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Edited by J.A. Bierlein and Victoria S. Hewitson

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AEROSPACE	ONR—Sails and Satellites	B.I. Edelson	147
	NATO Communications Satellite Program	B.I. Edelson	148
	Sonic Bang Tests	H.E. Williams	149
GEOPHYSICS	The Royal Meteorological Society	M.L. Barad	149
	Strikes in Scientific Services	M.L. Barad	150
MATHEMATICAL SCIENCES	Lords' Second Reading on Post Office Data Processing Service Bill	P.D. Maycock	150
MECHANICS	More About the RAE Farnborough Open House	H.A. Smith	151
	Euromech Conferences	H.E. Williams	152
OCEAN SCIENCE & TECHNOLOGY	First UK Submersible	J.D. Costlow, Jr.	153
	Drifting Continents and Segmented Molluscs	J.D. Costlow, Jr.	153
	Casting Bread upon the Waters	J.D. Costlow, Jr.	154
	Symposium on Marine Food Chains	J.D. Costlow, Jr.	154
	Mixed Blessings	J.D. Costlow, Jr.	154
	Congress on Corrosion and Fouling	J.D. Costlow, Jr.	155
PHYSICAL SCIENCES	Standard Telecommunications Laboratories Ltd. Open Days	R.L. McCracken	155
	Conference on Elementary Particles	L.M. Lederman	157
	Ultrasound in Opthalmology	Floyd Dunn	159
	Symposium on the Human Effects of Ultrasonic Radiation	Floyd Dunn	159
	Second International Conference on Magnet Technology, Oxford, 1967	N.M. Wolcott	160
	Some Cryomagnetic Investigations at Oxford	N.M. Wolcott	161
	The Second Conference on Static Electrification	Joseph T. Leonard	163
NEWS & NOTES	& Technical Reports of ONRL	Ed. by H. Fisher	164

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Prepared and Submitted by the Scientific and Technical Staff.

for A.W. PRYCE
Scientific Director

J.L. Carter
Commander, USN
Acting Commanding Officer

AEROSPACE

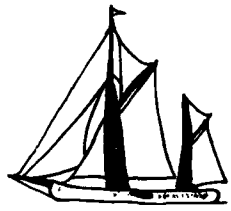
ONR—SAILS & SATELLITES

The ketch TECTONA measures 64-ft along the waterline, with a fat 18-ft beam. She was built as a pleasure yacht some forty years ago by a slightly eccentric British army surgeon stationed in India who had her scaled up from the lines of a Norwegian fishing cutter he had once owned. Rugged, seaworthy, her hull all of teak, with ribs and stringers as large as railroad ties, she sleeps 17 and carries 1700-ft^2 of heavy canvas. She has a romantic history and has recently become quite famous, having been glamorized in two rather saccharine articles written by Alan Villiers for National Geographic. Recently, TECTONA was purchased by the School of Navigation, Plymouth College of Technology, a British merchant marine academy, for whom she now serves as a cadet training vessel.

Sometime ago I was invited to that School to lecture on satellite navigation. I talked a long time, explaining to the cadets about orbital parameters, ionospheric refraction, doppler shifts, phase-lock receivers — modern technology, you might say. They found it curious but interesting. I wondered if they would ever find it useful. I received a hint of the answer when, in thanking me for the doubtful pleasure of listening to my lecture, the school authorities offered me an invitation to sail on their training ship.

What a contrast! But also what a rewarding experience for a naval technician. I had some apprehensions at first, particularly when I heard that the cadets, thrilled with the possibility of having an authentic Navy Commander as a guest, had been polishing bright work for two days and practicing nautical formalities. It made me nervous to hear this — I had distinct doubts on "authenticity" — my sailing days seem very long ago. I could remember "port" from "starboard" of course, but what about the names of all those sails, and what are the formalities on a sailboat anyhow?

When I embarked, I was saved the problem of whether to salute the quarter deck. Since the tide was out and the pier was high, it was necessary to step right into the rigging and clamber down a sort of rope ladder to the deck. The bearded Skipper greeted me, the Mate nodded, the boys glanced sidelong, and we departed under the power of our diesel engine. I watched the crew of fourteen, very young hard-muscled lads run up the canvas and listened carefully as the Mate order the sails up. Mizzen first, then jib, main, flying jib, foresail and finally main-and-mizzen topsails, in that order. I memorized their names. The wind was light that day, but it caught the sails and they puffed out. Then, as we passed the Plymouth breakwater the thumping engine stopped and it was quiet on board. So quiet! I remember that sensation — the peaceful, whispery feeling of being under sail in a large ship. When I remembered that, I remembered many other things about sailing — working in the sun in the salt air, the taste of salt, the flemished lines, the polished wood, the brass with green edges, and the easy roll of the deck.



I learned a lot of new things too. It's quite a trick to bring a full-rigged ship about; there are a lot of commands to remember — each sail, each line, each stay, halyard, sheet has its special name and a securing pin. Piloting and navigating were interesting too — no fancy gadgets — just pelorus and sextant. The cadets had navigation and seamanship drills; they stood watches and learned the routine of the sailing ship. I watched.

The weather, for England, was glorious — bright sun, light wind. The real sailors wished that it was heavier; I was secretly pleased that it was not. Cadets were shy at first but eager to talk once the ice was broken. I tried to join in the work — pull lines, climb rigging. No one laughed — everyone was very kind. We paused for tea. We talked of sailing, of the weather, of politics, of the merchant marine, of the Royal Navy and the US Navy. In the evening we stopped at a little fishing port and went ashore for some pub-crawling. We spent the night at anchor and sailed again the next day along the lovely southern coasts of Devon and Cornwall.

It was great to spend two days at sea. I made 16 new friends. I recalled a lot of hidden knowledge, and learned a few new things. Did I learn about the possible new applications of satellite navigation and communications? No, not really. Then did I at least gain a new appreciation for the fruits of modern technology: high-speed nuclear-powered steel ships with radar, sonar and satellite read-out equipment? No, I'm not sure even of that. Perhaps I

gained a new "respect" but not what might be called "appreciation." Here's the thought I was left with: while modern ships of war grow more lethal, more powerful and more complex, life aboard them more confining, and designing and developing their equipment an ever-more frenetic exercise — there are still men and boys aboard sailboats in this world where life is casual and interesting and relaxed. And where one can retain a sense of humor and of philosophy. Most of us could no doubt use a little more kite-flying, fishing, or sailing. The change of pace is fun and probably beneficial.

But now I really ought to get cracking and evaluate that last computer run-off — where the devil is my slide rule? (B.I. Edelson)

NATO COMMUNICATIONS SATELLITE PROGRAM

The United States has offered to its NATO partners an opportunity to participate in a cooperative communications satellite development project and to establish an operational system. The purpose of the offer, presented by Ambassador Harlan Cleveland in September 1966 to the North Atlantic Council, was really two-fold: to improve the communications capability of the Alliance and to engage NATO in an important advanced technological endeavor. This project would demonstrate the ability of NATO countries to cooperate on meaningful tasks for common defense, and at the same time it might diminish the so-called "technological gap" between national capabilities in a critical area.

The proposed NATO communications satellite program would be similar to the existing US-UK cooperative program. NATO was invited first, as were the British, to perform experimental work using existing US Defense Satellites and then to establish their own operational system using special NATO satellites. (See "Project SKYNET" reported in ESN-21-5.)

NATO took rapid action in accepting the first part of the US offer. Two small specially constructed "Mascot" terminals were leased by NATO from the Philco-Ford Corporation, flown to Europe and installed: one in Belgium to support the new NATO Headquarters and one in Italy to support NATO commands in the Mediterranean region. This link was inaugurated on 30 June 1967. The single link will demonstrate the reliability, flexibility and security of satellite communications for NATO and will give NATO personnel an opportunity to learn how to operate satellite terminals.

A special Senior Communication-Electronics Group of NATO, reporting directly to the Defense Planning Committee, has been charged with the responsibility for providing a plan to establish an operational satellite communications system to implement the second part of the US offer. The problems involved in multinational cooperation in determining technical characteristics for such a system, for funding it, and for establishing production-sharing procedures among industrial firms of the various participating nations are severe. However, a great deal of progress has been made, the plan has been completed, and at the present time implementation awaits only final approval and funding.

Under the proposed plan, the NATO satellite communcations system would link all of its major military command centers. The system would carry only vital and unique defense traffic. The NATO satellites would be truly synchronous, similar to those of SKYNET but stationed at such a longitude as to cover most of Europe and the Atlantic Ocean. They would be launched from Cape Kennedy by Thor-Delta vehicles. The configuration of the satellites has not been set, but if similar to those being procured for UK use, they would operate in the 7-8 GHz exclusive frequency band; they would be solar-powered and spin-stabilized with a mechanically despun antenna to provide a high effective radiated power. NATO would have to pay to develop, build and launch these satellites. Ground terminals could be built cooperatively by many NATO countries.

With a dozen or so terminals placed in strategic NATO areas from Norway to Turkey and from ships at sea as well, all NATO countries could be tied together with a tough, survivable, high-quality communications link for its vital defense traffic. The NATO satellite communications system could be operating by 1969. (B.I. Edelson)

SONIC BANG TESTS

As if it weren't bad enough that the Concorde project is costing several times its original estimate, some of the local citizenry are being subjected to an unpleasant reminder in the form of sonic bang tests. The first public announcement of the projected series of experiments was made in the House of Commons on 4 July in answer to a question put to the Government. The reply, by Mr. John Stonehouse of the Ministry of Technology, contains all that has been made public so far:

"Before undertaking any major programme of sonic bang tests it would be desirable to have a relatively small preliminary exercise. It has been decided that during the month of July, Lightning aircraft from the Ministry of Technology's Aeroplane and Armament Establishment at Boscombe Down should be permitted to fly

supersonically over various parts of Southern England in such a way as to create sonic bangs at intensities known from previous experience to be well below those likely to cause damage.

"The flights will be confined to the hours of daytime, and will be monitored by technicians from the Royal Aircraft Establishment, Farnborough."

Essentially what was being undertaken was a sample of public reaction to relatively low-intensity bangs. (The Concorde, being about 200 ft long, will produce a pressure pulse of longer duration and hence potentially more objectionable.) Strictly speaking, the only data that are being recorded are the number of complaints and the amount of damage. The address to which to send complaints has been published in the daily newspapers. However, in order to ease public criticism, the Royal Aircraft Establishment (RAE) has been asked to take measurements. It simply would not do to admit to the general public that, due to meteorological irregularities (winds, anomalous temperature variations, etc.), the data to be obtained from a reasonable amount of instrumentation are practically meaningless.

