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(10) J. E. Rasmussen Victoria S. Hewitson

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EUROPEAN SCIENTIFIC NOTES

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

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Commander, USN
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AEROSPACE

SPACE RESEARCH IN ISRAEL

Work in space technology will probably have slight impact on Israel's pressing problems in this decade: pushing its green line further into the Negev, equipping and supporting its military services, or developing its industrial productive capacity. Ten years hence such work may well make quite substantial contributions toward just such objectives. Perhaps it is a realization of this potential that has stimulated the entry of this tiny nation, beset with so many diverting problems today, into the space technology research which can pay off only in the future. But then, as any visitor quickly learns, it is a country which looks always toward the future.

Israel has no NASA. The principal coordinating body is the National Committee for Space Research of the Israel Academy of Sciences and Humanities located in Tel Aviv. The Executive Secretary is Dr. E. Lahav, a knowledgeable gentleman with a capability of putting his finger on most space-related research in the country. Lahav is an organic chemist and is quite familiar with the US and our programs, having spent the years 1956-1962 as Scientific Counselor of the Israeli Embassy in Washington. The Committee is two-and-one-half years old and has only two assigned responsibilities: 1) to coordinate space research within the country, and 2) to represent the country internationally, i.e., to COSPAR, CNES, NASA, etc. It is significant that the Committee does not have an assigned responsibility for "stimulating" or "creating" space research. That would probably be too much. But the Committee definitely recognizes and its spokesman is quick to extol the potential benefits of space research in new materials and processes as well as in education and commerce. The Committee prepares an "Annual Report on Space Activities" which would most likely be available to interested readers. Some of the work described in the Report is directly in space technology: collection of data from weather satellites, preparation of sensors for planetary probes. However, other work is more general or only "space-related": for example chemical reactions in shock tubes and dynamic stability of conical shell structures. The total research program is estimated at about $2 million (US equivalent). The actual cost in Israel is probably half that since scientific labor in the country is cheap. Whereas, a research physicist costs in excess of $50,000 per year to support in the US, it is claimed to cost less than $25,000 to support the same quality man working in Israel.

Most space research in Israel is carried out by the universities. These splendid establishments have been described in several recent ONRL reports (e.g., see Epstein ONRL-34-66, Tyree ONRL-24-66, or Brennan ONRL-23-66). A few of the more interesting projects now underway which were reviewed during a visit in December 1966 will be mentioned.

Tel-Aviv University - The newest of Israel's universities at Ramat-Aviv boasts an "Institute of Planetary and Space Sciences." Its acting director is Dr. Uri Shafrir, a young UCLA-trained physicist. There are six PhD's in the Institute with five others working toward their degree there, and some fifteen technicians. The Institute has had a cosmic-dust research program since early 1965 working partly in conjunction with the Institute of Geophysics and Planetary Physics at UCLA. They have developed and fabricated thin foil collectors which have been flown as part of the NASA LUSTER Program on Gemini's 9, 10, and 12. (You may recall our astronauts lost this experiment in space during Gemini 10 -- it's still out there!) The collectors which were recovered are being analyzed by electron microscopy, measuring the size and shape of holes punctured in several layers of nitrocellulose film and examining the collected particles. The particles so far collected and analyzed measure 0.2 to 1.0μ with velocities of 11 to 72 km/sec.

Laboratory studies are being made at the Institute on hypervelocity impact of small particles on very thin foils by use of a shock-wave gun capable of velocities of 10 - 12 km/sec. Parameters measured are ratio of the initial impacting mass to the ejected mass, influence of velocity on ratio of particle size to the crater or puncture size on foils, and refraction of a beam of particles impacting at various angles less than 90°.

The Institute has constructed and is operating an APT readout station to work with US meteorological satellites, which were, at the time of my visit, Nimbus II and Essa II. The terminal was just being completed, employing a 7-turn, servo-controlled, helix antenna on the roof of the Institute, no preamp, a Nems-Clarke IF demodulator and telemetry receiver, and a Sony-#300A tape recorder. None of the electronic equipment was built in Israel. The facsimile equipment had not arrived, and until arrival Video pictures were being stored on magnetic tape. They were projecting IR pictures on a CRT. Signal strength was 5-8 mV without a preamp, noise level never higher than 1 mV.

