



OCEANIC ENGINEERING SOCIETY

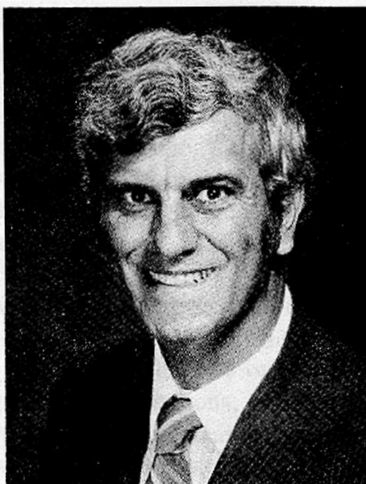
NEWSLETTER 

VOLUME XIX

NUMBER 4

EDITOR: HAROLD A. SABBAGH

WINTER 1985 (USPS 420-910)



Harold A. Sabbagh
Editor



Stanley G. Chamberlain
President

PRESIDENT'S COMMENTS

This year has seen significant advances in the Oceanic Engineering Society (OES) as a forum for electro-technology interaction and exchange for the oceanic engineering community. At this time last year, only a single local OES chapter had been officially formed. Today, I am pleased to say we now have five chapters (Central New England, Halifax Nova Scotia, San Diego, Seattle and Washington DC) and chapter formation activities are underway in five additional cities (Houston, Los Angeles, New Orleans, San Francisco, Southern Florida and Victoria, B.C.). These local chapters provide a forum for meeting with other professionals involved in the various aspects of engineering in the ocean environment. As such, they provide a grass roots foundation upon which we can continue to grow in the future.

At this time last year we had only a single technology committee within OES. Today, I am pleased to say, we have seven committees, including: Current Measurements, Arctic Instrumentation, Autonomous Underwater Vehicles, Marine Communications and Navigation, Oceanographic Instrumentation and Data Acquisition, Remote Sensing and Underwater Acoustics. We are looking to these committees to be forums for technical exchange in the various disciplines that comprise electrotechnical oceanic engineering. The committees can sponsor specialty workshops, assist in organizing technical sessions at Oceans and Offshore Technology Conferences and help put together special issues of the Journal. Members of the committees can also assist the associate editors of the Journal in reviewing papers submitted in their areas of expertise.

IEEE OCEANIC ENGINEERING SOCIETY

President

STANLEY G. CHAMBERLAIN
Raytheon Co.
Submarine Signal Division
Box 360
Portsmouth, RI 02871
(401) 847-8000 Ext. 4423

Vice President, East Coast

ANTHONY I. ELLER
Code 130
NORDA Liaison Office
800 North Quincy St.
Arlington, VA 22217
(202) 696-4951

Vice President, West Coast

LLOYD Z. MAUDLIN
Group Vice President
Integrated Sys. Analysts, Inc.
5461 Toyon Rd.
San Diego, CA 92115
(619) 265-9292 (H)
(619) 422-7100 (O)

Treasurer

EDWARD W. EARLY
4919 N.E. 93rd St.
Seattle, WA 98115
(206) 543-9825

Secretary

JOSEPH CZIKA
TASC
8301 Greensboro Dr.
Suite 1000
McLean, VA 22102
(703) 734-4100 (O)
(703) 938-0058 (H)

Jr. Past President

DONALD M. BOLLE
College of Eng. Phys. Sci.
Packard Labs #19
Lehigh Univ.
Bethlehem, PA 18105
(215) 861-4025

Membership Development

DAVID E. WEISSMAN
Dept. of Eng. & Computer Sci.
123 Adams Hall
Hofstra Univ.
Hempstead, NY 11550
(516) 560-5546

Chapters

ARTHUR S. WESTNEAT, JR.
Univ. of New Hampshire
PO. Box 208
Durham, NH 03824
(603) 659-2195 (H)
(603) 749-6056 (O)

Awards and Fellows

DONALD M. BOLLE
College of Eng. Phys. Sci.
Packard Labs #19
Lehigh Univ.
Bethlehem, PA 18105
(215) 861-4025

Nomination

DONALD M. BOLLE

Sr. Past President

LLOYD Z. MAUDLIN
Group Vice President
Integrated Sys. Analysts, Inc.
5461 Toyon Rd.
San Diego, CA 92115
(619) 265-9292 (H)
(619) 422-7100 (O)

Meetings

ANTHONY I. ELLER (East)
LLOYD Z. MAUDLIN (West)

Constitution and Bylaws Committee

JOSEPH CZIKA

The Journal of Oceanic Engineering has made great strides during the past year. Using number of pages as a measure, during 1985, JOE is averaging 115 pages per issue, which is a 60% increase over the page per issue average for 1984. The 1984 average is in turn a 50% increase over the average just two years earlier. Special issues of JOE have appeared during 1985 on: Instrumentation Development for High Level Nuclear Waste Disposal Beneath the Deep Ocean Floor, Special Bicentennial Issue and Beamforming, with one to appear shortly on Advances in Electromagnetic Remote sensing of the Ocean. Additional special issues are in process to appear in 1986. Technologies for these range from Ocean Acoustic Remote Sensing to High Frequency Radar for Ocean Ice Mapping and Ship Location, from Manned and Unmanned Underwater Vehicles to Applications of Machine Intelligence for Autonomous Submersible Vehicles.

The Oceanic Engineering Newsletter has also expanded and improved over the past year. During 1985, the Newsletter is averaging 24 pages per issue, which is a 50% increase over the 16 pages per issue average in 1983. News on chapter formation and technology committee activities appear regularly, along with technical and/or historical papers of broad membership interest. If you want an interesting challenge, try the "Tis a Puzzlement" teasers.

The annual OCEANS Conference continues to attract top quality papers and pace-setting special speakers. This year's OCEANS '85 Conference attracted over 700 attendees to hear the 260 papers in 56 sessions, held in lovely San Diego. Of particular note this year was the separately-sponsored classified 1985 Military Ocean Engineering Conference held in conjunction with OCEANS '85. This special classified conference augmented the OCEANS Conference by allowing state-of-the-art developments with a classified application to be considered by those working in such areas.

The other major conference co-sponsored by OES is the Offshore Technology Conference. After a year of no industrial exhibits, OTC-85 returned to standard format to draw some 65,000 attendees. This highly successful Conference is held each May in Houston.

Each of the above areas of Society activity is testimony to the outstanding value of membership in the Oceanic Engineering Society. Nevertheless, membership statistics indicate that we need to do a better job in getting the word out about this value. Society memberships declined by 6% from 2130 to 2011 members over the past year. This represents a 25% drop from the number of subscribers to JOE in 1982, the year just prior to our transition to society status. These drops, I believe, are a result of the transient caused by the transition from Council to Society and are not indicative of any ill health of the Society. Rather, OES today is a healthy vigorous society. With active chapters, technology committees, conferences and publications, OES is the electrotechnical oceanic engineering forum to become

involved in if you want to be stimulated and grow professionally.

This is my last "Comments" to the membership as President. I would like to thank those who have served the Society with distinction during my tenure as President. We are particularly indebted to those who, along with other responsibilities, have served on the ADCOM Executive Committee. Tony Eller has been our Vice President, East, as well as Co-Chair of the OCEANS'84 Technical Committee and Coordinator of our developing Technology Committees. As if these were not enough, he is the new OES President and is also Co-Chair of the OCEANS'86 Technical Committee. Lloyd Maudlin has been Vice-President, West, and Senior Past President. He was also on the Steering Committee for OCEANS'85 and General Vice Chair of OCEANS'83, and was instrumental in establishing the OES Chapter in San Diego. Don Bolle was our Junior Past President and Chair of our Awards Committee. In the former capacity, he chaired our Nominations Committee. Ed Early, our Society Treasurer, took on many additional assignments, including preparing our attractive OES Membership brochure and, along with Lloyd Maudlin and Tony Eller, prepared the Comprehensive Guidelines for OCEANS Conference host city proposals and those for Conference Committees. Joe Czika, a relative newcomer to Society activities, has pitched in faithfully as Society Secretary and, along with Tony Eller, helped establish the OES Chapter in the Washington, D.C. area.

Others who have served the Society with distinction include Stan Ehrlich, who has done an outstanding job as Editor of our Journal, leading to the growth cited above. The Editor of our Newsletter, Hal Sabbagh, has labored faithfully for the past eleven years to see that an interesting and informative Newsletter came out regularly. I also want to acknowledge Art Westneat for his efforts in coordinating the establishment of OES Chapters, and Glen Williams for his labors on behalf of the Offshore Technology Conference, first on the Technical Program Committee and now as our representative on the OTC Executive Committee. Glen is also serving the Society in his new role as Vice President, East. These, and the many others who have served the Society as members of the ADCOM, Associate Editors of the Journal or Newsletter, Chairs of our emerging Chapters and Technology Committees, and in other ways, have made the Ocean Engineering Society an interesting and stimulating forum for professional growth and enrichment. Thank you, each one.

Finally, thank you for the opportunity to serve you as President during this period in which we transitioned from Council to Society. While it has been a lot of work, it has been challenging, interesting and fun. I am sure I have grown from this experience and I trust I have contributed to the growth and stability of the Society.

Stanley G. Chamberlain

ADCOM MINUTES

2/18/87

to (Hil SobG...
for Sp... New...
Fredrick H. Matz...
Norman D. Miller
Don R. Younger

Dennis G. Douglas
Roger F. Dugan
Philip L. Katz

Daniel L. Alspach
Lloyd R. Breslau
Robert H. Cassis, Jr.
Thomas M. Dauphinee

Edward W. Early
Harold A. Sabbagh
Joseph R. Vadus
David E. Weissman

RESULTS OF THE ADCOM ELECTION BALLOT

As you know, a ballot for the election of ^{six} eight IEEE Oceanic Engineering Society Administrative Committee members was issued on October 30, 1985. The ballots returned have been counted, and the following candidates have been elected for a three-year term beginning on January 1, 1986:

We wish the newly elected AdCom members success and thank all nominees for their willingness to serve and for permitting their names to be included on the ballot.

RESULTS OF ADCOM OFFICERS ELECTION

At the ADCOM meeting held at OCEANS '85 the September 25, 1985, the ADCOM elected Daniel L. Alspach as Vice President, West. Don has been active in the ADCOM for many years. He joins President Tony Ester, Vice President, East Glenn Williams, Secretary Joseph Czuka, Treasurer Michael Serotta and Past Presidents Donald Bolle and Stanley Chamberlain as members of the ADCOM Executive Committee.
J. David Irwin

OCEANS '85 SUMMARY

OCEANS '85 was held November 11-14, 1985 in San Diego, CA. The meeting was sponsored by IEEE OES and the Marine Technology Society. The conference had more than 800 registrants and 117 exhibitors. There were 57 sessions and 264 papers which dealt with essentially every aspect of Ocean Engineering.

The technical sessions were preceded by nine tutorials which ranged from the basic principles of microprocessors to polar research.

The opening Plenary Session chaired by Professor William A. Nierenberg, Director of UCSD's Scripps Institution of Oceanography, consisted of a distinguished panel of experts who discussed the conference theme "Ocean Engineering and the Environment." The panel members and their areas of (expertise) are: Dr. John Flipse (Ocean Mining 1985), R. Curtis Croke (Offshore Oil and Gas Technology Assessment), Dr. Tudor Davies (Ocean Waste Disposal), Dr. Douglas Inman (Damming Rivers Leads to Beach Erosion), Harold Yates (Remote Sensing), and Michael Fischer (Environmental Concerns).

Erich Bloch, the Director of the National Science Foundation, was the Keynote Luncheon Speaker. He discussed the importance of our Nation's science and engineering base and our ability to compete in a global environment. He outlined our current position and discussed possible actions for the future. His recommendations include: Reallocation of resources to support basic research and the universities; strengthening multidisciplinary research through the establishment of basic science and technology centers; increased cooperation between industry and academia; and leveraging the federal budget to do as much as possible.

At the Awards Luncheon Dr. Stanley Chamberlain, President of the Oceanic Engineering Society, presented the society's annual awards. Dr. William A. Nierenberg, the Director of the Scripps Institution of Oceanography, received the Distinguished Technical Achievement award and Joseph R. Vadus of the National Oceanic and Atmospheric Administration, the Distinguished Service award. Our sincere congratulations to these two outstanding individuals for their numerous important contributions.

BASIC RESEARCH AND ECONOMIC HEALTH: THE CHALLENGE IN THE OCEANS

MR. ERICH BLOCH
DIRECTOR, NATIONAL SCIENCE FOUNDATION
KEYNOTE LUNCHEON ADDRESS
OCEANS 85
SAN DIEGO, CALIFORNIA
TUESDAY, NOVEMBER 12, 1985

Thank you for the introduction, and good afternoon.

It is especially a pleasure to have an opportunity to address a conference such as this one, which combines so thoroughly the interests of both industry and academia, the interests of Science and Engineering, and the interests of the various disciplines. One of the most important trends of the past few years has been a move towards greater cooperation among all these sectors. I can't think of anything that is more important, in Ocean affairs as in other areas. It is one of the central themes of everything that we are trying to do these days as NSF.

My remarks today are directed at what I take to be a serious national problem: the need to mobilize the scientific and technological capability of the nation to meet the economic challenge of international competition. It is a problem in almost all areas, not just in Ocean affairs.

These are indeed difficult days in Washington. Someone recently described the mood in Congress by observing that if the Ten Commandments were introduced as new legislation the result would be political stalemate. And if Noah were requesting funding for the Ark, the appropriation would be reduced and he would be asked to set priorities among the species!

- And if he had had to work under Gramm-Rudman he would have had to reduce the sample size of each species!

That's about the way things have been going with NSF's budget. But we hope to be able to save the Ocean scientists and engineers, and keep the ships afloat!