The tests began two days later. For obvious reasons, all tests are limited to within reasonable Lightning range of Boscombe Down, but, more to the point, tests are directed along the proposed flight corridor linking London with the Atlantic at the Severn estuary.

The Lightnings fly at about 8 miles altitude, producing a pressure pulse about 15 miles wide. Pressure measurements, taken by microphones, show statistical variations in intensity about a mean which is given by the predicted pulse, assuming an ideal atmosphere. However, there are factors which produce exceptional cases. The Director of the Swedish Aeronautical Research Institute, Bo K.O. Lundberg, long a vocal opponent of the SST, has shown that, due to statistical atmospheric effects, one out of 10,000 bangs will be double the mean intensity. A further effect is that during the acceleration phase of the flight, there may be a focusing of pressure disturbance over an arc on the ground, leading to higher intensity bangs — the horseshoe effect. Thus, there may be public outcry, and the Ministry of Technology wants to take each step cautiously.

The man in charge of the RAE's contribution is C.H.E. Warren, Head of the Flutter, Vibration and Noise Division. Originally a mathematician at Cambridge, and then an aerodynamicist at RAE, Warren was put in charge of noise and sonic bangs by M.J. Lighthill, previous Director of RAE.

This series of tests started rather poorly for Warren. While driving down a Dorset country lane, his car was demolished by a truck which skidded into him, thus registering the first and loudest protest the sonic bangs have so far received. Warren was unhurt, but this accident probably contributed to his seasickness on the small coaster which was chartered to take measurements on the Severn estuary.

Initially, it was expected that RAE would provide little more than moral support with these data measurements. However, problems are developing which require professional attention. When it was reported that instruments in the Pathology Dept. of Bristol's Frenchay Hospital were temporarily thrown out of adjustment, RAE engineers moved in to investigate. There have also been reports of damage such as broken windows, but none has been confirmed as due to the tests. One interesting fact was brought to light during the tests in a port city: shortly after a bang had produced a normal pulse on a measuring oscilloscope, a ship's whistle blew — and drove the needle off scale. (H.E. Williams)

GEOPHYSICS

THE ROYAL METEOROLOGICAL SOCIETY

Across the street from the Natural History Museum in the Kensington area of London lies a row of attached terrace houses resembling one another in much the same way as do the brownstone houses north of Union Square in New York City. One of these buildings, built in the 1880's, houses the offices of the Royal Meteorological Society, an organization which traces its history under various names to 1850.

It is in this building that a staff of about nine people, headed by Colonel J.H. Willink, Assistant Secretary of the Society, conducts the day-to-day business of the Society. It is here that the technical editing of the Society's publications is accomplished and where scientific papers which have appeared in the Society's Quarterly Journal are discussed at one evening session each month from October through June. And it is here that special lectures, summer meetings and visits, and field study courses are arranged.

But no summary of the Society's services would be worth much if it failed to include a note on the meteorological library. It is hard to believe that the collection includes about 20,000 books and about 1,200 pamphlets. Some of the older books are believed to be the only copies in existence.

However, the house at 49 Cromwell Road, purchased in 1921 and adequate, no doubt, for the period preceding World War II, is running out of library space. It has been suggested that some of the collection be

transferred on long-term loan to the National Libraries. It is difficult for an American familiar with the beautiful quarters occupied by the American Meteorological Society in the Beacon Hill section of downtown Boston to refrain from comparing them with the rather spartan rooms occupied by the RMS.

But quarters do not a professional society make. For the Society, serving a total membership of about 2,430 people (about 10% of whom are Foreign Members) publishes two excellent publications, the Quarterly Journal and Weather, which between them are designed to meet the requirements of the research scientist, those providing meteorological services, and the amateur interested in weather phenomena and climate. The Quarterly Journal, by the way, will soon have a new editor, Professor Henry Charnock of the University of Southampton, known to many for his work on air-sea interactions.

At the same time, the Society's new president will be Dr. F. Kenneth Hare, an Englishman by birth and training and whom most US and Canadian meteorologists know for his work in meteorology and geography while at McGill University in the period 1945 to 1964. More recently associated with the University of London, Hare will be leaving London in July of 1968 to become president of the University of British Columbia.

While on the subject of Canada, it should be added that a fairly strong relationship between Canadian and British meteorologists has been fostered by the Society, about 10% of whose total membership has been Canadian. However, with the creation of the independent Canadian Meteorological Society on 1 January 1967 and with the dissolution of the Canadian Branch of the RMS, there is likely to be a reduction, hopefully temporary, in the Canadian membership in the RMS.

American meteorologists visiting London and finding time to visit the fine museums in the Kensington area should not miss the opportunity to visit the nearby quarters of the Royal Meteorological Society. (M.L. Barad)

STRIKE IN SCIENTIFIC SERVICES

A sit-down strike is not an unusual occurrence these days. But one which started in London on 27 July may be of some interest to meteorologists back home.

As reported by The Times of London, Mr. Stanley Spiro, one of the assistants of the Meteorological Office, protested the lot of assistants by pitching a small tent on the roof of the Observing Office at Heathrow Airport and by announcing his plan to camp there for a few days with his wife, two small sons, and a dog.

What is his grievance? He is unhappy that he gets no tea-break during night duty, that he sometimes works 16 out of 24 hours, and that his work week is 48 hours long. Nor is he happy with his annual pay of £ 950 ($2,660) after 13 years of plotting weather charts. (M.L. Barad)

MATHEMATICAL SCIENCES

LORDS' SECOND HEARING ON POST OFFICE DATA PROCESSING SERVICE BILL

The British General Post Office (GPO) has proposed entering the data processing business in a big way. A grid of 20 or more large computers will be operated by the Government as a public corporation. Computer time and service will be sold to all comers, and the operation will be profit-making. The Bill enabling the GPO to expend funds and establish this service has passed the House of Commons, and on 14 July it was presented to the House of Lords for a second reading. (In order for a bill to pass the Commons or the Lords, it must be read and voted on three times by each House.)

The second discussion of the Bill in the House of Lords was in delightful contrast to the serious business that I observed in the House of Commons only an hour earlier. The Commons, after an all-night marathon session, was giving the Legalized Abortion Bill its third reading. Unable to write a serious ESN article on abortion, I moved to the House of Lords, where computer history was being made.

Lord Shackleton presented the Computer Services Bill to the House. He said that the purpose of the National Data Processing Service (NDPS) is twofold, "... The first is to encourage a more widespread use of the computer by industry and commerce, and the second is to provide a framework within which the possibilities now being opened by technological advances in computers can be coordinated and exploited to the maximum advantage of the economy ....

"The second point refers to possibilities which are now being opened up of having computer 'talk' to computer, and of being able to maintain large stores of information permanently on the machine from which individual items may be retrieved in fractions of a second. This latter facility leads to the concept of 'data bank' or 'random access' systems."

Lord Shackleton then referred to national pools of design data, population data, program files, etc. He said that the Government should entrust the NDPS to the GPO, partly because of the Post Office's knowledge in the matter of communications; but, more basically, because the Post Office, which is already a very large (computer) bureau operator for its own business, will provide a very considerable

base load for the new business which will generate substantial economies of scale."

Opposition to the Bill at this second reading was headed by Earl Ferrers. He built an image of the 20 GPO computers still unusued in 1971, competing unfairly with private enterprise and having tremendous difficulty in security with respect to data banks. Finally, he raised a key technological point, questioning whether the GPO is really capable of tying together 20 high-speed computers. He indicated that existing users of high-data-rate links are unhappy and that the present waiting period for a link is 18 months to two years! After highlighting the dangers of the Bill, he conceded that it is an exciting, progressive venture which will help the country "keep in the van of modern techniques and modern technology." Earl Ferrers said he was awed by modern computers and could not help recalling the astonishment of one man who made use of a computer — not really a sophisticated one, but a talking weighing machine on a railway platform: "Having inserted sixpence, the man was told in a loud voice that he was 6 ft 3 in. in height, 12 stone in weight, and was catching the 6:32 to Liverpool. He was so astonished that he felt that it must be a freak reaction; so he inserted another sixpence and was again told that he was 6 ft 3 in in height, weighed 12 stone, and was catching the 6:32 to Liverpool. He was so amazed that he called his wife to witness the wonders of modern technology. He inserted a further sixpence, was told he was 6 ft 3 in, weighed 12 stone, and that while he had been 'mucking about like this' he had missed the 6:32 to Liverpool."

Lord Lloyd of Hampstead was very concerned about security of data, accuracy of data, and use of data. He said, "My Lords, my aim is not to conjure up a melodramatic version of an Orwellian world, dominated by 'Big Brother,' but ..." and went on to recount that a US bill to set up a National Data Computerized Center was withdrawn as a result of severe criticism from various quarters about the lack of adequate legal safeguards. He offered the evidence submitted to the US Senate Judiciary Committee by a leading expert, Prof. Miller of the Univ. of Michigan.

A speaker for the Bill was the Earl of Courtown, who described his company's (Imperial Chemical Industries) difficulties in the area of telecommunication grids. ICI spent three years and £ 1,500,000 to develop its own grid for a 100-terminal computer system. It took over 12 months to get a GPO license to operate the grid. The license can be withdrawn at any time. The Earl stated that the present GPO teleprinter dates back to 1929. Despite his criticism of the Post Office's ability in advanced telecommunications, he supported the Bill on the basis that running a computer grid would force the telecommunications part of the GPO to solve the technological problems demanded by the NDPS, thereby benefitting all computer users.

After a 30-min debate, the Bill passed its second reading, thereby virtually assuring a successful third reading and approval by the Queen. This will give Britain the green light to develop the world's first national, government-controlled computer activity (P.D. Maycock)

MECHANICS

MORE ABOUT THE RAE FARNBOROUGH OPEN HOUSE
(See ESN-21-7 for a previous report)

An outstanding development publicized this year at Farnborough concerned carbon fiber in reinforced-plastics applications. This material in one of its variant forms will undoubtedly become a principal material for aircraft construction in the not too distant future. There are two main types of materials: those utilizing high-modulus fibers of a mean tensile strength of 300,000 lbs/in.^{2} and a Young's modulus of 60 M lbs/ins.^{2}, and those fibers having a high breaking strain with a mean tensile strength of 430,000 lbs/in.^{2} and a Young's modulus of 33M lbs/in.^{2} with a breaking strain of 1.8%. The specific gravity of the material seems to vary between the 1.74 and 2, dependent upon the amount of carbon fiber imbedded in the resin. A variety of technical applications are foreseen for carbon fiber technology. These include structural uses in the aerospace field in which a high stiffness-to-weight ratio is required, or in components for a chemical plant where resistance to corrosion, swelling and other forms of chemical attack is important, or in marine materials which require long-time resistance to water. A number of patents have been applied for by Mintech and these have been assigned to the National Research Development Corporation (NRDC) for exploitation in the UK national interest. British industry is now preparing for commercial production under appropriate licenses. A good reference on the subject of carbon fibers is a paper entitled "High Strength High Modulus Carbon Fibers" by Watt, Phillips and Johnson. It was published in the Engineer Magazine of May 27, 1966.

