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# EUROPEAN SCIENTIFIC NOTES

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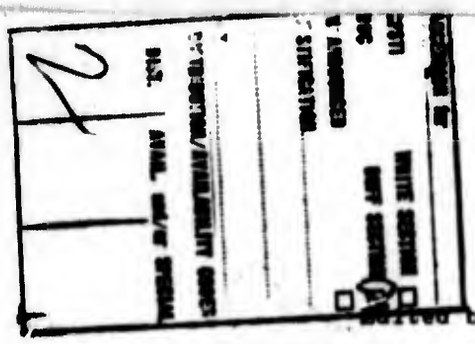

OFFICE OF NAVAL RESEARCH
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EUROPEAN SCIENTIFIC NOTES

Edited by J.E. Rasmussen and Victoria S. Hewitson

31 October 1966 Vol. 20 No. 10



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C.T. Froscher
Captain, U.S. Navy
Commanding Officer

## REFLECTIONS OF A WANDERING LIAISON SCIENTIST

For years the liaison scientists of ONRL have written articles for ESN, occasionally tongue-in-cheek, but for the most part a straightforward and factual reporting of specific scientific information on the European scene. While some of the most distinguished scientists in the US have spent a year or more in performing liaison duties at ONRL, there has not been a vehicle to convey their general impressions of their discipline at the completion of their stay in London. The following article, which is intended to be the first of a continuing series, constitutes an effort to overcome this omission.

The articles in this series are intended to be nontechnical in nature. It is hoped they will present a perspective which extends beyond the scope of the usual technical report and that they will be of interest to all readers of ESN. There are no "guidelines" for the authors; rather, each individual is encouraged to express himself on any aspect of his professional activity in Europe which he might choose. Thus, it is anticipated that the series will be quite heterogeneous in terms of content and topic.

In order to make a series a truly meaningful and unrehearsed expression of the individual scientist's feeling or opinion, the articles undergo an absolute minimum of editing. In this regard they should be looked upon as informal expressions of the given individual's thoughts as he concludes his stay in London --not as carefully documented scientific reports.

The first paper in this series is by Prof. S. Young Tyree, Jr., who joined our staff in June 1965 as Liaison Scientist for Inorganic Chemistry. After fourteen months with ONR London, he returned to the US this past August and joined the faculty of the College of William and Mary, Williamsburg, Va., as Professor of Chemistry.

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It has been my privilege to spend approximately 14 months visiting academic departments of chemistry throughout Western Europe. In addition, I got to the east end of the Mediterranean, visiting both Israel and Lebanon. It is my opinion, after having spent about a week in Israel and Lebanon, that this part of the Middle East might well be lumped into the "Western Europe" category. Chemistry departments were visited in Norway, Denmark and Sweden, England, Scotland, France, Belgium, Germany, Switzerland, Italy, Austria, Lebanon and Israel. Most certainly, one is entitled to reflect a little bit at the end of such a tour upon the state of chemistry in this part of the world, its relationship to European society as a whole, and its comparision with the chemical community in the United States. In what follows it must be remembered that my principal interests are inorganic and physical chemistry.

In the first instance my impression is stronger than ever that chemistry is pretty much the same no matter where one goes, nowadays. Instrumentation does not respect international boundaries, and one finds that the best instruments from various parts of the world find themselves to all other parts of the world quickly. Thus, the Atlas mass spectrometer, made in Germany, is clearly one of the most respected mass spectrometers in the world. It is widely used all over Europe. On the other hand, there seems to be an equal unanimity of choice for Varian in the way of nmr spectrometers. Without citing any more specific examples, suffice it to say that I was mildly surprised to see laboratories, from Trondheim in the north to Naples in the south, from Glasgow in the west and to Tel Aviv in the east, equipped with the same instruments that one finds in chemistry departments throughout the US. To be sure, a number of interesting specialties have evolved as chemistry has matured in slightly different environments. For example, after spending a couple of weeks visiting inorganic and physical chemists in academic institutions in Scandinavia, one cannot help but wonder if the embryonic chemist in this area of the world is not expected to learn the X-ray crystal structure technique at about the same time that he is expected to learn to ski. This remark should not be construed to infer that crystal structure determinations are the only kinds of chemistry done by inorganic and physical chemists in Scandinavia, rather it is meant to infer that the ability to do crystal structure determination among inorganic and physical chemists is about as prevalent as is the ability among the general populace of this area to ski.

A second generality (with the exception of France - more about her later) is that the language of science is English and personal contacts in the US are the rule. Without making an actual count, I would estimate that considerably more than half the departments of chemistry visited during the year had at least one member of staff who had spent a year or more in the US as a part of his professional life.

A third generality can be made with respect to the higher educational process whereby young people become professional chemists. By and large, students in European universities specialize very highly in comparison with their contemporaries in America. Regardless of the number of years required to earn the particular formal degree, which does vary widely from country to country, almost without exception the student studies chemistry for the duration of his university life, almost to the exclusion of other subjects. A very few ancillary subjects, such as physics and mathematics, are required during the first two years. The heterogeneity among curricula and degrees is enormous. Thus, I reckon it would be as difficult for a student in midstream of an English curriculum to change to a French university (over and above the language problem) as it would be for a similar American student to make the same change.

The fourth generality is difficult to articulate. It is that I am very much impressed with the number of individuals involved, and the extent of support given, for basic research in chemistry. I cannot help but wonder if the general academic scientific community is not, at the moment, living on a relatively rich diet. By diet I mean the salaries paid to professors and the funds they are given for equipment and expendable supplies. From my own point of view and with my personal background, similar to those of other scientifically trained people, it is easy to justify money spent in this way. However, a more dispassionate view discloses some research laboratories which are equipped almost to the state of opulence, completely surrounded by other segments of society that in general can only be described as being sadly neglected. To the extent that basic research is going to result in making the world a better place for the totality of society, it is possible to justify the opulence of the research laboratory to the man on the street. On the other hand, I cannot help but ask myself when is the day of reckoning going to arrive? When it does arrive, who is going to keep the score, and what will the judges' decision be? In short, I hope that public reaction will not relegate scientists to the position of second-class citizens again.

As a fifth generality and not completely unrelated to the fourth and preceding paragraph, another matter should be mentioned. Not by any means so general but in enough cases to be significant, I must admit to being a bit shocked at the attitude of the professors of chemistry in many departments toward the paths which they expect their students to chart for themselves. The attitude to which I refer is best described as follows. In the course of a leisurely conversation with a professor of chemistry in an English institution (the man has already received his FRS), I put this question: "What do most of your PhD students do when they complete their degrees?" The answer was not long in forthcoming to the effect that among all of the students he had ever had, he could remember no more than two or three who had gone into industry or government laboratory work; since, "he was happy to state," practically all of his students were sufficiently "able" to obtain university posts. Throughout much of Europe I found that professors expect to keep their best students with them as junior members of staff and research associates. Now, it is only right and proper for a professor to think highly of his best students and to think favorably of their continuing their association with him in a productive capacity for an indefinite period of time. On the other hand, there are other clear inferences to be gained in informal conversations with professors. It appears to me that they believe implicitly their best students should be recruited into the university system of the country concerned, and the less able students should be cast adrift into the "less demanding worlds" of industry and government technological and development laboratories. Furthermore, it is a widely accepted axiom that basic research, unsullied by relation to any "mission" or "practical problem," is Number One in the "pecking order."

There is always a cadre of American chemists anticipating a year abroad. The choice of department with which to affiliate is a difficult one. The large, well-established schools of chemistry with "big-name" professors are no longer

the obvious choice. To be sure, the variety of equipment to be found in the Institute of Inorganic Chemistry at Perugia is not nearly so great as in Rome. Yet, within the competence of Perugia (and many of the similar excellent, smaller chemistry departments throughout Europe) one will find one very important advantage always unobtainable in the larger departments; to wit, the interest, sympathy, and time of the professor and his senior colleagues. More often than not the professor in charge of a large department will be practically inaccessible, save for the occasional slap on the back in genuine goodwill and hospitality. He and his senior colleagues often have enormous administrative responsibilities and, as well, are away from their departments about as often as they are there. In general, I have found the quality of research and teaching done in some of the smaller, less well-known schools, to be at least equal to that which is done in the large big-name departments.

## COMMENTS ON SPECIFIC COUNTRIES

### FRANCE

In several ways France occupies a unique position in the Western world of chemistry. Not only at meetings and conferences in the US but also at those in Europe, outside of France itself, French chemists participate in far fewer numbers relative to their population than do chemists from the other countries of Europe. In addition, prior to my travels on the Continent, I was told by several Europeans that in almost any university chemistry department the scientists would prefer that I speak good English to poor anything else, with the exception of France. In fact, such proved to be the case. Even in the French-speaking part of Belgium, feeble attempts at French are answered, more often than not, in excellent English. On the other hand, in France the attitude appears to be the reverse. The preference is that one speaks French, even if it is very poor French, in preference to any other language. Never having been a rebel at heart, I took the advice of my European friends early on in my stay here and made a serious effort to become sufficiently fluent in the French language such that I did not have to rely on English while travelling in France. In about three weeks of visiting chemistry departments and research laboratories in various parts of France, I was told many times (with obvious pleasure) that I was the first chemistry professor from the United States that had ever visited them who was able to speak their language. I hasten to add that my daughter, who speaks French very well, having spent eight months at the University of Grenoble, living with a French family, tells me that my French is very poor. Nonetheless, in practically all of my relationships with French chemists, it was much appreciated that I was able to communicate in their language. To be sure, in one case, after laboring along for about three hours with a very able chemist, he changed without warning into English which was much more fluent than my French, with the offhand remark that "we will make more rapid progress if we speak English." Significantly, there was one and only one example of this, and the particular individual was not a native Frenchman. I am convinced that the average professor of chemistry and his junior associates have no better command of the English language than the average American professor of chemistry and his junior associates have of the French language. Thus, I find that a very real language barrier (not just "Charles' degree") separates French chemistry from the rest of chemistry. It is most unfortunate, since much first-class inorganic and physical chemistry is being done in France. In addition, I have seen with my own eyes that, as a matter of policy, the French government is investing truly enormous sums in building new faculties for the science departments in many universities. Entirely new chemistry buildings, both for instructional and research purposes, have been completed or are substantially complete at the Universities of Paris, Strasbourg, Lyon, Toulouse and Bordeaux. These new facilities are at places where I happened to visit. Other universities, where I did not happen to visit, have been given new facilities for science departments also. The new chemistry buildings which I have seen in France are very well equipped, comparable to chemistry buildings in the US in most ways.

In assessing the growth pattern and capability of academic chemistry in France, I would conclude that neither is dissimilar from that which was experienced in the US immediately after WWII. Bearing in mind the devastation which the French population found widespread in their country immediately after WWII,

it is perhaps understandable that some 10 to 15 years were required to rebuild bridges, buildings, roads, transportation systems, etc., before indulging in the luxury of new academic faculties. It is my opinion, however, that French chemistry is on the verge of arriving at post WWII maturity and that we should make every effort possible to lessen the barriers which exist between French chemistry and the rest of the Western chemical world. Individual French chemistry professors and their young associates are desirous of entering into the kind of relationship which exists between English chemistry and American chemistry, between Scandinavian chemistry and American chemistry, etc. One thing does give me pause in my plea. The working hours and eating habits of French academic chemists when they have a guest are perhaps a bit more strenuous than many of us in the States are prepared to cope with. Typically, one arrives at the chemistry building shortly after 9:00 and works until about noon, whereupon the group adjourns to a suitable restaurant for a déjeuner. A déjeuner may well consist of a six- to eight-course meal, with an appropriate wine for each course. It is certain to last until 3:00 p.m., possibly until 3:30 or 4:00, at which time the group staggers (not so much as a result of the wine, but rather from the sheer weight of the food intake) back to the laboratory and continues working until 8:00 or 8:30 p.m.