Let me begin my more serious remarks with three brief quotes:

“The party views scientific and technical progress as the main lever for the solution of all economic and social issues.”

- Mikhail Gorbachev said that last June.

“Science and Technology have emerged as a universal language for humankind.”

- Prime Minister Yasuhiro Nakasone of Japan said that, also last June.

“No nation depends as much as we do on the Science base.”

- Ronald Regan said that, last February.

These three quotes illustrate a consensus about the importance of Science and Technology in a modern society.

Let me put that differently: “in a *competitive* society.”

We depend on what we call the Science and Engineering base — the collection of people, institutions, equipment and facilities that enable us to do fundamental research in the Sciences and in Engineering — for economic progress.

This dependence is real. And, as those three quotes illustrate, it is recognized all around the world. So it is surprising that the United States is still not doing as well as it should at taking care of the Science and Engineering base.

- We aren't training enough young scientists and engineers.
- We aren't investing sufficiently in research equipment and facilities.
- We aren't supporting adequately the activities of our basic researchers.

The failure to support the Science and Engineering base is related to our economic problems. The connection between the two is the subject of my talk today.

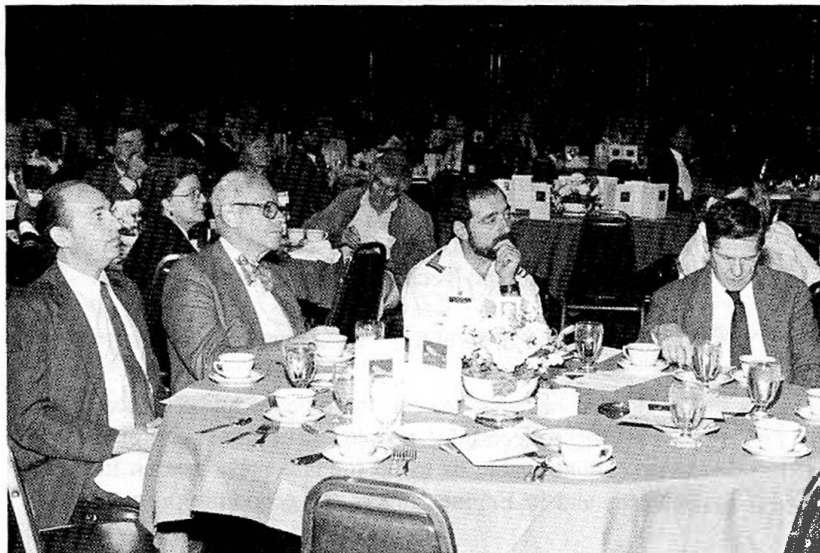
THE IMPORTANCE OF SCIENCE AND TECHNOLOGY TO THE ECONOMY:

I don't think I have to say much to convince this audience of the economic importance of fundamental research. But let me just summarize a few basic points:

- Since World War II, new technology has been responsible for nearly half of all productivity gains: far more than those due to more capital, better education, better resource allocation, or economies of scale. This is now a well established finding.
- We can't be economically competitive without high productivity. It should worry us that our productivity record over the ten years up to 1983 was substantially worse than that of our major competitors. They did five to nine times as well as we did during this period.

(continued on page 8)

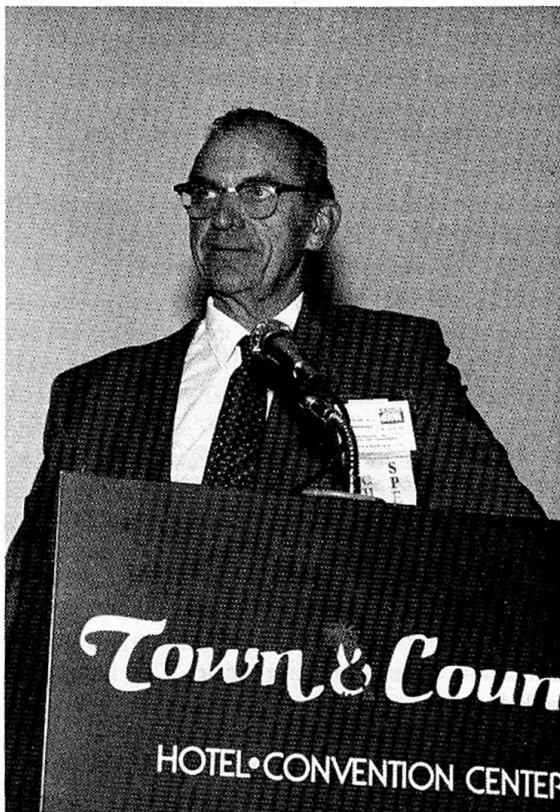
SCENES FROM SAN DIEGO



OES AdCom members attending the President's Awards Luncheon (L to R) Lloyd Breslau, Stanley L. Ehrlich, Bob Cassis and Art Westneat.



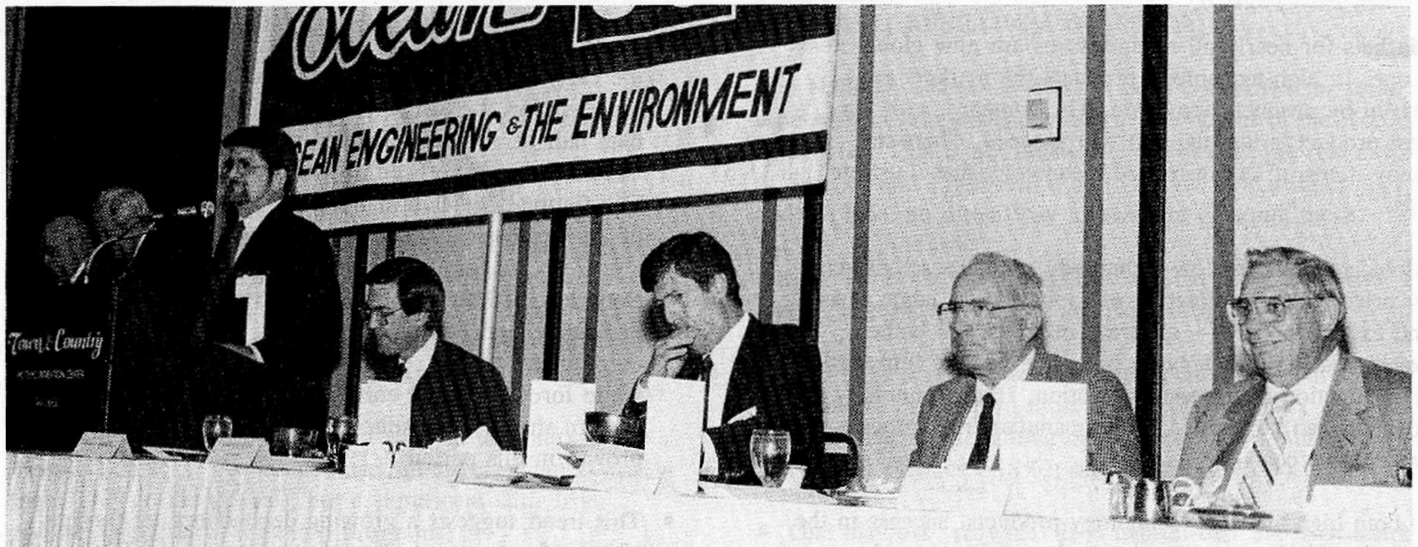
NSF Director Erich Bloch was the Keynote Luncheon Speaker.



Victor C. Anderson, General Chairman OCEANS '85.



Dr. and Mrs. Glen Williams at the President's Awards Luncheon. Glen the Vice-President — East Coast — for OES.



(L to R) Mr. Joseph Vadus (at the lectern), Dr. Stanley Chamberlain, President of OES, Dr. Donald Bolle, OES Awards Chairman, Dr. William A. Nierenberg, recipient of the Distinguished Technical Achievement Award, Mr. Lloyd Maudlin, Vice-President OES West Coast.



Distinguished panel of experts at the OCEANS '85 Plenary Session (L to R) Michael Fischer, Dr. Douglas Inman, R. Curtis Croke, Professor William A. Nierenberg, Dr. Tudor Davies, Harold Yates, and Dr. John Flipse.



OES President Dr. Stanley Chamberlain presents the Distinguished Service Award to Joseph R. Vadus.



OES President Dr. Stanley Chamberlain presents the Distinguished Technical Achievement Award to Dr. William A. Nierenberg.

(continued from page 5)

- Markets for nearly all manufactures are now global in scope. In high-technology products the markets are driven by product innovation. The company with the best product is the one that will succeed. There are many items of Ocean-related technology that illustrate this.
- Global markets for low-technology products are driven by price. That's a function of capital costs, labor costs, and exchange rates — all areas in which the United States is at a disadvantage. But price is also, importantly, a function of process innovation. High technology concepts can be applied to the manufacturing process to drive down costs.
- In both high and low-technology products, success in the global market means creating and applying new knowledge — which is to say new technology — faster than one's competitors. This is a fundamental law in this competitive world.
- For whatever reason, our record in competing has not been very good recently. Our trade balance has deteriorated badly in the past few years. The record is worst in the older industrial areas, but even in the high-technology areas we are slipping into deficit.
- We are vulnerable in these industries partly because we have been slow to automate production. We have only to compare the rate of adoption of robots in Japan and the United States to get an idea of the dimension of the problem.

THE HEALTH OF THE SCIENCE AND ENGINEERING BASE: EDUCATION:

I think that I have said enough to give you some sense of the economic problem. But what of the Science and Engineering base that I claim is so important? The Nobel Prizes were announced recently, and once again, the United States did well. We should take pride in the fact that our system continues to produce such successes. But unfortunately the Nobels are a better measure of the success of past policies than they are an indicator of the future.

We won't do well in Science and Engineering in the future if we don't continually train the people that we need. But recent data suggest that we are not doing this well enough:

- Science and Engineering BS Degrees have been relatively constant over the last ten years. Although the 22 year old population has been increasing. Now we are entering a period in which the 22 year old cohorts will decrease in size. Unless we attract a larger fraction of these young people to Science and Engineering, we will be faced with declining numbers of people with technical training.

- There has been a decline in Engineering PHD's since the early 1970's, although the figures have improved somewhat in the last few years. Also, since 1981, more than half of all PHD Degrees in Engineering in the United States have been awarded to foreign students. The figures for Math and Physics — the core disciplines of a technological society — are not much different.
- Between 1980 and 1983. Full-time graduate enrollment in Science and Engineering rose six percent overall. But enrollments of U.S. citizens rose only one percent, while foreign student enrollment rose 23 percent. Thus foreign students accounted for 85 percent of the total growth in this period.
- This trend suggests a growing dependence on foreign citizens for our research and teaching needs. While many of these people are of very high quality, we should not allow ourselves to become dependent on a resource which may not be under our control.
- A recent article in *SEA Technology* prepared by the Deans of several of the major oceanographic institutions reviewed the situation in the Marine Science disciplines. In all of these disciplines, as this chart shows. The trend has been one of slow decline for at least a decade now. This is simply not consistent with the need to exploit the Oceans for economic, national defense, and natural resource purposes.

There is no way to establish conclusively the numbers of technically trained people that a modern society needs. It won't do to try to look at the numbers required for specific jobs, because we are always finding new ways to use people with technical skills. But the society is getting more — not less — dependent on technology. We should be training more — not fewer — technical people.

- But the actual situation has been one of decline in the proportion of each age cohort achieving the higher educational levels. The peaks were reached in the early to mid-seventies, and the trends have been down since then.

I am talking mainly about quantity in making these points because that is a lot easier to measure than quality. But we can — and I think we *do*, to some extent — make up for lack of quantity by stressing excellence in everything we do. In a time of tight resources that is a saving grace, but it may not be enough by itself.

THE HEALTH OF THE SCIENCE AND ENGINEERING BASE: RESEARCH INPUTS:

As with educational levels, there is no way to establish objectively the "right" level of spending on R&D. The economists can give us a theoretical answer, but it doesn't help in practice.

But just as we did with educational data, we can look at trends. We can look at ourselves over time, and compare ourselves with other industrial nations.

If we do that we again see some interesting, and perhaps disturbing, facts:

- This slide shows the proportion of our gross national product that we spend on R&D. What is interesting is that the shape of our curve is so different from that of our competitors. We can't argue that our current level is not "right", but the comparison indicates the relative emphasis that our trading partners are putting on R&D.
- This figure shows the trend over the last ten years in the Marine Sciences. The total shows almost no change from 1979 to the present, but a significant shift from civilian to military-supported programs.
- That shift from civilian to military programs raises another important point. If we remove the defense-oriented work from the R&D figures, then our civilian R&D level is below that of both West Germany and Japan.
- The division of the federal R&D effort between the civilian and defense sectors is changing in an important way. In the sixties the civilian effort rose rapidly, and then for about fifteen years there was a rough parity between civilian and military efforts. In the last five years the balance has shifted strongly towards the defense side again. At present only a little more than a quarter of the federal R&D effort goes into civilian research.

It may be that the balance between military and civilian research is not that important. The strategic defense initiative, for instance, is clearly focussed on the most basic sciences and the most advanced technologies, and that should result in a significant payoff for the economy.

But it is also true that outside of SDI and DARPA most of the military effort is focussed on fairly short range development efforts. For a decade or two after World War II military research sought technologies that were important to the civilian world also: especially computers, semiconductors, and nuclear power. But as a rule, that is no longer the case. In computers and semiconductors today, for instance, it is the civilian side that is leading.

- This conclusion is consistent with the fact that, as the lower curve on this figure shows, the proportion of military R&D funding that is devoted to basic research has been declining ever since the enactment of the Mansfield Amendment in 1971.
- And as this slide shows, the increases in recent years in Marine Science funding have been almost entirely in DOD.

