker processors. The authors reported that the measured efficiency of the experimental system ranged between 80 and 100 percent. A projected larger system of 85 processor-memory modules was also discussed.

Japanese Machines

The Japanese gave several surveys of their new supercomputers. As is well known, in 1982-83 three Japanese companies announced new vector processors: the NEC SX-1/SX-2, the Fujitsu VP-100/VP-200, and the Hitachi HITAC S810-10/S810-20. It was reported that the last

two computers are in operational use in Japan. They are being used in computing centers at national laboratories to perform large-scale simulation in such areas as nuclear engineering, aerodynamics, meteorology, and molecular science. Preliminary results, as reported by R. Mendez, have shown the Fujitsu VP-200 to be faster than the Cray XMP (see Mendez, 1984; Schwartz, 1984). These results, based on a sample of five application codes, should not be considered definitive but do point toward the potential end of the American dominance in the supercomputing manufacturing arena.

Dr. T. Yuba discussed the SIGMA-1; this is a large-scale data-flow computer for scientific computation being developed at the Electrotechnical University. The machine is designed to accommodate 256 processing elements, each of which works in a data-driven principle. It was announced that work began on this project in 1982 with an expected completion date of 1987. Some participants noted that the architecture for this project relied on research that was done at the University of Illinois.

Conclusion

This conference clearly indicated that although European countries are not now major manufacturers of supercomputers, they are nevertheless significant users and are exploring novel architectures that may be used in specialized machines.

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10/3/84

NEW ASSESSMENT OF ALVEY PROGRAM PUBLISHED

by J.F. Blackburn. Dr. Blackburn was until September Liaison Scientist for Computer Science in Europe and the Middle East for the Office of Naval Research's London Branch Office. He is now the London representative of the Commerce Department for industrial assessment in computer science and telecommunications.

ONR, London, has published a 1984 update and assessment of the UK's Alvey program, a 5-year research effort in computer science.

ONR, London, report R-11-84 examines developments in the program since the 1983 assessment was published in *ESN* 37-12:447-450. The report covers the five categories that make up the program: computer architecture (a recent addition), very large scale integration, software engineering, expert systems and intelligent knowledge-based systems, and man-machine interfaces.

In September 1983, Professor Edward Feigenbaum of Stanford University gave a somewhat pessimistic assessment of the prospects of the Alvey program's success. He based this assessment on what he perceived as insufficient resources for a multifaceted approach to the research effort, shortage of talented manpower, tension between long-term and short-term goals, risk of the total commitment to PROLOG, weakness of ties between universities and industry, and lack of respect for artificial intelligence in the UK.

These were valid reservations at the time, and some of them remain. The Alvey program has been able to mobilize resources from industry, academia, and government sufficient to mount 50 major research projects. Since most of them involve participation of industry and academia, there is a good probability of a substantial degree of success in most of them. Coordination will be easier for the Alvey program than for Europe's ESPRIT program because most of the work will be done in one country rather than nine. (ESPRIT is the European Economic Community's European Strategic Planning of Research and Development in Information Technology; see *ESN* 38-2:64-71 [1984].) Although the Alvey program is, and must be, multifaceted, it is reasonably concentrated geographically.

The shortage of talented manpower remains a problem. For example, it may be difficult to find the talent to establish a department for computer architecture in the program. There is substantial talent in this area in several universities, e.g., Manchester; Imperial College, London; Cambridge; Reading; and Loughborough. However, it may be difficult to recruit a talented leader to serve in the Alvey Directorate for the very reason that the talent is needed in the universities.

The commitment to PROLOG may prove to be well founded. The Japanese are heavily committed to PROLOG in their fifth-generation computer program, and the UK and Japan expect to coordinate

their fifth-generation plans. They expect to collaborate on several areas of work, including machine translation of Japanese and English.

The ties between British industry and universities are being strengthened remarkably as a result of the collaborative programs established by Alvey. This collaboration will undoubtedly enhance the probability of success for the program.

Finally, the acceptance of artificial intelligence as a respectable discipline is growing in the UK. A report by Sir James Lighthill in 1972 certainly set back research in artificial intelligence, but the work has now been revived with considerable activity at Edinburgh; Imperial College, London; Sussex; Essex; and Strathclyde. Also, Professor Donald Michie has established the Turing Institute at Glasgow. The institute will concentrate heavily on artificial intelligence and expert systems.

In summary, then, it is highly probable that the Alvey program will be at least moderately successful because of the strong commitment to it on the part of government, industry, and academia.

Given at least modest success, then, what will be the impact of the program on the computer industry in Britain and abroad? It seems probable that the effect of the program will be to:

1. Strengthen the UK companies participating in the Alvey program.
2. Strengthen British ties with Japan through their collaborative efforts in the Alvey program. Both countries have a commitment to the PROLOG language for fifth-generation computers, and both appear to be leaning toward data-flow architecture for hardware parallel systems.

The results of the above effects are likely to be:

1. Greater participation in both domestic and foreign markets by UK companies participating in the Alvey program.
2. Increased penetration of the UK market by Japanese companies. The Japanese influence will be moderated somewhat if major American companies, like IBM, become involved in the Alvey program.

For more information, see ONR, London, report R-11-84, which you can order by filling out the self-addressed mailer inside the back cover of this issue.

10/23/84

ROBOTICS REPORT AVAILABLE

by J.F. Blackburn.

ONR, London, sponsored and ran a workshop on robotics on 10 and 11 September 1984; ONR, London, conference report C-5-84 provides a detailed discussion of the meeting. The workshop brought together 15 of the leading research professionals in European universities and several interested persons from the US government and from the North Atlantic Treaty Organization to discuss the present state of research in this important field and to assess future directions. The discussion of the first day was devoted to visual and tactile sensing; robot programming and control was the subject of the second day.

At the end of each day a free-ranging discussion was held. The discussion on robot sensing centered around the following questions: whether tactile sensor resolution is more or less important than the ability to use dynamical tactile information; the need for vision in the robot gripper; the need for vision sensors specifically made for robot applications; the adequacy of charge-coupled-device sensors for robot-mounted vision sensors; the applicability of fiber-optic sensors; and the need for large parallel-processing systems for computer vision.

The discussion on robot programming and control was devoted to the following issues: whether too much emphasis is being placed on developing intelligent software versus good mechanical design; the complexity of fire-fighting robots; the need for versatility; and the system-architecture problems associated with developing complex robot systems.

For more information about the workshop, see ONR, London, conference report C-5-84, which you can order by filling out the self-addressed mailer inside the back cover of this issue.

10/23/84

MATERIAL SCIENCES

MARINE CORROSION AND FOULING

by Kenneth D. Challenger and E.C. Haderlie. Dr. Challenger is the Liaison Scientist for Materials Science in Europe and the Middle East for the Office of Naval Research's London Branch Office.

He is on leave until May 1986 from the Naval Postgraduate School, where he is Associate Professor of Materials Science. Professor Haderlie is Distinguished Professor of Oceanography at the Naval Postgraduate School, Monterey, California.

The Sixth International Congress on Marine Corrosion and Fouling was held from 5 through 8 September 1984 in Athens, Greece. The conference was sponsored by the Comité International Permanent pour la Recherche sur la Préservation des Matériaux en Milieu Marin.

The congress was organized by the Vice-Rector of the National Technical University, Professor Th.N. Skoulikidis. Over 90 percent of the participants at the meeting were Europeans. The congress had two concurrent sessions: Marine Biology and Marine Corrosion.

All papers for the congress were submitted months in advance, and upon registration in Athens each participant was given two bound volumes of all papers, entitled *Marine Corrosion and Marine Biology*. For copies, write to Professor Th.N. Skoulikidis, The National Technical University of Athens, Athens, Greece. Many of the papers in the bound volumes were in fact not given during the Congress; a few papers were given that do not appear in the bound volumes.

Corrosion Induced by Mechanical Effects

Many field tests have shown that marine corrosion is a function of depth in the oceans for some metals but not others, and several different mechanisms have been proposed to explain these results. Professor E.D. Mor (Instituto par la Corrosione Marina dei Metalli, Genova, Italy) and his students have studied this phenomenon and conclude that the effect of pressure on the corrosion process depends on the type of oxide formed on the metal. If the oxide is a p-type semiconductor, with many cationic vacancies in the lattice and a high conductivity (e.g., copper), increased hydrostatic pressure enhances the reduction process due to H^+ ions and thus increases the corrosion rate. If the oxide is an n-type with excess negative changes (e.g., zinc), its anodic dissolution is increased by pressure due to easier anion absorption and corrosion increases. If, however, the oxide layer is a p-type with only a few lattice defects and a low protonic and electronic conductivity (e.g., nickel), the effect of pressure is insignificant as the effect of pressure on anodic dissolution and cathodic reduction is very small. This mechanism developed by Mor appears to explain the effect of pressure on the corrosion behavior of various metals.