Other work at the Institute involves experiments in plasma physics, fluid dynamics, and astrophysics. Space-related work in the Physics Department at Tel-Aviv University includes work on mathematical models for quasi-stellar sources and for an expanding universe in conformally flat coordinates. The Applied Mathematics Department is working on problems in the propagation of sound in rarefied gases, in the interaction of explosives with a surrounding elastic sphere, and in flows of shock waves in strong magnetic fields.

The Technion - Israel Institute of Technology, Haifa, conducts research in space-related technology mostly through its Department of Aeronautical Engineering under Prof. Joseph Singer. The work of this Department has been in such related areas as instrumentation for high altitude sounding rockets, wing flutter in supersonic flows, theoretical studies of MHD flows, and stability in conical and cylindrical shells.

An optical tracking facility established in association with the Smithsonian MOONWATCH program was in operation in the Department last year, under the auspices of the Israel Astronautical Society. Apparently, interest has waned since the facility was not very active. This seems unfortunate since the "seeing conditions" in the area are quite good. Dr. H.J. Shafer, one of several transplanted Americans in the Department, is working on a quick readout device for an optical telescope which will utilize an electronic pick off at the focal plane and magnetic tape storage. He is engaged in a tradeoff study of accuracy versus speed for such a device.

Prof. Moshe Zakai of the Department of Electrical Engineering is doing interesting work in information theory as applied to electronic systems. Research is in progress on probabilistic coding and decoding techniques, signal scattering effects from moving objects, tracking error analysis, theoretical effects of noise in nonlinear devices, and signature analysis of space radar returns.

Radio Observatory, Haifa - This quasi-governmental installation performs ionospheric research under the direct auspices of the National Committee for Space Research. The Director is Dr. Jonathan Mass. Several scientist-operators are on loan from the Technion staff. Support has been received since 1964 from the USAF Cambridge Research Laboratory. The station has utilized CW transmission from the NASA Ionospheric Beacon (S-66) to determine the ionospheric electron content and to study ionospheric irregularities. Reports on this work are available. The station expects to install a 1-20 MHz iono-sounder for the Israel Ministry of Posts (PTT). They are also interested in performing UHF work, particularly in doppler tracking and in studies of ducting phenomena at low antenna-elevation angles.

Hebrew University, Jerusalem - Prof. J. Neuman, ably assisted by Dr. Avraham Huss, directs an active Meteorological Department located in an old part of the city of Jerusalem, unfortunately for them and not at the splendid new campus on the western outskirts. The Department is doing excellent work on numerical weather prediction using many factors, and has performed some interesting cloud seeding tests intended, one presumes, to produce rain right up to, but certainly not over the border (or to use the local phrase "frontier"). They are working on measuring ozone concentrations above 50-km altitude; they have access to Tiros data from NASA which is in the process of being analyzed; and, to go even higher, Dr. I. Steuer, in a small workplace which looks like a high school physics laboratory of 1930 vintage, was proud to demonstrate his in-house-developed variable capacitance barometer designed for a Mars landing.

Dr. B.S. Fraenkel of the Physics Department (which does reside at the new campus) has made several important contributions to the identification of highly ionized atoms by differentiating lines in the far ultraviolet spectrum of the solar corona. This has been helpful to many American rocket spectroscopists, and work has been supported by the USAF OSR. Research is planned to extend the analysis to stellar coronae in the future. Fraenkel has mapped out a program to classify atomic lines according to the degree of ionization and spectroscopic transition for third and fifth row metals, using wavelengths from 40 to 500 Å. Attempts will be made to obtain all the coronal lines in the laboratory and correlate these with astrophysical data.

Ministry of Posts (PTT), Tel Aviv - Mr. Y. Levi, ex-Chief of the Army Signal Corps, is the Director General and Mr. Berman, Chief Engineer of this vital Ministry. Internal communications in Israel - like almost everything else in the country - has doubled in the last five years. This Ministry provides representation to Intelsat, and the country's interest in communications satellites is strong. At present only 17 HF telephone circuits connect Israel to the outside world, and at any given time 50% availability of these is the rule. Installation of their first cable, to France, will start early in 1967, finish in 1968, and provide 96 4-kc channels. Still they are most interested in communications in other directions and feel their country would be ideal as a communication satellite relay point. In discussions, the one point that seemed, not surprisingly, to fall flat was any reasonable hope for an area distribution system. Israel has asked for siting aid and technical communications satellite terminal advice from the ITU. This has not been forthcoming for administrative reasons, and the principals are now considering asking industry for technical assistance. (B.I. Edelson)

BIOLOGICAL SCIENCES

"TOWARDS THE BIOLOGY OF TOMORROW" THIS, OR A DEAD-LOSS?