THE HEALTH OF THE SCIENCE AND ENGINEERING BASE: RESEARCH OUTPUTS:

The National Science Board has been concerned for some time with developing indicators of the output of the R&D Enterprise. This is not an easy task, because the real output of Science and Engineering is important new insights — and we have no direct way to measure or count these.

Let me review a few items that can serve as barometers. Again, it is the trends that are interesting:

- The U.S. share of world scientific and technical literature declined in most fields between 1971 and 1982. The most striking declines were in Mathematics (-23%); Physics (-18%); and Biology (-17%).
- One may ask, so what? It is natural that the U.S. share should decline when the research efforts of the rest of the world are increasing. But it turns out that the citation ratios — the extent that U.S. literature is cited in proportion to its volume — are also declining. The most striking declines are in Engineering, Mathematics, and Biology. That speaks to *quality*: the quality of research in competing nations is improving relative to ours.
- And we find that the rate at which U.S. residents apply for patents in foreign countries — a measure of how aggressive we are at commercializing our ideas abroad — has also been declining. On this measure only the Japanese have been advancing steadily, but notice how much they have closed the gap with us in the last fifteen years.

I have reviewed these statistics in order to paint a picture of how things are at the present. In summary, the picture is fairly simple:

- In an increasingly competitive world, we can't take our continuing leadership for granted. The challenge for commercial markets is most obvious, but we also face a research competition for ideas.
- In both cases, we have to do better at exploiting our natural advantage in technology.
- That is the bad news. The good news is that there is much stirring in government, in the universities, and in industry to rectify the situation.

SCIENCE POLICY AND SCIENCE ORGANIZATION SINCE WORLD WAR II:

There are three basic reasons for the Federal Government to support research and development, and the education that goes with it:

- First, we support a certain amount of basic Science for its intrinsic value. Research on the origins of the

universe of a humankind fall into this category. No direct economic payoff is expected.

- Secondly, the government itself need new knowledge and new technology in order to carry out specific missions such as defense. This is the largest part of the government's effort.
- Thirdly, the nation's economic well-being requires research investments which are impossible for anyone but the government to make.

Any piece of research may serve more than one of these goals, but the three are conceptually quite distinct. They need to be kept in mind when thinking about the way the Federal Government goes about supporting R&D.

Federal Science and Technology Policy has gone through four distinct phases since the World War II. The first lasted until 1957, and was characterized by reliance on the mission agencies for most R&D support. In the Physical Sciences the key agencies were the Defense Department and the Atomic Energy Commission. They supported research because it served their missions, but the system worked fairly well for the country as a whole as long as the technologies they sought were important to the industrial sector as well.

The second period followed the launching of Sputnik in 1957. This was a major shock, and it revealed weaknesses in the Science and Engineering base that needed attention. The result was a major increase in support for the nation's universities and colleges. For a time, the Federal Government in this period accepted responsibility for the base, and the goal of economic competitiveness was reasonably well served.

But after 1968 the momentum of Sputnik was spent. The focus of government in this third period was on social problems: housing, energy, crime. Research was directed toward these efforts, with little concern for the Science and Engineering base that is required for economic competitiveness. This was the heyday of "relevance," which was institutionalized in the Mansfield Amendment and the Department of Energy.

- The effects of these periods on funding for the Science and Engineering base can be seen clearly in this chart. Funding increased rapidly between 1957 and 1968, and leveled off thereafter.
- Investment in the equipment and facilities necessary for research declined markedly after 1968. To a large extent, increases in support for research in this period were made possible by reductions in such investment. We are now seeing the results of this practice in very heavy demand for new investment in facilities and equipment.

The fourth period of post-war science policy began about 1980. Starting with the Reagan Administration there was an increased recognition of the need to support the science and engineering base.

- In the past few years a better definition of the appropriate roles of government and industry has been achieved, with the result that federal support of development in the non-defense area has been cut substantially, and basic research support has been increased.
- This chart shows the way non-defense support has been shifted towards basic research. Yet such is the dominance of defense R&D in the federal effort that overall, the proportion of basic research has declined slightly in the last two years.

WHAT IS TO BE DONE?

We now have a clear recognition of what the federal government should do. We understand the three goals of federal R&D support. The system serves the goals of intrinsic value, and of support of government missions, quite well. But we don't yet have the mechanisms in place to serve the goal of economic competitiveness well.

To serve that third goal, we need a major shift of resources towards basic research and the nation's universities. The universities have always attracted the best minds. They combine research and education in a way that is impossible in other settings. That is important because we must have education programs to provide researchers, and we cannot have effective advanced education in Science and Engineering without having students directly involved in research.

The funding should come from a reallocation from applied research and development accounts, without any overall increase in the federal budget. Something like a 2% reduction in those accounts would make \$1 billion available for the purpose, and the result would be an overwhelming improvement in our overall rate of technological progress.

We should do this notwithstanding the current budget pressures and Gramm-Rudman. No new federal dollars are required; we simply have to spend the dollars that we have in a more effective way. I hope that you will help in getting this accomplished.

The way we apply new resources in the universities is also important. Last year the National Science Foundation made six awards in a new kind of effort: the Engineering Research Centers. Each center focuses on an important area of engineering, and each brings together researchers from different disciplines and from both academia and industry. The problems they have chosen — in such fields as telecommunications, biotechnology, robotic systems, advanced materials, and manufacturing systems research —

are both intellectually exciting and of potentially great economic importance.

These centers will be successful because they meet a real need with a genuinely innovative approach. They bring together various disciplines to address important problems in the real world. In so doing they also institute change in the universities, reducing their organizational dependence on a disciplinary structure that is, for some purposes, no longer ideal.

The centers also bring together industry and academic researchers, with beneficial effects for both. The academic people gain the perspective that comes from working on problems of genuine economic consequence. And, with industry support, they gain access to research equipment that few universities can provide. The industry people also gain, with access to the most creative minds among the faculty and graduate students, and through contact with disciplines that can provide fresh perspectives.

The Foundation began with six centers, but we had 140 proposals. We have another 100 proposals in this year's competition, although we will be able to support only a

handful. And the idea need not be limited to engineering: many areas of science could benefit from the same approach.

We had several proposals for Engineering Research Centers dealing with Marine Science and Engineering topics. We would have funded two of them if our overall funding situation had made it possible. This clearly is a fruitful area for industry and government to work together.

We ought to move ahead with a major effort to fund an effort of this sort. Call them *Basic Science and Technology Centers*, because what they would do is basic research, but with the eventual aim of creating the technology that the nation needs.

Like the Engineering Research Centers, Basic Science and Technology Centers should be multidisciplinary, because it is at the intersection between the disciplines that one finds the most exciting work. They also have to be interdisciplinary because that is the way that industry works: the problems they have to deal with are almost always interdisciplinary in character.

SUMMARY OF THE OCEANS '85 ADMINISTRATIVE COMMITTEE MEETING

Joseph Czika

Oceanic Engineering Society President Stan Chamberlain chaired the Oceans meeting of the Administrative Committee (Ad Com), the Society's governing body. Twenty-five Ad Com members were present including Eric Herz, the IEEE General Manager. Chamberlain lauded the past year's achievements and announced a drive to increase the Society's membership.

Treasurer Ed Early reported that the Society is financially healthy. The Society's budget of nearly \$184k for 1986 was approved after discussion resulting in increases for membership and chapter development.

Editor Stan Ehrlich reported that the Journal of Oceanic Engineering is healthy, with the projected 1986 count at 400 pages. Cal Swift is retiring as Associate Editor at the end of 1985. Art Baggeroer and Gary Brown have both accepted another three-year appointment as Associate Editors. The appointment of Giorgio Tacconi as General Associate Editor for Western Europe was confirmed by Ad Com vote. Ehrlich encouraged the identification of topics and editors for future special Journal issues.

Newsletter Editor Hal Sabbagh reported that the circulation is nearly 7,000 readers. He issued an appeal for more articles, especially of a technical, historical, or personal reminiscence nature. He suggested that the newsletter can be used as an effective tool in the Society's membership drive.

West Coast VP Lloyd Maudlin reported that Oceans '85 is a success with nearly 260 papers, 117 exhibitors, and an expected attendance of about 800. Chamberlain was directed to express the Society's thanks to the Oceans '85 conference committee, especially Charlie Bishop.

East Coast VP and President-Elect (see below) Tony Eller reported that Oceans '86 planning is on track. The Oceans '86 chairman is Gil Maton. The National Geographic Society has pledged special support. Oceans '86 will be held on September 23-25, 1986, at the Washington Sheraton Hotel.

Chamberlain reported that the Oceans Committee, composed of the officers of the Oceanic Engineering Society

and the Marine Technology Society, approved the preliminary budget for Oceans '87 to be held at Halifax, Nova Scotia, in September, 1987. He also reported that the committee has chosen Seattle to be the site of Oceans '89. Oceans '88, by prior agreement, will be sited in the Washington-Baltimore area.

Glen Williams, OES representative to the Offshore Technology Conference (OTC) and East Coast VP Elect (see below), reported that about 200 papers have been chosen for the annual OTC at Houston in May.

Art Westneat, Chapter Development Chairman, reported local chapter activities are being conducted at 12 cities. Organized and functioning chapters (with chairperson) include New England (Mike Serotta), San Diego (Ken Kalbfell), Halifax (Ferial El-Hawary), and Seattle (Ted Heindsmann). Eric Herz approved the recently petitioned chapter at Washington, D.C. Significant organizational activities are going on in San Francisco, Miami, Houston, and Los Angeles.

Don Bolle, junior past president and chairman of the Nominations Committee placed in nomination Tony Eller as

OES President and Glen Williams as OES East Coast Vice President. The Ad Com elected the nominees to the respective office by voice vote. Their two-year terms will commence January 1, 1986.

Eller reported that new chairmen are required for several of the technology committees. Volunteers are encouraged. Bill Woodward announced the Third Working Conference of the Current Technology Committee to be held on January 22-24, 1986, at Hilton Head, S.C.

It was moved, seconded, and passed that a Military Systems Technology Committee be established. Chamberlain was appointed chairman with a charge to define at the next Ad Com meeting the committee's charter and planned mode of operations.

The meeting was adjourned at 12:25 a.m. with the announcement of the next Ad Com meeting at Houston (OTC) on 6 May 1986.

LATEST DEVELOPMENTS IN OCEAN MINING: A POTENTIAL FOR NEW CONFLICT

(Reprinted from the *OCEANS '85 Conference Record*)

V. V. Zdrovenin

United Nations*

ABSTRACT

Two opposing trends in the development of an international regime for ocean mining are now evident. The UN Conference on the Law of the Sea created a Preparatory Commission which was assigned the task of developing rules and regulations for ocean mining. On the other hand, the US and seven other States are trying to establish a separate international ocean mining regime. Recently, they adopted the "Provisional Understanding Regarding Deep-Sea Matters" (PU), which was criticized by many members of the Preparatory Commission as an attempt to circumvent the LOS Convention. The USSR and other socialist States took, in political terms, a strongly negative stand toward the PU. Now that the process of resolving overlapping claims for mine sites among the LOS Convention signatories is in progress, it becomes evident that should the overlaps be resolved, this will inevitably single out the

US and the USSR for legal and political confrontation over their respective claims in the Pacific. Pressure from the U ocean mining industry, which needs Government-sponsored political risk insurance, and from some strategists who point out the lack of domestic resources of strategic minerals found in manganese nodules, may compel the U Government to involve itself in a new type of political conflict.

BACKGROUND

Economic assessments indicate that in the early 80's the capital investments of the U.S. and other western companies in research and development (R and D) and exploitation in manganese nodule mining technology have sharply decreased after having reached their maximum in 1979.^{1, 5, 14, 15, 18}

* The views expressed herein are those of the author and do not necessarily reflect the views of the United Nations.

Approximately at the same time in the period 1978-1979, active development of national ocean mining legislation was initiated in the United States. Industry lobbied in the U.S. Congress for the adoption of such legislation for two main reasons. First, it needed a national legislative framework within which it could operate in the United States. Second, it wanted a basis for future international legal guarantees. These could only be provided by other States if and when such States adopt mutually recognized national laws governing ocean mining.

Such laws were adopted in the United States and in other western industrialized States, and then in the USSR, at the beginning of the 1980's, even before the completion of the United Nations Conference on the Law of the Sea. During the same period, expenditures of the multinational consortia for R and D and exploitation started to decline quickly, and these trends increased with the adoption of the United Nations Convention on the Law of the Sea. In his report to the U.S. Congress, the U.S. Comptroller General stated in 1982 that the budgets of consortia for ocean mining had been slashed by 75 per cent.¹² As an example, one consortium was mentioned as having cut its expenditures from approximately \$25 million a year to \$5 million, another, which had spent \$50 million total, had cut expenditures to zero. As the main reason for this decrease in investments, the American economists cite the lack of incentives for U.S. private industry which would not receive sufficient profits for manganese nodules mining in the foreseeable future in the generally depressed conditions of the world metal market. U.S. businessmen feel that activity as risky as ocean mining should have rates of return as high as 30 per cent whereas economic calculations give only estimates from basic 6 to 7 per cent to as much as 9 to 12 per cent, or as little as 3 to 4 per cent.^{2, 3, 4, 11} The legal-political climate created by the adoption of the Law of the Sea Convention further narrowed the chances that U.S. private industry would proceed with ocean mining due to the political risks and the associated economic and legal uncertainties which may result from acting outside and contrary to the Convention.^{5, 19} Having found themselves in this unfavourable situation, U.S. companies directed their attention and money toward the development of legislation which would govern possible ocean mining in the future.¹ Compared to money spent on R and D and exploitation, their expenditures in trying to influence the legislative process are now hundreds or even thousands times less.