Skoulikidis and his students have shown that the resistance to stress-corrosion cracking (SCC) of aluminum alloys in salt water can be improved by control of the anodizing conditions. If the oxide layer can be generated such that oxide cells form normal to the expected fracture stress, then the best mechanical strength of the oxide will exist, improving the SCC resistance. However, both specimen thickness and oxide thickness were also found to be important. Specimens thicker than 2 mm were not protected by the anodic oxide, whereas for thinner specimens the optimum oxide thickness for protection decreases as the sheet thickness decreases: 1.0 mm, 45 to 11 μm; 0.5 mm, 11 to 7.5 μm; 0.25 mm, up to 5.0 μm. This suggests that, if possible, sheets greater than 1-mm thick should be replaced by sheets 1-mm thick or thinner, as these thinner sheets can be more effectively protected. The proposed explanation of these results is that for thick specimens the secondary structure of the oxide, especially porosity, is affected by the geometry of the electric field during anodizing, and, further, the form of the stress field at a crack tip shifts from plane stress to plane strain between thicknesses of 0.25 mm and 2.0 mm. This same approach for improved SCC protection was also tried unsuccessfully for steel. Skoulikidis feels that protection cannot be obtained in steel because it is not possible to prepare oxides which are oriented normal to the applied stress for steel; the oxide always forms parallel to the lamination (a function of the rolling direction) in steel sheet independent of the specimen orientation during anodizing. He also believes that the mechanism of SCC is not a function of the properties of the oxide layer for steel.

Several other papers were presented in this session, but nothing new or novel was mentioned. The research by Mor and Skoulikidis has been and continues to be very innovative, making significant contributions to the understanding of corrosion mechanisms.

Corrosion Studies

Several papers evaluated how factors such as various alloying elements, inhibitors, and the environment affect corrosion resistance. However, nothing new was presented. The only fact worthy of note is that most laboratories are now using electrochemical impedance techniques for the study of

transient (rather than steady-state) corrosion events. The impedance technique was used for evaluating inhibitors, paints, and the relative corrosion resistance of various alloys.

Dr. T. Jossic and coworkers (Institut de Recherches de la Sidérurgie, St. Germain en Laye, France) presented the results of an interesting study on the influence of alloying elements on the marine corrosion of low alloy steels. The effect of Cr, Al, Mo, and Ni were investigated. Cr and Al reduce the general corrosion rate, but promote the development of localized corrosion (pitting). Of the nine different alloys investigated, the standard workhorse alloy of the power generation industry for decades, 2Cr-1Mo alloy steel, had the best overall resistance to general and localized corrosion, but 2Cr-1Al alloy was almost as good. The various alloying elements alter the corrosion behavior by modifying the sealing properties of the oxide with respect to the environment.

Coating for Corrosion Control

One of the highlights of the conference was a paper by Skoulikidis and Dr. P. Vassiliou (National Technical University of Athens). They have developed and patented an anticorrosion paint with a pigment that has intense n-semiconductor properties. By offering electrons to the metal substrate, cathodic protection is provided (similar to the protection offered by paints containing sacrificial metal pigments). However, since the n-semiconductor provides protection without dissolution, it will remain active much longer than the sacrificial metal pigment paints. Skoulikidis has developed processes to produce ZnO with enhanced n-semiconducting properties. At present the best results have been obtained with an epoxy base paint containing 30 percent ZnO, where the ZnO was produced by anodically oxidizing Zn in NaOH at a current density of 1.5 A/dm^2 at 35°C with platinum cathodes. Skoulikidis has a wealth of novel ideas; thus his work should be followed very closely by the US Navy.

The other papers in this session dealt with comparisons of the various standard anticorrosion paint systems (e.g., paints with dipole molecules, paints with a large electric resistance, organic coating systems, sacrificial metal pigment epoxy paints, coal-tar epoxy), with nothing especially exciting reported.

Marine Biology

For the first time in this long series of congresses representatives from the People's Republic of China participated. Three scientists attended, and two gave papers during the biology part of the program. L. Yanshun and L. Ruimu (Third Institute of Oceanography, Xiamen, China) gave papers on the microfouling organisms in Xiamen harbor and the effects of macrofouling organisms on steel corrosion. These were interesting papers for they summarized work that most Western biologists did not know about.

The most significant papers in the marine biology sessions were a series presented by R.L. Fletcher and other colleagues and students of E.B. Gareth Jones (Portsmouth Polytechnic, Portsmouth, UK). One of these papers dealt with the settlement of spores of the green alga *Enteromorpha*, and discussed the strength of attachment of the spores and young plants. The investigators used a radial flow chamber in these studies and made observations on the attachment site using scanning electron microscopy. Other papers out of the Portsmouth laboratory examined the attachment of several common fouling diatoms and protozoans, the influence of surface energy on spore development in common marine fouling algae, and benthic marine fouling communities at an oil terminal in the Shetland Islands. All these papers were first rate and add considerably to our knowledge of the structure and behavior of algal fouling communities. As in previous congresses, excellent scanning electron microscope slides were used by the Portsmouth group to illustrate their papers.

A second group of excellent papers were given by G. Relini, A. Tursi, S. Geraci, and their colleagues from Italy (Università di Genova; Istituto Sperimentale Tallassografico CRR, Taranto; Istituto per la Corrosione Marina dei Metalli Reparto di Biologia Marina, Consiglio Nazionale delle Richerche, Genova). Professor Relini gave a detailed account of a 3-year study of the macrofouling community at a power station at Torvaldaliga on the Tyrrhenian Sea north of Rome. The fouling community in the intake conduits showed high diversity but low biomass and slow growth. Mussels created the main fouling problem and had to be controlled from March to September using hypochlorite.

Another paper in this series dealt with over 10 years of experimental work on the settlement and growth of the mussel *Mytilus galloprovincialis* in the marina at Taranto in southern Italy. The mussels settle only on surfaces previously colonized by filamentous organisms which protect and give mechanical support to settling mussel larvae.

A third paper from researchers in Italy dealt with a 3-year study of the larval stages and settlement of four species of barnacles (*Balanus*) in the harbor of Genova. This study continues a long series of fouling investigation on barnacles in Genova. In passing it should be noted that Relini (1980) has published recently an excellent guide for the recognition and identification of barnacles from the coast of Italy.

Another very interesting and significant paper was given by D.P. DeVore (Vision Care Department, 3M Center, St. Paul, MN) on the isolation and characterization of adhesive proteins secreted by the mussel *Mytilus edulis*. New techniques were developed to isolate prepolymerized adhesive proteins from the mussel's foot, and these were fractionated by gel permeation and ion exchange chromatography. Two dominant proteins were found at molecular weights of 37,000 and 16,500 daltons.

Antifouling Coatings

Very little seems to have been accomplished in the last 4 years in antifouling research, despite the claims of many people. The best of the papers given were by C.M. Sghibartz (Jotum Marine Coatings, Sandefjard, Norway) on the various antifouling paints used in the past and the possibilities for the future, and by F.H. de la Court (Paint Research Institute, TNO, The Netherlands) on a system of classification for antifouling paints based on a dynamic flow test.

Microbiological Corrosion

Five papers were given on the relationship of microbiological fouling communities and corrosion. Again, very little that was really new was presented in these sessions. Perhaps the best paper was by R.G.J. Edyvean (University of Sheffield, UK) on the interaction between microfouling and calcareous deposits formed on steel in seawater protected cathodically. Another good paper was by B. Little (Naval Ocean Research and Development Activity, US) on the impact of extreme obligate thermophilic bacteria on corrosion processes. High-temperature aqueous systems often contain thermophilic bacteria on the surfaces of the piping, and some of these can lead to severe biologically induced corrosion.

Summary

Our general opinion following this congress is that although there are many investigators active in the field of marine corrosion and fouling, there are only a few doing anything really new. Relini and Mor (Italy) are advancing the current understanding of fouling and corrosion; Skoulikidis (Greece) has some very novel ideas about corrosion control and prevention; and Jones (UK) is providing fundamental information on attachment mechanisms for fouling organisms.

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9/28/84

MATERIALS RESEARCH IN SOME ITALIAN INDUSTRIES

by Kenneth F. Challenger.

Three laboratories in northern Italy are doing some very good materials research that is worthy of continued attention by the US Navy. This article describes the work at FIAT's Central Research Laboratory; CISE, the research laboratory of the Italian Electricity Board; and the Italian Welding Institute. The research at these laboratories is, as one might expect, applied in nature. Most of their research involves 1- to 3-year efforts aimed either at improving their products or at solving today's problems.