Another interesting exhibit featured the work which is done at an outlying RAE establishment at Cardington; this is near Bedford, in the old blimp hangars. A great

deal of lighter-than-air technology remains from the days of airships, and this has been utilized in Britain to develop fabrics suitable for making collapsible air-cushion vehicles and various derivatives. One such application is described as a hover pallet for lifting heavy loads. Such items as a large two and one-half ton truck are suspended within an igloo-shaped rubberized container which is pressurized and can serve as a transporter for this vehicle over a relatively smooth surface — such as a road or across a river. An inflatable hovercraft suitable for carrying a 1000-lb load or four men was also displayed. It is complete with skirts, load-carrying platform, and small engine and propeller to drive it. This will be subject of a more detailed report.

Marconi Instruments Company's low light-level isocon television camera was demonstrated in a room which was very slightly illuminated with simulated moonlight/starlight and with the model of an airfield serving as the picture to be projected. The amount of light amplification and the clarity of the picture on the television screen were considered very outstanding. The camera incorporates an image isocon tube and has an F 1.4 lens giving a field of view of 40°, and it is capable of operating under full nighttime conditions.

The Naval Air Department and the Blind Landing Experimental Establishment at RAE Bedford were well represented by films. One movie of carrier operations on HMS VICTORIOUS showed the operation of current naval aircraft from the catapults and arresting gear located on the ship as well as the test gear being developed at Bedford. A second movie showed the development of the new direct-acting water-spray arresting gear. The movie of the blind landing experimental work was most impressive with aircraft coming in for landings at very nearly 00 weather conditions.

There was (inevitably) a display featuring holography, the three-dimensional photography system without lenses. Principles of holography were demonstrated and two applications were noted: three-dimensional imagery of solid objects and automatic character reading. These relate to the storage of information in a digital computer.

The use of very high-speed photography relating to the study of atmospheric hazards to aircraft was also exhibited. Photographic techniques are exceptional, as rapid as eight pictures within 1 μsec. Rain erosion is simulated by firing a projectile from a pneumatic gun at a suspended drop of water 2 mm in diameter.

Various aerodynamic displays featured V/STOL aircraft models and discussed the work, particularly in transport aircraft, which is being conducted on V/STOL research problems. Various V/STOL propulsion schemes including deflected thrust, direct-lift jet engines, and various rotor systems are being investigated.

Another exhibit featured cockpit flight displays, head-up displays and simulators as they are being developed at the RAE. (H.A. Smith)

EUROMECH CONFERENCES

Small and informal characterize the recently established European Mechanics Colloquia (EUROMECH) on theoretical and applied mechanics. Planned and supervised by a committee of four, drawn from participating countries, the meetings are arranged for a period of three to five days. The participants, not exceeding 50 in number, are usually contacted by the Committee through national committees affiliated with the International Union of Theoretical & Applied Mechanics (IUTAM). Although attempts are made to encourage younger scientists and engineers, participants are chosen from those known to be active in the subject. Only under special circumstances are observers admitted. Papers are not normally published, but a summary report by the Chairman of each conference may be published in a journal.

The EUROMECH Committee is self-perpetuating, as it appoints its members for a period of four years, with one new member appointed each year. The Committee appointed for the first term includes Profs. G.K. Batchelor (Chairman), J.F. Besseling, R. Wille, and Dr. D. Küchemann (Sec.).

The Committee chooses the topic, location, time, and chairman for each colloquium. A list of recent and future colloquia is given below:

March 29-31, Southampton: Structure of Turbulence (EUROMECH 4)
April 3-5, Southampton: Vibration of Buildings (EUROMECH 5)
April 16-19, Norwich: Stability of Continuous Systems (EUROMECH 6)
Sept 19-22, Grenoble: The Mechanics of Liquids Containing Bubbles (EUROMECH 7), Chairman, Prof. A. Craya
Sept, Warsaw: Thermoelasticity (EUROMECH 8), Chairman, Dr. W. Nowacki
1967-68, Brussels: Aerodynamics of Rarefied Gas Flows, Chairman, Prof. J. Smoldern
1967-68, Stuttgart: Three-Dimensional Structural Analysis, Chairman, Prof. J. Argyris
1967-68, Paris: Shells under Large Displacements & Strain, Chairman, Prof. R. Mazet
1968, Liblice: Aerodynamics of Flow with Large Fluctuations in Flow Machines, Chairman, Dr. J. Jeris

1968, Poland: Hydrodynamic Stability of Boundary Layers and Jets, Chairman, Prof. W. Fiszdon
1968-69, Vienna: Mixed Flows - Lifting Bodies, Chairman, Prof. K. Oswatitsch
1968-69, London: Boundary Layers in Elasticity, Chairmen, Profs. W.H. Wittrick and K. Stewartson
(H.E. Williams)

OCEAN SCIENCE & TECHNOLOGY

FIRST UK SUBMERSIBLE

During the last week in July, the first two-man submersible vehicle to be built in Great Britain, SURV, was completing final tests. Preliminary work was started on SURV early in 1963 with the object of providing a tool for the engineer or research worker, enabling him to work down to continental-shelf depths in a near normal environment at atmospheric pressure for extended periods. Underwater and Marine Operations Limited, in cooperation with Lintott Engineering Limited of Horsham, developed a quarter-scale model which was made for tank testing. As a result of these tests work was begun on the full-scale vehicle in January 1966.

The design takes into consideration the performance on the surface as well as the ability of the vehicle to maneuver well under water. It is expected that it can be operated from the shore or from small vessels, not necessarily equipped with lifting gear. The present model is designed to work down to 600 ft, but it is expected that it will be reclassified progressively down to 1000-ft working depth. A cylindrical pressure hull was chosen instead of the more costly sphere. The cylinder permits both occupants freedom of movement and the ability to take up the best position for observation, be it standing, sitting, or lying down. The pressure hull is covered by a glassfiber shell which has been made to withstand as much punishment on the surface as a work boat constructed of the same material. The fore part of the shell surrounds the top portion of the pressure hull and contains the surface buoyancy tanks. The more streamlined after-section is compartmented for batteries and for air bottles to provide buoyancy control. The batteries are contained at atmospheric pressure in five neutrally buoyant pods designed for easy changing and recharging sea. The motors, two 2½-SHP ac-motors driven by separate solid state invertors, can be rotated independently through 120° in the vertical plane giving the vehicle exceptionally good control and maneuverability. A quarter-ton of ballast is attached to the bottom of the pressure hull for buoyancy adjustment and emergency jettisoning.

Various homing and fixing systems, including beacons, transponders, and doppler sounding, will be evaluated for survey purposes before a basic acoustic system is fitted. Visual observation by the occupants is through ten Perspex ports, three of which are mounted in the bottom dish, the remaining seven being placed around the sides of the pressure hull. There are also three side-looking ports and one upward-looking port in the entry tower. Still or movie cameras can be carried inside the hull and operated normally by the observers. External frames, however, are fitted for mounting lights and additional cameras. Sea-bed corers, samplers, and a simple manipulative arm can be operated through the hull, and the fore-foot framing has been designed to take a more sophisticated manipulator. The vehicle is designed to accommodate two people, but can be operated with one or three, with a duration of 80 man-hours with basic life support system.

SURV weighs 5.1 tons, ready to dive, and the builders advertise that the pressure hull and the fairing may be separated for air freighting to any part of the world.

More detailed information is available from Mr. R.E. Lloyd, Underwater and Marine Operations Limited, Dolphin Works, Walton Road, Woking, Surrey, UK. (J.D. Costlow, Jr.)

DRIFTING CONTINENTS AND SEGMENTED MOLLUSCS

The National Institute of Oceanography research vessel RRS DISCOVERY has recently returned from an eleven-week geological cruise in the Red Sea. Results of some of the studies during the cruise tend to support the theory of continental drift (ESN-21-3). The expedition, with Dr. A.S. Laughton of the NIO as chief scientist, has been investigating the structure and chemistry of the sea floor in the Red Sea, the Gulf of Aden, and the northwest Indian Ocean. Much of the expedition's effort was planned to examine the theory which was developed through earlier British studies during the International Indian Ocean Expedition of 1961-1963. The Red Sea and Gulf of Aden are thought to be relatively new oceans, formed during the last 60-million years as a direct result of continental drift. This drift caused Arabia and Africa to separate in a northeast to southwest direction. Seismic refraction studies have revealed that the earth's crust beneath the Gulf of Aden is of oceanic type and indicates that the mantle beneath the crust is characterized by a lower than usual sound velocity, comparable to that under the active crest of the Mid-Ocean Ridge system of the Indian Ocean. The Median

Rift Valley of the Mid-Ocean Ridge and its associated magnetic anomaly were traced through the Gulf of Aden, establishing the connection between the active Mid-Ocean Ridge and the rift valley in Africa. This line is interpreted by some to be the locus of continental drift movement.

A second result was the collection of specimens of a new species of Neopilina, a deep-water segmented mollusc, from the Gulf of Aden. It is presently being studied by Dr. N. Tebble, British Museum of Natural History, London, and should provide some interesting comparisons with the species described from the Pacific. (J.D. Costlow, Jr.)

CASTING BREAD UPON THE WATERS

Now that the suds of the Torry Canyon affair have been partially dispersed by time and hot air it is encouraging to find some constructive thoughts and measures emerging. According to an account in the New Scientist the Esso Petroleum Company, in collaboration with the Oleochemicals Division of J. Bibby and Sons, recently demonstrated an elegant method of clearing oil from water at their Fawley refinery. Shredded polyurethane foam, resembling crumbled white bread, is spread upon the surface where it absorbs the oil and is then swept onto land by a small mesh net where the oil is squeezed from the foam. In the demonstration 45 gallons of crude oil were poured into the water near Southampton and followed by the shredded foam. Within a matter of minutes the white foam turned black as it absorbed the oil. On shore 80 percent of the oil was recovered and the foam was ready for re-use. Although the technique is still in the developmental stage the foam is said to be non-toxic and harmless to marine life. Initial estimates would also suggest that the foam is considerably less expensive to use than detergents or dispersants. Fifty cu. ft. of foam would absorb one ton of oil at a cost of some £5, whereas dispersants would run about £130. It was suggested that the method would prove useful in mopping up spills for oil tankers tied up at inshore docks. At sea, the oil foam might best be collected by a modified shrimp net. Even if collection at sea proves to be impractical, a beach covered in foam would presumably be easier to clean than one covered with crude oil. (J.D. Costlow, Jr.)