RECENT DEVELOPMENTS

This process is taking place on a national as well as at international levels. On 3 August 1984, eight western industrialized States (Belgium, Great Britain, Italy, the Netherlands, France, the Federal Republic of Germany, Japan and the United States) signed the so-called "Provisional Understanding regarding deep-sea matters" (PU), to avoid mine site conflicts in the issuance of national authorizations to explore and exploit the international seabed area. This agreement appeared to be a result of a long process of negotiations that was initiated in 1982 by the

U.S. who, along with France, the Federal Republic of Germany and the United Kingdom, tried to forge a so-called "mini-treaty", an agreement which even before it reached the stage of conclusion, had been sharply criticized by parties to the Law of the Sea Treaty for its alleged conflict with the Law of the Sea Convention. Then, the idea of a "mini-treaty" evolved into the more neutral idea of the "reciprocating States agreement" when Japan was brought into the process. As some observers note, the efforts on the part of France and Japan, who signed the Convention and did not want to appear to be in an obvious contradiction with it, played a significant role in the adoption of the aforementioned PU, an agreement far more subdued when compared to the initially designed schemes.^{13, 14}

The signing of the PU took place in Geneva, just before the opening of a session of the Preparatory Commission for the International Sea-Bed Authority and the International Tribunal for the Law of the Sea (Preparatory Commission), which also met in Geneva from 13 August to 5 September 1984. Although the PU stipulated that it was non-prejudicial to any party's position on the Law of the Sea Convention, the agreement provoked critical reactions from many members of the Preparatory Commission. The developing nations' Group of 77 (G-77) stated that the Law of the Sea Convention established the International Sea-Bed Authority as "the only competent body to manage the deep sea-bed and authorize activities for exploration and exploitation therein", and that the Provisional Understanding "goes beyond the resolution of conflicts arising from overlapping claims, by including provisions regarding exploration and exploitation of the sea-bed resources, outside the LOS Convention". The Group "rejects the PU as a basis for creating legal rights and regards it as wholly illegal".

The Group of East European Socialist Countries supported the G-77 statement and called the agreement a mini-treaty attempting "to establish a regime for the exploitation of the resources of the international sea-bed area that is completely contradictory to the UN Convention on the Law of the Sea". They claimed that "it seeks to substitute, for the rules, regulations and procedures for activities in the area that have been elaborated in detail in the LOS Convention and are to be rendered more specific by the Preparatory Commission, its own 'standards' permitting western consortia to act without control in exploring and exploiting the resources of the deep sea-bed".

On 14 September 1984, following the meeting of the Preparatory Commission, the Soviet Union issued a separate statement against the PU which it called a "challenge to the entire international community", rejected it as "illegal and unlawful" and warned that it would not take its provisions into consideration.

The adoption of the PU had been preceded by a series of international negotiations at which the appropriate resulting agreements were concluded by the representatives of the national ocean mining corporations of France and Japan

and multinational consortia which comprised the companies and corporations of the US, the UK, the Federal Republic of Germany, the Netherlands, Italy, Belgium and Canada. As is now known, at these meetings the industry delegates negotiated and resolved their claims to mine sites in the Pacific Ocean between the Clarion and Clipperton fracture zones. Two resulting agreements were reached, one in May 1983, and another, after the Japanese joined the negotiations, in December 1983. Those participating in them were the French corporation Association Francaise pour l'Etude et la Recherche des Nodules (AFERNOD), the Japanese corporation Deep Ocean Resource Development Company (DORDCO), and the consortia Kennecot Consortium (KCON), Ocean Mining Associates (OMA — Deep-Sea Ventures), Ocean Minerals Company (OMCO-Lockheed) and Ocean Management, Inc. (OMI — Sedco).

Upon conclusion of the agreements, the consortia, which are registered in the United States, filed amendments to their initial applications that they had made with the US National Oceanic and Atmospheric Administration (NOAA) in 1982 in accordance with the 1980 Deep Sea-Bed Hard Mineral Resources Act. As a result, the total number of proposed US-licensed sites has been reduced from 10 to 5 that corresponded to a 42 to 50 per cent area reduction.¹ Subsequently, in April 1984, NOAA certified these four consortia to receive the first deep sea-bed exploration licenses for sites they claimed in the international sea-bed area.

After those licenses had been issued to the consortia, the Soviet Union sharply criticised this act in the TASS' statement of 5 June 1985 as an effort of the US Administration to implement the PU. It said that "the granting of licenses . . . is illegitimate and runs counter to the will and interests of the overwhelming majority of States". In connection with the issuance of the licenses the Soviet Union reaffirmed its previously expressed negative stand on "the arbitrary actions of the US Administration on questions of the international area of sea-bed", and declared that it did not intend to reckon with them.

Until not long ago, the precise location of the sites claimed by the consortia was kept secret. However, during November and December 1984, the co-ordinates of the sites of all four consortia were published by NOAA in the United States Federal Register after these groups had formally withdrawn their request for confidential treatment of this information and requested NOAA to make it public.^{8, 9, 10} As with the signing of the PU, the time for publication was chosen to be just before a session of the Law of the Sea Treaty parties. This time it was the Geneva meeting of 17 December 1984, where an exchange of mine site co-ordinates was to take place in order to ascertain whether any overlaps existed between the claims of pioneer investors from signatories to the Law of the Sea Convention. Participating in the meeting were France, India, Japan and the Soviet Union. Not being able to formally attend this event, the United States nevertheless made its claims known to the participants.

In fact, France and Japan did not need to know these co-ordinates since they had already learned this information when they had resolved all overlaps with multinational consortia by December 1983, and India did not need to know them either since its claim is in the Indian Ocean. It was the Soviet Union, which is known to have claims in the same region as the PU participants, who might have had a real interest in learning as to where U.S. claims were applied.

According to guidelines prepared by the Preparatory Commission, those applicants who discovered that they had conflicting claims following the exchange of mine site co-ordinates on 17 December 1984, were to meet no later than 11 January 1985, in order to commence negotiations to resolve overlaps. These negotiations were to be completed by 4 March 1985. As was noted at the last session of the Preparatory Commission held in Kingston, Jamaica, from 11 March to 4 April 1985, some progress was achieved by the negotiating parties in their efforts to resolve overlapping claims, although a final solution had not yet been reached.

DISCUSSION

The results of this process will have particular significance because if and when the possible overlaps of the claims of the USSR, France and Japan are resolved, it will inevitably single out the consortia with U.S. participation and the USSR for possible conflict over their sites with no mutually accepted method for resolving such conflicts. Taking into account the negative attitude of a political nature adopted by the Soviet Union and the East European Socialist States toward the efforts of the United States and its allies to establish an international ocean mining regime outside the Law of the Sea Convention, one may justifiably assume that the conflict over ocean mining clearly has political connotations. The potential for conflicts in ocean mining was noted during the general debate at the 39th session of the General Assembly, when the delegate from the Philippines pointed out that the present situation with regard to the mining of polymetallic nodules could lead to "dangerous confrontations".

According to the U.S. Deep Sea-Bed Hard Mineral Resources Act of 1980, the commercial mining of manganese nodules by U.S. citizens cannot commence before 1 January 1988. The economic assessments cited earlier, push this starting point even further — surely beyond the end of the 20th century. However, one must not overlook the possibility of a financial and legal intervention by the U.S. Federal Government on behalf of the American mining companies. Calls from industry for such help are not yet unanimous but some industry representatives recently argued that ocean mining probably cannot be done under venture capital anywhere in the world and that "at a minimum, government sponsored political risk insurance should be made available."¹⁹ Some others stated that the 1980 Act will not provide adequate protection for the U.S. mining industry if a non-

reciprocating State should encroach upon an established mine site. Therefore, they believed that national legislation should be modified accordingly.^{5, 6}

There are also those, in the U.S. Navy, who extrapolate "America's traditional frontier mentality of mining (the "high seas" approach)" on exploitation of deep sea-bed resources.¹⁶ They say that as a primary mission of the U.S. Army during the late 1800's was protection of continental resource gathering on the American frontier, the late 1900's and the next century may hold a critical naval mission of resource protection in support of a national ocean policy. In their view, the Navy will most likely provide much of the order, given the current U.S. rejection of the Law of the Sea Treaty regime.

It is known that the U.S. lacks sufficient internal resources for a number of minerals, including such manganese nodule components as cobalt, manganese and nickel. At present, imports from foreign sources provide, respectively, 91, 99 and 75 per cent of the nation's supply of these minerals,⁶i.e. "those minerals which would be needed to supply the military, industrial and essential civilian needs of the United States during a national emergency and are not found or produced in the United States in quantities sufficient to meet such needs".¹⁷ A forecast by the U.S. Bureau of Mines⁷ shows that the U.S. demand of ores of the aforementioned metals must rise significantly by the year 2000.

This dependence of the U.S. on foreign sources of strategic minerals causes concern on the part of some American strategists. A report to the U.S. President by the national Advisory Committee on Oceans and Atmosphere (NACOA) entitled "Marine Minerals: An Alternative Mineral Supply"⁶ points out that such foreign dependence can lead to uncertainties in supply ranging from cost instability to actual disruption. Class struggle and national liberation movements in the supplying countries are shown in the report as a possible cause for the disturbances in supply of raw materials to the U.S. In addition, some of the countries from which the U.S. obtains minerals can be expected to reduce exports as they develop or increase their own capability to produce finished products from raw materials.

The NACOA report points to the fact that the United States as a non-signatory is not bound by the UN Convention on the Law of the Sea and acting together with like-minded non-signatory nations it could create a separate "international regime" for the resources of the deep sea-bed. It is in this context that the NACOA "supports the President's decision to work with other countries to develop a framework for sea-bed mining beyond areas of national jurisdiction" and it "recommends that Congress enact legislation, or modify existing legislation, to clarify current federal responsibilities for the commercial development of deep sea-bed minerals both within and seaward of the Exclusive Economic Zone".

CONCLUSION

As the recent events have shown, the U.S., along with a few other nations, is heading steadily towards establishing a separate international ocean mining regime, a possibility which is feared and condemned by most of the parties to the Law of the Sea Treaty. And while actual ocean mining is still years away, the potential for conflict and confrontation over deep sea-bed resources is becoming more and more real.

ACKNOWLEDGEMENTS

The author wishes to express his appreciation to Dr. J. M. Broadus of the Woods Hole Oceanographic Institution and to Mr. Mitchell Werner of the United Nations Department of Political and Security Council Affairs for reviewing this manuscript and providing valuable comments and suggestions.

REFERENCES

1. Broadus, J. M. Hoagland III, P., 1984, "Conflict Resolution in the Assignment of Area Entitlements for Sea-Bed Mining", *San Diego Law Review*, v.21, N3, P. 541-576.
2. "Consultants Urge Government Financing of Ocean Mining Test", 1981, *Engineering and Mining Journal*, v.182, P. 11.
3. *Deep Sea-Bed Mining, Report to Congress*, 1981, Prepared by the Office of Ocean Minerals and Energy, National Oceanic and Atmospheric Administration, U.S. Department of Commerce.
4. Flipse, J. E., 1983, "Deep Ocean Mining Economics", *Proceedings*, 15th Annual Offshore Technology Conference, Houston, Texas, May 2-5, 1983, OTC 4491, p. 415-418.
- "Impediments to U.S. Involvement in Deep Ocean Mining Can Be Overcome", 1982, The Comptroller General, General Accounting Office, *Report to the Congress of the United States*, EMD-82-31, p. 30-33.
6. "Marine Minerals: An Alternative Mineral Supply", *National Ocean Goals and Objectives for the 1980's*, 1983, National Advisory Committee on Ocean and Atmosphere, Washington, D.C.
7. *Mineral Commodity Summaries, 1983*, U.S. Bureau of Mines, U.S. Department of the Interior, Washington, D.C.
8. Notices, 1984, [U.S.] *Federal Register*, v.49, N220, p. 44938.
9. *Ibid.*, v.49, N232, p. 47081-47082.

10. *Ibid.*, v.49, N239, p. 48205-48206.
11. "Ocean Mining Feasible but Risky", 1981, *Mining Magazine*, February, p. 186-187.
12. *Oceans Policy News*, 1984, COL Update, July, Citizens for Ocean Law, Washington, D.C., p.2.
13. *Ibid.*, September, p. 7.
14. *Recent Events in the Law of the Sea*, 1983, Spring/Summer, Citizens for Ocean Law, Washington, D.C.
15. "Sea Riches: What Future?", 1984, *World Press Review*, v.31, no.11, p. 23-25.
16. Stavridis, J., 1985, "Resource Wars", *Proceedings*, U.S. Naval Institute, v. 111/1/1983, p. 72-77.
17. "The Strategic and Critical Minerals Stockpiling Revision Act", 1979, *U.S. Public Law 96-41*.
18. "Treasures of the East", 1984, *Far Eastern Economic Review*, v.123, N13, p. 71-72.
19. "Uncertainties Surround Future of U.S. Ocean Mining", 1983, The Comptroller General, General Accounting Office, *Report to the Congress of the United States*, GAO/NSIAD-83-41.

OF OCEANIC INTEREST

(Reprinted from *Ocean Science News*, Vol. 27, Number 43, November 11, 1985)

The *Titanic* is making waves, although it's still 13,000 ft. under north Atlantic waters. At issue is who shall have access to the wrecked liner, under what conditions access will be granted and who should be given credit for developing the deepsea technology which located the ship's gravesite. The debate is polite, modestly intense, somewhat one-sided and reminiscent of scholarly nineteenth century arguments over who discovered the source of the Nile. (For background, see OSN, 23, 16&2Sep85).