FIAT Central Research Laboratory

The relevant research activities at FIAT were described to me by Dr. Massimo Castagna, Head of the Materials Department. This central laboratory has the responsibility for the medium- to long-range (2 to 10 years) research and development for the company's Operative Sectors (such as the truck division) and for the FIAT group as a whole. Specific product-oriented research (such as fatigue life of truck axles) is performed by each Operative Sector, whereas research that would benefit many of the Operative Sectors (such as a fatigue-damage-assessment model) is the responsibility of the Central Laboratory. Over 80 percent of the research at the Central Laboratory is funded by the Operative Sectors, with the remaining 20 percent coming from outside sources. About one-half of this outside support comes from the European Economic Community to support FIAT's part of a Joint Research Committee on the Cooperation Agreement among European Car Companies

(FIAT, British Leyland, Peugeot-Citroen-Talbot, Renault, Volvo, and Volkswagen). This agreement is for work in the field of basic technological research of a pre-competitive character. The Materials Department has major programs on the fatigue, corrosion and formability of high-strength, low-alloy steel; wear, machinability, and the effects of thermal (laser treatments) on gears; creep and low-cycle fatigue of conventionally processed and rapidly solidified aluminum alloys; creep and thermal fatigue of nickel-base superalloys for gas turbines; thermosetting plastics; composites; and silicon nitride processing and characterization. All steel alloy development is now done by Italsider (the nationalized Italian steel company); this work, which was very active at FIAT, was transferred to Italsider 2 years ago when the steel industry was nationalized in Italy. As part of this same agreement, FIAT is required to purchase all of its steel from Italsider (which has caused some problems for FIAT as the quality of the steel has not always been what FIAT requires).

FIAT is committed to the use of high-energy lasers in its production facilities for welding, surface treating, and surface coating. The Central Laboratory has a 15-kW laser with three work stations where they perform experiments on metal cutting, welding, application of surface coatings, and surface modification by local laser heating. In support of this work they perform experiments on the fatigue behavior of laser-welded components and wear studies on laser-treated cast-iron cylinder walls. (I believe they actually use laser treatment of the cylinder walls for all of their small diesel engines.)

They intend to replace steel with aluminum alloys for connecting rods in their engines. The operating temperature of 120°C is, however, in the creep range for the aluminum alloys. Therefore, they have a rather extensive creep and creep-fatigue characterization program for commercial aluminum alloys (2618 is the best evaluated so far), and they are evaluating rapidly solidified aluminum-alloy material made by powder metallurgy techniques with and without fiber (SiC and Al_2O_3) reinforcement.

Pressureless sintering (liquid phase sintering) of silicon nitride components is under study because these methods are much less expensive than sintering with pressurization. Both MgO+Fe and Y_2O_3+Fe have been evaluated as the sintering agents. The main limitation of this sintering method is that a maximum operating temperature limit of about 1200°C exists due to the amorphous grain boundary phase that forms during the sintering process.

FIAT, like all automobile manufacturers, is trying to incorporate fiber reinforced composite materials whenever possible. They have developed leaf springs and drive shafts for lightweight truck and automobile applications.

Another development project of interest is a collaborative project between FIAT's foundry research group and Professors C.A. Groia and G. Del Gandia of the Politenico di Milano. They have developed a new method of sand casting which considerably reduces the cost of model preparation. Their method uses a polystyrene foam pattern specially coated with a thin refractory film (quartz, alumina, chromite, or similar coating in an organic binder with either alcohol or water as the carrier). The key to success in this process is the coating, as it controls the gas removal rate (evolved when the polystyrene vaporizes). The coated pattern is buried in sand and compacted. When the hot metal enters the mold, the polystyrene evaporates, partly by direct contact with the molten metal, but mainly by radiation from the molten metal. The pressure from the vaporized polystyrene helps to support the refractory coating of the pattern until the metal solidifies. This process is termed "Policast" and is now at an advanced stage of development at Teksid iron foundaries (FIAT Group).

It is quite obvious from the preceding paragraphs that the research at FIAT is applied but, further, it appears to be motivated by either reducing cost or improving performance *without* increasing cost. Their present feeling is that many components in, say, automobiles, trucks, and gas turbines are overdesigned and that considerably more efficient (lighter) and less expensive products can be produced by removing this "fat" from the design. This philosophy is motivating their research programs on materials.

CISE

CISE is the research arm of the Italian Electricity Board (INEL) and thus receives about 80 percent of its funding from INEL. The laboratory facilities are excellent, and the output significant (over 600 employees) in all phases of research in support of the generation of electricity. Much of their work is applied, but some good fundamental work is performed.

In addition to the research activity, CISE provides industrial surveillance and diagnostic services for INEL. This involves the development of nondestructive testing methods and the use of

these methods for surveillance of INEL's power plants.

Many of the ideas that evolve from their research and development are carried through to commercial products which CISE then has produced through licensees. Three such products were discussed during my visit. An armored fiber-optic cable has been developed for applications where a standard cable is too fragile. (It would seem to me that this would have many applications in the US Navy.) CISE has just been given approval to build (over a 3-year period) a pilot plant in collaboration with FIAR to produce GaAs solar cells; the Italian Consiglio Nazionale delle Richerche (National Research Council) is funding the project. This pilot plant is similar to those under construction in the US (Hughes) and Japan (Mitsubishi). It will be able to produce 10,000 cells per year; at present CISE can produce, at best, three cells per day. They feel that the main application for these solar cells is in space, where their better conversion efficiency compared to Si (18 percent versus 13 percent), their increased resistance to irradiation-induced degradation, and the lower temperature dependence of their photovoltaic properties justify their higher cost. They have developed and produced several high-power lasers for industrial use. (Two 5-kW CO_2 transverse-flow, electrical-discharge lasers were in the process of being moved to one of Alfa Romeo's automotive production facilities.) With a stable-unstable (instead of just one or the other) optical resonator, the beam intensity distribution can be varied from small spot sizes (0.3 mm) for welding to a square beam of about 1 cm^2 for surface treating.

The materials research is performed under the direction of Mr. G. Angelino, Head of the Materials Department. I had the opportunity to discuss the research activities in his department with over a dozen different investigators. The department is organized into three sections: Mechanical Properties (Dott. Fossati), Coatings and Surface Analysis (Dott. Caruso), and Corrosion (Dott. Quaglia).

The coating and surface analysis work is concentrated in a few topics: thin membrane fuel-cell development, ion implantation and other coating processes for wear and erosion resistance, and development of new techniques for surface analysis. Raman spectroscopy is being used to study the mechanism of stabilization of the cubic ZrO_2 by Y_2O_3 and its effect on the electrical conductivity of ZrO_2. Rutherford scattering is being used to study the interface of $Pd/(ZrO_2,Y_2O_3)$. The adherence and structure of surface coatings on titanium are also under study. Acoustic emission is being developed as a nondestructive *in-situ* method to monitor wear of sliding surfaces; their results to date indicate that this method should be very successful. (This work by Dott. Martinella should be followed by the US Navy.)

Most of the corrosion research at CISE appears to be in support of the nuclear reactors that the Electricity Board is building. Their work in this area appears to be a duplication of what was done by General Electric and Westinghouse in the US years ago.

The work in the Mechanical Properties Section is of very high quality and is addressing topics of high interest to the US Navy. Fossati and Angelino, along with others at the laboratory, are very active in the field of fatigue, fracture, and elastic-plastic fracture mechanics. They have just produced some experimental data that appear to verify their questions on the validity of the J-R curve approach (the US Navy's accepted method) for determining J_{IC} (the elastic plastic fracture toughness of a material). These data have just reached the international community, and the reaction is not yet known. CISE has a beautiful fracture and fatigue laboratory which works closely with another section in the Engineering Department, where full-size components (pipes, I-beams, welded structures) are tested to verify the predictive models developed by Fossati's group.

There are many other projects in the Mechanical Properties Section, including research on environmentally assisted fatigue crack growth, development of techniques for dynamic fracture mechanics testing, and development of damage evaluation models for low-cycle fatigue. All of these are similar to, and complement, on-going programs at several US Navy laboratories.

Italian Welding Institute

During my tenure in Europe I plan to review the welding programs active in Europe; the following discussion, dealing specifically with the Italian Welding Institute, is the first of many that will appear in *ESN*.

The Istituto Italiano della Saldatura is located in Genova. Established in 1948, it is a private organization whose chief aims are to develop, research, and teach in the field of welding. I met with Dott. U. Girardi, Secretary General of the Institute.

Although their charter includes research and development, in fact very little is actually performed. They have

a small laboratory, but most of their work is by contract to an industrial customer--for example, to evaluate a certain manufacturer's welding equipment or a new filler metal.

The main activity of the 125 employees is to supervise, welding in industry under contract. They provide the qualification and training of welders for the Italian Registry of Shipping, Pressure Vessel Authority, and Nuclear Energy Organization. The institute is a member of the International Institute of Welding, whose main interest is in the development and verification of welding specifications.

Their activities in the near future will be on the development of methods to characterize and verify the quality of welds made by high-energy processes, and the development of new quality-control test methods to assess the resistance to brittle fracture of steel welds.

Conclusion

Although it is difficult to visit industrial laboratories because many of their projects are proprietary, considerable applied research is taking place which is of keen interest to the US Navy. Laser processing of materials, high-strength aluminum alloys, fatigue and fracture test methods and mechanisms, surface characterization, and surface coatings are of high interest. The researchers often work in more isolation than their counterparts in academia and government laboratories and thus welcome the opportunity to interact and exchange technical information.

10/24/84

STAINLESS STEELS/84 HIGHLIGHTS NEW DUPLEX STEELS

by A.J. Sedriks. Dr. Sedriks is Head, Environmental Effects Branch, Material Science and Technology Division, Naval Research Laboratory, Washington, DC.