AUSTRIA-ISRAEL CONTRAST

The contrast between Austria and Israel is worth some description. To begin with a bit of orientation is in order. Austria is about the size of Maine or South Carolina, but with a population of ca. $7 \times 10^6$, is an old country, with a relatively homogeneous population. On the other hand, Israel is about the size of New Jersey, but with a population of ca. $2.2 \times 10^6$, is a new nation, heterogeneous in most aspects (except religion). In Israel, facilities and equipment for scientific research are second to none, and compare favorably with what one is accustomed to in the US. However, the comparison of the status which science enjoys in Israel with that accorded other segments of the society is downright appalling. Much housing is substandard and totally inadequate for the planned immigration program. Public transportation equipment is in unbelievably bad condition - busses, trains, and taxis. The cost of living is frightful. Most cities are dirty, Tel Aviv is downright filthy and a disgrace. The physical plant for primary and secondary education is woefully inadequate. Several individuals expressed to me the wish that the nation's well-meaning benefactors could be persuaded to channel their bequests into areas other than scientific research buildings and equipment, for the time being. To at least some of the scientists in Israel, the situation is a bit embarrassing even though they have had little control over the evolving patchwork that is Israel. (At the risk of offending Californians and Floridians, I found the oranges in Israel the best I've ever tasted.) Regardless of other aspects of the society, Israel can point with justifiable pride to a truly impressive and vigorous scientific research establishment, including buildings, equipment and scientists. Exchange, both ways, of personnel with the US is considered essential by all Israeli scientists.

The position of the scientific establishment in Austria is almost the reverse of what one finds in Israel. With three times the number of citizens as Israel and a much more settled general economy, Austria has the same number of academic departments of chemistry as Israel - five. From first-hand knowledge of three of the five, it is clear that academic chemistry enjoyes a very inferior status in Austrian society. The buildings are all very old, at least pre-WWII, some pre-WWI. Funds for equipment are meager at best. Modern instrumentation is scarce. Salaries are so ridiculous that it occurs to this wandering chemist that chicanery may be resorted to in order to enable junior academic staff to subsist. Despite such handicaps, Austrian chemists are doing some first-class work in inorganic and physical chemistry and continue to produce good young chemists. As an example, the only person in all of Europe who tells me he has been able to obtain useful spectra for a reasonable period of time with the AEI (British) nmr spectrometer is young Mairinger, an associate of Viktor Gutmann in Vienna. Admittedly, the Austrian Alps and the culture and history of Vienna are prime assets to the natives who claim that, on the average, one bed out of 18 or 19 is occupied by a tourist each night. Nevertheless, the Austrians would do well to look to the health of their scientific hierarchy, lest the same will cease to exist. The International Atomic Energy Agency, with headquarters in

Vienna, and a sizeable laboratory in Austria, may well serve as the means of awakening the country to the plight of her scientists. Thus, while association with IAEA could be an exciting and useful experience for an American scientist, it is doubtful that an association with an academic department of chemistry in Austria would prove to be so fruitful. (S.Y. Tyree)

## ACOUSTICS

### PTB Speech Visualizer Demonstration

Prof. Dr. M. Grützmacher, Director of the Acoustics Division, Physikalische-Technische Bundesanstalt at Braunschweig, Germany, presented a lecture demonstration "Physics of Speech Formation" at the German Institute, London, on 24 October. He demonstrated his speech visualizer (ONRL Technical Report 33-65), a formidable array of electronic equipment that worked flawlessly during his one-hour lecture.

Speech, picked up by a microphone, passes through a nonlinear distortion network, a low-pass filter, and a clipping amplifier to a differentiating network which determines the duration of the vertical sweep on a memory tube oscilloscope. The vertical frequency scale is marked off at 65, 130, 260 and 520 Hz. The horizontal time scale can be varied from 1 sec to 15 sec or more. In the demonstration lecture he used two speakers; a television camera and two television sets displayed the oscilloscope picture. The sonograph displays the fundamental and prominent harmonics (8 to 10 in some cases) as detected from axis crossing points. A separate sweep at the bottom of the picture shows signal amplitude versus time. He concluded the lecture with a short German song displayed in fundamental frequency mode.

The equipment is useful in training a deaf person to talk in a well-modulated voice instead of the usual monotone. From what I learned at the Symposium "Bionic Models of the Animal Sonar System," Frascati, Italy, 26 Sept - 2 Oct 1966, this type of instrumentation would be very useful in recording the sonar pulse produced by bats and marine animals. (W.J.Trott)

### Ultrasonics for Industry 1966, Conference and Exhibition

Ultrasonics for Industry 1966, Conference and Exhibition was held in London 11-12 October at the St.Ermin's Hotel. The meeting was sponsored by "Ultrasonics," a British quarterly journal reporting the science and technology of ultrasound in industry. Exhibits displayed instruments for flaw detection, hardness testing, leak detectors, underwater sound velocity meter and machines for cleaning, welding, disintegrating biological materials, and displays of piezoceramic materials. There were two simultaneous sessions, applications and research.

G.R. Williams (Dawe Instruments, Ltd. Western Avenue, London, W 13) described the Ultrasonic Hardness Tester which consists of a diamond-tipped magnetostrictive rod which penetrates the sample 2 - 7 $\mu$, causing the frequency of resonance to shift. This frequency shift within the range of 20 - 30 kHz, is converted to a hardness scale. The tester is calibrated for the Young's modulus of the sample. Dynamic compliance of the sample must be the same as the static compliance, and the mass of the sample plus its oil coupled support must be larger than the mass of the vibrating rod.

Philips Research Laboratories' (Netherlands) H.P. Daniels described welders for metals and plastics foils. The tip vibrates laterally for welding metals and normal to the surface for welding thermoplastics. He showed thermocouples welded to glass. Seam welding is done with a roller anvil, and the transport is produced by using an unbalancing shim mass to cause lateral and longitudinal vibration of the tip. The machine is powered with 25W.

Prof. R. Pohlman (Head of the Ultrasonics Laboratories, Rheinisch Westfalische Technische Hochschule, Aachen, Germany) discussed the influence of ultrasound on metal friction. He showed that the force to draw wire could be reduced to $\frac{1}{2}$ by vibrating the second die and tuning the length of wire between the first and second die.

Ultrasonic Aids to Blind Mobility were presented by R. Dufton (Director of Research, St. Dunstan's Home for the Blind, 191 Marylebone Rd., NW 1). He described aids developed in the UK and US. (I had heard Prof. L. Kay, Univ. of Canterbury, Christchurch, New Zealand, discuss and demonstrate the UK hand-held and head-mounted units at

the Symposium on Bionic Models of the Animal Sonar System at Frascati (Rome), Italy on 29 September.) The UK units use a charge-biased mylex condenser speaker and microphone in a 90 - 45 kHz FM sonar system, in which the audible beat signal is proportional to the distance from the reflecting object. Ten feet away it produces a 3-kHz tone. The head-mounted unit is binaural with receivers on each side of the head and seven units across the forehead to produce a 60° arc of radiation. The two receivers are directed 60° apart. The units can detect the knob on a door.

Dr. J.C. Cook (Principal Scientific Officer, Admiralty Research Laboratory, Teddington) described the ARL Bifocal 300-kHz Sonar. An article was published in "Ultrasonics" 4, p.1 (January 1966). By delineating the shadow, the recorder charts clearly showed the presence of a shipwreck, a helicopter, a 3/4-inch diam cable and clearly outlined a trawling net and shoals of fish. It is a plane array using 100-μ sec pulses, sector scan with 30° and 75 channels far range, 10° and 25 channels close range, 5° vertical beam, and has a maximum range of 700 yds.

Prof. Ian Donald (Regius Professor of Midwifery, Univ. of Glasgow) described the routine use of ultrasonic diagnosis at the Queen Mother's Hospital, Glasgow. Currently it is being used in 113 cases per month by six trained operators. The equipment uses 1.5, 2.5 and 5 mHz in the detection of pregnancy at six weeks, X-ray is useless under 16 weeks. They can measure the head size to 1 mm and detect twins at seven weeks, detect the presence of cancer, cysts, cyrosis of the liver or the need for curettage. Donald is at a loss to understand why the method is not more widely used. He has published articles in the "American Journal of Obstetrics and Gynaecology," 93, p. 935 (1965), and the "Journal of Obstetrics and Gynaecology of the British Commonwealth," 72, p. 907 (1965). (W.J. Trott)

## AERONAUTICS AND SPACE SCIENCES

### The Controlled-Circulation Rotor

One of the most interesting exhibits at SBAC Farnborough Air Show in September 1966 was the controlled-circulation rotor, currently under development at the National Gas Turbine Establishment, Pyestock (NGTE). This device also was discussed briefly by Prof. A.R. Collar (Bristol Univ) in his paper presented before the Centenary Congress of the Royal Aeronautical Society -- "Some Aspects of Aeronautical Research in the United Kingdom." The following account has been extracted from his paper and the NGTE Technical Information Sheet.

The aircraft industries of the world have devoted substantial effort in the last decade toward the realization of aircraft which can take off and land vertically. Such aircraft have obvious attractions and there are many potential applications in both military and civil use.

VTOL schemes can be classified according to the quantity of the ambient air they displace to generate lift and the associated downwash velocity of this air. They range from helicopters using high air quantity and low downwash velocity through convertible rotor or tilt-wing aircraft to jet lift aircraft with relatively low air demand but correspondingly high downwash velocity. Only helicopters are widely used so far. The high downwash schemes incur disadvantages of high fuel consumption and high noise level, and present some difficulty in operating from unprepared sites because of the violent scrubbing action of their high speed jets. Attention has therefore swung more and more towards large lifting rotors, varying from large dual-purpose propellers to more conventional helicopter rotors.

The major disadvantage of a large rotor propeller is that it severely restricts the forward speed of the aircraft, thereby curtailing its effectiveness in the military role and its earning capacity in the civil role; hence, the choice of jet lift for a fighter aircraft. But if a rotor could be used only for take-off and landing, being parked parallel to the line of flight or retracted and stowed away during cruise, the aircraft could fly supported on its wings alone at normal jet aircraft speeds. Unfortunately, there seems little prospect of parking a conventional aerofoil rotor in flight. Firstly, the aircraft would be unstable during the parking maneuver, because as the rotor was slowing down, any sizeable gust would produce substantial lift on the advancing blade but none on the heavily-stalled retreating blade, leading in the limit to overturning

the aircraft. Secondly, aerofoil rotor blades capable of lifting an aircraft are too large and too flexible in relation to the fuselage and wings to consider parking them in flight; and stowing them presents severe engineering problems.

In recent years, the NGTE has conducted a continuing research on the integration of lift and propulsion systems. One interesting and ingenious offshoot of this work is the controlled-circulation rotor developed by Dr. I.C. Cheeseman and his collaborators. In its initial form, the rotor consisted simply of a rigid circular cylinder. Circulation around the cylinder, and hence lift, are generated by blowing compressed air from narrow spanwise slots, appropriately positioned and directed; the rotor itself can be made to revolve either by a mechanical drive or by tip blowing -- the latter method gives no torque reaction. In the test rig, the rotor diameter is 12 ft and the cylinder diameter is 5.6 in; there are no hinges, since the lift can be controlled through control of blowing.