SYMPOSIUM ON MARINE FOOD CHAINS

An announcement has been received of an International Symposium on Marine Food Chains which will be held at the University of Aarhus, Denmark, 23-27 July 1968. The Symposium will be held under the auspices of the International Council for the Exploration of the Sea with the cosponsorship of the FAO, the International Commission for Northwest Atlantic Fisheries, the United Nations Educational, Scientific and Cultural Organization, and the International Biological Program. The view is expressed that there is considerable interest in attempts to study the interrelation between different trophic levels, particularly in terms of the energy processes involved. Our understanding of these processes in the sea is least in the intermediate levels between primary production and the commercial exploitation of fishery resources. Efforts to alter the environment of selected areas for the cultivation and harvesting of marine resources will require not only descriptions of the food webs but also considerable understanding of their energetics. Similarly, the control of pollution should be based on some insight into the changes which can take place in the pattern of food chains. One purpose of the Symposium will be to provide a review of similarities in the definition and structure of these problems which would hopefully lead to a better understanding of those features which aquatic food chains have in common. Since the general problems are common to all branches of ecology, some papers should deal with topics common to aquatic and terrestrial ecology.

Tentatively, four general sessions are planned. These are: (1) biological variations and behavior relevant to feeding, capture, and reproduction; (2) food web structure, particularly covering the re-use of non-living organic matter, the benthos, and the food requirements of fish stocks; (3) methods for measurement of parameters, such as field indices of viability and productive potential and experimental studies pertinent to food chain dynamics; and (4) theoretical and experimental models concerned with the development and testing of concepts in trophodynamics.

The Symposium will be planned for approximately 30 papers of 40 minutes each, providing some time for discussions. Papers should be submitted to the convener, Dr. J.H. Steele, Fisheries Laboratory, Victoria Road, Aberdeen, Scotland, before December 1967. A detailed program of the Symposium will be available by the spring of 1968. (J.D. Costlow, Jr.)

MIXED BLESSINGS

Although we have become accustomed to reading of problems associated with water pollution, it is still rather unusual to be confronted with accounts of the problems resulting from the purification of natural

waters. According to an article in THE CLEANER THAMES, a new Port of London Authority publication, approximately £20 million has been spent in recent years toward cleaning the river. It was encouraging to note that during the past three summers there has not been any portion of the river wholly deficient in oxygen and that the improvement is such that freshwater fish are now thriving miles below their former limits of activity. It was a bit disconcerting, however, to read that the cleansing measures have been so successful that eels, small crustacea and especially timber borers have now become a nuisance in the salt water areas of the Thames where they have not been seen for many years.

Another article in the TIMES may provide evidence that antipollution measures have been equally successful in still another part of England, even to cleaning up the sewers! An account is given of a local resident catching eels from a hole in the road dug by workmen in the town center at King's Lynn, Norfolk. One might assume that, as with most road repairs, the hole had been there for a sufficiently long period of time to permit the development of an entire ecosystem. However, the local resident, in a more considerate explanation, maintained that the hole led to a sewer and river which was a favorite haunt for eels. (J.D. Costlow, Jr.)

CONGRESS ON CORROSION AND FOULING

The Second International Congress on Marine Corrosion and Fouling will be held in Athens, Greece, during the period 20-24 September, 1968. The Congress, organized cooperatively by the International Committee on Marine Corrosion and Fouling and a number of Greek institutions, will be sponsored by the Government of Greece. Within the general framework of corrosion, papers may be presented on protection of structures immersed in sea water or subjected to the marine environment, cathodic protection, and electrochemistry of sea water. In the biological portion of the Congress topics to be considered are fouling and its prevention, physiology, biochemistry, and ecology of sessile organisms, and marine borers. Papers should be submitted in English, French, German or Greek, not later than 1 October 1967. The complete texts of papers to be presented will be available prior to the Congress, and simultaneous translations of the papers and discussion will be provided in the four working languages. Fees for the Congress are as follows: private individuals, $50.00; representatives of organizations, $80.00; and relatives of delegates, $20.00. Further details of the Congress are available from Prof. Dr. Ing. Th. Skoulikidis, National Technical University of Athens, Athens, Greece.

It is to be hoped for the amount of money the planning committee will take advantage of this opportunity to profit from the First Congress which was held in Cannes in 1964. A number of participants who were scheduled to give papers did not appear and at least one section was chaired by a last-minute volunteer who had considerable difficulty in stimulating any discussion on the few papers which were presented. In several instances it might have been better if the papers hadn't been given at all, inasmuch as the subject matter was readily available in textbooks published in the early 1950's. If sufficient progress in the field of fouling prevention has occurred since 1964 to warrant another international congress, the general subject would definitely be enhanced by the presentation of truly current and significant results. (J.D. Costlow, Jr.)

PHYSICAL SCIENCES

STANDARD TELECOMMUNICATIONS LABORATORIES LTD. OPEN DAY

Standard Telecommunications Laboratories Ltd. (STL), located at Harlow, Essex, recently held "Open Days" from 9-17 June 1967 to commemorate their 21st anniversary. STL is the principal research organization for Standard Telephones and Cables Ltd. (STC). This parent company is well known in the field of telephone exchange equipment, radio communications equipment, design of submarine cables, and automatic landing systems for aircraft. Many of these items were researched at STL.

In the early history of STL extensive work in microwave techniques was undertaken. During 1950 a portable microwave link was used by the BBC to transmit television pictures from the Queen's Head at Chiswick to Riverside Exchange at Hammersmith. It was a laboratory model and worked quite well. Similar equipment was used on a Dover-Calais TV link in the first Eurovision broadcast. Actually this was not a new idea for STC. In 1931 they conducted the first microwave broadcast across the Channel using a "micro-ray"device with a 3-m-diameter parabolic reflector.

In 1960 STL moved into their new multi-story laboratory in Harlow, which has a total floor space of 140,000 ft.^{2} They have a staff of about 650 people, 400 of whom are qualified engineers and 24 hold a doctorate level degree.

The research program conducted by STL covers the broad field of telecommunications

and is aimed towards providing the longer-term needs of STC in the UK and associated companies throughout the world. This program includes projects of many different types; from those of a basic or long-term nature, to advanced development work involving the construction of experimental equipment.

STL's work may thus be summarized as covering the spectrum of activities from basic research through applied research to advanced development. Its product is knowledge and information which, when turned over to manufacturing affiliates, become new products and systems.

Work at STL is covered by six divisions. Some of their investigations will be mentioned in some detail and some of the equipments that were on display and demonstrated will be indicated.

The Telecommunications Transmission Division, composed of several laboratories, is managed by Mr. K.G. Hodgson. Its work is concerned with the design and evaluation of terminal and line or radio equipment for communications by landline, submarine cable, or microwave. Their pulse-code modulation laboratory is working on coding and transmission in digital form speech and other forms of information. Signals in this form can be recognized in the presence of high noise-levels and can be regenerated so that noise or distortion is not cumulative in succeeding amplifier sections. This laboratory demonstrated the P.C.M. techniques involved in transmission of telephone conversation and broadcasting of music and speech. The radio systems laboratory deals with the design of mainline broadband microwave systems. Development of low noise input devices and microwave sources, including varactor multipliers and Gunn oscillators, are included in this work. The electromechanical filter laboratory is engaged in R&D of high grade filter networks using metals and insulators as vibrating elements, with magnetostrictive or piezoelectric input and output transducers. Highly selective filters in the 50 to 500-Hz range are under development. They showed new active filters using only resistors, capacitors and amplifiers, developed to exploit the advantages in cost and reliability of integrated circuits.

The various aspects of data collection, processing, transmission and dissemination are the chief interests of the Digital Systems Division, which is directed by Mr. D.A. Weir. This Division had on display a dependable computer, incorporating information, hardware, and time (diagnostic routine) redundancy, to enable a single fault to be detected, automatically corrected and subsequently repaired without affecting the operation of the computer. There was also a Ferrodot system in operation. The Ferrodot printing machine is initially intended as a high-speed alpha-numeric character or facsimile output device. In this form the machine magnetically records the required pattern on a drum which is then dusted with a resin-coated magnetic powder. This powder is attracted to the pattern, from which it is subsequently transferred onto paper, and fixed by melting the resin. The printing rate is not limited by any reciprocating mechanical components within the machine, so it is anticipated that speeds on the order of 60,000 characters per second may ultimately be obtained. Such speeds can satisfy the need for high-speed printers for future computing and data transmission systems.

In the Materials and Components Division, headed by Mr. J. Evans, the materials synthesis group searches for materials with unusual properties and invents unconventional techniques for preparing them. The main fields of interest are vapor phase techniques, using glow-discharge induced reactions to give unusual non-crystalline materials; high temperatures, where the main emphasis has been on preparing ultra-pure metals and alloys by a "silverboat" process, which eliminates container contamination of the melt by means of short-range electromagnetic repulsion; and very high pressures, which show that at 100,000 atm, phase diagrams differ greatly from their one-atmosphere forms, and entirely new phases become stable. The recovery of such phases at one atmosphere metastably, like a diamond, offers a new field of materials research. They demonstrated the formation of new polymers with novel electrical properties, produced by feeding acetylene and cyanogen gases into an rf plasma, splitting the molecules into reactive fragments which recombine on a substrate, forming coherent film. Other work in the Division covers hf-electron devices, materials, semiconductor devices, and the chemical laboratory.

The Acoustic Division, managed by Mr. H.S. Leman, covers all the problems (speech processing, perception, and recognition; telephone sets and evaluation) which arise in converting speech sounds into electrical signals suitable for transmission. The Division has a project studying a speech recognition system which will enable electronic equipment to be operated directly by the spoken word. A voice-excited voice coder, or vocoder, was shown. This is an experimental device for real time analysis and synthesis of speech.