The conference Stainless Steels/84 dealt with the scientific and technical advances in stainless steels and their applications in the energy industry.

The conference was held at Chalmers University of Technology, Gothenburg, Sweden, from 3 through 5 September 1984. The joint sponsors and organizers were Jernkontoret (the central steel producers' organization in Sweden), The Metals Society, and Chalmers University of Technology. Over 190 delegates attended from some 20 countries.

This article provides an overview of the six technical sessions. For more detailed information, see the conference proceedings, which will be published by The Metals Society, 1 Carlton House Terrace, London, SW1Y 5DB, England.

Physical Metallurgy

In the session "Physical Metallurgy" the keynote speaker, F.B. Pickering (Sheffield City Polytechnic, UK), summarized the general metallurgy of stainless steels. Emphasis was placed on the physical metallurgy of the superferritics and the duplexes. Nitrogen strengthening of the austenitics and duplexes was discussed in terms of smaller grain size and the effect of nitrogen on stacking fault energy.

T.M. Williams (Atomic Energy Research Establishment, Harwell, UK) dealt with the subject of avoiding the recrystallization of the cold-worked austentic structure in Type 316 stainless steel used in fast reactor core components. Type 316 was used as the control, and the behavior of the niobium-modified grades FV 548 and HL 548 was described in terms of the steels' better resistance to irradiation-induced void swelling.

Behavior in Corrosive Environments

In the session "Behavior in Corrosive Environments," I described the metallurgical aspects of the corrosion of stainless steels. Emphasis was placed on the beneficial effects of molybdenum plus nitrogen and on high chromium contents. It was noted that the elimination of sigma, chi, manganese sulfide, delta ferrite, alpha prime, and sensitization all gave rise to more passive alloys. Laser surface treatments aimed at improving passivity were also noted, as was hydrogen embrittlement of superferritics in the presence of cathodic protection and crevice corrosion in superferritic tube/Type 316 tubesheet crevices.

B. Brox (Chalmers University, Sweden) described studies of passive films on single crystals of ferritic stainless steels. S. Tahtinen (Technical Research Center of Finland) showed differences in the passivation behavior of different crystallographic low-index planes. A (110) surface exhibited rapid passivation, whereas (111) surfaces were the most active in sulfuric and hydrochloric acid solutions.

The pitting resistance and stress-corrosion resistance of duplex stainless steels were discussed by M. Tsuda (Nippon Koyogo Co., Ltd., Japan) and I.A. Ward (Sandvik Australia Ltd., Australia), respectively. Tsuda discussed

the importance of the ferrite/austenite ratio, suggesting that the pitting resistance is maximized at about 35 percent austenite in a 25%Cr-6%Ni-3%Mo-0.1%N stainless steel. Ward discussed both popular and discarded theories of stress-corrosion cracking and suggested that the stress-corrosion resistance of duplex stainless steel could be improved by future research incorporating alloying elements that either poison or catalyze hydrogen ion recombination. No experimental data were given in support of these ideas.

W. Roberts (Swedish Institute for Metals Research) described studies of the precipitation of borides and carbides in Type 304L stainless steels. Borides $(Fe,Cr)_2B$ precipitate extremely rapidly and can accelerate precipitation of $M_{23}C_6$. Both give rise to chromium depletion, although at low levels of carbon and boron the resulting sensitization is not serious.

M. Kurkala (Outokumpu Oy, Finland) described the corrosion behavior of an austenitic grade (POLARIT 778) containing 6%Mo and 0.2%N. As in the case of similar steels produced in other countries, the corrosion resistance was good.

Welding

In the session on welding the keynote speaker, T. Gooch (The Welding Institute, UK), summarized the present status of the field. Gooch noted that in the case of austenitics the sulfur content determines the molten pool size, requiring the maintaining of sulfur levels equal to or greater than 0.01 percent. The superferritics exhibit better weldability than the conventional ferritics. Regarding future studies, more research should be aimed at liquation cracking rather than solidification cracking since the latter can be avoided by correct practices.

Proprietary alloys and their welding procedures were described by several authors. B. Holmberg (Avesta Jernverks, Sweden) described the use of Filler P12 (equivalent to Inconel alloy 625) for the welding of the high molybdenum austenitic grade 254SMO. M. Niset (Soudometal, Belgium) described the development of the coated electrode Soudinox B316 for welding Type 316 for fast-breeder-reactor applications. J. Pleva (Uddeholms AB, Sweden) described the welding evaluations of the duplex grades 44LN and 744LN.

Nuclear Power Generation

In the session "Nulcear Power Generation" the keynote speaker, J. Wareing (Springfields Nuclear Power Development Laboratories, UK), dealt with stainless steel requirements in British nuclear technology (i.e., civil advanced gas-cooled reactor and the fast breeder reactor). A stainless steel containing 20%Cr-25%Ni-Nb is used as the fuel-can material in the gas-cooled reactor (700°C, CO_2, neutron irradiation), and Type 316 is the structural component material for the fast breeder reactor (600°C, liquid sodium). Fatigue, creep, and creep-fatigue resistance are important. Extrapolation of plant lifetimes from short-term laboratory data is a problem.

J. Wilkinson (BSC Stainless, UK) dealt with the development of a high-boron Type 304; the purpose of the boron is to attenuate neutron flux in the storage and transportation of spent nuclear fuel. At an optimized boron level of 0.8 percent, conventional fabrication could still be used with specialized welding techniques to eliminate hot cracking. The range of boron levels investigated was 0 to 2 percent.

Oil and Gas Recovery

In the session "Oil and Gas Recovery" the keynote speaker, R.D. Kane (Cortest Laboratories, US), defined the environments of interest to the "oil patch" (solutions of H_2S, CO_2, and brine at elevated temperatures) and discussed the use of martensitic, duplex, and highly alloyed austentic stainless steels as well as nickel-base alloys.

Several researchers described stainless steels made by new production techniques. G. Guntz (Vallourec Research Center, France) described the manufacture of VS28 (austenitic) tubing by extrusion of compacted powder billets. T. Andersson (Nyby Uddeholm, Sweden) described the production of seamless tubes, fittings, and weld-neck flanges by hot isostatic processing of powders of 984LN (a high molybdenum austenitic). P.G. Stone (BSC Stainless, UK) described the advantages, in terms of life-cycle costs, of using stainless steels in the topside construction of offshore oil and gas platforms. Type 316 has been used for this.

Thermal Power Generation

In the last session of the conference--"Thermal Power Generation"--the keynote speaker, N.G. Persson (Avesta Jernverk AB, Sweden), provided the background for the use of stainless steels in combustion systems and in desulfurizing scrubbers. Among the topics noted were the use of concentric (Type 310/carbon steel) tubes in combustion systems and the need for 6%Mo minimum for stainless steels in sulfur scrubbers.

Conclusion

My general impression was that the conference succeeded in blending basic research with applications technology. Commercial promotion of new alloys and processes was minimal, with major emphasis being placed on technical content. The most striking single aspect was the large amount of research and development that has gone into the new duplex stainless steels. Seven years ago at the conference Stainless Steel/77, only two papers dealt with duplex stainless steels. At Stainless Steels/84 there were 10 papers dealing with this topic. By way of contrast, there were far fewer papers at Stainless Steels/84 on ferritic and superferritic stainless steels than at Stainless Steel/77. At the latter conference about half the papers presented dealt with ferritics or superferritics.

Another aspect of Staniless Steels/84 was the emergence of the 6%Mo austenitic grades for applications requiring high resistance to localized corrosion. Many major producers of stainless steel now appear to have a 6%Mo grade in their product line, with sigma formation problems being minimized by mischmetal and nitrogen additions.

10/24/84

MATHEMATICS

CHAOS AT ICTAM

by C.J. Holland. Dr. Holland is the Liaison Scientist for Applied Mathematics/Computational Science in Europe and the Middle East for the Office of Naval Research's London Branch Office. He is on reassignment until December 1985 from the Office of Naval Research, Arlington, VA, where he is the Deputy Division Director of the Mathematical Sciences Division.

The Sixteenth International Congress of Theoretical and Applied Mechanics (ICTAM) was held from 19 through 25 August 1984 at the Technical University of Denmark. Special sessions on chaotic behavior and other sessions on turbulence captured a large share of the attendees at the conference. The experimental, analytical, and numerical work presented by researchers in France was especially strong; this article concentrates on their work. (European work on chaos in electrical circuits has been described in ONR, London, report R-6-84.)

Background

This quadrennial event was held under the auspices of the International Union of Theoretical and Applied Mechanics and was organized by the Technical University's Center for Applied Mathematics and Mechanics. Proceedings of the congress will be published by the North-Holland Publishing Company and will be available at the beginning of 1985. The proceedings will contain the full text of only the major lectures at the congress.