A rotor test vehicle has been built to supplement the RAE 24-ft tunnel in the testing of controlled circulation rotors in forward flight. Based on a standard commercial chassis, it carries the rotor at speeds up to 110 ft/sec along airfield runways. Much interesting data has been recorded from the tunnel and runway experiments: cylinder lift coefficients as high as 6 vary nearly linearly with the momentum coefficient of the air blown from the slots; wake drag coefficients (including the thrust due to the blown air) can be small or negative; the blowing cleans up the ordinary zero-lift flow around a cylinder, leaving only a small region of separation -- another form of boundary layer control designed primarily to generate lift.

Some virtues of a blown circular cylinder as a basis for a lifting rotor may be listed: 1. High $C_L$ is achievable, requiring small cylinder diameter; 2. The cylindrical section is structurally suitable for non-articulated rotors; 3. Cyclic blowing control can, even in forward flight, make lift independent of azimuth angle. The effectiveness of the cyclic control was demonstated by the ability to trim out the pitching and rolling moments encountered without serious changes in lift or power; 4. Lift is insensitive to gusts, since the lift-incidence slope is virtually zero; 5. If forward flight is wing-borne, the blown rotor can be stopped and parked without the difficulties facing conventional rotors; 6. Rigid blades require only small clearances and little maintenance; 7. Tests of the NGTE rotor in the RAE 24-ft wind tunnel showed that the ratio of lift force to slot thrust varied only slightly (lying between about 30 and 40) with advance ratios up to about 0.5 and lift coefficients up to 5.

There is, of course, a reverse side to the coin. In order to avoid compressibility effects, the tip speed of the rotor must be kept low, and this in turn leads to high induced power. In an attempt to overcome this difficulty the NGTE has experimented with a rotor in which the section changes from a circle to an ellipse with increasing rotor radius. This means compromising some of the virtues listed above; however, most good engineering involves compromise.

Possible applications of the controlled-circulation rotor have included the study of a BAC 1-11 aircraft as a twin rotor VTOL transport. It is calculated that the aircraft is able to hover at maximum weight at an altitude of 5,000 ft at ISA plus 20°C on one Spey engine, and that including the weight penalty of the rotor installation and normal reserves, the range at full payload with vertical take-off and landing is 300 nm. (H.A. Smith)

## The Combined Aeronautical Society's Centenary Congress and the Fifth Congress of the International Council of the Aeronautical Sciences

The ceremony opening this combined Congress held in London, 12-16 Sept., made the remainder of the meeting almost anticlimactic. After a series of congratulations and gifts by learned societies of many countries, the Duke of Edinburgh, Honorary President, gave a stirring opening address. He pointed out that the problem of making the right selection in research programs and development projects has become crucial to the whole of aeronautical evolution; that the time has come to make a rational assessment of the principle of applying Government support to the aviation industry. Needless to say, remarks of this type, though welcome to say the least, are certainly unexpected from a member of the royal family.

In the Daniel and Florence

Guggenheim Memorial Lecture, M.B. Morgan (Ministry of Aviation) examined the aeronautical scene in terms of the possibilities being thrown up by current research work. In the talk entitled "Some Aspects of Aircraft Evolution," he gave examples of improvements that are possible in the fields of aerodynamics, materials and engines. Such improvements as in the use of lift engines, laminar flow wings, composite materials and computer control for engine operation can mean considerable savings in over-all costs, all-up weight, and the improvement of range. He noted three problem areas which will require exceptional scientific and engineering skill, namely: (1) the design of the intakes and nozzels for supersonic flight; (2) variable geometry wings; and (3) terrain followers (in order to allow aircraft to operate safely at very low altitudes). Finally, it was pointed out that 60% of the current work load is in the further development of existing hardware, while the remaining 40% is in new projects.

Sir George Edwards (Managing Director of the British Aircraft Corporation), in his talk entitled "Anglo-French Collaboration -- the Present Position and Some Thoughts on the Future," gave some personal reflections on the general subject and made particular comments on the three current projects, Concorde, Jaguar, and Variable Geometry. After discussing the detailed contribution that Britain and France are making in the Concorde project, he noted the particular enthusiasm that is characteristic of the French contingent and the apparent success in France of the graduates of the Ecole Polytechnique. It was apparent that Sir George was indirectly commenting on the rather strained position that British engineers occupy in knowing that both the Government and the country are not wholeheartedly backing their efforts.

The remainder of the program consisted of technical papers of both survey and comprehensive nature which spanned the subject of aeronautics. Of particular importance to those in mechanics was that of Prof. A.R.Collar (Dept of Aeronautical Engineering, Bristol Univ.). His talk, "Aeronautical Research in the UK," surveyed a few topics in which the Aeronautical Research Council and he, as its Chairman, had taken an active interest over the past few years. As examples, Collar noted the work of Prof. H.C.H. Gurney (Cardiff) in crack propagation, of Prof. J.H.Argyris (Imperial Coll.) in matrix methods in structural analysis; and the controlled-circulation rotor of the National Gas Turbine Establishment. (H.E. Williams)

International Astronautics Congress, Madrid

The XVII Congress of the International Astronautical Federation (IAF) was held in Madrid, 9-15 October 1966. The host association this year was the Asociacion Española Astronautica.

The seventeen-year old IAF is a nonprofit organization with its secretariat in Paris. It's members are some thirty scientific and professional societies and organizations interested in space technology and astronautics, the principal US representative being the AIAA. The IAF numbers some of the top names in world space leadership among its past and present officers; Von Karman and Pickering (US), Sedov (USSR), Brun (France), Shepperd (UK); and its principal business, sponsoring the annual Congress, has taken it in recent years to Washington, Paris, Warsaw, Varna, Athens, and now Madrid.

Each Congress has been a highly mixed and somewhat confused potpourri of political, social and technical events, and this year's was no exception. Representatives present included the Air Minister of Spain, the Queen of Greece, an American Astronaut, several members of the Soviet Academy of Sciences, and some 1050 others from 37 Eastern and Western nations. The US sent more than 300. Spain was represented by about 265, with other large delegations coming from France, Germany, Greece and the Soviet Union. They came also from Argentina and Japan, Cuba and Bulgaria, Israel and the United Arab Republic.

There were concomitant business meetings of the IAF, the International Academy of Astronautics, the International Institute of Space Law, press briefings and 34 technical sessions, as many as five of these running simultaneously. There were also four cocktail parties, hosted by the Mayor of Madrid, the Spanish Air Minister, the Spanish Astronautical Association, and the American Ambassador, a visit to the NASA-INTA Deep Space Tracking Station at nearby Robledo, a Corrida (Bullfight) and a banquet.

The technical sessions generally

were well attended and the mechanics of the meeting were adequate. A lot of cloakroom discussions took place on a technical level - some between colleagues from different countries and more within delegations; particularly among the Americans. Bull sessions occurred at every event on the schedule ...even the bullfight.

It is fair to say that the US dominated the technical sessions. Americans gave the greatest number of papers and certainly the meatiest. The only other country capable of presenting really advanced work in space technology, the USSR, as usual released almost no technical details. An exception to this trend was in biogastronautics, in which the Soviets seemed to be willing to talk, and some good papers were delivered.

Press coverage of the Congress was extensive. Many European papers, including the Paris editions of American papers, carried daily front-page articles on the progress of the meetings. One of the favorite subjects of these reports was alleged dissension between delegations. The city newspaper, Madrid, headlined its lead article one day "The Americans, talkative, the Soviets, tight lipped," and the Herald Tribune found some Russians at cocktail parties who claimed that "the US 'monopolizes congresses' and turns them into commercial fairs with free drinks, advertising pencils, cigarette lighters, photographs and press releases." At the meeting, however, the Soviet speakers seemed friendly, eager to get US information and genuinely embarrassed by their own inability to present more information. The quality of their graphic aids was particularly poor.

There were some accusations of censorship. At least three US papers on the schedule were not given because of failure to obtain clearance at the last moment, though the authors were present. On the Soviet side, several papers could not be given since their authors "failed to arrive." The newspapers made much of these cancelled papers.

There was the usual speculation about future Soviet launches. No spectacular event coincided with the Congress this year as has frequently happened in the past. The first Sputnik was, in fact, launched during a previous Congress in Madrid in October 1957. There was talk of a 7,500,000-pound thrust booster to be demonstrated soon and a multiman space station. The week after the Congress they did orbit a Molniya and Cosmos, followed by a new lunar attempt, but these did not seem to be related to the meeting.

Most Europeans at the Congress were concerned with the possibilities for ESRO and ELDO. These seemed pitifully small and slow efforts compared with the progress being made by the two giants. A report by Val Cleaver (Chief Rocket Engineer of Rolls-Royce, UK) stated that the ELDO vehicle which will orbit in 1970 or 71 will be "five years too late."

One announcement in a technical paper on gravity-gradient stabilization of a "collision in space" received great notoriety, probably unduly. H.W. Paige (General Electric Company, USA) explained how two stabilized space-craft collided in orbit and restabilized to work successfully. Listeners and readers conjured up visions of a head on crash at 5 miles-per-second against almost incalcuable odds in all that space! Actually, the two Naval Research Laboratory satellites involved were launched together by the same booster in March 65, placed in similar velocities. Their long booms "nudged" each other in orbit. Hardly a "collision"!

Many of the US papers were rewrites and compilation of previously released material, but several of the review papers were outstanding. Worth special mention were two by Leroy Day and Kenneth Nagler (both of NASA) showing some breathtaking photographs taken during the Gemini program. Dr. Eberhardt Rechtin (JPL) presented a masterful review of deep space communications and tracking, and pointed to things to come in this field, and Harold Finger (NASA) did the same for nuclear propulsion in space.

Prof. K.Y. Kondratyev (Leningrad Univ.) chaired a session on "manned geophysical observations from satellites" and gave the survey paper in the field himself. An obviously enthusiastic and well-informed scientist, his discussion on cloud pictures and measurements of atmospheric structure by radiation scattering and absorption were followed with great interest. Yet, like most of the Soviet papers, there was a paucity of photographs and quantitative date.

The abstracts of almost all of the 300 technical papers presented were available and distributed at the Congress. The complete proceedings will

be assembled and published in about six months. Proceedings of previous Congresses are still available through the IAF Secretariat.

The Daniel and Florence Guggenheim International Astronautics Award for 1966 was made to Dr. Robert R. Gilruth, Director of the NASA Manned Spacecraft Center, Houston. Prof. L. Napolitano, Univ. of Naples was elected Chairman of the IAF for 1967, and Belgrade, Yugoslavia, was selected as the site for the Congress in the Fall of 1967. (B.I. Edelson)

## MATERIALS SCIENCES

### A European Materials Research Center

A proposal has been initiated by interested North European scientists to start a Materials Research Center. This would be similar in purpose to the ARPA interdisciplinary laboratories in the US, but organized similarly to CERN. Included would be work on materials preparation, structure, electronic behavior, imperfections and application. About 120 scientists, many on short-term appointments, and an auxiliary staff of 200 are contemplated. The proposed center would involve 14,000 $m^2$ on 35 acres and cost $12 million to build and equip, over a three- to five-year period. Annual operating costs are estimated at $6.3 million.