In the New Systems Division, headed by Mr. P. White, the solid state laboratory is studying high-field conducting phenomena in thin-metal insulator-metal samples, including Schottky effect, Poole-Frenkel effect, phonon-assisted tunnel-hopping processes, etc. A further aspect of thin film research is hot-electron coherent scattering in thin metal films, as well as

cold cathode emission in the film insulators. The optical communications systems group has a project concentrating on the study of the transmission characteristics of dielectric waveguides in glass fiber form, using an optical surface-wave mode at an optical interface within the fiber. Work in advanced microwave circuits is aimed at design procedures for integrated microminiaturized microwave circuits, and is presently based on the transverse electromagnetic mode used in printed strip lines, produced by thin film deposition of conductors, dielectrics and resistors onto suitable substrates.

Some of the items demonstrated were: two dimensional leaky-wave antenna, excited by two klystrons at different frequencies, illustrating the possibility of frequency scanning; thin film resistive memory device, which is a new circuit element whose impedance can be set by application of a voltage or pulse; and a dielectric-fiber surface waveguide, forming a transmission medium for an optical communications system, capable of carrying very wide-band signals.

Of necessity this article describes only a few of the many demonstrations seen at the STL "Open Day." No description will be made of the Planning Division which, under the director of Mr. D.L. Thomas, covers the Advanced Development Planning Group, Over-all Systems Planning Group, and external relations. (R.L. McCracken)

CONFERENCE ON ELEMENTARY PARTICLES

A Conference on Elementary Particles, sponsored by the Physical Society and the Institute for Physics, was held at University College, London, 17-19 April 1967. This was in the form of a topical conference not usually used for APS meetings. The first two days were devoted to a series of invited speakers who, in hour-long talks, reviewed and brought up-to-date (for an audience composed largely of young British physicists) these important topics: Invariance Principles - L. Van Hove (CERN); Pion-Nucleon Interaction - W.S. Woolcock (Univ. College, London); Peripheral Processes - A. Wetherall (CERN); Quarks in Theory and Experiment - R. Dalitz (Oxford); Hypernuclei - D.H. Davis (Univ. College, London); Meson and Baryon Resonances - F. Heymann (Univ. College, London); and Current Algebras - D. Bailin (Sussex) and V. de Alfaro (Turin). The third day was devoted to contributed papers separated into simultaneous theoretical and experimental sessions. The only fault I could find with this format was the failure to provide a subsequent plenary session in which the high points of the contributions in the separated sessions could be brought to all. This defect was somewhat ameliorated by having the contributed papers abstracted in the program booklet. Inasmuch as proceedings will not be published, a short review of some of the papers follows.

Among the invited speakers, Van Hove stressed the historical lesson that the hierarchy of interactions (strong-electromagnetic-weak) had until recently been matched to the hierarchy of symmetries (the strong obeying all the symmetries, weak forces violating most). Now, the origin of the $K_2 \to \pi\pi$ CP violation seems to threaten this pattern. New results from Princeton and CERN give a branching ratio $K_2^0 \to \pi^0\pi^0$ which seems to rule out a violation in a "weaker than weak" interaction which would fit the hierarchy pattern. Van Hove broached the new theoretical idea of Kabir and others who speculate that there may be a deep, hitherto unknown law of nature (it used to be CP) which prevents a direct distinction between particle and antiparticle. If so, a consequence would be the orthogonality of K_S^0 and K_L^0 states. This alone predicts that $|\eta_{00}|^2 / \Gamma_L \geq 3.2 \pm 0.6 \times 10^{-3}$ (using the previously measured partial widths), and this is in agreement with the new data presented by CERN ($4.3 \pm 1.1 \pm 0.8 \times 10^{-3}$). In addition, the phase of η_{00} is predicted:

$$\phi_{00} = \pi \pm \cos^{-1}\left(2\,\mathrm{Re}\,\eta / |\eta_{00}|\right)$$

and this remains to be tested.

Dalitz reviewed the successes of a simple quark model for the known meson and baryon resonances. Taking, for example, the non-relativistic states which result from the binding of a quark and an anti quark in a judiciously chosen potential, all the known vector meson states are consistent with the resulting configurations $^{2S+1}L_J$ with S = 0, 1 and L is the orbital angular momentum. An impressive fraction of the vast amount of data on the meson and baryon states, magnetic moments, selection rules for decay (these seem to come from the quark structure directly) form factors, forward scattering relations, appear to be consistent with this simple picture and and existence of states with L = 0, 1 and 2. This leads to the question of the reality of quarks themselves. Dalitz reviewed the set of (negative) experiments searching for quarks in cosmic rays, at accelerators and as a constituent of the earth's crust. A quark mass of $\gtrsim$ 4-5 BeV and respect for the uncertainties in cosmological models and surface chemistry would still permit the hypothesis that these exist and may still be discovered.

Of the 37 contributed papers, only those which I found especially interesting are briefly reviewed. A. Allaby presented recent results of Cocconi's group at CERN on elastic proton-proton scattering at high

energy and large angle. It has been most remarkable that so simple (conceptually) a program can turn up so many surprising results. Data at 11, 14, 17, 19 and 21 GeV/c are fitted by an exponential $\exp\left(-\frac{p_T^2(\text{Trans})}{b}\right)$ and the parameter b studied as a function of momentum. When compared to lower energy data, a sharp break between 8 and 11 GeV/c is observed. New data at 8, 9, 10 GeV are in hand but not yet analyzed. When the data are graphed as $d\sigma/dt$ vs $s \sin\theta^*$, a two-slope curve is generated which is remarkably like the Michigan-Argonne (Krisch) data at lower energies.

An example of the sophistication to which high energy physics has arrived (and the complexity of the proton) is given by UC-Westfield collaboration on 2 GeV πp elastic scattering. The partial wave analysis $d\sigma/d\Omega = \sum C_n P_n(\cos\theta)$ is carried out to 11 terms, the CM momentum dependence of each of the C's is studied, and it is concluded that C_9 and C_{10} require a resonant behavior in the partial waves $G_{7/2}$, $H_{9/2}$, $H_{11/2}$ or $I_{9/2}$. They conclude that at 2.20 GeV/c, the $H_{11/2}$ is the most likely culprit.

A spark chamber study of the missing mass region 1.0 - 1.5 GeV was carried out in the $\pi^- + p \rightarrow n + X$ reaction at NIMROD by a UC-Southampton collaboration. The f° enhancement is observed with a curious depletion of events near 90° in the CM.

Asymmetries in the elastic scattering of negative pions and kaons by polarized protons were studied by J. Thresher's group (Vancouver, Oxford, Rutherford collaboration). This research is distinguished by the application of complex hodoscopes coupled to a new, sophisticated fast logic system ("tunnel electronics") recently developed at the Rutherford Laboratory. The 200-MHz modular system, based on tunnel diodes, is much closer to a special function computer than is the conventional 100-MHz system used at BM and elsewhere. Coupling to the on-line POP 5 is then simplified as is the use of more complex elements. The polarized target is a 1 x 1 x 3 in^3 assembly of lanthanum magnesium nitrate crystals in which the hydrogen of the water of crystallization is polarized. Data were presented of asymmetry vs cos θ* and the shape was observed to change as one goes through a resonance. The Y* (1820, 1915) were studied in some detail. Some work on muon-pairs from vector mesons was presented by B. Hyams (Munich-CERN). He presented data showing the clear decay of the ρ (Γ = 22 MeV for muon pairs), indications of $\omega \rightarrow \mu^+ + \mu^-$ and an upper limit for $\phi \rightarrow \mu^+ + \mu^-$. It was stressed that the strong alignment at production necessitates an understanding of the acceptance of the apparatus since the normalization pion pairs have a different angular distribution from the lepton pairs.

An interesting application to nuclear physics has been made by the UC group presented by Lovell and Brooks. They study K^- captures in emulsion nuclei and observe the relative rates of production of charged hyperons from light and heavy elements. This permits a separation of captures on neutrons and protons. It is concluded that there is five times as much capture on neutrons! The explanation (Burhop) offered is that capture occurs in the nuclear surface, and if one assumes a 50% greater neutron surface thickness, the effect can be reproduced.

Many other contributions in this densely packed Conference can be summarized only by title: Study of $\omega \rightarrow \pi^+\pi^-\gamma$ in the deuterium bubble chamber at NIMROD: $(+-\gamma/+-0 = 0.27 \pm .03)$; Search for $\omega \rightarrow \pi^0\pi^0\pi^0$ (SACLAY); Meson-nuclear coupling constants from nucleon-nucleon forward dispersion relation (Bugg, Rutherford Lab); Quark model for inelastic processes (Kajantie and Trefil, CERN, "the results are encouraging.").

The concluding plenary session was devoted to an amusing and informative discussion of the future 300-BeV European accelerator by M. Hine (CERN) and E.H.S. Burhop (UC).

Hine reviewed the history of technical and administrative steps leading to the present positions of Europe and the US on future large accelerators. In December 1966, there was a formal agreement that the CERN Council should organize itself to administer the future 300-GeV accelerator laboratory. In January 1966, the European Committee for Future Accelerators started a review of the technical and scientific situation. This review is due imminently but will reaffirm the design and the scientific need for higher energy. It was pointed out that there are at present 800 European physicists directly dependent on the CERN 25-GeV synchotron and that by 1975 this number would grow to 2000. It was also noted that by this date the CERN accelerator will have been running for 15 years, the USSR 70-GeV accelerator at Serpukhov will have been running five years and that a new step will be urgently required in Europe. The requirement of providing facilities for this large community dictates the scope of the new accelerator, both as to intensity and ancillary experimental facilities. It was commented that a US 200-BeV machine may, by 1975, be in existence and that, in order to insure the traditional collaboration between laboratories, the 300 BeV may be escalated to 400 BeV by clever design. Site problems were described with the inspired description: "20 km^2 of hard, flat and socio-attractive ground are required!"

The cost is estimated at $450 million including research equipment, with an annual operating budget of $75 million. The time scale would be X + 6-7 years, where X is official authorization, presumably during 1968.