Talks at the congress covered the entire field of analytical, solid, and fluid mechanics--including applications. The traditional areas--such as acoustics, crack mechanics, dynamics, plates and shells, waves in fluids, and solids--were covered in both lecture and poster sessions. There were 273 lectures and talks, and 184 poster presentations. In addition, the organizers arranged three special sessions focusing on the current research interaction involving different areas of mechanics: "Marine-structure Wave Interaction," "Microcomponents of Multicomponent Media," and "Development of Chaotic Behavior in Dynamical Systems."

The conference was attended by approximately 750 participants. The US had the largest representation, with 182 participants (down from 247 at the 1980 Toronto meeting). The next largest was Denmark, with 70 registrants. This participation results from Denmark's strength in theoretical and applied mechanics--as evidenced by the Danish Technical University--and from Denmark's being the host country. Despite the USSR's scientific strength in theoretical and applied mechanics, there were only 12 participants from the Soviet Union--approximately the level of participation at the meeting in Delft in 1976 and Toronto in 1980. However, there were 1200 Soviet participants at the Moscow meeting in 1972.

Analytical Work

Professors P. Chossat and G. Iooss, mathematicians at the University of Nice, reported on their analysis of the preturbulent primary and secondary bifurcation in the Taylor-Couette problem (see Chossat and Iooss, 1984).

This problem has a long history; it has been much studied--both experimentally and analytically--in the last decade since it provides a good example of successive transitions to turbulence in a closed system. The Taylor-Couette problem concerns the fluid flow between

two concentric rotating cylinders (let a and b denote the angular velocities of the inner and outer cylinders respectively). The basic flow is the Couette flow consisting of current lines, which are coxial circles.

For this case the outer cylinder is rigid (b=0), G.I. Taylor in 1923 assumed that the cylinders were infinitely long and used a formal linear stability analysis to determine the primary transition to the steady bifurcating solutions--the now well-known Talyor vortices, which occur as the Reynolds number is increased.

In case both cylinders are rotating (either corotating or counterrotating), there are numerous routes to turbulence. Chossat and Iooss have applied bifurcation theory in the presence of symmetry to analyze the potential transitions. This technique is not based upon a formal linearization but works directly with the nonlinear problem and uses the center manifold theorem to reduce the problem to a finite dimensional problem. Chossat and Iooss also do not make the unrealistic assumption of infinite length of the cylinders. Instead they assume a cylinder of fixed height, but for their analysis to be valid, they are forced to assume periodic boundary condition at the top and bottom. It is argued that these assumptions do not affect the flow away from the boundaries.

Chossat and Iooss' analysis shows that there are numerous routes to turbulence in this problem, depending on the sign of the product of a and b. When the product of a and b is not too negative, the first transition from the Couette flow consists of the steady bifurcating solutions--the Taylor vortices--which were first studied by Taylor in 1923 for a fixed outer cylinder. The second bifurcation may give rise to different kinds of rotating waves--either wavy vortices or twisted vortices. In case b is zero, then only wavy vortices are possible. In the case of counterrotating cylinders with a sufficiently large angular rotation rate for the outer cylinder, then the first transition is to a time-periodic state of a rotating wave structure. While some of the flows have been known for some time, it is only recently that all these flows have been observed in experimental work at the University of Texas at Austin (Anderek, 1983).

Computational Work

Dr. Laurette Tuckerman of Commissariat à l'Énergie Atomique-Saclay reported on some numerical investigations concerning the formulation of Taylor vortices in the flow between differentially rotating concentric spheres (known as spherical Couette flow). The case of gap size equal to 0.18 (gap size = (large radius-small radius)/small radius) was studied numerically using an axisymmetric initial value code. Transitions to one or two vortices were observed numerically. The interesting result was that the transition to the one vortex case occurred asymmetrically with respect to the equator despite the symmetry of the initial and final value states. This partially explains why numerical codes, assuming symmetry about the equator, had been unable to observe the phenomenon. It was shown that for a small interval of Reynolds numbers, the primary bifurcation branch, consisting of zero and two vortex states, is linearly unstable to an antisymmetric perturbation. It is this instability that initiates transition to the secondary branch containing the one vortex state.

Experimental Work

Researchers at the École Normale Supérieure reported on several interesting experimental efforts. Professors J. Chomaz, Y. Couder, and C. Basdevant reported on their experimental technique for creating a circular shear zone in a thin layer of fluid (see Couder, 1984; Rabaud and Couder, 1983). The fluid is air, with the use of a soap film to permit a novel visualization of the flow. The experimental cell consists of a vertical cylinder of radius r(2) and height h much smaller than r(2) closed at the top and bottom by circular plates. The central parts of the plates are independent disks of radius r(1). The central disks rotate at an angular velocity v(1), while the rest of the cell rotates at a velocity v(2). A thin soap film is made to stretch across the cell at the middle height h/2. Since the thickness of the cell is small, friction on the walls drives the fluids into two concentric solid rotations with angular velocities v(1) and v(2) separated by a shear zone with an inflection in its velocity profile. This experimental setup allows the observation of a Kelvin-Helmholtz instability that affects the shear zone. At a critical value of the velocity difference V=v(1)-v(2), an oscillation of the fringes in the shear zone amplifies into a regular mode of m vortices of elliptical shape. The structure of the vortices rotates as a whole at a fixed angular velocity. This mode is stable for a range of velocity differences. At another critical value of V, transition

occurs to another symmetric mode of n vortices with n less than m.

This is a clever experimental setup. To be affected by the Kelvin-Helmholtz instability, the velocity profile had to have an inflection point, and the flow needed to be two dimensional in planes perpendicular to the rotation axis.

Professors S. Fauve, C. Laroche, and B. Perrin presented results from an experimental study of thermal convection in a horizontal layer of mercury heated from below and rotated about a vertical axis. In this setup there are competing experimental instabilities arising from heating as well as rotation. If the rotation rate is small, the experiments show that the steady state bifurcates toward a stationary convective state as the temperature difference across the layer is increased. However, at high rotation rates, a Hopf bifurcation occurs corresponding to the generation of inertial waves in the fluid.

Conclusion

There is currently a wide range of experimental, analytical, and numerical work investigating the transition to chaos in model systems. Researchers in France are playing an important role in this area. Most of the work has concentrated on nonlinear dynamics in oscillators governed by ordinary differential equations and transitions to chaos in *closed* fluid systems. One hopes--especially if one is interested in the performance of naval vehicles and weapons--that the research in these model systems will give insight and techniques for understanding (and hence delaying) routes to chaos in turbulent shear flows in *open* systems. At ONR, Arlington, this topic is being investigated in a new Selected Research Opportunity program. It will be interesting to see if this transition can be made by the time of the next ICTAM meeting in Grenoble, France, in August 1988.

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10/17/84

MECHANICS

DRAG REDUCTION AT THE UK'S NMI

by Patrick Leehey. Dr. Leehey is the Liaison Scientist for Naval Architecture and Applied Mechanics in Europe and the Middle East for the Office of Naval Research's London Branch Office. He is on leave until September 1985 from the Massachusetts Institute of Technology, where he is Professor of Mechanical and Ocean Engineering.

The Applied Fluid Mechanics Division of the UK's National Maritime Institute, Limited, has a vigorous research program focusing on the use of riblets and compliant coatings for drag reduction.

Background

Prior to 1976, AFM Division of the NMI in Teddington was the Aerodynamics Division of the National Physical Laboratory (NPL). In 1976 the transonic and supersonic research activities and facilities were transferred to the Royal Aircraft Establishment, Farnborough. The remaining fluid dynamics activities are now combined under NMI, which has its headquarters at Feltham, 5 miles northwest of Teddington. Approximately 1 year ago the UK government divested itself of NMI and a number of other government research activities; hence today NMI is a private nonprofit corporation dependent upon industrial and government contracts for its support. The personnel are no longer part of the civil service.

The present head of AFM Division is Dr. Melvyn E. Davies. Davies is a young mathematician who has come to AFM from the ship research portion of NMI at Feltham, where his most recent research work was on cavitating propeller-induced hull vibration. My host at the AFM Division was Dr. Michael Gaster, who is very well known in fluid dynamics circles for his experimental studies of wave-packet behavior in the transition from laminar to turbulent boundary layer flow. The AFM Division is not large, comprising approximately 25 professionals. It operates eight or 10 subsonic

wind tunnels, depending upon one's definition. In Gaster's words, "There is one tunnel per investigator." One major work area involves the activities of what are known locally as "chimney doctors." This involves a variety of industrial experimental fluid dynamics studies of buildings, bridges, racing cars, trucks, and ship hulls. They also have the capacity to study combined wind and water-wave actions upon ship hulls and offshore platforms. They have a special wind tunnel which produces an aerodynamic turbulent boundary layer over water. A water-wave generator is also installed. A large subsonic tunnel, number 7, has been recently modified to provide a very long rectangular test section. A wall jet is produced on the floor immediately behind the contraction section. This, combined with roughness elements installed between the jet and the test section, permits the development of a very thick aerodynamic boundary layer within which flow measurements are made around various models of industrial structures.