The Center will have an educational function as well as its responsibility to perform interdisciplinary research. The countries involved are those in Scandinavia plus Iceland and Poland; participation by Belgium and the Netherlands will be delayed as these countries feel the initial costs are too much for them. All of these smaller countries are having a considerable problem maintaining their expensive atomic energy establishments, and one gets the distinct impression that the use of equipment, facilities and staff in such locations by other groups is a possibility. In fact, it is suggested that the Center be placed near one such establishment, and it would not be at all surprising if the initial costs were reduced merely by using such a ready plant to initiate the program. (J.B. Cohen)

### The Fulmer Research Institute's Open Day

The Fulmer Research Institute at Stoke Poges celebrated the completion of its new laboratory with an Open Day on 30 September 1966. A large number of guests were received by Mr. Merton, Chairman of the Institute, and Mr. E.A.G.Liddiard, Director of Research. After the guests toured the facilities, Sir Paul Chambers, Chairman of ICI, ceremoniously unlocked the doors and led a tour of the new laboratory building.

During lunch, Sir Paul noted that the Institute has shown remarkable growth in its first 20 years; income increased from £25,000 in 1946 to £2,357,000 in 1965, while staff increased from 44 to 117. He noted its exceptional stature as the first sponsored research organization wholly owned by a professional scientific institution, the Institute of Physics and the Physical Society (IPPS). The presence of Sir Paul was significant, as it was ICI which sold the Institute in 1965 to the IPPS, after ICI had acquired its parent company, Alwin, Ltd.

The new laboratory is a two-story building centered in the original laboratory complex. It houses work in corrosion, analytical chemistry and spectroscopy. Prominent in display were the AEI MS 702 Mass Spectrograph and the Siemens 125-kV Elmiskop 1A Electron Microsope.

In additon to the numerous displays related to the Institute's many activities in metallurgy and metal science, there was a display of work in fluid mechanics undertaken by the Chemical Engineering Section. An open channel about 2-ft wide and 1-ft deep has been constructed to study the hydraulic transport of solids. This complements work done in pipes in order to develop the important parameters in the movement of ore suspensions and in the removal of swarf.

Flow properties of non-Newtonian fluids have been studied and correlations developed to obtain data for pumping in larger systems.

A portable fire fighting pump on display was developed for producing thickened water by injection of a suspension of an additive. In order to illustrate its versatility, it was disclosed that the pump had recently fallen from a Land Rover moving at 30 mph!

Other laboratories open for inspection were the Physical Chemistry Laboratory, the Process Metallurgy Laboratory & Foundry, the Physical Metallurgy Laboratory, the Engineering and Mechanical Testing Laboratory, the Machine Shop,and the Physics Laboratory. (H.E. Williams)

## Metallurgy at the Fulmer Research Institute

The 10th anniversary of this private research organization finds an aggressive group, headed by Mr. E.A. Liddiard, Director of Research. The Fulmer Research Instititue takes no money from its parent body and makes an annual profit of 7 - 10%. Cost accounting is done monthly. Proposals are thought through, but little or no work is done in most cases until contracts are received, so that only about 2½% of the contract charges constitute prior effort. The group is very conscious of patents, and if the project is sufficiently interesting, they will do enough preliminary ground work to obtain one in order to offer it to the program sponsors. Jobs can be long-range projects or short-term "quick and dirty" tests. A survey revealed that if they had a mass-spectrometer enough companies would send a few samples a year to them to pay for the instrument and its operation; so they are just installing one - not for any profit on this particular operation, but with the hope that when these firms visit with their small jobs, they will find other features of the laboratory useful.

Dr. John Coiley, formerly at Aeon Laboratories (another laboratory similar to Fulmer) heads metallurgy. There are three electron microscopes in use, including a new 125-kV Siemens, complete with a curved crystal microprobe attachment that they are helping to develop. The feeling here is that they prefer this combined instrument to a microprobe, per se, because of the better resolution of the microscope (100 Å). At the same time it is a third scope. They are also of the opinion that a high-voltage microscope is not sufficiently more useful over this combined instrument to justify spending the money for it.

Dr. G.J. Williams runs an X-ray section, which interacts strongly with many of the other groups - not only on a service basis but also with long-range projects. This group is perhaps best known for its work on liquid metals and alloys. The X-ray unit used for this employs a large flat horizontal liquid surface, and the X-ray tube and counter are moved manually to vary 2 θ. The liquid level is kept constant by measuring its position relative to a rigid knife edge with an optical microscope. The radiation is monochromated with a bent quartz crystal. The initial alignment, to make the incident and diffracted angles equal, is done with the aid of a quartz single crystal floating on the liquid. Absolute measurements are obtained by matching the high angle data to the calculated scattering for independent atoms - in the usual way. This match is adjusted to eliminate oscillations at small distances in the radial distribution curve.

With Sn, Au, Cu-Sn, and Au-Al, a shoulder has been found on the high angle side of the main peak. The intensity of this shoulder varies with composition, and in some cases, e.g., $Cu_3Sn$, there is just one sharp peak at at its position. The interatomic distance corresponding to this peak is found by transforming the difference between the actual pattern and one obtained by extrapolation under this ledge or shoulder. Because this ledge seems to be present in all alloys of a binary, the group feels it corresponds to some interatomic distance present in liquids of all compositions.

The group has just recently found such a shoulder in liquid Hg, by comparing its pattern to the more symmetric pattern for, say, gold. It appears to correspond to a distance in the low temperature or high pressure polymorph. Other properties of these liquids are also being studied.

Some of the results on Cu-Sn alloys are being used at Harwell, along with neutron diffraction studies of alloys made with two Cu isotopes, to do an anlysis for AA, BB and AB pair densities.

Another X-ray unit has been adopted to study grain growth at high temperatures, using Warren's analysis of the scatter in intensity with sample position to yield grain size. An external heat lamp is used for heating, and the specimen is in a vacuum of $1 \times 10^{-7}$ mm of Hg. The sample's position is changed with a magnet. The X-ray windows are 1.5-mils thick and made of an Al-Si alloy sealed to the glass vacuum system with a glass-to-metal seal. With about 1½% Si, work-hardening during rolling is sufficient to allow easy handling of these thin windows.

The Warren technique has been checked against metallographic results with an equi-axed Cu-Sn alloy, and the agreement is within 10%.

To study phases that develop rapidly in U-Mo alloys, a very small Debye-Scherer camera is being used in conjunction with a rotating anode

X-ray source.

One quite ambitious study is under way. They are setting up to measure short-range order in a Ag-Zn alloy, for A. Le Claire at Harwell, so that he can test a new theory (involving these parameters and Cowley's theory) on the anisotropy of the internal friction peak due to solute redistribution.

There is an excellent group with years of experience and data studying Al-base alloys. A ten-year testing project is just being completed on a proprietary Al-Cu-Cd alloy, which eliminates the exfoliation problem.

Much of the work on the effects of trace elements in Al on precipitation is well known. Particularly interesting to me was the fact that with some trace elements, precipitate formation after quenching can be delayed for many months. Here, again, is evidence of some particular configuration required for a precipitate, not just excess vacancies to enhance the kinetics.

Dr. P. Gross is continuing his studies of thermodynamics of alloys, particularly these days using halide reactions. He has also used these compounds to deposit superconducting compounds and W.

A new group in a new building is much involved in studies of stress corrosion and hydrogen embrittlement, particularly to determine their relative roles in slow deformation in a corrosive environment. A potentiostat is being employed, which will alter the anodic potential and hence affect stress corrosion - but not hydrogen embrittlement. Poole who heads a "process metallurgy" section has been involved in developing a floating-zone device for growing crystals of $Al_2O_3$, using an electron beam for heating. It is in operation and producing crystals. A scanning electron beam has been used as well to purify alumina.

In the same group they have been trying to find out why certain cast irons have better heat transfer in engines than others, and why machining off a relatively large thickness can help some of the poorer products. They find that nucleate boiling is enhanced by graphite flakes that stand out in relief from the surface, after some corrosion takes place. Thus cast irons with well-developed flakes are better as heat transfer media. (J.B. Cohen)

## MATHEMATICAL SCIENCES

### MOT Accelerates Advanced Computer Technology Program

Mr. F.J.M. Laver (Head, Computer Division, Ministry of Technology) described a "forward leap" program in advanced computer technology supported by the Ministry of Technology (MOT). Several million pounds have been awarded to British electronics firms in order to accelerate the development of computer technology in the UK.

Since the general election in October 1964, the Labour Government has implemented its plans for reorganization of the administration of education, science and technology. With the passing of the Science & Technology Act, 1965, the Department of Scientific and Industrial Research (DSIR) disappeared, and the responsibility for government-sponsored industrial research was divided between the Ministry of Technology and the Department of Education and Science.

The MOT is headed by A. Wedgwood Benn, M.P. The five Divisions responsible for government support of R&D are: Computers - F.J.M. Laver; Telecommunications & Electronic Science - A.M. Houghton; Machine Tools - R. Bullock; Mechanical Engineering - C. Coffin; and Electrical & Chemical Plants - A.C. Capisarow.

The Advanced Computer Technology Program, headed by Laver, supports both research and applied projects. The Program is managed by the Advisory Committee, which meets three times a year at the site of one of the contractors. One half-day is spent reviewing the progress of all contractors and the other half is spent reviewing the progress of the host contractor. The Advisory Committee comprises several civil service professionals, two or three representatives of each of the industrial contractors, and several university members. Progress reports are made to the MOT and are treated as "Commercial in Confidence." They are not released outside Government. Patent protection is afforded the contractor precisely as in the DoD. Most contracts are of the 50/50 cost-sharing type.

The selection of contractors, determination of funding, etc., are performed by an Executive Committee, also headed by Laver, which is divided in two sections, Software and Hardware. Members are all government scientists. They identify weak areas, solicit proposals, and proceed to fund the R&D.

Contracts awarded in the past four months total several million pounds. The table below shows the recipients, funding, and subjects covered. One contract not listed is for £2 million to Elliott Brothers for R&D on applications of computers to process control. Automated paper production will be a major subtask. (P.D. Maycock)

RECENT CONTRACT AWARDS BY MOT

| Contractor (No. of Contracts) | Total Value* | Subjects |
|---|---|---|
| International Computers & Tabulators, Ltd. (7) | £392,500 | high speed logic, design automation, optical store, fluid logic, optical character recognition, integrated circuit interconnections. |
| Plessey, Ltd. (4) | 129,100 | pattern recognition, plated wire store, high speed plated wire memory, production control soft ware. |
| Ferranti, Ltd. (3) | 127,000 | integrated circuits, bipolar transistor store, circuit integration, and interconnection. |
| Mullard, Ltd. (2) | 186,000 | MOST store, character recognition |
| Standard Telephones & Cables Ltd. (2) | 108,600 | speech recognition, dependability of digital systems |
| Elliott Bros., Ltd. (1) | 75,000 | tunnel diode logic |
| Associated Electrical Industries, Ltd. (1) | 66,000 | GaAs tunnel diodes |
| Bedford Computer Svcs, Ltd. (1) | 60,000 | production control |
| British Telecommunications Research, Ltd. (1) | 52,000 | fluid logic |

*(£1 = $2.80)

## MISCELLANEOUS

### John Dalton's Birthday Party

"Matter is corpuscular, and the indivisible particles of its elementary substances have a definite mass and combine with one another in simple integral ratios." So said the Manchester schoolmaster, John Dalton, in 1803. His atomic theory laid the basis for the remarkable development of chemistry during the nineteenth century, and -- despite the fact that atoms are not after all the ultimate and primitive stuff of the universe that he envisaged -- his concept stands as one of the most durable and fruitful in the whole fabric of science.

The bicentenary of Dalton's birth was celebrated at Manchester during the week of 19 September in a program of ceremonies sponsored by the Royal Society, the Manchester Literary and Philosophical Society, the Chemical Society, the Royal Institute of Chemistry, and the Society of Chemical Industry. Representatives of the principal learned societies of Europe and America were on hand to join with the local community in the proceedings -- symposia, invited lectures, evening receptions, and the conferring of awards and honorary degrees -- all of which were carried off with faultless style and polish.