House lawmakers currently are pondering the wisdom of the *Titanic* Memorial Act of 1985 (H.R. 3272). The legislation, reported out of the House Merchant Marine & Fisheries Committee last week (6Nov), would: (1) declare the sunken ship to be an "international maritime memorial"; (2) direct the Natl. Oceanic & Atmospheric Administration to establish guidelines "for conducting research, exploration, and if appropriate, salvage of the shipwreck *Titanic*"; and (3) order the Dept. of State to fashion an international agreement committing other nations to abide by NOAA rules.

The committee approved the measure after adopting an amendment offered by the bill's sponsor, Rep. Walter B. Jones (D-NC), who chairs the panel. In addition to making some technical changes and clarifications, the amendment made two additions. As amended, H.R. 3272 amplifies its intent that any discussions, guidelines or agreements relating to the *Titanic* should be both cooperative and international in nature. Newly incorporated into the bill is a requirement that the federal agencies involved in the *Titanic* negotiations (State and NOAA) report semiannually to Congress on the progress of discussion. The other addition states that it is the "sense of Congress that only research

and limited exploration designed to enhance public knowledge should continue at the site until the agreement is concluded."

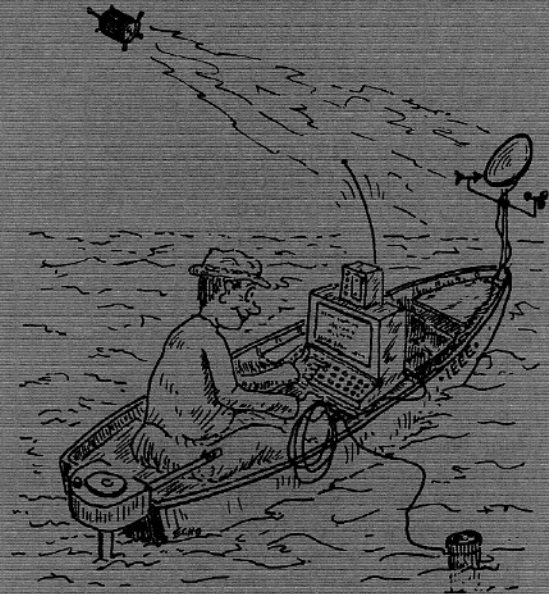
Robert Ballard, director of the Deepsea Submergence Lab at Woods Hole (MA) Oceanographic Institution and discoverer of the *Titanic*, supports the memorial. He wants the *Titanic* left where it is, and is prepared to use the technology which found the shipwreck to give the scientific community and the general public "a clear, high resolution, museum-quality look at the vessel." When Ballard speaks of *Titanic* technology, he, of course, refers to sonar and video systems towed at extreme ocean depths and capable of transmitting data, via electromechanical cables, to observers aboard a slow-moving or hovering surface ship.

The SAR system, developed by the French Institute for Research & Exploitation of the Sea (IFREMER), is a wide-swath, side-scan sonar device looking very much like a fat torpedo. It can scan a mile-wide path and is supported by a trailing proton magnetometer, which allows operators to distinguish between metallic and non-metallic signatures. The ARGO system is a 16-ft. cage decked out with an array of strobe lights, side-scanning sonars and video cameras. The cameras are SIT (Silicon Intent by Target) units. They are able to produce viewable video tape under extremely low light conditions. They also can function at an altitude high enough to produce useable video tape and single-frame photographs covering as much as 2.5 acres.

Ballard is not opposed to salvaging some artifacts (china, silverware, wine bottles, etc.), but he wants to save the *Titanic* and other historic shipwrecks from salvage

MEMBERSHIP INFORMATION & APPLICATION

OCEANIC ENGINEERING SOCIETY



THE INSTITUTE OF ELECTRICAL
AND ELECTRONICS ENGINEERS, INC.

IEEE

N. Spiess and his coworkers.”

Tethered seafloor imaging and mapping technology similar to that used in the *Titanic* search is hardly revolutionary, according to Ryan. In fact, he claims it has been used by the U.S. Navy since 1978, by his own geological observatory since 1980, and by Canadian, German and Japanese researchers since 1982. Woods Hole, he says, was “the last of the major U.S. laboratories to acquire and exploit the technology.”

med
ogy
rd of
visit

within
robotic
rooms

ting
on is,
te that
elf
mpact,
my

is
teams
31 and

that
)
at, a
, to

Ryan,
erty

lest
ef-
f
ew
the
ng
that

en
ong
l
logy
time
1981

Fred

“There is no wish to downgrade the ARGO system,” Ryan says, “and the technical effort of Woods Hole, IFREMER and the U.S. Navy (which has put \$1.6 million into ARGO) in a field program executed flawlessly. There is no need for Woods Hole to give credit to Lamont-Doherty, Scripps Institution or the various (Grimm-funded) corporations for the marvelous success it had in finding and photographing the *Titanic*. However, Woods Hole might reflect that it is not the only accredited laboratory qualified to undertake further documentation of the *Titanic* nor should it suggest that its new survey tools are so extraordinarily sophisticated as to make other existing tools obsolete or unqualified.”

The *Titanic* dispute has created a good deal of uncertainty on Capitol Hill. Two “shipwreck bills” are being evaluated there — the *Titanic* measure and the Abandoned Shipwreck Act of 1985 (H.R. 3558). The latter bill would establish a national register of historic shipwrecks and give the various states title to any wreck in their coastal waters. Day-long hearings were held on the two measures 29Oct85 before the House merchant marine committee. It was a full-bore media event with network TV crews and colorful testimony.

One of several “stars” was Melvin A. Fisher, the entrepreneur who located the *Santa Margarita* and the *Nuestra Senora de Atocha*, Spanish treasure ships which sank off the Florida coast during the 1622 hurricane. He is president of Treasure Salvors, Inc., and a hard-line free enterpriser, who has recovered coins, bullion and other treasure with a probably-exaggerated estimated value of over \$400 million.

Fisher also is more than a little exasperated with “federal and state bureaucrats who cite archaeological and historic facts in an attempt to take what salvage operators legally have recovered from the sea.” His reknown rests not only in his locating the Spanish wrecks, but in an expensive and successful court battle that ended with his winning clear title to the *Atocha* and *Santa Margarita* treasure. The nation’s salvage law gives U.S. district courts (sitting as Admiralty Courts) extensive power to determine who owns what might be recovered from shipwrecks and some such courts require claimants to document adequate efforts to preserve the archaeological and historical provenance of wrecks.

Fisher spent well over \$1 million to gain control of the treasure from the two ships and won a court declaration crediting him with “keen awareness of the historic and archaeological importance attributed in general to old wreck sites, but specifically to the *Atocha* and *Santa Margarita* sites.” The president of Treasure-Salvors suspects the goals of the shipwreck bill are more economic than historic; more bureaucratic than reasonable.

“If we were really serious about protecting historic shipwrecks,” he said, “we will concern ourselves with how

operators and treasure hunters, who are themselves armed with relatively sophisticated technology. "The technology we used to find the *Titanic*," he says, "is the vanguard of the technology man will use to find, document and revisit historic pieces of preserved history in the deep sea. I strongly believe that, if the *Titanic* is left alone, that within the next few years, beginning as early as next year, robotic vehicles will be able to enter its beautifully-designed rooms and document, in color, its preserved splendor.

"Literally thousands of ships lie in the deep sea awaiting mankind," Ballard said, who continued: "The question is, will he come to plunder or appreciate? This is a debate that will grow louder, not quieter. Technologists like myself can only cause the problem and suggest its possible impact, but Congress must take the necessary actions and, in my case, hopefully before the *Titanic* is destroyed."

Not everyone agrees with Ballard. One who does not is Jack F. Grimm, a Texas oilman who funded research teams which scanned the *Titanic* gravesite area in 1980, 1981 and 1983. Grimm contends he has "staked a claim to the *Titanic*" by video taping the ship's propeller — tape that was not recovered from the seabed. He is prepared to spend \$1 million to recertify the mothballed *Aluminaut*, a 52-ft., eight-man aluminum submersible of the 1960s, to use the vessel to dive on the *Titanic* in 1986 or 1987.

Grimm long has been associated with William B. F. Ryan, associate professor at Columbia Univ.'s Lamont-Doherty Geological Observatory and a principal player in the *Titanic* controversy. In essence, he argues that the technology of which Ballard is so proud is but a modest refinement of technology developed through the joint efforts of himself, Grimm and the Scripps Institution of Oceanography. Ryan is particularly dismayed by a New York *Times* story "based on information released by the Woods Hole Oceanographic Institution" and describing ARGO technology as "revolutionary and far beyond that available to other laboratories and agencies."

"In fact," says Ryan, "the Scripps Institution has been deploying sonar and video/photographic vehicles on long electro-mechanical cables in deep water since the mid 1960s. The strobe flash and video frame-grab technology that supposedly was used in the deep sea for the first time (during the Woods Hole *Titanic* search) was used in 1981 on MPL-Scripps Deep Tow Instrumentation vehicle developed at the Univ. of California (San Diego) by Fred N. Spiess and his coworkers."

Tethered seafloor imaging and mapping technology similar to that used in the *Titanic* search is hardly revolutionary, according to Ryan. In fact, he claims it has been used by the U.S. Navy since 1978, by his own geological observatory since 1980, and by Canadian, German and Japanese researchers since 1982. Woods Hole, he says, was "the last of the major U.S. laboratories to acquire and exploit the technology."

"There is no wish to downgrade the ARGO system," Ryan says, "and the technical effort of Woods Hole, IFREMER and the U.S. Navy (which has put \$1.6 million into ARGO) in a field program executed flawlessly. There is no need for Woods Hole to give credit to Lamont-Doherty, Scripps Institution or the various (Grimm-funded) corporations for the marvelous success it had in finding and photographing the *Titanic*. However, Woods Hole might reflect that it is not the only accredited laboratory qualified to undertake further documentation of the *Titanic* nor should it suggest that its new survey tools are so extraordinarily sophisticated as to make other existing tools obsolete or unqualified."

The *Titanic* dispute has created a good deal of uncertainty on Capitol Hill. Two "shipwreck bills" are being evaluated there — the *Titanic* measure and the Abandoned Shipwreck Act of 1985 (H.R. 3558). The latter bill would establish a national register of historic shipwrecks and give the various states title to any wreck in their coastal waters. Day-long hearings were held on the two measures 290ct85 before the House merchant marine committee. It was a full-bore media event with network TV crews and colorful testimony.

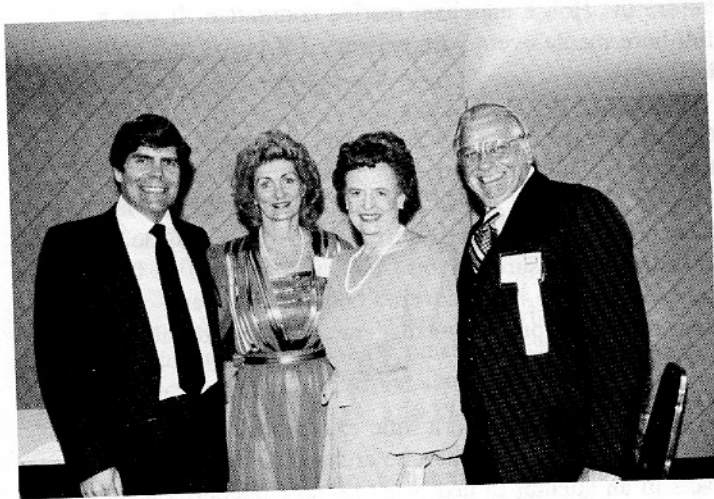
One of several "stars" was Melvin A. Fisher, the entrepreneur who located the *Santa Margarita* and the *Nuestra Senora de Atocha*, Spanish treasure ships which sank off the Florida coast during the 1622 hurricane. He is president of Treasure Salvors, Inc., and a hard-line free enterpriser, who has recovered coins, bullion and other treasure with a probably-exaggerated estimated value of over \$400 million.

Fisher also is more than a little exasperated with "federal and state bureaucrats who cite archaeological and historic facts in an attempt to take what salvage operators legally have recovered from the sea." His reknown rests not only in his locating the Spanish wrecks, but in an expensive and successful court battle that ended with his winning clear title to the *Atocha* and *Santa Margarita* treasure. The nation's salvage law gives U.S. district courts (sitting as Admiralty Courts) extensive power to determine who owns what might be recovered from shipwrecks and some such courts require claimants to document adequate efforts to preserve the archaeological and historical provenance of wrecks.

Fisher spent well over \$1 million to gain control of the treasure from the two ships and won a court declaration crediting him with "keen awareness of the historic and archaeological importance attributed in general to old wreck sites, but specifically to the *Atocha* and *Santa Margarita* sites." The president of Treasure-Salvors suspects the goals of the shipwreck bill are more economic than historic; more bureaucratic than reasonable.

"If we were really serious about protecting historic shipwrecks," he said, "we will concern ourselves with how

MORE SCENES FROM SAN DIEGO ...





'TIS A PUZZLEMENT

LAST QUARTER'S PUZZLE

RISKY BUSINESS

Last quarter's puzzle was an analysis of the game of Risk.[®] Below are the odds I calculated. These probabilities show that it is best for the attacking player to roll all of his three dice and for the defender to roll both of his dice. However, if both players follow this strategy, the odds come out very close to even.

		DEFENDING		DICE		
		1		2		
A T T A C K I N G D I C E		A wins 1 Army	D wins 1 Army	A wins 2 Armies	A wins 1 D wins 1	D wins 2 Armies
	1	.417	.583	.255★	—	.745★
	2	.579	.421	.228	.225	.547
	3	.660	.340	.348	.294	.358

★A or D only win 1 Army

THIS QUARTER'S PUZZLE

IN THE TRENCHES

Studies of temperature profiles in deep ocean trenches show that the temperature reaches a minimum at a depth of about 10,000 feet. Below this point the seawater temperature slowly rises. Why does this temperature rise occur and what prevents the deeper, warmer water from rising?