Drag Reduction

My principal reason for visiting the AFM Division was to discuss its work on drag reduction. This involves two phases, both directed by Gaster. One phase has to do with the experimental determination of the effect of riblets in reducing turbulent boundary layer frictional drag. These riblets are finely spaced streamwise grooves in the wall which provide approximately 5 to 7 percent frictional drag reduction. The precise nature of the mechanism is unknown. However, it has been found that the spacing of the grooves should be a fraction of the spacing of the steady longitudinal vortices which have been discovered in the viscous sublayer. These vortices are spaced approximately 100 viscous lengths laterally.

The work here is being conducted by Dr. K.S. Choi. The plan is to use large riblets in very slow wind-tunnel flow affording the possibility of installing hot film shear-stress gauges within the riblets. It is also intended to use laser-illuminated visualization of the flows directly over the riblets. This work is in its early stages. Experiments were to begin in December 1984, with the project continuing for approximately 2 years.

The second phase of the drag-reduction work is being conducted by Drs. A.P. Daniel and G.J.K. Willis. This involves the use of compliant surface layers under a laminar boundary layer in water to delay transition by suppressing the generation of surface-wave instabilities in the boundary layer. Such work began 25 years ago with the experiments of Dr. Max Kramer of Göttingen, West Germany. The original Kramer "lamiflo" coating consisted of an elastic surface layer over a labyrinth whose spaces could be filled either with viscous fluid or with air. In those early years, Kramer and his associates conducted a number of experiments which reported showing either delay of transition by the coatings or a reduction of turbulent frictional drag itself. Unfortunately, later investigators could not reproduce Kramer's results. Theoretical investigation by Dr. Brooke Benjamin in England and Drs. Kaplan and Landahl in the US showed that although the Tollmien-Schlichting instability of the boundary layer could be suppressed by a suitable coating, other instabilities developed. Further, such layers were susceptible to divergence at moderate flow speeds. Recently the numerical solutions of Kaplan and Landahl have been extended by Dr. Peter Carpenter at Exeter University (UK) and by Gaster and his colleagues at NMI. A particular feature of the numerical work at NMI is the development of a fast method for obtaining eigenvalues of the Orr-Summerfeld equation for small changes in the compliant surface boundary condition. For a given velocity profile the fluid dynamics portions of the characteristic equation are computed once and for all as a complex Fourier series. Evaluation of the characteristic equation then is reduced to algebraic treatment of the surface admittance. The material properties of the compliment surface itself can be altered over a wide range of complex moduli without the necessity for a re-solution of the entire problem.

This numerical work has indicated that a suitable compliant coating can produce a marked narrowing of the ranges between branches 1 and 2 of the neutral stability curve for a specific excitation frequency and, moreover, reduces significantly the value of the maximum growth rate between the branches. This indicates the transition resulting from a specific range of excitation frequencies probably could be appreciably delayed. The experimental program is intended to verify these numerical calculations.

A smooth, flat plate test rig has been constructed and installed on the carriage of one of the towing basins at Feltham. This test plate has an 18-inch-square insert for the installation of compliant coatings. It uses hot film surface-shear-stress gauges to detect transition. To generate Tollmien-Schlichting waves of the desired frequency,

a series of holes drilled transversely in the plate forward of the test section are connected to a common plenum within which a nearly pure tone pressure signal is created of the desired frequency.

This system has been checked out using a rigid control test plate. The researchers have been successful in generating and measuring Tollmien-Schlichting waves and their growth rates in water. Since the towing carriage must operate necessarily with both acceleration and deceleration phases, it is possible therefore to study the effect of acceleration and deceleration on the growth of Tollmien-Schlichting waves both with and without complied coatings present. This is important because numerical calculations indicate that the combined effect of acceleration and compliant coating is much more favorable toward the delay of transition than either of the individual effects alone. It is presently intended to operate the carriage at speeds of approximately 2 m/s--slightly below the speed at which divergence of the compliant coating is expected to occur. The program is of fundamental interest not only in the eventual prospect for drag reduction, but also because it will be the first well-planned experiment in which numerical results, some of which are over 20 years old, will have been verified experimentally.

Conclusion

In its day the Aerodynamics Division of NPL was the home at one time or another of many of the well-known names in British aerodynamics--e.g., Frazer and Duncan. It is pleasant to be able to report that its successor, the AFM Division of NMI, is carrying on the tradition of vigorous and intelligent research in fluid dynamics, although in a somewhat reduced scope. The investigations of riblets and compliant coatings presently under way should provide significant new insights into the mechanisms for frictional drag reduction.

10/22/84

SCIENCE POLICY

NATO PROGRAMS SUPPORT SCIENTIFIC COOPERATION

by Henry Durand. Mr. Durand is NATO's Assistant Secretary General for Scientific and Environmental Affairs.

For 25 years the North Atlantic Treaty Organization has supported programs to encourage scientific cooperation. Most of the programs are the responsibility of NATO's Division of Scientific Affairs, which concentrates its efforts on three areas: the promotion within NATO of scientific and technological relations; the technological development of the less favored countries of the alliance--e.g. Greece, Portugal, and Turkey; and the coordination of national initiatives designed to improve the quality of life. This article concerns the first two areas.

Program Achievements

Its scientific exchange program rapidly established NATO as a leading organization responsible for promoting exchanges between Western scientists--and, more modestly, with scientists from the rest of the world. The Science Committee, with the backing of the NATO Council, sought both to diversify and intensify its activities in order to keep them abreast of changing requirements in the scientific community in member states. These activities are designed to:

1. Augment the pool of qualified scientists by encouraging exchanges of students and young research workers in all scientific disciplines (at the doctoral and postdoctoral level) through a Science Fellowship Program under which there are some 900 beneficiaries each year.
2. Increase the effectiveness of national efforts in science by pooling scientific capacities and facilities through the Collaborative Research Grants Program, which involves more than 1000 qualified scientists annually.
3. Promote the dissemination of up-to-the-minute scientific knowledge and exchanges of information through a program of summer schools and workshops, which bring together more than 5000 scientists each year.
4. Identify deficiencies in both scientific knowledge and capacities and set up a series of activities focused on specific themes. These special programs reflect the freely determined scientific policy of the Committee.
5. Furnish the Council with advice on scientific and technological problems of concern to member states.

The programs set up to achieve these objectives complement purely national programs. The grants made under them to individuals contrast with the institutional-type funding practiced by most other international scientific organizations. In the past generation,

more than 200,000 scientists have benefited from NATO's financial assistance.

The broad tendencies of the programs have evolved in parallel with changing requirements within the alliance. Whereas at the outset the emphasis was on basic research, more attention is now being paid to applied research and industrial technology; another example of this evolution is the growing importance of the life, as opposed to the physical, sciences.

Support for Less-Prosperous Countries

NATO's science programs attempt to encourage the technical potential latent in the less-prosperous countries. A program called Science for Stability has been launched for the benefit of Greece, Portugal, and Turkey.

The Science for Stability Program has taken a different approach from that of the traditional activities of the Science Committee, in that it actively supports research projects in which NATO assumes the role of partner to Greece, Portugal, and Turkey. The program began in 1981 with a budget of $15 million spread over 6 years--a budget matched by national contributions. The program is designed to help the three countries develop the scientific and technological capabilities of their governments, universities, and industries. The choice of projects is linked to their potential for contributing to the scientific and technical development of each country.

The first results, which are now beginning to appear, have encouraged the Council to ask the Science Committee to examine the possibility of continuing the program beyond the initial cut-off date of 1986.

Science Programs' Future

The next year or two will be particularly important to NATO's science programs. In 1985 a decision will be made about adopting on a more permanent basis the experimental Advanced Research Workshop. For 2 years this program has successfully complemented the long-established Advance Study Institutes. In late 1985 or early 1986 NATO will consider a major extension of the Science for Stability Program. Later in 1986 there will be a decision about adopting the International Intersectoral Exchange Program. This is an experimental program that emphasizes industrial research activities.

10/9/84

SPACE SCIENCE

IAF CONGRESS HIGHLIGHTS EUROPEAN SPACE PROGRAMS

by Norman F. Ness. Dr. Ness is the Liaison Scientist for Space Physics in Europe and the Middle East for the Office of Naval Research's London Branch Office. He is on reassignment from Goddard Space Flight Center, NASA, where he is Chief, Laboratory for Extraterrestrial Physics.

The 35th Congress of the International Astronautical Federation (IAF) was held in Lausanne, Switzerland, from 8 through 13 October 1984; the theme was "Space Benefits for All Nations."

Over 800 registered attendees participated in the presentation of over 400 papers dealing with space technology. Simultaneous with the IAF sessions were those of the International Institute of Space Law, which since 1958 has annually organized a colloquium on the Law of Outer Space held during the IAF congresses. The IAF program is devoted to progress achieved and the problems involved in different fields of astronautics. In close cooperation with the Committee on Space Research (COSPAR) of the International Council of Scientific Unions, the IAF assiduously avoids including scientific results of space exploration. Instead it concentrates on the technological aspects of both instruments and spacecraft on recently and to-be-launched missions, as well as more general mission considerations such as tracking and communication.