The theme of the meeting was provided by a series of papers and discussions by historians of science dealing with Dalton's life and times, tracing the background and evolution of his contributions in chemistry, meteorology, and the study of color-blindness. These symposia, while decidedly the work of specialists insofar as any scholarly give-and-take was concerned, could nevertheless be understood and enjoyed by all of the assembled company, few of whom were historians even by way of avocation. For this happy choice of subject matter, the organizers are to be commended.

The Victoria University of Manchester conferred three honorary degrees. Prof. H.C. Urey of the Univ. of California (Santa Barbara) was cited

for contributions to science -- especially the isolation of deuterium -- having special pertinence to the extension and development of atomic theory. Prof. H. Butterfield of Cambridge was honored as an outstanding historian and interpreter of science. And Prof. Michael Polanyi of the Manchester faculty was recognized as a rare universalist who, having achieved eminence as a scientist, was able to bridge the gap between Snow's two cultures and pursue a second distinguished career in economic and social studies.

The Dalton Medal of the Manchester Literary and Philosophical Society was awarded to Sir Cyril Hinshelwood. His acceptance speech, like a companion lecture of Polanyi's, dealt with some aspects of the nature of reality -- or What Is Truth? I do not believe that this matter was settled during the symposium; we will have to make do a while longer with the pragmatic definition that truth is any consistent body of ideas that fits observable facts. A less cosmic sidelight in connection with the matter of reality is that as recently as the first decade of the present century, the literal existence of Dalton's atoms was by no means universally accepted. Notwithstanding the success of the atomic theory in unifying chemical phenomena, such reputable scientists as Ostwald and Kahlenberg were unbelievers, and it remained for J.B. Perrin to dispel all reasonable doubts through his experiments on Brownian motion. His son, Prof. F. Perrin, was the delegate from l'Institut de France at the celebrations; as high commissioner of the French nuclear energy authority, he is convinced -- quite apart from filial loyalty -- that atoms are indeed real.

The finale of the celebrations was the annual Dalton lecture, delivered this year by Prof. R.H.Nyholm of University College, London. I suspect that this may have been a more climactic event than was really intended by the organizers. The title, "Atoms and Energy in Modern Science," turned out to be something of a misnomer. After a perfunctory bow to John Dalton, Nyholm launched into a rousing indictment of the British educational and cultural tradition and of the policies and attitudes which have shaped it. In essence, his speech was a plea--more accurately, a warning -- to teachers and administrators to "drag Britain, kicking and screaming, into the twentieth century." Unless this is done soon, he says, the country is done for as a significant force in the modern world, and no comfortable recountings of past glories or reliance on muddling through will save the situation. The main ingredients in his own prescription for salvation comprise a broader grounding in general scientific knowledge for the educated public at large, even if this means that future business and civic leaders cannot read Greek classics in the original; more emphasis on the training in technology and engineering as opposed to "pure" science, and the elimination of the stultifying image of the applied sciences as rude mechanic arts unsuited as occupations for gentlemen; more effective use of scientists and engineers by industry, and more aggressiveness and enterprise by management in exploiting new science and developing new technology; and finally, harder work by university students, which he thinks needs to be exacted primarily by their teachers but reinforced where necessary by requiring the students to pay a greater fraction of their educational expenses from their own pockets.

I am sure that these sentiments have been uttered before, but I doubt whether they have been stated with greater force, or in blunter language, or to an audience which expected an hour's bland entertainment in popular science. Reaction was predictably mixed. But then every party has an unconventional guest, and John Dalton's was no exception. That's the way it should be. Gingers things up! (J.A. Bierlein)

Building Research - An Open Day

The Building Research Station, Watford, England, established in 1921, was the first organization of its type. Responsibility for the Station, previously with the Department of Scientific and Industrial Research (DSIR), moved to the Ministry of Technology in 1965. Policy is formulated by a Steering Committee directly responsible to the Ministry and chaired by Dr. E. Lee, Deputy Comptroller (MOT). It includes Dr. J.C. Weston, the new Director of the Station, and Sir Robert Wynne-Edwards, Chairman of the much broader-based Advisory Committee on Building Research which has representation from all branches of the industry.

The Station, pleasantly situated on some 70 acres, held its third

series of Open Days between the 19th and 27th of September. The first and second series of Open Days, held in 1961 and 1964, attracted some 3,000 and 6,000 invitees, respectively. For the current series, 12,000 were expected, and it had been necessary to extend the program into a second week. Sir Robert, opening the private view on the 19th, emphasized the continuing broadening of the Station's interests, which over the years had grown from building materials through structural engineering, soil mechanics, the physical environment within buildings, e.g., noise, heat, building methods, user needs, and most recently, the study of building operator skills. Throughout the years, in fact, it had continued to maintain a broader program than any comparable station, although somewhat similar stations have been established in almost all developed countries. Commenting on the growth of the Station - it now employs about 700 with a growth rate of 4% per annum - he pointed out that its funding represented less than 1/10th of a penny per pound sterling of the industry's turn-over (1 part in 2,400), and called for a greater growth rate.

To meet the diverse needs and interests of the wide range of invited guests, politicians, union leaders, building contractors, scientists, engineers, architects, etc., the Station utilized a wide range of techniques including films, lectures, working demonstrations and displays in presenting its program, covering environmental design, structural design, materials and components, production, and its information and advisory service. Indicative of the broad scope of scientific and technical disciplines involved at the Station were the following from among some 50 displays: (1) Sound transmission through partitions using the large adjacent anechoic reverberant chambers; (2) wind tunnel investigations concerning air movement around large buildings; (3) the study of building operative skills aimed at providing a basis for a review of training methods; (4) instrumentation for measurement of the deflection in underground tunnel systems; (5) structural testing; (6) corrosion protection of steel in concrete; and (7) work on fiber-reinforced cement products employing glass fibers resistant to alkalis. Historically, the Station has produced numerous specialized publications to carry its results to industry, supplemented by its information advisory services, "Open Days," etc. There is little doubt, however, that along with further emphasis on the applied side in line with increasing recognition of the many practical problems faced by the building industry, additional consideration will be given to the methods of carrying the Station's research to industry. Among other items appropriate post-graduate courses will be offered next year at the Station. In many ways, the Station and its relationship with the industry it serves, which accounts for approximately 1/8th gross national product, is typical of the whole problem of the relation of research and industry in the UK which the Ministry of Technology must face. (A.W.Pryce)

## OCEAN SCIENCE AND TECHNOLOGY

### Irish Scientists and the Irish Sea

Within the past few weeks two separate meetings were held in the interest of evaluating the present state of marine biology in Ireland and to consider the present efforts directed toward the scientific exploration of the Irish Sea by individuals from a variety of disciplines and institutions.

The review of marine biology in Ireland took place 15-16 September at the Queen's University, Belfast. Representatives from a number of universities and fisheries in Northern Ireland and Eire were present, including those from Queen's University, Belfast; University College, Dublin; Trinity College, Dublin; University College, Galway; University College, Cork; Magee University College, Londonderry; Ministry of Agriculture and Fisheries, Belfast; and Department of Agriculture and Fisheries, Dublin.

As may be anticipated at conferences of this nature, the view was presented that the state of the science has reached a point at which a general discussion of future developments would be appropriate and helpful. Further, there was complete agreement on the need for providing some means for closer communication and cooperation in the future. The possibilities for initiating a formal organization, i.e., Irish Marine Biological Association, were considered, but it was felt that at the present time a less formal organization could accomplish the desired goals. Informal meetings of an Irish Marine Sciences Convention

were agreed upon similar to those adopted by workers in freshwater fisheries, and Dr. Went (Dept. of Agriculture and Fisheries, Dublin) agreed to act as the convener for the first of these meetings which will be held in Dublin, 25 February 1967.

In the discussion of the existing facilities and the need for additional laboratories there was general concern that future developments might result in the establishment of many small field stations, none sufficiently large to be competitive in the international field. This led to the following conclusions: (1) it is not practicable to combine fisheries laboratories and marine biological laboratories. They differ in their aims and in their work, and this should be made clear to the authorities by the analogy of existing institutions elsewhere; (2) there are two general types of marine biological establishments, (a) field stations, usually small buildings used for portions of the year and without permanent staff, having a useful function in the provision of undergraduate courses, and (b) marine biological laboratories, larger more fully-equipped buildings in full-time use and with their own scientific staff, offering good facilities both for research workers and for student courses; and (3) future developments should aim at providing two large marine biological laboratories in Ireland, one on the east coast and the other on the west. An expansion of the existing facilities at Portaferry and at Carna could fulfill this purpose. It was recommended that a joint letter from the representatives attending this meeting be prepared, setting forth these views. The letter would be sent to appropriate university and government authorities in Eire and Northern Ireland.

Various possibilities concerning closer cooperation in teaching marine biology were considered. Special emphasis was given to joint courses in specialized marine topics at the senior undergraduate or "post-graduate" level, perhaps following the successful pattern established by the Nordic Council (see ESN 19-5, 79). This would involve the cooperation of staff from the various Irish universities as well as provide for the use of outside specialists in the various fields. It was agreed that this would require rather careful planning to coincide with established programs within the universities.

The proposal to exchange students and staff for the various undergraduate courses in marine biology was enthusiastically received. Other possible ways of cooperation include the pooling of funds to enable visiting lecturers to be brought to Ireland to deliver lectures, the circulation of conference reports, and the offer by the Zoological Station, Naples, of unused table space to be used by other institutions.

To facilitate the exchange of data, it was suggested that a common system of keeping fauna records might be desirable. Professor O'Ceidigh (University College, Galway) and Dr. Boaden (Queen's Univ., Belfast) agreed to draw up a scheme for further consideration.

The second meeting was held on 25 Sept. 1966 at the Marine Biological Station, Port Erin, Isle of Man, following the regularly scheduled meeting of the Challenger Society. A considerable number of institutions are at present working on biological, chemical, physical, or geological problems in the Irish Sea or are planning such work. It has been suggested that an improved exchange of information on programs in this area might result in more effective cooperation between different laboratories and avoid wasteful duplication of sampling.

Existing programs in the Irish Sea were briefly summarized as follows: Marine Biological Station, Port Erin, Isle of Man: Chemical hydrography has been concentrated in a region near Port Erin on a transect across the Irish Sea along 54°N. Studies on plankton distribution, migrations of herring, and on the scallop fishery have been confined to the region within about 25 miles south of Isle of Man. Other work has included studies on burrowing amphipods in the littoral and shallow water around the Isle of Man and, to a lesser extent, in the sandy areas around the periphery of the Irish Sea and investigations by diving of bottom fauna and algae in the sub-littoral zone south of the Isle of Man. A new research vessel should be in operation in 1967, and numbers of both staff and research students are expected to increase. Extensions of the hydrographical and plankton surveys into St. George's channel are planned, and the herring

investigations will be extended further beyond the Isle of Man.

Marine Science Laboratory, Menai Bridge: Surveys of chemical hydrography, phytoplankton and zooplankton, and benthos have been concentrated in an area within 10 - 12 miles of Anglesey to the north, 20 miles to the west, and south to the north end of Cardigan Bay, including the release of current drifters in the same general area. Studies on the acoustic and other properties of sediments of the Irish Sea have been in cooperation with departments at the Universities of Durham and Birmingham. The new vessel, expected to be operational in 1967, will increase the frequency of plankton surveys (with high-speed nets) and the benthic surveys will gradually be extended southwards to cover all of St. George's Channel. This will include detailed productivity studies in Caernarvan Bay or Tremadoc Bay and direct measurements of currents at different depths.