Burhop described the report of a Utilization Study composed of a large number of European scientists. One strong conclusion was that presently existing techniques are powerful enough to exploit the forthcoming high energy facilities. In particular the Disc Cerenkov-counter can now separate π's from K's at 100 GeV/c and p's from K's at 190 GeV/c. The modest extrapolation of superconducting cavity technology permits beam separators up to 150 GeV. Neutrino beams of sharply defined energy, pion and kaon intensities 1000 times higher than now available and finally a 3500-m^3 hydrogen bubble chamber with 230 tons of liquid hydrogen swishing around in it were some of the sugar-plum visions which danced in our heads as we made our way home through the London traffic. (L.M. Lederman, Professor of Physics, Columbia University, on leave of absence at Imperial College)

ULTRASOUND IN OPHTHALMOLOGY

In June, 1964, a symposium on ultrasonic diagnostic techniques in ophthalmology was held at the Humboldt University in East Berlin, bringing together investigators and clinicians from Eastern and Western Europe, Britain, North America, and Australia. The apparent success of this gathering was the stimulus for the Second International Symposium on Ultrasonic Diagnostics in Ophthalmology (SIDUO II) organized by Prof. J. Vanýsek of the J.E. Purkyně University and held in Brno, Czechoslovakia 24-26 May 1967. The latter meeting was attended by 76 investigators (with the largest representation being 25 from Czechoslovakia); 54 came from Eastern Europe and 21 from Western Europe and North America, although the 44 formal presentations were nearly equally divided between the eastern and western representatives.

The topics discussed covered the full range from ultrasonic absorption spectra of biological media and studies of interaction mechanisms of ultrasound and tissue, through design considerations of instrumentation and calibration methods for determining transducer output, to discussions of diagnostic techniques and clinical results. An appreciable number of papers were preliminary reports of recently undertaken studies associated with interaction mechanisms and transducer and electronic design considerations which did not lead to definitive results. Reports on clinical studies, however, illustrated very well the potential available from ultrasound as a diagnostic tool in ophthalmology.

As may be expected from the range of topics discussed, the participants represented a very diverse set of disciplines within which communication is not perfect. This was emphasized by the desire of most of the clinical attendees to initiate studies to unify nomenclature and set up standards of procedure, while the participants with a more basic science approach preferred to hold short courses to increase and homogenize the educational level of all those involved. The latter group felt that nomenclature and standards studies should be delayed until meaningful meetings could be held with both groups participating; however, it appeared that their view did not prevail. The Proceedings of the Symposium are to be published in Acta Facultatis Medicae Universitatis Brunensis. (Floyd Dunn, Dept. of Engineering, Univ. of Illinois, Urbana)

SYMPOSIUM ON THE HUMAN EFFECTS OF ULTRASONIC RADIATION

The newly formed British Acoustical Society continues to hold symposia on selected topics in acoustics, rather than periodic meetings of the entire Society with simultaneous sessions and other forms of confusion. The above titled Symposium was held on 16 June 1967 at the Physics Department, Imperial College, London, under the chairmanship of Dr. R.W.B. Stephens (Imperial College), and was attended by 61 investigators, virtually all from England, Scotland and Wales. The atmosphere of the Symposium was very relaxed, with adequate time for discussion of presented papers and virtually no business being transacted in the hallways. Thirteen papers were presented, several of which must be considered premature reportings and are not discussed below.

Prof. F. Dunn (U.S.A.) described the ultrasonic interaction studies carried out at the University of Illinois during the past twelve years which show that cavitation and thermal mechanisms are unimportant, under specific dosage conditions, in the mammalian central nervous system. Recent studies have shown that, in the absence of cavitation, with acoustic intensities as high as 10^4 W/cm^2, no interaction occurs with biological macromolecules with molecular weights of the order of 25 x 10^3 in solution, though interaction does occur with high molecular-weight nucleic acids in solution. Current studies are directed toward investigation of the interaction with the transport properties of biological membranes. J. Pond (Guy's Hospital, London) reported that pulsed, low-intensity ultrasound accelerated the healing of puncture wounds in rabbits ears by as much as 50% and that

considerably less collagen was deposited, as compared with non-ultrasonically treated specimens. Rate of regeneration was greater at 0.5 W/cm^2 than at 0.25 W/cm^2.

Prof. I. Donald (Queen Mother's Hospital, Glasgow) presented a very engaging discussion of diagnostic ultrasound in childbirth. The normal rate of abnormality in pregnancy is 1 in 50, and Donald makes enormous use of ultrasound to identify and obtain additional information on such cases. For example, in cases of placental insufficiency he monitors the rate of fetal growth to determine the optimum time for delivery. He can detect a pregnancy at 5-$\frac{1}{2}$ weeks and twins at 7-$\frac{1}{2}$ weeks, and at some time during pregnancy he can determine the relative size of twins — a very important piece of information since delivery can become very complicated if the second twin is larger than the first. Pregnancy could probably be detected earlier than 5-$\frac{1}{2}$ weeks, but Donald hesitates to use ultrasound before this time for fear that deleterious effects may occur to the fetus. As a result of this uncertainty, he has influenced some investigators in Britain to search for possible biological effects arising from the ultrasonic dosage conditions of exposure from diagnostic instruments, though none have been found thus far.

J. Woodcock (Guy's Hospital, London) reported on the splitting of sucrose into glucose and fructose with low-level (10 W/cm^2) pulsed ultrasound at 3 MHz. Cavitation was eliminated as a possible mechanism and heating of the solution was shown not to be the main cause of the reaction. Drs. J.J. Knight (Institute of Laryngology and Otology, London) and W.I. Acton (University of Southampton) presented results of independent studies on workers exposed to industrial noise originating from ultrasonic equipment. Both studies showed that the present hazard to hearing is negligible, although unpleasant subjective effects were observed under certain conditions.

There will be no publication of the lectures as a whole; contributors have been urged to avail themselves of the offers of publication in either the Journal of Sound and Vibration or Ultrasonics. (F. Dunn, College of Engineering, Univ. of Illinois, Urbana)

SECOND INTERNATIONAL CONFERENCE ON MAGNET TECHNOLOGY, OXFORD, 1967

The first International Symposium on Magnet Technology was held at Stanford University in 1955. At that time the hope was expressed that the conference could be repeated periodically to keep track of new developments and progress made, and the Oxford Conference, as its name implies, is the successor to the Stanford meeting, with the same broad aims. The Conference was jointly sponsored by the International Union of Pure and Applied Physics, the Institute of Physics and the Physical Society, the Institute of Electrical Engineers, and the Science Research Council — all United Kingdom organizations.

The main items of interest at the Conference were the applications of magnetic fields in nuclear physics; this emphasis is not surprising as the international organizing committee of the Conference is composed of representatives from the major nuclear centers — W. Marshall, AERE Harwell; J. Lutz, CEN Saclay; L. Mezzetti, CNEN Frascati; K. Johnsen, CERN Geneva; H. Brechna, Stanford Linear Accelerator Center; R. Carruthers, Culham Laboratory (UK); W. Jentschke, DESY Hamburg; and T.G. Pickavance, Rutherford High Energy Laboratory (UK). A particular effort was made to solicit the participation of industrial representatives, so that the magnet makers as well as the magnet users would be represented.

The Conference was held 11-14 July at the Oxford College of Technology, Headington, Oxford, one of the new colleges of technology which have sprung up all over Britain. Participants were housed in Oxford hotels and colleges about two miles distant, with bus transportation provided. The main themes of the Conference are revealed in the titles of the general sessions: General Design Principles, General Applications and Special Magnets, Superconducting Magnets, Power Supplies, Constructional Techniques and Materials, and Instrumentation. In general the papers presented were of the "hardware type," involving systematic application of known techniques for the production of required magnetic fields. There were discussions of iron core magnets, superconducting magnets, and Bitter or other type solenoids. Additionally there were a number of papers concerned with the considerable analytical problem of calculating fields and gradients. The solution of these problems requires the extensive use of computers and hence these papers also had a "hardware," or perhaps one should say "software" aspect. A few of the one hundred or so papers submitted will be commented on below.

R. Boissier et al. (Société Alsthom, Belfort, France) described the Bitter type solenoid which they constructed for the Laboratoire d'Electrostatique et de Physique du Metal at Grenoble. The magnet dissipates 1.13 MW (4550 A at 250 V) and produces a central field of 103,500 oersted in a 3-cm hole. The hope to be able to obtain 150,000 Oe in a 2-cm hole using 1.89 MW.

M. Williams (GEC Ltd., Hirst Research Centre, Wembley, UK) commented on the problem of flux jumping in superconductors. One of the difficulties in producing superconducting magnets is predicting flux jumping on other

than a purely empirical basis. Williams called attention to Lange's recent paper (Cryogenics 6, 141 (1966)) which treats the problem using classical stability analysis. The result predicts a lower temperature limit (T_L) for stability against flux jumping dependent on the specific heat of the material. Assuming this to be proportional to T^3, a lower limit for stability is predicted to be $T_L = (3/4)\ T_c$, a result which has been qualitatively confirmed.

M. Sauzade, et al. (Institute d'Electronique Fondamentale, Faculté des Sciences, Orsay, France) described their efforts to produce superconducting solenoids for NMR work. The problem is a complex one because field gradients, presumably arising from mechanical deformation during cooling and of the order of relative magnitude 10^{-5} to 10^{-6}, are produced each time the magnet is cooled, and the field must be trimmed each time. Four rectangular coils are added in order to produce five gradients at the center of the field. Homogeneity of 10^{-8} has been obtained in a 25 mm^3 (mm !) sample. An 80 -kG NMR magnet and a 100-kG ESR magnet are also under construction.

Containment of a plasma requires a magnetic field which rises in all directions from the plasma center, i.e., a magnetic well. Previously it has been shown that such a magnetic well can be produced by two mirror coils and four stabilizing coils. F.M. Larkin (CLM-R 37, H.M.S.O. 1964) has ingeniously shown that these six coils may be replaced by a single winding having the shape of the seam on a tennis ball (or baseball for American use). J. Last and S. Skellet (UKAEA Research Group, Culham Laboratory, Abingdon, Berks., UK) discussed the design and operational features of the tennis-ball seam coil. Design work carried out to date indicates that it will be feasible to make a 1-m tennis-ball seam coil with a basic well depth of 3.2:1 and a central field of 17 kG. Extra field coils would enable the well depth to be varied over any desired range.

C. Taylor (Lawrence Radiation Laboratory, Univ. of Calif) described some features of the magnet system to be used to carry out 300-BeV experiments at balloon altitudes, as suggested by Prof. Alvarez. A 1-m bore 12-kG field will be required, the coil weighing about 330 kg.

P. Bonjour and A. Septier (Institute d' Electronique Fondamentale, Orsay, France) have made the interesting suggestion of using rare earth metals to increase the field strength of superconducting magnets by flux concentration. The saturation magnetization of cobalt steel is about 25 kG, whereas the corresponding figures for dysprosium and holmium are 31 and 33 kG, and experimental magnets have shown that fields of 50 kG in a 6-mm gap can be obtained easily inside a 10-cm coil. Such configurations would be very useful for high-field small-volume magnetic lenses.