EURATOM, the bulletin of the European Atomic Energy Community, carried a very thought-provoking article in its December, 1966, issue (Vol. V, No. 4, 98). The article, "Towards the biology of tomorrow," is part of an address by Dr. Raymond K. Appleyard, Director of Biology Services, Euratom. While one cannot do it justice in abstract form, it seemed sufficiently worthwhile to try in the interest of stimulating some to look up and read the entire address.

Modern concepts of physics and chemistry, having evolved from the revolution which has been occuring during the past sixty years, have eliminated the inhibition and mystery previously associated with the study of life. The incorporation of some of these concepts into biological research has led to a series of "astonishing discoveries" since 1934, including the detailed description of the physico-chemical structure of genetic material, the scheme by which it and derivatives control life processes, and the duplication of genes. These developments have led to a more complete merger of the biological sciences with the physical sciences, instilling a new facility and coherence into the teaching of biological subjects and permitting new and freer patterns of ideas and the convergence of thoughts and research efforts. The author contends that all of this must be viewed against the socio-economic background of our time with special emphasis on the role and responsibility of governments in the administration and control of "Society's surplus," be this surplus money, brains, or research. The investment in the future made through research varies from perhaps 1-2% of the gross national product in some West European countries to 3-4% of the American GNP. These vast expenditures on scientific research have had a number of effects already. Research has now become a career in itself, and, in some areas, has become dominated by 100% research institutes. Although the needs have never been greater, universities find themselves relatively handicapped by partial commitments to teaching, with the exception of those sufficiently large to have some staff devoted to teaching, others to research, and still others to portions of each, with the ratio varying during different phases of their careers.

If we accept the role of governments in setting the general trends by the magnitude of the allocations, we must also see that the task of allocating is well done. Comparing what the author calls "transforming power" of biological research with that of nuclear research, in view of relative expenditures, the long standing neglect of support for the former in terms equal to its importance should be corrected. In the event that this should happen, we must be prepared to accept responsibility for seeing that the necessary decisions are made with full and objective knowledge of the potentialities of the field and also recognize that the tremendous expansion which results will bring specific difficulties to the life sciences. One problem, and perhaps the most serious, is the supply of trained brains. If plans are to be made to increase this supply significantly within the next thirty years, the pattern of training and available opportunities for research in the realm of merged disciplines must be laid down now. One inevitable result will be "big science," programmed research, and geographically dispersed networks of related programs. It will be essential that these be adjacent to permanent, non-project research institutions so that mutual exchange of skills and men will be possible. We need to accept the concept that a man may spend a few years on loan to a project, a few with a little teaching and much research, and at the end of that period he (supposedly) will be better prepared to do more teaching and less research. In this way it should be possible to combine the professionalism and overall purposefulness that is needed in research with the close relation between teaching and research. The author comments on the need to achieve a correct balance between so-called basic and applied research, indicating that the distinction in its simplest form is naive, dangerous, and not exact. He suggests an intermediate zone, oriented research, where efforts would be directed toward shedding light on a group of problems rather than attacking them head-on. The old distinction has separated scientists into two camps and restricted and retarded necessary exchange of ideas and people and implementation of results.

The "fun-period," when new discoveries could be made with two water baths and a refrigerator, is now shortened or virtually vanished altogether. Research by teams, which change in composition to bring new ideas and techniques to bear on a problem, will continue to grow in importance. There is great need for cooperation of individual groups within a wider network, bringing into focus with the larger groups the efforts of smaller groups and thus realizing the fuller potential of all. A complex organization, not yet fully explored, will be required to assure a maximum of exchange of ideas and realignment of the "ad hoc" teams. If the concept, a research community, is not promoted in the life sciences, the present efforts will come to a dead loss "here in Europe."

In concluding the author suggests, to those who govern and to those who direct, that the life sciences be given the resources appropriate to their potential. At the same time emphasis should be placed upon equal recognition of all disciplines and those individuals involved in fundamental research, applied research, and teaching, insisting upon maximum freedom of movement of men and ideas and the encouragement of all institutions to engage in their full role of mutual help in the total network of the biological sciences.