Queen's University, Belfast: Research at the Portaferry field station is limited to Strangford Loch and up to six miles offshore. At the present time it is restricted to studies on interstitial fauna, crabs, scallops, and parasitic copepods. Plans are underway for a permanent staff and an extension of the facilities at the field station.

Fisheries Division, Dublin: Present investigations include those on whiting, plaice, nephrops, and, to a lesser extent, sand-eels and sprats. Two ships are working, largely in the Irish Sea, and space is frequently available on these ships for visiting scientists.

Fisheries Experimental Station, Conway: The laboratory has a general interest in all shell fisheries (molluscan and crustacean) on the English and Welsh coasts. These include projects to survey scallop beds off west Wales, distribution of nephrops between the Isle of Man and Cumberland, supervision of industrial pollution off Cumberland, and the rearing studies at Conway on several species of marine invertebrates.

University College, Swansea: Present efforts are limited to a survey of fauna and algae, largely restricted to the north coast of Bristol Channel to Pembrokeshire Islands. It is expected that a hydrographic oceanographer will be appointed to the staff.

University College, Aberystwyth: Largely in collaboration with the group at Menai Bridge, studies are being continued on the hydrography and geology of Cardigan Bay.

Department of Oceanography, Liverpool: Research includes studies on currents of Liverpool Bay, mixing and turbulence off Anglesey, and current measurements from induced electric currents in submarine cables. Direct measurements of water currents in these areas are necessary for calibration. Individuals within the Civil Engineering Department are working on sediment transport in Liverpool Bay, and members of the geology staff are interested in the floor of the Irish Sea.

Lancs. and West Seafisheries, Preston: This group is interested largely in the area from Solway to south of Cardigan Bay. A new laboratory has recently been completed, a marine biologist appointed to the staff, and one ship is available. Future studies will involve the effects of sewage and industrial effluent, especially in estuaries and surveys of littoral flora and fauna before and during discharge of effluents.

Fisheries Laboratory, Lowestoft: Interest in flatfish rearing continues concomitant with studies of existing stocks and recruitment of plaice, especially east of the Isle of Man. Nutrients of the area, including horizontal and vertical distribution, are being studied in addition to the use of anchored stations and bottom and surface drifters to obtain data on water movements. They are also involved in regular monitoring for radioactivity in the Irish Sea.

Department of Geology, Birmingham: The studies of this group include gravimetric, magnetic, and seismic surveys of St. George's Channel (with Cardigan Bay) from chartered vessels, extending south of Ireland.

Department of Geology, Durham: A seabottom gravity survey of the north Irish Sea from chartered vessels is nearing completion.

Department of Geodesy & Geophysics, Cambridge: Efforts within this Department are restricted to studies on the geological structure to the edge of the continental shelf, largely to the north and south of Ireland. It was suggested that the R/V John Murray was not being used to capacity during the winter months.

University College, Dublin: At the present time surveys of planktonic copepods and amphipods are being continued.

Tidal Inst., Birkenhead: The studies

are primarily concerned with separation of tidal and non-tidal variations in level and currents, but there is considerable interest in all forms of current measurement.

Dale Fort Field Centre: Studies largely coastal, including effects of industrialization on coastal waters.

Admiralty, Hydrographic Department: Occasional surveys of depth, gravity, and magnetism.

In the discussion which followed the resumés, it was agreed that biologists, hydrographers, and geologists should be better informed of each other's activities and of plans in the Irish Sea and that there should be some machinery for periodical exchanges of views between the various disciplines. It was asked that these views be conveyed to the committees of the National Environment Research Council and the Challenger Society and that the latter consider the suggestion that half a day of most regular society meetings should be set aside for informal discussions on programs and projects in the general area of the host laboratory.

It was suggested that a colloquium on the biology and hydrography of the Irish Sea should be arranged to take place in Birmingham in December 1967 at the time of the geological symposium now being arranged and that the British National Committee on Oceanic Research (within the Royal Society) should be asked if they would be interested in organizing such a meeting.

Attention was drawn to the recent formation of the Irish Marine Sciences Convention, whose first annual meeting will be held in Dublin, 25 February 1967.

This author is not the first American scientist to visit Ireland to view developments in the marine sciences. Previous reports (ESN 19-10, 166) have reviewed the potential for the development of marine biology, fisheries, and oceanography there. The laboratory which was considered for the West Coast over five years ago is still only a subject of discussion, and within the university circles, the continued delay is attributed solely to the reluctance of the fisheries biologists to leave the cosmopolitan comforts of Dublin for the rural beauty of the Galway coast. Thus, while the two recent meetings could represent a significant effort toward the development of these disciplines in Ireland, it remains to be seen whether they represent a positive step or just another discussion in a prolonged delaying action.

Scientific research within the Irish Sea may be visualized as a miniature replication of the numerous marine biological-oceanographic ventures throughout the world. Successful efforts toward cooperative planning, joint utilization of facilities, and improved means of exchange of information at the level of the individual researcher should certainly be a major contribution toward the scientific exploration of the Irish Sea and, conceivably, provide a working model of an interdisciplinary approach which other larger groups could profitably emulate. (J.D.Costlow, Jr.)

## Marine Biology - International Journal on Life in Oceans and Coastal Waters

At the recent First European Symposium on Marine Biology, Helgoland, Germany, Prof. Otto Kinne, Director of the Biologische Anstalt Helgoland and host for the Symposium, commented on the fact that the gap due to the absence of an international journal devoted to the study of life in oceans and coastal waters will soon be filled. Kinne has been invited by Springer-Verlag (Berlin, Heidelberg, New York) to organize such a new journal. He will meet with their representatives in the near future to consider the details, and hopes to have the first issue out sometime in 1967.

As Kinne views the new journal, its scope will include marine zoology (including fisheries biology), marine botany, and marine microbiology (bacteria, fungi, blue-green algae). Papers on physical, chemical, or geological oceanography will only be included if they are immediately pertinent to marine biological problems. The view was expressed that purely taxonomic studies would be better included in journals primarily devoted to systematics. Articles in English, French, and German will be considered for publication and, assuming that the technicalities can be overcome, manuscripts in Russian will also be welcomed.

In considering marine zoology and marine microbiology, the following aspects seem to be of particular interest:

(a) Ecological dynamics: Production, transformation and decomposition of organic matter; food chains; energy flow and balance; population dynamics; ecosystems; biological oceanography; organic resources of the sea; water

pollution problems.
(b) Experimental ecology and physiology: modifying effects of environmental factors upon tolerances, rates of metabolism and activity, reproduction and other functions, as well as on external and internal structures. Mechanisms of regulation (e.g., volume-, ion-, osmo-, turgor-regulations) and adaptation (genetic and non-genetic).
(c) Distributions, zonations, communities, etc.
(d) Cultivation, life histories and diseases of ocean and coastal water living organisms.
(e) Biochemistry, genetics and evolution
(f) Methods and apparatuses employed in marine biological studies.

Kinne expressed high hope that through the composition of the Board of Editors and Advisors, a high professional standard and truly international character may be initiated and maintained. The editors will be fully responsible for manuscripts accepted and edited by them. Each editor shall, in agreement with the editor-in-chief, select one to four members of the Board of Advisors. This Board, composed of perhaps some 30 individuals chosen to represent adequately the various scientific fields covered by the journal, will be consulted by the editors regarding the scientific merit of the manuscripts submitted.

In replying to the comment, "Oh no, not another journal," Kinne pointed out the two major factors which have convinced him of the genuine need for a journal such as is contemplated. First, his present efforts in organizing Marine Biology (a comprehensive, integrated multi-book treatise on life in oceans and coastal waters) have presented him with numerous inquiries concerning such a journal. Secondly, a study of marine biological journals presently published has revealed that there exists a total of 45 such journals; 40 of these are "station journals," issuing publications of individual marine laboratories; three are review journals; and two are regional or national in character.

Kinne, as editor-in-chief, stresses his intention to pass along the responsibility for the journal, as well as the contents thereof, to the individual editors. In this way he hopes to avoid the charge, heard from time-to-time, that editorial boards are composed more for prestige than for productivity. It is to be hoped that he succeeds in achieving prestige in fact as well as in name. (J.D. Costlow)

## PHYSICAL SCIENCES

### Microwave Spectroscopy in Bangor

Prof. John Sheridan is well known for his research on microwave spectroscopy of gases (Annual Rpts of the Chemical Society 1963, 60, 160). He first became active in millimeter wave spectroscopy during the late 1940's while serving on the staff of the Physics Department, Duke University, under Prof. Walter Gordy. After returning to England, he was for some years a Senior Lecturer in Chemistry at the University of Birmingham. Two years ago he became the Professor of Physical and Inorganic Chemistry at University College of North Wales in Bangor.

Univ. College of North Wales received its Royal Charter in 1885. It is located on a magnificent site on the ridge to the north of the valley in which the old town and the cathedral lie. Bangor was the site of the Celtic religious and learned community, founded perhaps in the sixth century. Archaeological evidence of the remote past still exists in the College park.

Since the end of WWII, the rate of expansion in Bangor, as elsewhere, has been far greater than in any previous period. Student members have increased from 500 in 1946 to 2000 in 1966; the academic staff, including 33 professors, numbers 235. All science departments have acquired extensions and new buildings; the Chemistry Department is located in a new six-to-eight story building of modern architecture.

At Bangor, 60 students receive undergraduate degrees in chemistry each year, and there are about 20 chemistry graduate students. Sheridan says that most of this efforts in Bangor have been directed toward building up instrumentation and personnel for a strong group in spectroscopy. Dr. Peter Curnuck, also a chemist, accompanied Sheridan from the University of Birmingham and is a key assistant for the experimental program.

Sheridan bubbles with excitement over the promises to spectroscopy o offered by our advancing technology. He is planning experiments on hyperfine structure that require sources which are highly stabilized, dreaming of measurements on previously unreported molecules with instrumentation having excellent amplitude sensitivity, and planning to have available instrumen-

tation for covering all frequencies from microwaves through infrared. The availability of on-campus computer services at Bangor is also exciting to Sheridan. He says that the productivity on computing molecular structures is so vastly improved by computers that his whole outlook has been changed on the classes of molecules that can now be analyzed through spectroscopy. Above all, Sheridan is working toward the availability of instrumentation with which the inexperienced chemistry graduate student can reliably obtain "state of the art" spectroscopic data.

Most of the current spectroscopy is done in the frequency range of 8-40 Gc, but Sheridan plans to completely overlap the gap between microwaves and infrared through use of the best available millimeter and submillimeter wave techniques. In addition, a new Perkin-Elmer Type-225 spectrometer is being used which permits infrared measurements to be made for wave-lengths as long as 0.05mm. Infrared data are being used in combination with microwave data to study effects of interference in the rotational lines caused by various vibrational states.

Spectroscopists desire to span the gap between microwaves and infrared because of the common and exasperating experience that "the all important" line always seems to fall outside the available coverage of one's instrumentation. If good millimeter and submillimeter data were available, more could be learned about molecules previously studied with microwaves. For example, studies of centrifugal distortion, in general, require data from rotational transitions that are widely separated in frequency. The availability of a wide frequency coverage can, in effect, also serve as an isotopic separator. For example, rotational lines for the various isotopic species of a molecule are separated more for the high rotational transitions than for the low ones. Small detailed effects are often far more pronounced in one region of the spectrum than they are in another. It is sometimes of interest to study effects of nuclear quadrupole splitting at the lower rotational transitions of a molecule, but it may also be desirable to subdue these effects; this can be done by studying the high rotational transitions that often are at millimeter or submillimeter wavelengths.