Puzzlement Editor:
David Hollinberger
1607 Mahan Avenue
Bremerton, WA 98310

OF OCEANIC INTEREST

(continued from page 17)

they are worked, not who owns them. We will not place unclimbable barriers to private enterprise, but will have a consistent and fair national policy administered by federal Admiralty Courts as the Constitution intended and not a proliferation of state laws which will only benefit looters as has occurred in all countries of the world with a hands off policy as to historic shipwrecks."

The fate of the two bills is uncertain. The *Titanic* rests in international waters well outside the jurisdiction of the U.S. It may be possible to negotiate a protective agreement with nations having the technological ability to explore the wreck. Such an agreement, however, would not necessarily abrogate all salvage rights. Cunard, which owns the *Titanic* and continues in existence, could claim ownership of the hull. Successor companies to Commercial Union, the British firm that insured the *Titanic*, could claim ownership

to the cargo. Passengers who survived and heirs of passengers who died could claim lost property. Time is not a factor in salvage cases. European admiralty courts today are litigating claims over 200 years old.

As to other historic shipwrecks, 26 states or local political entities have passed protective laws, although the success Fisher had in winning title to the *Atocha* and *Santa Margarita* treasure has clouded the validity of such laws. Of more significance, however, is the fact that Sect. III of the U.S. Constitution specifically gives the federal court system sole jurisdiction over all admiralty and maritime disputes — a legal hurdle preservationists will find hard to overcome.

ELECTRICAL PERSONALITIES

Georg Simon Ohm

(1789-1854)

The conduction of an electric charge traveling along a conductor was established by Stephen Gray, working in London in 1731. Gray demonstrated that by using a packthread over 750 feet long, an electric charge produced by rubbing a glass tube at one end of this thread would cause an ivory ball to be attracted to the thread at the other end. A century later, a physicist and mathematician, Ohm, adopted this problem as a major item of interest. The discovery by Oersted of the relationship of magnetism to electricity had inspired a new group of experimenters to search further into determining the laws of behavior of this new force. Ampere had provided the concept of "potential" electricity between the ends of a wire carrying current from the terminals of a voltaic cell. Further, the physicist Fourier had established that the flow of heat in a metal bar was directly proportional to the difference of temperature between the ends of the bar. Ohm applied this analogy heat flow in a metal bar to the flow of an electric current in a conductor, by using Fourier's concept of the temperature gradient and also by imagining the distribution of current along sections of a homogeneous metal ring. He wrote that "the force of the current in a galvanic circuit is directly as the sum of all the tensions (along the ring) and inversely as the entire reduced length of the circuit." The difference in the values of the force at two points of a circuit would provide the required "driving-power" acting on the current between these two points. Ohm was relying on an earlier concept of Volta's theory of the electrostatic "tension" on an open pile.

Of humble origin, the son of a locksmith, he had persevered in his struggle to obtain an education, which consisted of a course at the "Gymnasium" at Erlangen and three terms at the University. With money saved as a tutor, he completed his course and then accepted a teaching post at Cologne. It was here that he experimented and completed his major work in the nature of a galvanic circuit. In this study he investigated the nature of unipolar conductors, the relative conductivity of various metals and the theory of the galvanometer. Aware of the importance of the task of resolving the forces in a galvanic circuit, Ohm, in April 1826, got a leave of absence from the University and, at his brother's home in Berlin, he applied himself for the next year to the problem and the preparation of his book.

Ohm summed up his theory and deductions on the characteristics of a galvanic circuit, concluding: (1) In a closed voltaic circuit, the same quantity of electric current passes across each section perpendicular to the direction

of current flow irrespective of the form of the conductor. (2) Changes made in any portion of the circuit affect its entire action. (3) The current flow is in direct ratio to the electromotive force and in inverse ratio to the circuit resistance. The resistance of a circuit is the sum of the resistance of the liquid conductor and the wire which connects its terminals. If a number of voltaic cells is in series in a circuit, the current is proportional to their number if the external resistance is very large, but is independent of their number if the external resistance is small.

Ohm thus formulated the basic law of electric science known by his name. He considered the term "electromotive" force as the force driving the current thru the conductor, and thought of the current and resistance much in the same sense as today. Ohm's law, once grasped, has become the basis of determination of all electric circuits. His pioneering mind had to bridge the gap between the behavior of a static charge and the steady flow of a voltaic current. He had to reconcile the fact that whereas a static charge exists only on the surface of a conductor, an electric current in flowing thru a conductor occupies the surface and also the entire cross-section of the wire.

Ohm's attention had been drawn to the work being done by Barlow in London and Becquerel in Paris on the conductivity of wires of differing lengths and diameters but of the same material. Ohm had noted a difference in their reported results and set out to reconcile these differences thru experiments of his own. Using a copper-zinc voltaic battery, he connected the ends of this battery to two mercury cups. Into these cups he placed six wires ranging from 4 inches to 23 feet long, one at a time. The shortest wire was rather thick but the rest of the wires were uniformly 0.03 inch thick. Over each conductor was placed a torsion balance, the deflection of which registered on the needles and indicated the magnitude of the current. Ohm used the thick conductor as a standard of reference against the deflection for each of the other conductors.

In a paper appearing in Schweigger's Journal in 1826 he summed up the results of his experiments and restated his law: "Electrical conductors of the same substance, but different diameter, have the same conductivity values in their lengths in proportion to their cross section." It is, undoubtedly, the ambiguity of his presentation in this paper (expanded in 1827 into book form titled "Die Galvanische Kette") that caused it to remain unnoticed and unaccepted for many years. This embittered the author, whose paper was called foolish.

As a result of the criticism of his book he lost his position at the University and went into retirement for six years and had to earn his living by tutoring and odd jobs. Twenty-two years later, his contribution was recognized for its worth, but he was 60 years old when he was appointed to the chair in physics at the University of Munich. England had awarded him the Copley Medal of the Royal Society in 1841 and in the following year he was made a Foreign Associate of the Royal Society, a Distinction previously won only by one other German, Gauss. At the presentation of the Copley Medal it was stated Ohm had resolved "a subject of vast importance, and hitherto involved in the greatest uncertainty." The Council of the Royal Society in granting the medal pointed out, further, that Ohm had clarified the distinction between current intensity and quantity and had proved that the magnitude of current flow was equal to the sum of all the electromotive force divided by the sum of the resistances. This was true irrespective of the nature of the source of the current, whether thermo-electric or of voltaic origin; if the quotient is equal, the effect is the same. Thus, the recognition of Ohm's contribution was first made abroad and slowly returned to the area of its source. In his book Ohm also

confirms Davy's observation that the conductivity of the metals he used increased by the lowering of temperature and was decreased by raising it.

The fame and name of Georg Simon Ohm (he was christened Johann Simon Ohm) is locked in perpetuity in a law and in a term that will be used as long as electricity flows, and yet with not a century between our time and the date of his death, we have no record of the exact place of his birth. Further, because of erroneous dates on tablet and tombstone, even the date of his birth is often given in error; he was born March 16, 1789 somewhere in Erlangen in Bavaria. Following the depressive slump that resulted from the failure of his colleagues to evaluate his book properly, Ohm moved from school to school in minor teaching positions until 1849 when the coveted Professorship of Physics at the University of Munich came to him. To his electrical studies he added research in molecular physics, interference phenomena of polarized light, acoustics and telegraphic communication. The International Electrical Congress, meeting in Paris in 1881, established the "ohm" as the standard unit of electrical resistance.

ANNOUNCEMENTS AND CALL FOR PAPERS

SPECIAL ISSUE ON OCEAN ACOUSTIC REMOTE SENSING

Reprinted from *IEEE Journal of Oceanic Engineering*

Vol. 11, No. 1 1986 January

TABLE OF CONTENTS

GUEST EDITORIAL AND OVERVIEW	John E. Ehrenberg
INVITED PAPERS	
Current Velocity Measurements Using Acoustic Doppler Backscatter:	
A Review	William E. Woodward Gerald F. Appell
Incoherent, Multi-Beam Doppler Current Profiler Performance:	
Part I — Estimate Variance	Kenneth B. Theriault
Incoherent, Multi-Beam Doppler Current Profiler Performance:	
Part II — Spatial Response	Kenneth B. Theriault
Ocean Incoherent Doppler Sonar Spectral Analysis by Conventional and Finite-Parameter Modeling Methods	D. Scott Hansen
Space-Time Acoustic Scintillation Analysis:	
A New Technique for Probing Ocean Flows	David M. Farmer Steven F. Clifford

Acoustic Oceanography by Remote Sensing	James A. Mercer
Simulating Ocean Acoustic Tomography Measurements with Hamiltonian Ray Tracing	T. M. Georges R. M. Jones J. P. Riley
Performance Bounds for Acoustic Tomography in a Vertical Ocean Slice	Thomas J. Eisler Denise A. Stevenson
Sonar Echo Statistics as a Remote Sensing Tool: Volume and Seafloor	Tim K. Stanton Clarence S. Clay
Channel Capacity in Bits/Joule	Hyuck M. Kwon Theodore G. Birdsall
A Microprocessor-Based Acoustic Telemetry System for Tide Measurement	Salvatore D. Morgera Keith A. Reuben Cedric Cole

PAPERS

The Extension of the Practical Salinity Scale 1978 to Low Salinities	Kenneth D. Hill Thomas M. Dauphinee Donald J. Woods
Characterization of Shallow Ocean Sediments Using the Airborne Electromagnetic Method	I. J. Won K. Smits
A Reconfigurable Real-Time Interpolation Beamformer	P. DaSylva P. Menard Dipak Roy
A Simulation Involving MAPS Video Bandwidth Reduction, Acoustic Channel Errors, and Error Checking	Michael P. Shevenell

BOOK REVIEWS

Military Modeling, Edited by Wayne P. Hughes, Jr. Reviewed by Anthony I. Eller	
Seafloor Scour-Design Guidelines for Ocean-Founded Structures	John B. Herbich Robert E. Schiller, Jr. Ronald K. Watanabe Wayne A. Dunlap

ERRATUM

Erratum: "Asymptotic Detection Performance of Discrete Power and Higher-Order Spectra Estimates	Roger F. Dwyer
--	----------------

ANNOUNCEMENTS

Oceans '86 Conference and Exposition,
1986 September 23-25, at Washington D.C. — Call for Papers

Forthcoming JOURNAL OF OCEANIC ENGINEERING Special Issues

IEEE COPYRIGHT FORM

SPECIAL ISSUE ON UNDERWATER ACOUSTIC SIGNAL PROCESSING

A special issue of the IEEE Journal of Oceanic Engineering, scheduled for publication in January 1987, will be devoted to theoretical and/or experimental developments in underwater acoustic signal processing. Topics may include, but are not limited to, the following:

- 1) Medium Characteristics
- 2) Statistical Properties of the Medium
- 3) Signal and/or Noise Modeling
- 4) Detection
- 5) Estimation
- 6) Tracking
- 7) Classification
- 8) Localization
- 9) Robust Detection, etc.
- 10) Statistical Signal Processing
- 11) Spectral Analysis
- 12) Higher Order Spectral Estimation

Prospective authors should prepare their manuscripts in accordance with the "Information for Authors" published on the back cover of any issue of the IEEE Journal of Oceanic Engineering and forward the completed text by 1 April, 1986, to:

Guest Editor
Dr. Roger F. Dwyer
Code 3314
Naval Underwater Systems Center
New London, CT 06320

Special Issue: **COMPUTER CONFERENCING**

The March 1986 issue of the IEEE *Transactions on Professional Communication* is a special issue on **computer conferencing** as a form of communication that combines techniques of speaking and writing. As engineers and writers exchange ideas ranging from simple memos to collaborative writing projects, they are finding computer conferences indispensable. IEEE *Transactions on Professional Communication*, Volume PC-29, Number 1 (March 1986) explores the human dimension of the form. Articles cover a variety of topics, such as:

- structuring a computer conference
- indexing comments and responses
- moderating a computer conference
- motivating the participants
- comparing a computer conference to other forms of communication
- using a computer conference in education

The price per copy is \$6.00 for IEEE members and \$12.00 for non-members. For individual copies contact:

IEEE Service Center
Publication Sales
445 Hoes Lane
Piscataway, NJ 08854

INTERNATIONAL SYMPOSIUM* ON MARINE POSITIONING

Symposium Directors: Muneendra Kumar and George Maul

14-17 October, 1986
U.S. Geological Survey
Reston, Virginia

The purpose of the Symposium is to focus attention on the special problems associated with positioning in marine environment, to provide a timely forum for the indepth discussion and exchange of ideas, to identify the immediate and future requirements/applications and to promote interdisciplinary/interagency collaboration between numerous investigators and users.

The topics to be addressed by the Symposium will include: instrumentation, systems and methods; achievable and/or projected accuracies, relative and absolute; current and future requirements with various uses and applications; methods, types, problems and requirements related to monumentation; theoretical/experimental research and related validation efforts; and other futuristic ideas/concepts.

*To be organized by Marine Geodesy Committee, Marine Technology Society, with the IEEE Oceanic Engineering Society serving as a Participating Society.

COMMUNICATIONS HELP AVAILABLE

The Professional Communication Society (PCS) was formed and exists primarily to assure that your ideas are properly related.

PCS membership includes authorities in almost every field of communications. You need only contact Lois Moore or Jim Hill, either of whom will promptly suggest one or more sources to assist you.