In the U.S. the transformation to which Appleyard refers has been underway for some time, be it planned or accidental, and I'm sure that most biologists can recognize the particular stage which they, their research interests, and institutions have attained in the over-all development. From time to time one feels that the analysis of the total problem has not been as objective as would be befitting the scientific community. In many cases there has been a general reluctance among scientists to recognize that a transformation exists and to accept the frequently less than welcome and time consuming responsibility which Appleyard indicates is essential. While the "fun-period" may be in its twilight years, I would hope that the individual, to whom no reference is made, will not become extinct. We may have uncovered the physico-chemical basis for a number of isolated parts, but there is still the little matter of putting them together again, first as an integrated living being and then as a community. There undoubtedly will be those biologists who do not agree with Appleyard's analysis of the situation or his recommendations, but if not, they should (having first read the entire article) be prepared to offer an alternative in an equally logical fashion. This will not be easy. (J.D. Costlow, Jr.)

EARTH SCIENCES

OCEANOGRAPHY COMES OF AGE

The First International C gress on the History of Oceanography, recently held in Monaco, seems to have accomplished several things. First, assuming that such a basis was necessary, it established oceanography as a respectable are in which to conduct historical studies. A number of faculties in American universities are being set up for this purpose, and if only because the development of the subject has occurred largely within the last 100 years and virtually complete records are available, the subject is very suitable for examination at this particular stage in its evolution. Secondly, with the recent emphasis and expansion of offshore activities of a commercial nature, it would seem appropriate to re-examine some of the various techniques and hypotheses in the interest of providing clues which might assist in the solution of present day problems. The Monaco conference also provided an opportunity for the specialists in the more applied aspects of oceanography to meet with those who are more familiar with the historical aspects of the subject.

As with any detailed examination of "historic fact," a certain amount of debunking was to be expected. The professional historians have now come to the conclusion that Maury, the man generally credited with initiating oceanography in the US, was actually a career officer rather than a scientist (this apparently should make a difference?). The view was expressed that for the period, superior oceanographic studies were being carried on by Ferrel, with whom Maury disagreed. In attempting to find a lesson for today, the recent account of the meeting in the New Scientist selects the Challenger expedition of 1872-76. There is general agreement that the expedition established oceanography, especially in the geological and biological sciences. The article points out, however, that the money spent on the expedition was comparable with that supporting modern science projects and that the British Treasury was extremely difficult in its dealings with the chief scientist, W. Thompson. In concluding, the article suggests "those in the Treasury who today wish scientists to account for every penny should examine their true motives before they behave in a similar fashion."

From this author's point of view, historical analysis requires the same caution that statistical analysis demands. Otherwise, one may get the answer he was seeking in the first place. In so far as modern treasurers, scientists, and motives are concerned, a standard procedure involving a little consideration and responsibility on both sides would frequently go a long way. (J.D. Costlow, Jr.)

GREAT METEOR BANK

A recent article in the German Tribune (weekly review) discloses places for an "Atlantic Peaks Expedition, 1967" beginning on 11 January. The announcement was jointly made by Prof. Dietrich and Prof. Seibold at a combined meeting of the Hydrographic Institute and the Federal Research Association.

The research ship METEOR (named after the old ship METEOR which first explored this seamount in 1938) will support four rotating teams on this six months' expedition during which data will be collected for analysis by geodesists, geologists, geophysicists, oceanographers and marine biologists. It is expected that these analyses will consume five to ten years' effort.

Although emphasis in this area will be on geophysical studies, there are four other areas in which physical oceanography takes center stage, and the over-all program includes a broad spectrum of factors, e.g.: temperature, salinity, current, and bottom and sub-bottom profiles; an underwater television camera is also available on board. (Joseph E. Bennett)

AUTOMATIC PLANKTON SAMPLER

During a recent visit to the Port Erin Laboratory, Isle of Man, UK, Dr. D.I. Williamson described an improved model (Mark II) of the automatic plankton sampler which he designed several years ago. While the sampler should not be considered in the same category as the Hardy Plankton Recorder, it possibly would be a very useful tool in estuarine and marine research. If the weight is reduced as he expects by the use of plastics, it could be used by one man and a small power boat. If the cost is brought down to approximately $280.00, as expected, it would also be possible to consider the use of several samplers at different depths.

Williamson has provided a description of the modifications which are underway in the interest of bringing this information to the attention of ESN readers. Anyone interested in further details should write Williamson.
(J.D. Costlow, Jr.)

AN IMPROVED AUTOMATIC PLANKTON SAMPLER

A Mark II model of the automatic plankton sampler described in 1963 (Bull. Mar. Ecol., 6, pp. 1-15) recently has been developed. In both versions the towed instrument takes a series of up to 20 plankton samples, each of pre-determined towing-distance, without attention from the time of launching to the time of hauling. Each sample is collected in a small net, and methods of killing the plankton in the net are described in the 1963 publication. The plankton sampler may be used with a submarine depressor at any depth or without a depressor for sampling near the surface.