In the bubble chamber arena T. Peel, et al. (Dept. of Nuclear Physics, Oxford University, England) described the operation of the 80-cm helium bubble chamber. Stepping up the scale H. Benz (Oerlikon Engineering, Zürich, Switzerland) described the design of their proposed 1.3-m i.d. 50-kG superconducting bubble chamber magnet system. The magnet would be an iron-core superconductor magnet. The iron-core yoke would weigh 140 tons, and the superconducting Helmholtz pair about 20 tons. J. Purcell (Argonne National Laboratory) described the proposed 3.66-m bubble chamber with an 18-kG field. The weight of the coils will be 45,000 kg, most of which comprises the copper required to stabilize the superconductor. A cool-down time of 60 hours is anticipated.

Complete proceedings of the Conference will be available 1 Dec. 1967 at a cost of £5 ($14.00) each from the Conference Secretariat, Rutherford Laboratory, Chilton, Didcot, Berkshire, UK. (N.M. Wolcott, Lt. USNR, NBS, Washington, D.C.)

SOME CRYOMAGNETIC INVESTIGATIONS AT OXFORD

The Clarendon Laboratory has grown considerably in the past few years, with facilities perhaps doubling those available a decade ago. Much of the new construction has involved the Mullard Cryomagnetic Laboratory, a wing of the old Clarendon designed to house experiments utilizing high-magnetic fields, particularly for investigation of nuclear orientation. Dr. N. Kurti, one of the pioneers in this field, has recently been made a University Professor, and will continue to direct this work, discussed in more detail below.

The magnet facility consists of a motor-generator set, heat exchanger, and water circulating system, all located in the old building, with the experimental stations located in the new wing. Power from the generator can be fed into any of eight rooms, which are located on two floors (one above the other) with doors onto a central octagonal area from which magnet control is exercised for all magnets on that floor. The magnets comprise 4-in, 2-in, and 1-in solenoids, with the 40-kG 4-in magnet being the workhorse and the others scaling upward in field roughly inversely with hole size. Provision is made for sweeping the field at preset rates; for example, one can set the field to demagnetize over a period of two hours, and return to find the demagnetization completed. The system is not completely interlocked, however,

so that occasionally one "blows a magnet." This is not the catastrophe it might seem, however, for the lifetime of the solenoids used (pancake continuous strip coils) is about two years due to decline of insulation or silting up. An expert magnet shop is maintained where coils are made and designed to suit particular experiments. The pancake coils are preferred to the Bitter design; although the latter may give slightly higher central fields, the stability and uniformity obtainable with the continuous strip magnet is superior — obviously a desirable factor in many experiments. It is also possible to tailor the field to a desired profile, which the Bitter design does not easily allow. The magnets are operated at off-peak electrical hours, with experimenters putting their name in the hat for use on any given day. They may opt for a short or a long duration experiment, the latter returning them to the end of the line for the next use. Lack of use for a period of three weeks also returns one to the end of the line.

As was perhaps inevitable, the new wing is very poorly heated. This has resulted from the low inlet temperature of water available from the University's central supply in the area. A scheme to use a heat pump to utilize the heat dissipated in the magnet cooling water has never operated completely satisfactorily. So, for the time being, "partial central heating" (currently advertised in the local press for home heating) must be supplemented with space heaters.

The original alignment work done in paramagnetic salts has by and large been completed, and interest has now turned to the investigation of hyperfine effects in metals. Samoilov (Soviet Physics SEPT 9, 448 (1959)) first demonstrated the presence of large hyperfine fields at the nuclei of non-magnetic atoms dissolved in ferromagnetic host metals. Since then a number of such fields have been determined from measurements of the anisotropy of radiation from oriented nuclei, nuclear specific heats and nuclear magnetic resonance, and Mössbauer experiments. The orientation work applies the techniques of adiabatic demagnetization to obtain temperatures of between 0.01 and 0.03° K and then studies the anisotropy of gamma rays emitted from impurity atoms embedded in the host (iron) lattice. This technique has an important advantage over the other conventional techniques mentioned above in that "alloys" of vanishingly small concentration can be studied, and hence the true "impurity-lattice" interaction can be investigated devoid of complications of "impurity-impurity" interactions (in even a 1% alloy, every third impurity atom has a neighbor). The anisotropy measurements are made in a field of about 15 kOe which saturates the iron, and at the lower temperatures is sufficient to orient ^{54}Mn in copper, which is then used as a thermometer. Typical of these investigations are the orientation of ^{48}V nuclei in iron and cobalt (Cameron et al, Proc Phys Soc 87, 87 (1966)) and $^{109}Ag^{m}$ in iron (Cracknell and Wilson, Physics Letters 5, 306 (1966)). More recently, interest has shifted to alloys of the noble metals with 3-d transition metal admixtures in which localized moments can exist. For example, Cameron et al (Physics Letters 20, 569 (1966)) studied ^{54}Mn in copper, silver, and gold. In this case the applied 15-kOe field aligns the local moments of the Mn ions, and the nuclear orientation of the Mn nuclei can then be studied in the aligning field of the Mn ions. Parallel to the orientation work, there are several stations for measuring specific heats of dilute alloys below 1° to determine the hyperfine interaction. See for example the work of Pickett (Physics Letters 21, 618 (1966)) on dilute Ag-Gd alloys.

A particularly interesting recent technique involves the combination of nuclear magnetic resonance and nuclear orientation techniques. Conventional NMR usually requires sizeable amount of impurity or solute in an alloy; it must be powdered, and only the atoms near the surface contribute to the NMR signal. In addition there are problems of electrical noise and line width which limit the detection sensitivity. In the proposed scheme utilizing nuclear orientation, the nucleus being investigated would be polarized in an applied field at very low temperature. An rf field is then applied and the frequency varied: when the NMR frequency is reached, the orientation of the nuclear spins is destroyed. The sensitivity of the method is limited only by the patience of the experimenter and the sensitivity of the gamma ray counters. In addition, by diffusing the impurity atom onto the surface of the host, all of the impurity atoms can be concentrated within the skin depth, and it is unnecessary to use a powdered sample. The technique should also be useful in looking for resonances whose frequency is not known because the disorientation of the nuclei is a large effect and there are no line-width problems. The limitation is, of course, that one is forced to investigate those nuclei which have decay schemes suitable for orientation work. For increased detection sensitivity more complete nuclear polarization can be obtained at lower temperatures. The use of He^3/He^4 dilution refrigerators to obtain temperatures of a few millidegrees has been proposed for this.

Dr. R.W. Hill who has also been involved in much of the orientation work has just left for a year at Monash University, Victoria, Australia. (N.M. Wolcott, Lt. USNR, NBS, Washington, D.C.)

THE SECOND CONFERENCE ON STATIC ELECTRIFICATION

The Second Conference on Static Electrification was held in London, 8-10 May at the Institution of Electrical Engineers. The meeting, which was sponsored by the Institute of Physics and the Physical Society, was attended by approximately 120 scientists, mainly from the UK and Europe. Apparently due to the inadequate publicity which the meeting received in North America, there were only five attendees from the USA and Canada combined.

The Conference was divided into three main sessions with one day being devoted to each of the following topics: Static on Solids; Static in Liquids; and Industrial Static: Wanted and Unwanted.

Dr. P.S. Henry (Shirley Institute, Manchester), chairman of the committee that organized the Conference, delivered the opening address. He pointed out that despite the broad implications of the electrostatics problem in the textile, paper, petroleum and other industries, this was the first general conference on the subject sponsored by the Society since 1953. He suggested that judging from the enthusiastic support given to the second Conference, perhaps the meeting was a little overdue.

Dr. W.R. Harper (formerly of Imperial College, London) introduced the first session on "Static on Solids" with a survey paper of the same title in which he stressed the role of charge carriers. A method of studying the discharge of insulators by means of ionization of air was presented by H. Bertein (Laboratoire Central des Industries Electriques, Fontenay-aux-Roses, France). Mlle. Bertein described how the patterns formed by colored powders projected onto the surface of a charged insulator, which is then presented to a charged point of a radioactive source, could be used to explain the mechanism of electric and radioactive static eliminators. Dr. R. Challande (Laboratoire d'Electrostatique et de Physique de Metal, Grenoble, France) showed that the amount of charge generated by the rubbing of solid on solid is a function of pressure. The function was found to be linear in the case of a perfect crystal and exponential if the solid has lattice defects. Dr. J.D. Cross (Physics Department, University of Manchester, Institute of Science and Technology, Manchester) described how the electret effect of simple substances, e.g., carnuba wax, could be studied by direct measurement of the microscopic dipole moment by means of a torsion balance. An electrometer-probe technique for the absolute determination of the density of charge on dielectrics in vacuum was described by Dr. D.K. Davies (The Electrical Research Association, Leatherhead, Surrey). Davies also showed that magnitude and sign of the charge produced on certain dielectrics by contact with metal electrodes is dependent upon the work function of the metal. Prof. I.I. Inculet and E.P. Wituschek (Faculty of Engineering Science, The University of Western Ontario, Canada) presented some preliminary results of studies on the charges developed between zirconium, copper and nickel against glass in a vacuum chamber - Faraday cylinder at 10^{-7} Torr. Chemically pure metals were used and special handling procedures were employed in order to obtain meaningful results. Dr. J. Latham (University of Manchester, Institute of Science and Technology, Manchester) discussed the importance of temperature gradients in ice on the charge-transfer mechanism associated with atmospheric electricity. According to Latham, thunderstorm and snowstorm electrification can be explained in terms of the thermoelectric effect of ice. The trapping of electrostatic charges by polymer films was described by E.L. Zichy (I.C.I. Limited, Herts,, England). If the film is laid flat on a plate electrode and the charge deposited from a pointed electrode, the charge is held in shallow traps on the film surface. Peeling away the film results in the deposition of a charge on the newly peeled surface, identical in quantity but opposite in sign to that originally trapped. The charge deposited in peeling is held in deeper traps because of the higher potential difference and greater particle velocity involved in its deposition.