This year's meetings concentrated on the following topical areas: Space Transportation Systems; Space Stations and Space Platforms; Communication Satellites; Earth Observations From Space and Space Environment; Microgravity Sciences and Processes; Life Sciences; Space Exploration; Space Economics and Benefits; Space Safety and Rescue; Communication With Extraterrestrial Intelligence; History of Astronautics; Space Energy, Power and Propulsion; and Global Habitability. There also were some more general technical sessions. The quality of papers varied considerably, as did the different sessions, in part because of the policy of the IAF to accept all submitted papers, and in part because of the absence of some authors, so that papers were omitted or read by someone else. This latter approach was most prevalent in the USSR contributions.

Highlights of the past year in space were presented in four early evening sessions by the US, the USSR, France, and the European Space Agency (ESA). The US program summarized the highly successful (and first of its kind) Solar Maximum Spacecraft repair mission. The very well attended USSR program overviewed their Venus missions, including some recent Venera 15 and 16 synthetic aperture radar images as well as their planned two-spacecraft VEGA mission to Venus and Comet Halley (launch was scheduled for December 1984). Their more recent Salyut-7 cosmonauts, Yeliseyev (male) and Sovietskaya (female) presented color slides and film of their activities in training and in space. The USSR presentation was well done, especially by comparison with their dismal presentation at COSPAR in Austria in July 1984.

The French Centre National d'Études Spatiales presented a top-quality film summarizing their 20 years of progress in both scientific and applications spacecraft. The French also reviewed their pivotal role in the development of the ESA Ariane launch vehicle, which is now a strong economic competitor to the US shuttle for launch of many application missions. Long-term plans are aimed at launch of a manned space station, Columbus, in 1995 on the Ariane 5 vehicle. This vehicle will also place 6 tons in geostationary transfer orbit. Finally, the ESA presented a film and comments by the two European astronauts involved in the Spacelab I mission.

In the technical presentations, which were mainly by Europeans, the emphasis was clearly on development of advanced space technology within their own national boundaries, as opposed to purchase from the US. This seemed to be partly due to their hopes for exploitable commercial uses as much as to the current US administration's attempts to discourage or prohibit technology transfer or the export of "high technology." This was dramatically represented in the ESA Columbus spacecraft studies currently under way as part of their tentative role in the space station program of the US.

In June 1984 West Germany and Italy proposed that an autonomous manned space station (Columbus) be built by the Europeans, with the guiding principal being the mandatory development of enabling technology in Europe so that they would not be dependent upon the US. The European Retrievable Carrier (EURECA) space platform is now being built on the basis of Spacelab experience. It is an *unmanned*, reusable, autonomous space station scheduled to be launched (and retrieved) in late 1987 by the US shuttle. As a follow-up to Spacelab, EURECA provides capabilities beyond those of Spacelab with respect to time in orbit and microgravity environment.

In the area of Earth resources, oceanology, and meteorology, the ESA's Earth Resources Satellite (ERS) for studying oceans and ice, or national programs like France's SPOT missions seem especially vigorous. SPOT-1 is scheduled for launch in September 1985. Certainly no better acknowledgment of their state-of-the-art accomplishments exists than that of the inclusion in the US TOPEX satellite mission (on an Ariane launch) of a French-provided radar altimeter (Poseidon) and spacecraft positioning system called DORIS (Doppler Orbitography and Radiopositioning Integrated from Space).

The SPOT-3 follow-up program is an attempt to anticipate the commercial success of satellites which monitor renewable resources. The present studies envisage an 8-year lifetime for a two-spacecraft mission covering the period 1990-98 with ongoing surveillance of vegetation, geology, and oceanography. The SPOT spacecraft will use Swedish and Bengali ground stations. The ESA is also considering the value of its own data relay satellite system to handle the distribution of applications satellite information and is able to show an expected economic benefit from its studies thus far. Launch is proposed for sometime after 1990.

The USSR presented several papers on the technology and some sample oceanographic results from their Cosmos 1500 satellite's side-looking radar using a 3-cm wavelength with some data processing on-board the satellite. Antenna width (3 dB) is 0.15 degrees in azimuth by 30 degrees. Measurements are made at incidence angles of 22 degrees to 52 degrees, corresponding to a swath of 450 to 500 km. These results on oceanic surface structure were compared with SEASAT-A and shuttle synthetic aperture radar results. As in their space science program, USSR researchers have begun to involve their East European colleagues in applications satellites and their manned space flight program through the Interkosmos office of the USSR Academy of Sciences. East Germany presented results from the Salyut-7 flight of a remote sensing instrument (MKS-M), two multichannel (18) spectrometers covering from 415 to 880 nm. The analysis of data was discussed in several papers developing algorithms for the inversion of such spectra to retrieve atmospheric, oceanic, meteorological and geological/agricultural parameters.

West Germany is planning a continuation of its first Spacelab mission (SL-1), calling the next one D-2. It is scheduled to be shuttle-launched in mid-1988 and will be a dedicated microgravity mission with experiments in the disciplines of materials research and processing, biology, and medicine. Four of the five payload elements will come from West Germany, while one will come from ESA. West Germany is soliciting experiments for the 10-day mission; the announcement of opportunity was to be made in late 1984, with proposals due in April 1985.

The Italians are cooperating with the US in a unique venture to provide a tethered subsatellite attached to the shuttle. The goals are: (1) scientific with respect to plasma interactions and geomagnetism, (2) practical with regard to power generation and orbit modifications, and (3) commercial with respect to microgravity processes with controllable non-zero values of g. Launching is expected in 1987, following selection of instruments in late 1984.

Considerable emphasis upon results of the COSPAS-SARSAT (Search and Rescue Satellite) system was demonstrated by a number of papers. (COSPAS is a Romanization of the Cyrillic words for Space System for Search of Distressed Vessels, which is the USSR spacecraft used.) One of the four opening invited lectures (by Yv. Atserov) dealt with the Soviet COSPAS system and its role in an integrated international system for ships, personnel, and aircraft in distress in remote or relatively inaccessible areas. This program is a joint venture developed by Canada, the US, the USSR, and France, with countries such as Norway, the UK, Finland, and Bulgaria participating as co-investigators.

Multiple satellites in low Earth polar orbits are used as receivers for distress signals, whose reception and subsequent Doppler analysis by Mission Control Centers allow Rescue Coordination Centers to initiate more conventional search and rescue operations in precisely defined locations. Thus far, the program has had several hundred successful recoveries of stranded, lost, or distressed personnel as well as numerous tests with sailing vessels and land vehicles.

A portion of the proceedings of the congress will be published in a book to be entitled *Space Benefits for All Nations*, while original contributions will appear in special issues of *Acta Astronautica*. The editor in chief for both publications is Professor Luigi Napolitano of the University of Naples, Italy. The next meeting of the IAF will be held in Stockholm, Sweden, from 7 through 12 October 1985 with the theme "Space for Peace." Information can be obtained from IAF Congress, P.O. Box 27322, S-10254 Stockholm, Sweden.

10/18/84

NEWS & NOTES

URSI MEETING ON MILLIMETER AND SUBMILLIMETER ASTRONOMY

A Union Radio Scientifique Internationale meeting on millimeter and submillimeter astronomy was held in Granada, Spain, from 11 through 14 September 1984. The first two days of the conference focused on technology and instrumentation for millimeter and submillimeter astronomy; during the last two days, individual astronomers reported on their latest astronomical observations.

The first session opened with an excellent review of the state of the art in telescope design by R.W. Wilson (Bell Telephone Laboratory). Wilson summarized the impact of the latest technologies on existing and proposed designs. Carbon-fiber reinforced plastic (CFRP), homologous design, active thermal control, holographic surface measurement, and active surface control were some of the topics mentioned.

Contributors to this session reported on the status of the Institut de Radioastronomie Millimetrique (IRAM) 30-m telescope at Pico de Veleta; the Japanese 45- and 10-m telescopes at Nobeyama; the IRAM interferometer (15-m dishes); the European Southern Observatory in Chile; the California Institute of Technology 10.4-m telescope at Mauna Kea, Hawaii; the UK/Netherlands 15-m telescope (also at Mauna Kea); and the joint Max Planck Institute for Research and University of Arizona 10-m telescope to be placed near Tucson, Arizona. Most of the new instruments were European and were based on CFRP technology.

Later in the conference the attendees were treated to an enlightening description of a proposed 70-m telescope with a specified surface accuracy of 70 microns (rms) to be built on the plateau Suffa (40 degrees north, 69 degrees east) in the USSR. These somewhat remarkable specifications are to be achieved by using a real-time, computer-controlled servo system that will control about 1200 panels of the telescope.

In the session on receivers, discussion focused on the cooled Schottky

mixer and the SIS mixer. There was no clear indication about which technology will ultimately prove superior for ground-based millimeter astronomy receivers. J.W. Archer (National Radio Astronomy Observatory, US) reported on a multiplier chain which gave 0.5-mW output over the frequency range 320 to 350 GHz. This result, as well as the Gunn oscillator described by R.L. Plambeck, demonstrates the availability of local oscillators up to 350 GHz with sufficient power for either cooled Schottky mixers or SIS mixers.