Lois K. Moore	James Hill
President, IEEE PCS	Vice-Pres., IEEE PCS
The Johns Hopkins Univ.	HRB-Singer, Inc.
Applied Physics Lab.	Box. 60, Science Park
Laurel, MD 20707	State College, PA 16804
301/953-5000, Ext. 8313	814/238-4311

1986 INTERNATIONAL GEOSCIENCE AND REMOTE SENSING SYMPOSIUM (IGARSS '86)

8-11 September 1986
University of Zurich-Irchel
Zurich, Switzerland

For further information, please contact:

Prof. Dr. H. Haefner
General Chairman
Department of Geography
University of Zurich-Irchel
CH-8057 Zurich/SWITZERLAND
Telephone: 01/257 51 31
Telex: 55575 uniz ch

ARCTIC ENGINEERING FOR THE 21ST CENTURY



PROCEEDINGS OF THE FIRST SPILHAUS SYMPOSIUM

The Marine Technology Society is pleased to announce publication of the proceedings of the First Spilhaus Symposium - "Arctic Engineering for the 21st Century," edited by Ben C. Gerwick.

The Symposium, convened in Williamsburg, Virginia, 14-17 October 1985, and sponsored by the Marine Technology Society, represented the first in a series of symposia named in honor of Dr. Athelstan Spilhaus, eminent engineer, scientist, inventor, and humanist. Patterned after the Gordon Conferences in Science, the Spilhaus Symposia are designed to provide a forum for informed ideas to range freely into the future.

The conference record is divided into four parts: Arctic Perspectives, Workshop Reports, Closing Plenary Session, and Appendices. The first consists of technical presentations by invited speakers; the second summarizes workshop reports on the areas of work systems, oil and gas, environment, transportation, scientific research, materials, minerals, and sea ice management; the third encompasses technical presentations, general discussion and closing remarks; and, the Appendices include a list of attendees, background abstracts, a copy of the Arctic Research and Policy Act of 1984, and technical presentations voluntarily submitted by symposium participants.

To obtain a copy of these proceedings, send a check or money order (payable to MTS Arctic Engineering Proceedings) in the amount of \$30.00 to:

Marine Technology Society
2000 Florida Ave., NW
Suite 500
Washington, DC 20009

CALL FOR PAPERS



FOURTH WORKING SYMPOSIUM ON OCEANOGRAPHIC DATA SYSTEMS-1986

Scripps Institution
of Oceanography
La Jolla, California

February 4-6, 1986

Sponsored by:



IEEE Computer Society
Technical Committee on
Oceanic Engineering
and Technology



Scripps Institution
of Oceanography

The SYMPOSIUM ON OCEANOGRAPHIC DATA SYSTEMS is a forum for the presentation of the state of the art and a projection of the future of oceanographic data systems. It is the aim of this meeting to update and disseminate the trend of technological impact in the field of oceanographic research.

Authors are invited to submit papers describing recent advances on all aspects of oceanographic data acquisition, processing, retention and presentation. Suggested topics are provided below.

MULTIBEAM SONAR ARRAYS
HIGH RESOLUTION NAVIGATION
SHIPBOARD COMPUTER NETWORKS
DIGITAL COMMUNICATIONS
DATA ACQUISITION SYSTEMS
HYDROGRAPHIC DATA SYSTEMS
REMOTE SENSING FROM AIRCRAFT
AND SATELLITES
SENSOR TO COMPUTER INTERFACING
DATA BASE SYSTEMS
GRAPHIC AND IMAGING SYSTEMS
AND APPLICATIONS
SHIPBOARD STANDARDS

INSTRUCTIONS FOR AUTHORS:

The conference will accept both regular and short papers. Regular papers will consist of 100 word abstract and full text, whereas, short papers will consist of 100 word abstract and a summary of 1,000 words. A slide/viewgraph presentation without formal text will also be accepted. The deadline for papers is July 15, 1985. A 100 word abstract will be required at that time. The time schedule for papers is:

JULY 15, 1985—SUBMIT 100 WORD ABSTRACT
SEPTEMBER 1, 1985—ACCEPTANCE NOTICE
OCTOBER 15, 1985—FINAL PAPERS DUE

The abstracts should be submitted before July 15, 1985 to:

Daniel Steiger (202) 767-3265
Naval Research Laboratory
Code 5103
4555 Overlook Avenue, SW
Washington, DC 20375-5000

Please include name, address and phone number(s) of authors on abstract submitted.

Submitted papers will be acknowledged promptly and authors will be notified of acceptance by September 1, 1985.

CONFERENCE PROCEEDINGS:

The regular papers and the summaries of the short papers will be published in the conference proceedings. Special sheets for the preparation of accepted papers for the proceedings will be sent to each author.

CONFERENCE ENVIRONMENT:

The conference will be held at the Scripps Institution of Oceanography in La Jolla, California. La Jolla is 20 minutes north of downtown San Diego. The general amenities of San Diego, such as its world famous zoo, Mission Bay, hotels, restaurants, beaches and resort facilities will all be within a short drive of the conference. Adequate hotel facilities are available in La Jolla and throughout the area. The conference has arranged for parking at Scripps.

Informal, open bar gatherings will be held nightly for the conference participants.

A Conference brochure with pre-registration form and technical program will be prepared and mailed in August of 1985.

KEYNOTE SPEAKER:

The keynote speaker for the conference will be Professor Walter H. Munk of the University of California Institute of Geophysics and Planetary Physics.

CONFERENCE CHAIRMAN:

Dan Steiger (202) 767-3265

TECHNICAL PROGRAM CHAIRMEN:

J. Lynn Abbott (619) 452-6054
Stuart M. Smith (619) 452-2752

TREASURER:

Vicki Tencer (619) 452-6054

PROGRAM COMMITTEE:

Ron Macnab/BIOI(902) 426-5687
Rod Mesecar/OSCI(503) 754-2208
Robert Spindel/WHOI(617) 548-1400
Jim Syck/NUSCI(604) 380-2885
Robert Tyce/URI(401) 792-6853



IEEE COMPUTER SOCIETY





THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC.

Announces the 14th Annual Competition for

1986-1987

Congressional Fellowships

A CONGRESSIONAL INTERNSHIP FOR MEMBERS OF IEEE

PROGRAM: Electrical and Electronics Engineers and Allied Scientists are competitively selected to serve a one-year term on the personal staff of individual Senators or Representatives or on the professional staff of Congressional Committees. The program includes an orientation session with other Science-Engineering Fellows sponsored by the American Association for the Advancement of Science (AAAS).

PURPOSE: To make practical contributions to more effective use of scientific and technical knowledge in government, to educate the scientific communities regarding the public policy process, and to broaden the perspective of both the scientific and governmental communities regarding the value of such science-government interaction.

CRITERIA: Fellows shall be selected based on technical competence, on ability to serve in a public environment and on evidence of service to the Institute and the profession. Specifically *excluded* as selection criteria shall be age, sex, creed, race, ethnic background, and partisan political affiliations. However, the Fellow must be a U.S. citizen at the time of selection and must have been in the IEEE at Member grade or higher for at least four years. Additional criteria may be established by the selection committee.

AWARDS: IEEE plans to award two Congressional Fellowships for the 1986-1987 term. Additional funding sources may permit expansion of awards.

APPLICATION: Further information and application forms can be obtained by calling W. Thomas Suttle (202) 785-0017 at the IEEE Washington, D.C. Office or by writing:

Secretary, Congressional Fellows Program
The Institute of Electrical and Electronics Engineers, Inc.
1111 Nineteenth St., N.W.
Suite 608
Washington, D.C. 20036

Applications must be postmarked no later than March 31, 1986 to be eligible for consideration.

MISCELLANY

RETURN OF THE COMET

(Reprinted from *Instrumentation and Measurement Society Newsletter*, April/May, 1985)

In 1948 a small chunk of dirty ice deep in space reached the peak of its trajectory and began a rapid flight back toward our solar system. At first, it was more than a billion miles from earth, but it moved so quickly that by the early 1970's it drew nearer than Neptune and Pluto, the planets most distant from our sun.

In 1982, as it neared earth, astronomers spotted this hurtling chunk and predicted its future path, which takes it around the sun early 1986 in a tight curve, after which it will recede once again as it begins another lap of its enormous, eternal orbit. During its relatively brief visit to our part of the solar system, the chunk will grow a long, dramatic tail and hang — visible to the naked eye — in the evening sky. It is, of course, one of the most famous astronomical objects of all time: Halley's Comet.

Edmond Halley, noted British astronomer and cohort of Isaac Newton, first spied "his" comet in 1682. Intrigued by Newton's theory that comets traveled in huge parabolic or elliptical orbits, and fascinated by their beauty, Halley sought historical proof of regular return appearances by comets. Usually he was wrong, but his one correct prophesy — "Whence I would venture confidently to predict [the comet's] return in 1758," as he wrote in 1705 — was enough to ensure his eternal fame.

Edmond Halley may have been the first to predict the comet's return, but a glance back through history shows that Halley's Comet has been seen and recorded for millennia. The first definite sighting, noted by a Chinese court historian, occurred in 87 BC, while other reports dating hundreds of years earlier may also be accurate.

In the West, the first record of Halley came in 1066, just before the Norman invasion of England. This and other sightings were treated as bad omens by superstitious onlookers; as recently as 1910, the comet's arrival provoked widespread panic when scientists revealed that the earth would pass through its supposedly noxious tail.

In 1910, the last time Halley showed up, the science of astronomy was still young. Astronomers were able to view the comet only through relatively small light-gathering telescopes, and learned little. When a team of scientists managed to take 70 photographs of Halley's tail, their results were ignored. No one knew what to look for.

In the intervening three-quarters of a century, the breadth and precision of astronomy have grown at an extraordinary pace. Researchers can now study heavenly objects — either from the ground or from space — with

telescopes that are far more powerful than any dreamed of in 1910. Even more importantly, instruments are now in use that can study the previously "invisible" universe — the emissions of X-rays, radio waves, and infrared and ultraviolet radiation sent out by stars, planets, and other objects. These technological advances will make Halley's Comet the most thoroughly analyzed dirty snowball in history.

Not all the comet-gazing will take place from the heavens, of course. Here on earth, Halley's impending arrival has spurred a wide-ranging cooperative effort among astronomers. The International Halley Watch (IHW), established in 1982, is an organization of professional and amateur astronomers devoted to a comprehensive study of the comet. IHW includes scientists from nearly every country on earth; more than 2,000 amateurs are also involved.

Professional astronomers have been watching Halley's Comet for months. For the rest of us, our chances won't arrive until October, 1985, when it will come into range of amateur telescopes. Halley will not be visible to the naked eye, however, until January, 1986, and its weeks of true glory won't begin until after perihelion (when it's closest to the sun, on February 9, 1986). Late that month, its long, glowing tail should be visible just above the southeastern horizon in the early morning hours. By March 1, 1986, the whole comet will be in sight still fairly close to the horizon; its tail will stretch anywhere from 10 to 40 degrees across the sky. April, 1986, will see Halley at its brightest, hanging head downward almost due south. As the month progresses, it will grow fainter, finally receding from view by the beginning of May, 1986. Its next visit is slated for 2062.

For best views of the comet, clear nights with little or no moonlight are a necessity. A telescope will give you an early view; but once Halley gets closer, a good pair of binoculars will be all you'll need for a close-up look. City dwellers won't get a clear view because smog and streetlight tend to obliterate the night sky, particularly low over the horizon, so for a clear view they'll have to leave town.

For those who are willing to make the effort, however, the show should be spectacular. While scientists are unwilling to predict precisely how bright the comet will be, some think it will rival the brightest stars in the sky — and stretch farther than a dozen full moons strung together.

Edited from article by
Joseph Wallace, USAIR
February, 1985

AUTHORS' AWARDS — 1984

(Reprinted from *Raytheon Soundings*, July/August, 1985)

Authors were awarded plaques and bonds for papers published during the period October through September 1984. Authors who were already presented certificates for papers published from January through September 1984 were presented and honored again at the ceremonies. Awards are given for publication of papers in the open literature of technical and non-technical journals and proceedings — 27 authors were eligible in 1984.

Author-of-the-year honors for ROSC went to Francis C. Jarvis for his paper in the *IEEE Journal of Oceanic Engineering* titled "Description of a Secure, Reliable

Acoustic System for Use in Offshore Oil Blowout Preventor or Wellhead Control."

The honors for the engineering laboratory went jointly to Roger G. Pridham and Frank J. Gualtieri, Jr. (both of Research/Analysis) for their paper in the *IEEE Journal of Oceanic Engineering* (coauthored by Charles Kaufman, a consultant from the University of Rhode Island) titled "Data Recording and Processing for High Resolution Frequency Analysis." The awards are presented only for technically reviewed papers or their equivalent.



THE SECOND BIENNIAL NATIONAL OCEAN SERVICE INTERNATIONAL HYDROGRAPHIC CONFERENCE

MARCH 24-27, 1986
OMNI INTERNATIONAL HOTEL
NORFOLK, VIRGINIA
U.S.A.

For information, contact: HYDRO U.S.A. '86, c/o Ms. Carol Petruska, NOAA, 439 W. York St., Norfolk, VA 23510. Telephone: (804) 441-6206.

OES MEMBERS ELECTED TO FELLOW GRADE

Our congratulations to the following OES members who were elected to Fellow Grade as of January 1, 1986:

Dr. Gary S. Brown
1310 Oak Drive
Blacksburg, VA 24060

For contributions to the understanding and application of electromagnetic scattering from rough surfaces.

Dr. Raman K. Mehra, Pres.
Scientific Systems Inc.
35 Cambridge Park Drive
Cambridge, MA 02140

For contributions to development of theories of identification, estimation, and optimal control and their applications in aerospace and industrial systems.

Mr. J. Barry Oakes
3890 Jennings Chapel Rd.
Woodbine, MD 21797

For leadership in the application of electrical measurement instrumentation.