Dr. A. Klinkenberg (Imperial College, London) introduced the session, Static in Liquids, by reviewing the history and state of the art of research in this area. He emphasized the differences in charging mechanisms for liquids and solids. The disintegration of drops of charged liquid in an electric field was discussed in a paper by M.A. Abbas, A.K. Azad and J. Latham (University of Manchester, Institute of Science and Technology, Manchester). Their results were in agreement with Taylor's theory which expresses the relationship between the forces acting on the drop, namely: surface tension, the electric field, and the difference between the external and internal pressures at the poles and at the equator of the drop. M.D. Foster (BP Research Centre, Sunbury on Thames, Middlesex) discussed the role of ions in the generation and dissipation of charge in purified petroleum products. Since ionic dissociation and association are comparatively slow processes in hydrocarbon liquid, changes in ionic concentrations become important factors in the charge generation and dissipation mechanisms. The electrification of toluene in pipe-line flow was described in a paper by N. Gibson and F.C. Lloyd (Imperial Chemical Industries Ltd., Manchester). The authors analyzed the relationship between the charging current and such

parameters as the flow velocity, pipe length, pipe diameter and conductivity of the liquid in terms of the equations derived by Schon, Hignett and Kosman and by Gavis. The nature of the discharges taking place in a laboratory-scale apparatus between a charged-fuel surface and grounded probes of various configurations was described in a paper by J.T. Leonard and H.W. Carhart (Naval Research Laboratory, Washington, D.C.). True spark discharges were found only at small gaps (up to 2.5 cm) with pointed and small spherical electrodes. At larger gaps, these electrodes gave corona discharges. With larger spherical electrodes and at larger gaps, discharges occurred by means of pre-breakdown streamers which were much less energetic than spark discharges at the same gap. The effect of filtration on the charging tendency of fuels was discussed in two papers. In the first, by S. Masuda and G. Schon (Physikalisch Technische Bundesanstalt, 33 Braunschweig, Germany), a distinction was made between the effective conductivities, namely: K_{mo}, the conductivity measured at a certain distance from the filter and K_{moo}, the conductivity of the fuel after it passes through the filter, and the conductivity of the uncharged fuel. The charge transport process is determined solely by the effective conductivities. In another paper, J.P. Wagner and J. Gavis (Johns Hopkins University, Baltimore, Md.) presented an expression for describing the electrification of hydrocarbon liquids flowing through Millipore filters. The expression is based upon experimental data and also on ideas from Gavis' theory for electrification of hydrocarbon liquids in tubes during turbulent flow. Prof. Schon and S. Matsuda also presented the results of theoretical calculations on the expansion of a space-charge cloud within a medium of constant conductivity. They showed that when the conductivity inside the cloud is greater than that on the outside at time $t=0$, the cloud will expand; if the conductivity is less, the cloud shrinks.

On the final day of the Conference, papers were devoted to the more practical aspects of electrostatics. N.J. Felici (SAMES, Grenoble, France) opened the session with a paper entitled, "Electrostatics and Electrostatic Engineering," The static-discharging characteristics of a sonic-jet ion-generator were then discussed in a paper by H.W. Cleveland (Eastman Kodak Co., Rochester, N.Y.). In these jets, ions produced by a corona discharge are swept by compressed air through an orifice to discharge a dielectric. R.E. Cunningham (Chemstrand Research Center, Durham, N.C.) described the effect of filament conductivity on the charging tendency of finish-free nylon and acrylic monofilaments passing over a stainless steel bar. The data obtained with the acrylic filaments conformed to present theory, but the results with nylon filaments showed variations in the magnitude and sign of the charge due to the formation of polymer deposits on the friction bar. Dr. E. Heidelberg (Physikalisch Technische Bundesanstalt, 33 Braunschweig, Germany) evaluated the ignition hazards resulting from coating fuel tanks and other containers for combustible liquids with nonconducting plastics which may become charged by the liquids. The degree of hazard is related to the thickness of the coating, the diameter of the grounded electrode and the composition of the combustible mixture. The accumulation of electrostatic charge by a belt of dielectric material passing over grounded metal rollers was discussed by R.W. Hubbard (Eastman Kodak Co., Rochester, N.Y.). Hubbard demonstrated that electrification characteristics of a particular belt-roller combination could be determined if the values of two constants were known. A new method of electrostatic sorting was described by A. Morel (SAMES, Grenoble, France). By applying an electric field to a fluidized bed containing material to be sorted, one can obtain selective separations of the elements by utilizing differences in density, resistivity and triboelectric characteristics. The final paper of the Conference was presented by Dr. M.A. Point (SAMES, Grenoble, France). Point reviewed the various methods of electrostatic spraying, citing the advantages and limitations of each method. He also discussed techniques and applications for "Samesation," i.e., the production of plastic coatings starting from a powder.

The proceedings of the Conference, including the comments made during the discussion period which followed each paper, will be available from the Institute of Physics and the Physical Society in late 1967. (Joseph T. Leonard, Chemistry Division, NRL, Washington, D.C.)

NEWS & NOTES

The British Minister of Technology, Mr. Wedgwood Benn, has announced in Parliament that the Atomic Energy Authority is to reduce its effort in plasma physics and fusion research during the next five years. This will affect the work at the Culham Laboratory, Oxford, which has only been fully operational for three years. Expenditure there will be reduced by nearly half to £2 million ($5.6 million) a year, and staff cuts will also be made.

This statement followed a day or two after the Government's decision to bear the major share of Euratom's Dragon reactor costs. Dragon, an experimental gas-cooled reactor, located at Winfrith Heath, Dorset,

England, is operated jointly by 12 European countries, with Britain contributing around 40 percent of the cost of the £25 million project. The current agreement expires at the end of 1967 and no agreement has yet been reached between the participating nations as to the terms for renewal. To avoid its premature shut-down, the British Government is offering to take over the financial responsibility for the project, with the understanding that it will no longer be an international project, but will pass entirely into British hands.

The title of Emeritus Professor has been conferred on Prof. E.E. Aynsley, Professor of Chemistry at the Univ. of Newcastle.

Dr. K. Bagnall, Senior Principal Scientific Officer at the Atomic Energy Research Establishment, Harwell, has been appointed Professor of Inorganic Chemistry at the Univ. of Manchester, from 15 Sept., 1967.

Dr. L.J. Bellamy, Director of the Ministry of Technology Explosives R&D Establishment, Waltham Abbey, has been elected to an Adrian Visiting Fellowship in the Dept. of Chemistry, Univ. of Leicester, for the next three years.

Dr. P.G. Burke has been appointed to the Chair of Mathematical Physics at the Univ. of Belfast.

Professor Hermann Bondi, FRS, presently Professor of Mathematics, King's College, London, has been elected Director General of the European Space Research Organization (ESRO) where he will succeed Professor Pierre Auger. Bondi is a noted cosmologist and co-orginator of the steady state theory of the universe. Recently he headed a task force of senior scientists for the Ministries of Defence and Technology in a study of military space applications for Britain. He is to take up his duties at ESRO Headquarters in Paris in September.

The title of Emeritus Professor has been conferred on Prof. A.F. Burstall, Professor of Mechanical Engineering and Director of the Stephenson Engineering Laboratories at the Univ. of Newcastle upon Tyne.

Dr. J.W.S. Cassels, Reader in Arithmetic, has been appointed Sadleirian Professor of Pure Mathematics at Cambridge Univ. from 1 Oct 1967.

Prof. D.B. Edwards, Prof. of Computer Engineering, has been appointed to the Chair of ICT Computer Engineering, Univ. of Manchester.

Dr. E.J. Field, Senior Lecture in Neuropathology, has been appointed to a Chair of Experimental Neuropathology, Univ. of Newcastle upon Tyne.

Dr. F. Kenneth Hare, Master of Birkbeck College, London University, President-elect of the Royal Meteorological Society, has accepted an appointment as President of the University of British Columbia. He will join UBC in July 1968.

Prof. Ronald Hartles, Professor of Dental Science, has been appointed warden of Rathbone Hall, at Univ. of Liverpool.

Dr. J.B. Helliwell, Reader at Strathclyde Univ., has been appointed to the Chair of Mathematics in the Board of Studies in Engineering at the Univ. of Bradford.

Prof. Raymond Hide, presently at Massachusetts Institute of Technology, is to return to Britain and take up a senior post at the Meteorological Office, as Director of a new laboratory of geophysical fluid dynamics.

Prof. Christopher Hooley, Prof. of Pure Mathematics at the Univ. of Durham, has been appointed to the Chair of Pure Mathematics at University College, Cardiff.

H.H. Hopkins, at present Reader in Applied Optics at Imperial College of Science and Technology, London, has been appointed Professor of Applied Optics at the Univ. of Reading.

D.P. Howson, Senior Lecturer at Birmingham Univ., has been appointed to the additional Chair in Electrical Engineering at the Univ. of Bradford.

Lord Jackson of Burnley has been appointed Rector of the Imperial College of Science and Technology, London, from 1 Oct 1967, in succession to Sir Owen Saunders, who assumes the Vice-chancellorship of the Univ. of London on 1 Sep 1967.

Dr. F.A. Leckie, Lecturer in Mechanical Sciences at Cambridge Univ., has been appointed to the second Chair in the Dept. of Engineering at Univ. of Leicester.

Dr. Martin Löb has been appointed Professor of Mathematical Logic at Leeds Univ.

Dr. R. Markham, FRS, Director of the Agricultural Research Council's Virus Unit at Cambridge, has been appointed Director of the John Innes Institute, Norwich, and John Innes Professor of Cell Biology at the Univ. East Anglia.

A. Morton, Group Services Engineer of the Southern Projects Group in the Central Electricity Generating Board, has been appointed to an additional Chair of Engineering with the title Professor of Mechanical Engineering, Univ. of Manchester, on a date to be arranged.

The first fellowships under the Ministry of Defence scheme for encouraging the study of defence problems in universities have been awarded for the academic year 1967-68. Lt.-Col. D.F. Densham-Booth (Staff Officer, Royal Engineers), Squadron Leader E.S. Williams (RAF Defence Intelligence Staff) and N.S. Forward (Assistant Secretary concerned with Naval matters at MOD) have been elected research associates of Univ. College, London, in the Depts. of Town

Planning, Mathematics and Psychology, respectively. Lt.-Col. P. Harris, on the staff of the Commandant General, Royal Marines, will study at Oxford Univ.

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ONRL-46-67 Notes on Mechanics in Belgium by H.E. Williams

ONRL-47-67 Marine Science in Northern Ireland and Erie by J.D. Costlow, Jr.

The following conference reports are releasable to European scientists:

C-7-67 British Mathematical Colloquim at University College, Swansea, Wales by Lt. Col. L. Mittenthal (ERO, Frankfurt)

C-8-67 Conference on Industrial Physics — The Contribution of Government Laboratories, Harrogate, 7-9 June 1967 by P.D. Maycock

C-9-67 International Conference on Psychological Research in Deep Diving by J.E. Rasmussen

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