For some years Sheridan's millimeter and millimeter wave research has been partly supported by US Air Force grants. While wavelengths near 1 mm have been used by a few microwave laboratories (Phys. Rev. 135A, A295, July 1964), the techniques have been largely empirical and have been sufficiently erratic to prevent their wide adoption. To obtain short-wavelength radiation, Sheridan and others have generated harmonics of a fundamental frequency in a point-contact diode, and another diode is also generally used for detection. Spectroscopists usually use driving powers of approximately 100 mW obtained from a klystron operating in the 1-cm wavelength region. Although the spectroscopy, per se, does not require much power, the high power is required for good efficiency in generating harmonics. Unfortunately, diodes are sensitive to burn-out and degradation in performance at these power levels. Also, millimeter-wave diodes with point-contact geometry have extremely small dimensions and fabrication is difficult to control (Proc. IEEE 54, 575,(1966)). Because of these difficulties, Sheridan previously directed a good bit of effort toward the fabrication of diodes in order to obtain better and more consistent control of the generation and detection of harmonics.

In spite of the problems with harmonic generation, it has the advantage that expensive and generally unavailable sources of power at very short wavelengths are not required. Another advantage is that for a relatively small tuning range at the fundamental frequency, a very wide and continuous band of frequencies is accessible. This is so because a reasonably small tuning range at the fundamental source frequency can be sufficient to sweep one harmonic into the band swept by the next.

Sheridan has apparently abandoned further attempts to scale down the size of harmonic generators in his effort to cover the submillimeter region. He is now developing a system based on the Froome-type harmonic generator that consists of a metal-plasma junction. Harmonics at over 1000 Gc have already been detected with such a device (Jnl.Sci.Instr. 40,225 (1963)). Sheridan plans to drive the generator with either a 4-mm or 2-mm Carcinotron that will be frequency stabilized.

A Froome-type harmonic generator is being fabricated in Bangor in accordance with designs obtained from Dr. P.H. Knapp of Queen Mary College,

London. Knapp has used such a generator in conjunction with a 10 to 20-w klystron, and has found evidence that considerably more power could be usefully employed. When using a Golay cell detector, a signal-to-noise ratio of about 10 has been obtained for the 20th harmonic (0.43-mm wavelength) at Queen Mary College (Proc. IEEE 54, 528, 1966).

At conventional microwave frequencies, a substantial effort is being directed toward the study of relatively complex planar molecules. Sheridan says that these molecules are a dream to work with experimentally, because their large electric dipole moments cause the absorption lines to be very strong. The molecules produce many lines, but they are easy to analyse now that substantial computer time is available locally. According to Sheridan, asymmetric rotors that require calculations so complex that they would have never been considered prior to the advent of computers are now being handled on a routine basis. (M.W.Long)

## Commercially Available Submillimeter Wave Spectrometers

Interference spectroscopy, or Fourier transformation spectroscopy, is a modern infrared detection technique that is becoming widely used in the submillimeter region. In this technique the radiation from an incoherent source is divided between two beams, and a variable path delay is introduced in one of the beams. The direct output of the spectrometer as a function of path delay is called an interferogram. The power spectrum can be obtained from it by Fourier transformation, which is usually performed on a digital computer. The principal advantage of interference spectroscopy is that for each spectral element, the integration time is the full recording time of the interferogram; thus, the signal-to-noise ratios available with interference spectrometers are higher than are those available with grating spectrometers. Therefore, for a given source and detector, improved frequency resolution can be obtained with interference spectrometry.

Two companies -- Sir Howard Grubb Parsons and Company Ltd., Walkergate, Newcastle upon Tyne 6, England, and Research and Industrial Instruments Company, 17 Stannary St., London, SE 11, England -- have been marketing interference spectrometers for two to three years. Details have, of course, changed over that period, but the basic design criteria were evolved from specifications originally supplied by Dr. H.A. Gebbie of the National Phsycial Laboratory, Teddington. Both companies have spectrometers that cover the range 10-500 $cm^{-1}$ (1 mm-0.02 mm). Each instrument contains a mercury lamp source and a Golay cell detector, and the outputs are suitable for feeding a digital computer. Maximum theoretical frequency resolution of an instrument is equal to the reciprocal of the maximum difference in beam path-lengths. However, attainable resolution is limited by various other parameters such as marking intervals (sampling rates), drive uniformity, available source power per unit bandwidth, and detector sensitivity. Based on various specifications supplied by the manufacturers, I would guess that fractional resolution, depending on the model selected, is between 10 to 30 and 50 to 150 for wavelengths corresponding to 1 mm and 1/10 mm, respectively.

One manufacturer features a supplementary unit consisting of an analog Fourier transform computer at an additional cost of about $17,000, and the other manufacturer features direct teletype communications to the main plant where digital computing services are available at a nominal cost. The cheapest instrument sells for slightly more than $10,000 and the more expensive unit is sold for about $30,000. Although the instruments are far from being fool-proof, they certainly represent a major step toward the submillimeter region becoming one of the best instrumented for spectroscopy. (M.W. Long)

## Services Electronics Research Laboratory, 21st Anniversary Open Days

For the first time in 21 years, the Services Electronics Research Laboratory (SERL) at Baldock, Hertfordshire, opened its doors to the public and presented a detailed status report on its unclassified research on 14 and 17-18 October.

SERL was founded in 1945 by combining several teams which had been working for the Admiralty during WWII on microwave valves and other vacuum tube devices. The laboratory specializes in active components, originally valves and gas discharge devices, but in recent years solid state devices have been emphasized.

Semiconductor research at SERL mainly involves the III-V compounds. The laboratory has made major contributions ranging from refining the liquid encapsulation technique for pulling single-crystal GaAs to advanced optical rangers, scanners, and communication links using carrier injection light sources and lasers made from advanced epitaxial III-V structures.

Molecular gas discharge laser research was pioneered at SERL by the investigation of nitrogen (L.E.S.Mathias & J. Parker, Appl. Phys. Letters 3, 16 (1963)). Water was extensively investigated (A.Crocker, H.A. Gebbie, M.F. Kimmittee, L.E.S. Mathias, Nature 201, 250 (1964)) and some 150 lines were characterized. Recent work (IEE.S. Mathias, A.Crocker, M.S. Wills, Electronics Letters 1, 45, 1965)) has identified even more spectral lines in compounds involving hydrogen, nitrogen, and carbon. Several $CO_2$ lasers were operating at the open house, and considerable emphasis is being placed on both improving and using this remarkable 10-$\mu$ source.

Research on ion implantation was demonstrated. Metal masks are used to provide geometrical resolution, and junctions in Si and Ge have been made with reasonable electrical properties after annealing. The consensus was that the value of this method will not have been demonstrated until ion implantation is utilized to make p- and n-type regions in a material (such as II-VI (ZnSe)) which has doping difficulties.

Major progress has been made in power capability of broad-band traveling wave tubes which can be achieved by mounting these slow wave structures on BeO (high thermal conductivity) supports. Present project goals are 5 kW cw in the 6 GHz band.

Recently the British press has given extensive coverage to the SERL research on neutron radiotherapy as an alternative to X-ray therapy (P.D.Lomer & D.Greene, Nature 198, 200; and D.Greene, Nature 202, 204 (1964)). The development of high output neutron tubes ($10^{11}$/sec to $10^{12}$/sec) by SERL is the key to this exciting medical advance.

Visitors to the open days were met at the railroad station, escorted to the registration point, and left to find the well-marked exhibit areas. One interesting bit of information overheard in the halls was that a special open house was held for VIP's (Valve Industry Personnel). At each experimental site senior professionals were present to discuss the research. Live demonstrations were given whenever possible, and a short printed technical description was given to the visitor.

Should the reader desire more detail on the SERL programs, an ONRL Conference Report on the open house is forthcoming, and an article by M.S. Wills (Bul. Ins. Phys. & Phys. Soc. 17, 283 (1966)) would be useful. (P.D.Maycock)

International Conference on Luminescence, Budapest

Luminescence is one of the oldest phenomena of solid state science, going back in its early beginnings into the last century, long before any understanding of solid state effects in the modern sense of the word was even indicated. This long history and the fascination it always held for the applied scientist might possibly explain why it has been so susceptible to the "cook-book" approach, and is only gradually evolving from this stage. Possibly influenced by the big strides in which the understanding of recombination radiation is progressing, the field has taken a definite turn and the Budapest Conference testifies to this effect.

Numerous International Conferences on Luminsecence have been held in the past, the very first one on a large scale in Oxford in 1937. There was even an International Symposium on the subject in Hungary before, in 1961. The International Union of Pure and Applied Physics came into the picture in 1963, giving for the first time the Conference in Torun, Poland its truly international air. The Budapest Conference, held during 23-30 August 1966, was only the second one of the IUPAP-sponsored meetings.

The attendence was correspon ingly international. Over 400 people came from 28 different countries, counting the Federal Republic of Germany, the German Democratic Republic and West Berlin as separate countries, as is customary in this part of the world.

The 300 contributed papers were presented in a way that was novel, at least to this referee. Approximately 10-15 papers were arranged in a topical group and a scientist of international reputation reviewed and summarized these papers in a lecture of appropriate length. A discussion period followed, in which the authors them-

selves could elaborate on details and answer questions from the audience. All papers had been distributed in full length with illustrations at the beginning of the Conference, so that it was possible to go to the respective sessions well-informed. With one exception, the referee's spoke either English or Russian, and the text of each lecture was projected in the alternate language on a screen. If the quality of projection would have been better, this approach would have been superior to simultaneous oral translation.

This system of presentation of the contributed papers worked very well and gave the feeling of more internal coherence in a group of papers than is ordinarily experienced. The sessions would have been even more useful if more time for discussion had been available, but it was already necessary to hold up to four parallel sessions in order to deal with the huge amount of information. The field seems almost too big to be reviewed in one conference only. Future meetings may very well be split into smaller sub-groups of luminescence.

The President of the US National Academy of Science, Prof. Frederick Seitz, opened the Conference with a lecture on the "Future of Solid-State Science." He recalled in the beginning his personal attachment to Hungary through his teacher Wigner, and described how he had on the preceding day visited the house to which he had addressed so many letters during the vacations that Wigner was at home in Budapest. It was this life-time interest in solid-state science and his eminent contributions to the field that made Seitz's speculations on the future of this field so interesting, although somewhat saddening. Starting out from science in a broader sense, he divided it into interpolative and extrapolative science, and pointed out that many of the most significant extrapolative steps in science came out of studies that were initially intended to be interpolative. Seitz predicted that there will be a tendency in our society in the future to place an increasing difference in value on interpolative and extrapolative work, similar to the attitude that has long been applied in industry when supporting the two types of work. One compelling reason for this trend stems from the fact that, even at the university level, society begins to recognize the distinction between "little science" and "big science" and the threat that originates from the fact that "big science" could easily spend any fraction of the national budget made available.

So far solid state science has been an exception to the trend toward "big science" by still offering profitable exploitation of the field through the techniques of "small science." This is gradually being changed, however, and more and more extrapolative work is being identified with big science, as in other fields. In spite of all the large magnetic and cryogenic facilities available to some groups, it is evident that solid state science as a whole is becoming more and more interpolative and less and less extrapolative. Comparing science with a mining operation, Seitz clearly indicated that the times are past when only very rich deposits were exploited. To the past generation, only the major principles were of chief intellectual interest. Now, solid state science is characterized by an enormous growth of interest in the practical consequences, and the apparently leaner aspects of the field come to have increasing importance.