Dr. Morris Schulkin
9325 Orchard Brook Dr.
Potomac, MD 20854

For contributions to underwater sound propagation, acoustic oceanography, sonar performance evaluation, and prediction.

COMMENTS ON APPLICATIONS OF ARTIFICIAL INTELLIGENCE IN UNTETHERED OCEAN SYSTEMS

Arthur S. Westneat

As we rapidly make our computers smaller, and cheaper, our ability to handle data, as well as knowledge, is expanding tremendously. Perhaps we may soon make intelligent machines, capable of long-term survival and extensive accomplishment deep in the Sea, with reliance only on the tenuous acoustic path for communication. With such machines the Ocean may be opened up for man's exploitation in ways that are only dimly seen today. The EE has changed the world fundamentally in the last century. Perhaps the Ocean is our new frontier where our impact can be equally as great, and even more beneficial.

In June a 4-day Symposium took place at the University of New Hampshire to consider the technologies implied in the goal of placing intelligence in underwater systems. One day was given to classified papers. I am pleased to share some of my impressions related to these technologies, as received in these meetings, the Fourth International Symposium on Unmanned, Untethered Submersibles. Systems, such as the ROV, and the ARGO of TITANIC fame, employ tethers with wide-band transmission links and so there is no demand for intelligence to be incorporated at the work site. This is not true for the unattended, the long distance, and perhaps the inexpensive system of the future.

Interest in intelligent machines in the Ocean has expanded greatly since the most recent meeting late in 1983. The number of participating Companies, as well as Federal Agencies, more than doubled. The number of Countries participating increased by a third. Many topics were discussed, only some of which were of interest to the Ocean focused EE.

The concept of removing man from control, and evolving totally self contained working systems, was not accepted by all of the speakers. The problems appear immense to some, and simply visionary to others. A few others are making excellent progress toward that goal.

The problems that dominate these systems include:

- the development of architectures that permit real time system operation with computationally intensive knowledge based guidance.
- incorporation of microcomputer systems with ample storage, and sufficient speed in small low power packages.
- navigation capable of substantial precision at ranges in the tens of kilometres.

- communication of useful realtime imagery upward from depths in the thousands of km, with bandwidth left over for a downward C&C link.
- vision systems that permit useful remote control of manipulation, despite the acoustic time delay.
- power plants that accommodate long ocean voyages.

Excellent progress is being made in all these areas, far too much to be discussed in detail here: Some of the points that interested me, however, were the following:

Most people still are working with adaptive algorithmic controllers dealing with time series, rather than symbolic systems that deal with concepts. The future self contained system must be able to make qualitative assessments of a situation, and to then make decisions based on accumulated experience and best risk judgements. Lessons from the A-I Community must be applied.

Programs for the algorithmic systems generally are written in C, for the symbolic systems in LISP or PROLOG, interfacing with operating systems written in C.

At least two systems have been placed in the water employing knowledge based control. The current capabilities of these systems are minimal indeed.

Not unexpectedly, the unclassified sessions involved academic institutions and industrial firms who discussed wide ranging advanced concepts, and unusual ideas. The classified sessions dealt with massive projects, and large budgets, but little of the technology that has been developed in the past few years.

The parallel national effort in land based, as well as extraterrestrial robots, which was reviewed by Odetics, Inc., appears to be substantially ahead of Ocean technology in hardware realization, but not necessarily in concept.

Advanced unmanned untethered submersibles were shown by International Submarine Engineering, although the guidance was generally of conventional design, sufficient for the missions being attempted.

Shenandoah Systems Company discussed concepts for exceptionally long range work systems.

Heriot-Watt University, of Edinburgh, is doing much in both the theory and practice of intelligent underwater

systems. Their ANGUS series of systems are demonstrated work horses, altho their innovative concept of knowledge based guidance has not yet been widely incorporated.

Heriot-Watt as well as UNH have been attempting to employ the deep water acoustic link to transmit real time television. Band width reductions in excess of 100 to 1 were reported on typical underwater pictures, employing a microprocessor computer based on the 68000, in a redundancy removal concept.

Bandwidths of 10 KBS with low error rate appear available from the deep sea floor to the surface. Transmission from the seabed of 2 frames per second of 256x256 pictures now appears feasible with a reasonably small remote data processing package.

The effects of transmission error rates on image quality, after redundancy removal, were examined by Mike Shevenell of UNH. Substantial impulse errors in the range of 1 part in 100 could be tolerated in some cases.

MIT/WHOI are dealing principally with tethered vehicles, but are addressing key system elements, such as non-linear servo controls, and the development of primary sensors. Heriot-Watt contemplates a tethered "garage", and an untethered automaton, not unsimilar to WHOI objectives.

Martin-Marietta Aerospace of Baltimore, is engaged in developing a forward looking sensor that may have ability to classify obstacles. They intend to complete a precision area seafloor search mission in 1986, in cooperation with UNH. Notable is their intent to include an onboard ability to reprogram the mission due to obstacles or unexpected events.

Speakers from UNH described ongoing efforts to implement a knowledge based concept for remote system use. A "blackboard" module was described in detail, as well as an intelligent "supervisor" aimed at serving as vehicle Commander.

Energy Conversion Systems discussed a small nuclear reactor for small vehicle applications. Technology appeared excellent, while licensing may be a problem.

Aquanautics Corp. discussed the Artificial Gill, a means of extracting oxygen from seawater while in motion to permit use of hydrocarbons for fueling remote robotic systems.

Autonomous vehicles are being designed for a number of tasks, including:

Measurement of the Topography of the underside of the Arctic ice.
Surveying of exposed pipelines.
Inspection of an offshore drilling rig.
Collection of Side Scan Sonar data.
Survey of the Arctic seafloor.
Transportation of loads.
Photography of the deep sea floor.
Recovery of lost instruments.

(More — Announcements and Call for Papers)

CALL FOR LECTURERS

IEEE members are invited to apply for the 1986 Distinguished Lecture Tour of Region 9 scheduled for October 20 — November 7, 1986. The group will be composed of lecturers in the following fields:

(a) Power: new developments in power system protection; power transmission (new developments, EHV, DC transmission, compact transmission lines); power distribution (new developments, underground systems); (b) Computer: computer networks; microprocessor applications (control, industrial applications); robotics; (c) Communications: digital communications (public networks, packet switching, satellite communications, integrated networks); fibre optics; local area networks.

IEEE Sections in Latin America to be visited include Mexico, Central America, Panama, Columbia, Chile, Argentina, Sao Paulo, Venezuela and Puerto Rico & Caribbean.

Local accommodations and meal expenses will be paid by the hosting Sections with all other costs to be borne by the tour participants. The deadline for application is **MAY 1, 1986.**

Prospective tour participants should send letters indicating their interest in the tour, accompanied by a resume and a one-page summary of their proposed technical lecture, to their respective Society or Council president. A copy should also be sent to the Transnational Relations Committee Chairman, c/o Ms. Barbara Ettinger, TRC Administrator, IEEE Headquarters, 345 E. 47th St., New York, NY 10017-2394.

IEEE OCEANIC ENGINEERING SOCIETY

Administrative Committee

DANIEL L. ALSPACH
ORINCON Corp.
3366 North Torrey Pines Ct.
LaJolla, CA 92037
619/455-5530

MR. WALTER L. BACON*
323 N. Elizabeth Ave.
Monterey Park, CA 91754
818/573-5663

ARTHUR B. BAGGEROER*
Dept. of Ocean Engineering
Room 5-326
Mass. Inst. Technology
Cambridge, MA 02139
617/253-4336

DONALD M. BOLLE*
Packard Lab #19
Lehigh University
Bethlehem, PA 18018
215/861-4025

LLOYD R. BRESLAU
Naval Oceanographic Office
Code 02
Bay St. Louis
NSTL, MS 39522-5001
601/688-4205

ROBERT H. CASSIS, JR.
Commanding Officer
USCG Support Center
Coast Guard Island
Alameda, CA 94501
415/437-3171

STANLEY G. CHAMBERLAIN*
Raytheon Company
Box 360
Portsmouth, RI 02871
401/847-8000, ext. 4423

JOSEPH CZIKA**
TASC
8301 Greensboro Dr., Ste. 1000
McLean, VA 22102
703/734-4100 (O)
703/938-0058 (H)

THOMAS M. DAUPHINEE
Div. Physics, Nat. Resrch. Council
Montreal Road
Ottawa, Ont., Canada K1A 0R6
613/993-9372

RUI de FIGUEIREDO**
Dept. of Elec. & Computer Eng.
Rice University
P.O. Box 1892
Houston, TX 77251
713/527-8101, ext. 3569
713/723-7684 (H)

EDWARD W. EARLY
4919 N.E. 93rd Street
Seattle, WA 98115
206/543-9825 (O)
206/525-2578 (H)

STANLEY L. EHRlich*
Raytheon Co., Sub. Sig. Div.
P.O. Box 360
Portsmouth, RI 02871
401/847-8000, ext. 3130

ANTHONY I. ELLER*
Code 130
NORDA Liaison
800 N. Quincy Street
Arlington, VA 22217
202/696-4951, ext. 5120
703/790-9731 (H)

J. DAVID IRWIN**
Electrical Engineering Dept.
Auburn University
Auburn, AL 36849
205/887-1810

LLOYD Z. MAUDLIN**
Group Vice-President
Integrated Systems Analysts, Inc.
5461 Toyon Road
San Diego, CA 92115
619/265-9292 (H)
619/422-7100 (O)

RICHARD C. ROBINSON
800 Follin Lane, Suite 245
Vienna, VA 22180
703/281-7920

HAROLD A. SABBAGH
Sabbagh Assoc., Inc.
2634 Round Hill Lane
Bloomington, IN 47401
812/339-3446

MICHAEL SEROTTA**
Raytheon Company
P.O. Box 360
Portsmouth, RI 02871
401/847-8000, ext. 2042

ROBERT SPINDEL*
Dept. of Ocean Engineering
Woods Hole Oceanographic Inst.
Woods Hole, MA 02543
617/548-1400, ext. 2283

JOSEPH R. VADUS
U.S. Dept. Commerce
NOAA Office of Ocean. Eng.
6001 Executive Blvd.
Rockville, MD 20852
301/443-3778

DAVID E. WEISSMAN
Dept. of Eng. & Computer Sci.
123 Adams Hall
Hofstra University
Hempstead, NY 11550
516/560-5546

ARTHUR S. WESTNEAT, JR.*
Univ. of New Hampshire
P.O. Box 208
Durham, NH 03824
603/659-2195 (H)
603/749-6056 (O)

GLENN N. WILLIAMS**
Data Processing Center
Texas A&M University
College Station, TX 77843
409/845-5484, ext. 8419
409/846-9187 (H)

WILLIAM E. WOODWARD**
NOAA WSC-5
6010 Executive Blvd.
Rockville, MD 20852
301/443-8444

Newsletter Editor for Technology

ROD MESECAR

Central New England

MICHAEL D. SEROTTA

Halifax

FERIAL EL-HAWARY

Chapter Chairpersons

San Diego

KEN D. KALBFELL

Seattle

THEODORE HEINDSNANN

Washington D.C.

JOE CZIKA

Houston

WILLIAM PINEBROOK

**Term through 1987. *Term through 1986. All others, term through 1985.

Technology and Standards Committee Chairpersons

Arctic Instrumentation

EDWARD W. EARLY*
4919 N.E. 93rd St.
Seattle, WA 98115
(206) 543-9825

Autonomous Underwater Vehicle

ARTHUR S. WESTNEAT, JR.*
Wadleigh Falls Rd. RD#1
Newmarket, NH 03857
(603) 659-2195

Marine Communication and Navigation

Capt. ROBERT H. CASSIS, JR.*
U.S.C.G. Support Ctr.
Government Island
Alameda, CA 94501

Remote Sensing

DAVID E. WEISSMAN*
Dept. of Engineering
Hofstra Univ.
Hempstead, NY 11550
(516) 560-5546

Current Measurement

WILLIAM E. WOODWARD
U.S. Dept. of Commerce
NOAA WSC-5
6010 Executive Blvd.
Rockville, MD 20852
(301) 443-8444

Ocean Energy Conversion

Underwater Acoustics

DAN J. RAMSDALE*
Naval Ocean Research
& Development Activities
Code 240
NSTL, MS 39529
(601) 688-5230

Oceanographic Instruments and Data Acquisition

THOMAS M. DAUPHINEE*
Div. Physics, Nat. Res. Council
Ottawa, Ont., Canada K1A 0R6
(613) 993-2313

REPRESENTATIVES TO IEEE/LAB COMMITTEES, GROUPS, SOCIETIES

Professional Activities
Committee for Engineers
(PACE) Coordinator

Division IX
Nominations

STANLEY G. CHAMBERLAIN

Communications and
Information Policy

Energy

Environmental Quality

WALTER L. BACON

Large Scale Systems
DANIEL L. ALSPACH

Man and Radiation

Research and Development
JOSEPH R. VADUS

Social Implications
of Technology
FRANCOIS A. ENVENT

Offshore Technology Conference (OTC)

Executive Committee

GLEN N. WILLIAMS
Data Processing Ctr.
Texas A&M Univ.
College Station, TX 77843
(713) 845-4211/5531

Technical Program

ALFRED M. WILLIAMS
C.E. Oil & Gas Controls Co.
3726 Dacoma
Houston, TX 77092
(713) 683-1255
(713) 682-6444

Future Meeting Chairpersons

General

Victor C. Anderson/Charles B. Bishop
Gilbert Maton
Alan Longhurst/Clifford Tyner

Technical

Jack Jager/James Brown
Anthony Eller/Gene Russin
David McKeown/Ulrich Lobsiger

OCEANS '85 (San Diego, CA)
OCEANS '86 (Washington, DC)
OCEANS '87 (Halifax, NS)