The prototype of the Mark I version has been in use since 1957, and a number of models have since been made, either as copies of the prototype or departing very little from the original design. This version has been sufficiently successful to establish the usefulness of this type of sampling apparatus, but it has a number of limitations. Experience gained with it has led to the design of the Mark II sampler which should be a more reliable and more versatile instrument whose weight and cost will each be about one-third those of the Mark I version.

The Mark I automatic plankton sampler is made of brass. A spring-loaded trap-door over each net can be held in a raised position by a catch; when the catch is depressed by a traveling cam, the door snaps shut to close off the net. A rotator towed behind the sampler operates through reduction gearing to turn a 30-inch lead-screw, along which the traveling cam slowly moves. Before the commencement of sampling, the traveling cam is wound to the front of the sampler and all the trap-doors are set in the raised position. As the plankton sampler is towed, water is diverted by the first door into the net below it. When its catch is operated by the traveling cam, this door moves against the stream of water, under the action of its spring, to close off the first sample in the first net. Water then passes over this door to be diverted by the second door into the second net, until the traveling cam operates the second catch, and so on. The length of each sample, of course, depends upon the reduction gear used; samples each of 4 sea-miles have most commonly been used with the Mark I plankton sampler, allowing a line of up to 80 sea-miles to be sampled without hauling the instrument. It has a sampling-aperture of 3/4-in^2, and is effective at towing speeds between 4 and 10 knots.

Some of the disadvantages and limitations of the Mark I automatic plankton sampler are as follows. At 85 lbs, it is inconveniently heavy for handling at sea on small vessels. At £250-300 ($700-840) it has proved too expensive for many interested planktologists, particularly those who would have liked several for such purposes as simultaneous sampling at different depths. Brass is subject to slight surface corrosion in sea water and careful servicing is necessary to ensure that corrosion patches do not form where they could interfere with the movement of the doors. The doors close against water pressure and this pressure is proportional to the square of the towing speed; strong springs are needed to close the doors even at moderate towing speeds, and any weakening of the springs with age leads to failures in operation; for towing speeds of 12 knots or more the springs would have to be prohibitively strong or the sampling-aperture drastically reduced. The reduction gearing gives the traveling cam large reserves of power, but the cam has no direct action on the doors (only on the catches), so that a door jammed open by a sand grain or corrosion will stay open when the cam operates the catch, and no samples will be taken by the subsequent nets.

The Mark II automatic plankton sampler should overcome all these disadvantages of its predecessor. Most of the instrument will be moulded in "fibreglass," with consequent great reduction in weight and elimination of corrosion. This method of manufacture also leads to a large reduction in cost, since the moulds used in the production of the prototype can be used for making further models relatively cheaply. In place of the trap-doors of the Mark I sampler, a type of cylindrical valve has been introduced (see Fig. 1). The stream of water, instead of opposing the movement of the deflecting plate from the raised to the horizontal position actually gives slight assistance to this