After a brilliant historical survey of the whole field up to the latest accomplishments, Seitz concluded his lecture by analyzing his own experiences over this period. He expressed his amazement over the tremendous growth of interest in detailed facts of solid state science, although it seems evident that there are very few outstanding mysteries extant at present and the field most certainly is no longer in its infancy. Coming back to his picture of the mining operation, he expressed his feeling that there is still some valuable ore left, but that it can be exploited only by methods tailored to make profit even from leaner minerals. Seitz's account of the future perspectives of solid state science was one of a series of introductory lectures. G.F.J. Garlick (Hull University, England) presented a review of luminescence centers in solids and V.L. Levshin (Moscow Univ., USSR) summarized the processes of energy transfer in the physics of inorganic crystal phosphors.

After this series of introductory lectures, the Conference broke up into four separate but parallel sessions, on general problems of luminescence,

the luminescence of organic and amorphous materials, the luminescence of inorganic materials, and special problems in luminescence. Since this writer is even more a stranger to the luminescence of organic and amorphous materials than to the rest of the field, he neglected this series in favor of others. The invited papers gave the impression, however, of the rapidity with which this field -- possibly the most susceptible to the cook book approach in the past -- is emerging from this stage and striving for theoretical models and interpretations.

The sessions on inorganic materials dealt with the luminescence of halogenides, sulphides and oxyphosphors. A brilliant lecture by H.Pick (TH, Stuttgart) reviewed progress in the field of the alkali halides, possibly the best understood part of the whole field. In particular, the application of electron resonance techniques has greatly improved the identification of the active centers, establishing model cases for the possible combinations in which disorder can perturb the ideal arrangement of the lattice. The basic processes which lead to luminescence seem better understood in the case of the color centers than in any other luminophor.

The studies on sulphide phosphors seem to offer greater difficulties, because the centers are less well defined. Studies of the emission, in particular at low temperatures and with respect to the degree of polarization, appear to open this field to theoretical interpretation. The difficulties are still formidable, however. In ZnS, for instance, years of work have been invested in establishing the mechanism of pair-luminescence, only to see the final proof of such mechanism being established in "easier" materials, such as GaP. Borates, oxides, halophosphates and other oxygen-dominated luminophors represent the subgroup of inorganic materials in which the fundamental processes are least recognizable at the moment.

The fourth big group dealt with special problems in luminescence, including the rare-earth activated luminophors and electroluminescence and injection phenomena. The application in lasers places strong interest in the rare-earth activated materials, with inorganic as well as organic substances as host lattices. The well-defined states of the rare-earth ions result in precisely structured spectra, which can be interpreted satisfactorily. Electroluminescence and injection phenomena also receive their backing from the application in light generation. The crucial problem here is the production of pn-junction as a well-defined source of injection. The basic mechanisms seem best understood in the materials in which the preparation of pn-junctions is possible, and further progress will largely depend upon refinement in the art of preparation. Electroluminescence is at its very best in the studies of pair-luminescence in GaP, as pioneered by M. Gershenzon and co-workers at the Bell Telephone Laboratories. The well-defined emission spectra, interpreted on the basis of pair-recombination of impurities at different lattice sites, seems to establish something like an "ideal" luminescence physics - a model case, on which the field could orient itself, if every material would have the convenient properties of GaP.

The organizers of this Conference in the Hungarian Academy of Science deserve credit for an organization which functioned very well in the technical as well as the social aspects of the gathering. Very little could be improved upon and their efforts in translating and distributing the pertinent material in time were exemplary and must have required a tremendous amount of work. They hope to have the full Proceedings ready early in 1967, published by the Hungarian Academy of Sciences. (B.O.Seraphin)

## PSYCHOLOGICAL SCIENCES

### International Conference on Applied Military Psychology

This Conference, the third in a series sponsored by the Office of Naval Research, was held in London, 3-7 October 1966. Representatives from military psychology programs in Denmark, Germany, Great Britain, Israel, the Netherlands, Norway, and the US, participated in a five-day period of extensive discussion of three problem areas. The agenda included consideration of non-cognitive factors in personnel selection, training of military personnel, and the impact of psychology on the military services.

Participation was limited to two delegates from each country occupied with full-time in-service military psychology programs. The focus of the Conference was on a review, discussion,

and critical evaluation of research methodologies, techniques, and fundamental issues arising from the agenda items. Position papers were prepared in advance and distributed to the delegates, but were not read at the meetings. The program was organized in such a manner as to facilitate spontaneous discussion and exchange of ideas in an informal atmosphere. In essence, the primary purpose of the Conference was to provide a platform for discussion on applied military psychology problems which is not available through the usual professional meetings and congresses. In order to encourage spontaneity and freedom of expression in a potentially sensitive area such as applied military psychology, no formal report or summary of the proceedings will be prepared. However, on the basis of the comments by the participants, it would appear as if this form of international gathering did, in fact, achieve its purpose. (J.E.Rasmussen)

## NEWS AND NOTES

### Upwelling?

Within the past fewweeks several oceanographers in the UK have commented to this author on an interesting phenomenon which has been observed to the north of England. Mr. R.I. Currie, newly-appointed Director of the Marine Station, Millport, Scotland, has also assumed the responsibilities of the Secretary of the oceanographic section of the International Union of Biological Sciences. Dr. Harold Barnes, also of the Millport Laboratory, was designated Chairman of the European Association of Marine Biologists which was created early in October at the First European Symposium on Marine Biology, Helgoland, Germany. Mr. R.S. Glover, Director of the Oceanographic Laboratory, Edinburgh, has been the Chairman of the subcommittee on Productivity in Marine Communities within the British National Committee for the International Biological Program. Speculation has centered on whether this concentration of productivity within a fifty-mile radius in Scotland could represent random distribution or if it could be attributed to upwelling. (J.D.Costlow)

### New High Field Microscope to be Produced in England

Associated Electrical Industries (AEI) has six months of support in the form of a contract from the Ministry of Technology to take the prototype of Dr. Cosslett's 1-MeV electron microscope in to production. Options to buy have been placed by AERE, Harwell, the National Physical Laboratory (NPL) and other laboratories. This is an attempt to cash in commercially on the vast amount of scientific knowledge in this field available in the UK and to compete effectively with the Japanese in this area. Because, with a prototype available, the investment is relatively small but the sales potential quite reasonable, this is one of the areas the Ministry feels worth stimulating. (J.B. Cohen)

### North Sea Pollution

Professor Dr. Otto Kinne, Director of the Biologische Anstalt Helgoland, Germany, has scheduled the 1967 International Symposium to celebrate the 75th anniversary of the Station. The Symposium, September 19 through 21, will emphasize "Biological and Hydrographical Problems of Water Pollution in the North Sea." As presently planned the general topic will be introduced by two invited speakers, one dealing with the general aspects concerning biological problems and the other, hydrographical problems. Submitted papers will be limited to 20 minutes, followed by a discussion period of 10 to 15 minutes. Selection of papers to be presented will be based on the pertinency to the general topic and, if necessary, the date of submission. Abstracts, to be distributed prior to the symposium, should be submitted before August 31, 1967. The papers, as well as the discussions, will be published in the Station journal, "Helgolander Wissenschaftliche Meeresuntersuchungen." Simultaneous translation in English, French, and German will be available for all papers.

Individuals interested in further details of this symposium should contact the Director, Biologische Anstalt Helgoland, 2 Hamburg 50, Palmaille 9, Germany. (J.D. Costlow)

### Miscellaneous

Agreement for a working association has been reached between the Royal Aircraft Establishment (RAE Farnborough, and the Univ. of Southampton. This will provide for collaboration in teaching, planning, and execution of research, and scientists from RAE will be co-opted on the university staff and given honorary university titles. It will enable RAE equipment to be made available to

university research workers and RAE staff to study for higher degrees at the University. The first joint research programs will be in the fields of theoretical and experimental aerodynamics, acoustics, structures, automatic control, and materials.

The sub-department of Cloud Physics at Imperial College, London, has recently closed, but most of the research scientists, with their equipment, have followed Prof. B.J. Mason to the Meteorological Office, Bracknell, where a new branch for Cloud Physics has been established.

Four new English universities have been inaugurated for the start of the new academic year: the Univ. of Surrey, formerly Battersea College of Technology; the Univ. of Bath; the Univ. of Bradford, formerly the Bradford Institute of Technology; and the City University, formerly Northampton College of Advanced Technology.

F.A. O'Niens, Manager of Satellite Communications for the Plessey Company, has been seconded to World Satellite Terminals, a consortium set up earlier this year by Associated Electrical Industries, General Electric Company, and Plessey to build and sell complete ground stations for communications satellites. He will hold the post of Chief Engineer and General Manager of this group.

Prof. A.S. Duncan, Executive Dean of the Faculty of Medicine at Edinburgh Univ., has been appointed to a new personal Chair of Medical Education at the University -- the first chair of its kind in Britain.

Dr. C.B. Wilson, has been appointed to a new post of Director of Building Physics in the Dept. of Civil Engineering, Edinburgh Univ., under Prof. A.W. Hendry.

Dr. Peter Swan has returned to England after six years with U.S. Steel's E.C.Bain Laboratory for Fundamental Research. He is Senior Lecturer in the Metallurgy Dept. at Imperial College of Science and Technology, London.

Dr. J.L. Livesey is now Professor of Fluid Mechanics at the Royal College of Advanced Technology (proposed Univ. of Salford).

Prof. C.R. Tottle of the Dept. of Metallurgy, Univ. of Manchester, is taking a Chair at the new Univ. of Bath.

Dr. C.A. Taylor, Reader in Physics at Manchester Univ., has taken a Chair of Metallurgy at Cardiff University.

Dr. M.M. Woolfson occupies the Chair of Physics at York University.

Technical Reports of ONRL

The following reports have recently been issued by ONRL. Copies may be obtained gratis by Defense Dept. and other US Government personnel, ONR contractors, and other American scientists who have a legitimate interest. However, because of the frequent content of proprietary and prepublication information, the reports cannot be sent to libraries or to citizens of foreign countries. Requests for ONRL reports should be addressed to: Commanding Officer, Office of Naval Research Branch Office, Box 39, Fleet Post Office, New York 09510.

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| ONRL-41-66 | Some Programs on Millimeter & Submillimeter Wave Spectroscopy in Europe by M.W. Long |
| ONRL-42-66 | European Nuclear Energy Agency: Its Functions & Background by J.W.Hemann |
| ONRL-43-66 | Fundamental Research on Materials at the Atomic Energy Research Establishment, Harwell by J.B. Cohen |
| ONRL-44-66 | Operational Guide to Synoptic Applications of Meteorological Observations from Satellites by A.D. Hamilton |

The following conference reports are releasable to European scientists:

ONRL-C-18-66, Int'l Symposium, Joint Services Electrical Power Sources Committee, 1966 by P.D.Maycock

ONRL-C-19-66, 1966 Symposium on Gallium Arsenide by P.D. Maycock

ONRL-C-20-66, Electron Microscopy in Metallurgy; Conference Sponsored by British Institute of Metals, 28-30 Sept 1966 by J.B. Cohen

ONRL-C-21-66, Tenth Int'l Conference on Low Temperature Physics (LT 10), Moscow by R.S. Allgaier

ONRL-C-22-66, 16th Meeting of Int'l Committee on Thermodynamics & Electrochemical Kinetics, Budapest by A.L. Powell

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