Millimeter- and submillimeter-wave astronomy, through the study of the many spectral lines available in this frequency range, can provide significant insight into the chemistry and kinematics of star-forming regions in our galaxy. It was encouraging to see so much effort being dedicated, particularly by the European community, to this important area of research.

Conspicuous by their absence were any new, nonheterodyne submillimeter or far-infrared (IR) spectrometers. This is surprising because it was clear from the remaining talks on astronomical observations that submillimeter and IR spectroscopy is the exciting new area of astrophysics. It would seem that in this case that the instrumentation is lagging behind the scientific interest rather than driving it.

For information about obtaining the proceedings of the meeting, write to:

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D.L. Thacker
10/17/84

BRITISH TELECOM GETS ALVEY FUNDS

The UK's Alvey Directorate has provided research funding to British Telecom (somewhat similar to Bell Telephone plus ITT). The current total volume of support is in excess of £20 million (about $25 million). Telecom's research labs are heavily involved in developing the science and technology for the next generation of silicon integrated circuits. Five projects in this area are supported by Alvey: novel dry-etching techniques, electron-beam lithography, high-resolution chemical analysis, failure analysis via new microscopy techniques, and multilevel interconnections for chips. Apart from these focal areas, another eight Telecom projects also receive Alvey funds.

The Alvey Directorate of the UK's Department of Trade and Industry is dedicated to intensive support of information technology. The Directorate awards grants and other fiscal resources to all sectors of research and development, from universities through research labs to industry and other private enterprises (see *ESN* 37-12:447-450 [1983]).

Paul Roman
10/19/84

ITALY CREATES PHD PROGRAMS

In 1984 Italy introduced the PhD degree into its educational system for engineers. Previously, there was no opportunity for graduate engineering education in the country. The only degree available to engineering students was the Laureate Degree, a 5-year course of study. These Laureates received (and will continue to receive) the title Dott. Ing. (doctor of engineering).

Italy's graduate education program is styled after the British PhD in that it is a 3-year research degree with no formal classroom instruction. The Italians have not decided what title will be given to those who complete this program, but the title given to all Laureates, Dott. Ing., will no doubt cause some confusion.

Kenneth D. Challenger
10/22/84

CONFERENCE ON ELECTRIC AND MAGNETIC FIELDS IN MEDICINE AND BIOLOGY

The UK's Institution of Electrical Engineers is planning to hold an International Conference on Electric and Magnetic Fields in Medicine and Biology on 4 and 5 December 1985. The conference is scheduled to be held in London.

The aim of this conference is threefold: (1) to provide a forum for the presentation of recent work in the various aspects of the topic area, including the clinical evaluation of the effectiveness of the techniques; (2) to inform participants of the wide range of biological interactions of electric and magnetic fields; and (3) to indicate areas of possible therapeutic benefit and potential hazard. The conference is

to include discussion of the effects of frequencies up to about 27 MHz but not nuclear magnetic resonance, which is the subject of another conference in August 1985. It is noteworthy that hyperthermia at microwave frequencies seems to have been purposely omitted.

The conference will attempt to cover four broad topic areas:

1. Fundamental studies. This area will deal with mechanisms of interaction between electromagnetic fields and biological tissue, the threshold of perception of such fields, and electrode effects.

2. Diagnosis. This will cover stimulation of nerves using magnetic fields, impedance imaging, and magnetic fields due to naturally occurring electrical activity.

3. Treatment. This is a broad area of application that encompasses bone healing using magnetic fields and direct currents, soft tissue healing using steady magnetic fields, pulsed short-wave diathermy, transcutaneous electric nerve stimulation for pain relief, and skin batteries.

4. Safety. Most aspects of safety will be dealt with here. Topics such as effects of low-frequency fields, safe field strengths, interaction between fields and pacemakers, acute hazards (such as electrocution), and effects of long-term, low-level exposure.

For more information, write to the following address: Secretariat, Conference Services, The Institution of Electrical Engineers, Savoy Place, London WC2R OBL, UK.

Thomas C. Rozzell
10/17/84

SYMPOSIUM ON ELECTROMAGNETIC COMPATIBILITY

The Sixth Electromagnetic Compatibility and Technical Exhibiton will be held at the Swiss Federal Institute of Technology in Zurich (Eidgenossische Technische Hochschule Zurich, or ETHZ) from 5 through 7 March 1985.

The Institute for Communication Technology of the ETHZ will once again be responsible for the conference organization under sponsorship of the Swiss Electro-technical Association. The conference will attempt to deal with classical topics such as interference coupling, lightning and nuclear electromagnetic pulse impact, and measuring techniques, as well as with some related special disciplines such as biological effects and electromagnetic-interference countermeasures in communication systems (e.g., spread-spectrum techniques). In addition to technical and scientific lectures, there will be workshops, exhibits, and excursions to local institutes and industries. The authors of the best papers will receive awards and monetary prizes.

For further information, contact Dr. T. Dvorak, ETH Zentrum-IKT 8092 Zurich, Switzerland; telephone: (411) 256-2790, telex: 53 178 ethbi ch.

Thomas C. Rozzell
10/15/84

NEW COMPUTER JOURNALS

Two new computer journals dealing with advances in large-scale computing have recently been announced by North-Holland (American Elsevier Publishing Company). Publication of both journals began in the summer of 1984.

Future Generation Computer Systems (FGCS) will report on computer systems and supercomputers of the fifth generation and beyond. The journal is addressed to scientists, managers, and policy makers interested in information technology. The editors are Professor H. Aiso, Yokohama, Japan; Dr. F. Kuo, Menlo Park, California; and Professor P. Raulefs, Kaiserslautern, West Germany.

Parallel Computing will cover the theory and use of parallel computer systems, including vector, pipeline, and fifth-generation computers. This journal is intended for a more technically inclined audience than FGCS. The editors in chief are Professors M. Feilmeier and U. Schendel of West Germany, and G.R. Joubert of The Netherlands.

C.J. Holland
10/4/84

SCIENCE NEWSBRIEFS FOR OCTOBER AND NOVEMBER

The following issues of *Science Newsbrief* were published by the ONR, London, Scientific Liaison Division during October and November. *Science Newsbrief* provides concise accounts of scientific developments or science policy in Europe and the Middle East. Please request copies, by number, from ONR, London.

Science Newsbrief Number	Title
2-14-84	A Call for Papers on Electric and Magnetic Fields in Medicine and Biology, by Thomas C. Rozzell.
2-16-84	A Call for Papers for International Laser Congress and Exhibition, by Paul Roman.

OCTOBER MAS BULLETINS

The following *Military Applications Summary (MAS) Bulletins* were published by the ONR, London, Military Applications Division during October. The *MAS Bulletin* is an account of naval developments in European research, development, test, and evaluation. Its distribution is limited to offices with the US Department of Defense. DoD organizations should request copies of the *Bulletins*, by number, from ONR, London.

MASB Number	Title
68-84	New Jet Engine Test Facilities in Use in the UK
69-84	Air-launched Weapons Developments at British Aerospace
70-84	MIZEX84: An Overview
71-84	Development Under Way for Reconnaissance Variant of Tornado for Employment with the RAF

ONRL REPORTS

To request reports, check the boxes on the self-addressed mailer and return it to ONR, London.

C-5-84 *ONR, London, Workshop on Robotics*, by J.F. Blackburn. The US Office of Naval Research, London, hosted a workshop on robotics on 10 and 11 September 1984. The meeting brought together 15 of the leading researchers in European universities. The main topics were robot sensing, programming, and control.

C-6-84 *Electromagnetic Waves and Neurobehavioral Function: An International Workshop*, by Thomas C. Rozzell. An international workshop on electromagnetic waves and neurobehavioral function was held in Belgium from 19 through 23 August 1984. The objective was to analyze the current knowledge about the interaction of electromagnetic energy and the nervous system.

C-7-84 *Fifth Meeting of the European Society for Neurochemistry*, by C.E. Zomzely-Neurath. The fifth meeting of the European Society for Neurochemistry was held in Budapest, Hungary, from 21 through 26 August 1984. The theme for the meeting was "Regulation of Transmitter Function: Basic and Clinical Aspects." This report examines selected topics that not only are of fundamental importance for neurobiologists, but also are being actively pursued by European neuroscientists. The research trends as evidenced by the

meeting are: (1) increasing awareness and use of techniques in immunology and molecular biology as aids in elucidation of neurotransmitter regulation; (2) the use of synthetic compounds as agonists or antagonists of neurotransmitter function to obtain more refined neuropharmacological data; and (3) collaborative studies between the various subdisciplines of neurobiology--e.g., pharmacology, physiology, biochemistry, and clinical neurology--to integrate the results obtained into a more comprehensive picture.

R-11-84 *The UK Alvey Program in Computer Science: 1984 Update and Assessment*, by J.F. Blackburn. The UK's Alvey program is a 5-year research effort in computer science. This report examines the developments for 1984 in the five areas that make up the program: computer architecture, very large scale integration, software engineering, expert systems and intelligent knowledge-based systems, and man-machine interfaces.

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