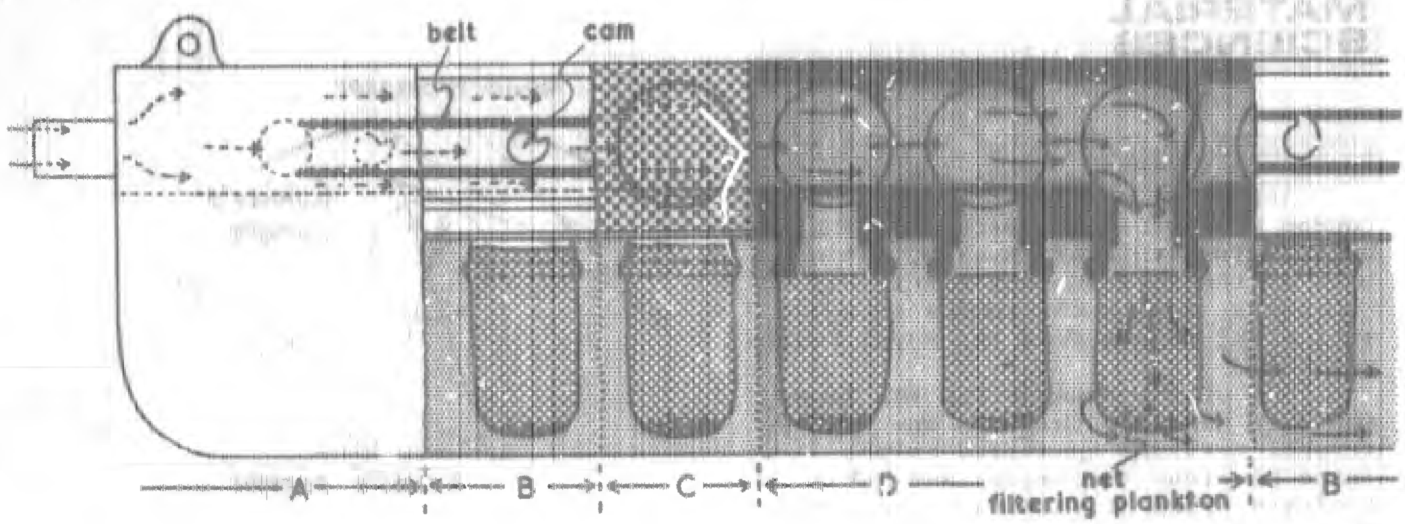

Fig. 1. Diagrammetic side plan of front end of automatic plankton sampler, cut away to different levels from left outer cover (A) to mid-line (D). Arrows show flow of water through the instrument. (Figure by permission of Coe's (Derby) Ltd.)

movement. Strong springs to overcome water pressure are therefore no longer necessary, and the potential maximum operating speed of the sampler is greatly increased. In place of the traveling cam, lead-screw and door-catches, all situated on the top of the Mark I sampler, the Mark II design employs a driven belt on each side of the sampler and simple cams on the ends of the axle of each valve. A projection on the belt engages with each cam in passing to initiate the turning of the valve, and this movement is completed by a light spring, assisted by the flow of water. Each valve is therefore set in motion at the appropriate time by direct application of power from the gear-box, in contrast to the indirect system used in Mark I. The belt drive of the Mark II sampler allows an increase in the length of the instrument which would have been inadvisable using an unsupported lead-screw as in Mark I. The greater length allows bigger nets to be used, which in turn permits either a larger sampling aperture or longer samples than are possible with the Mark I version.

A firm of plastics engineers, Coe's (Derby) Ltd., Thirsk Place, Ascot Drive, Derby, England, have prepared working drawings for the production of the Mark II automatic plankton sampler and are making the prototype. This will be tested at sea during the spring of 1967, and as soon as these tests are completed the firm will be prepared to accept orders for production models. There are good prospects that the cost of such models can be kept below £100 ($280) each.

The following table summarizes the main characteristics of the Mark II automatic plankton sampler:

Length (excl. rotator on flexible line): 5 ft 10 ins (approx)
Length (incl. rotator on flexible line): 11 ft (approx)
Width (excl. fins): 6½ ins (approx)
Width (incl. fins): 1 ft 6 in (approx)
Height: 8 ins (approx)
Weight: less than 40 lbs
Max diameter of sampling aperture: 1 in
Filtering area of each net: 18 in^2
Towing distance per sample (depending on reduction gearing supplied): ½ - 20 miles
Range (towing distance for 20 samples): 10 - 400 miles
Effective towing speeds: 4 - 20 knots
(A larger rotator may be fitted for speeds below 4 knots.)

(D.I. Williamson,
Marine Biological Station,
Port Erin,
Isle of Man, UK)

MATERIAL SCIENCES

CONFERENCE ON SMALL-ANGLE SCATTERING, 17 and 18 NOVEMBER, 1966, LONDON

About 200 people attended this London Conference, sponsored by the British Institute of Physics. It was held at the Institute of Electrical Engineers, facing the Thames Embankment right across from the Royal Festival Hall.

One of the reasons for the large audience was that this was one of the several meetings sponsored by the joint Electron Microscopy and X-Ray Analysis Group of the Institute, and there were many microscopists in attendance. (We could do with more of this cross fertilization at smaller meetings in the US.)

Twenty papers were given—four major introductory talks and the remainder on more specific research work; two of the latter papers were from Germany, one from France. Some 35 attendees were from the Continent.

The main features of the meeting were the complete absence of talks on slit corrections, and the large number of papers devoted to small-angle scattering in electron diffraction, which clearly has the potential of replacing X-rays for much work on materials with large "d" spacings.

Prof. A. Guinier (U. of Paris) opened the meeting with a very interesting historical sketch of the field. He pointed out that Raman had first observed small-angle X-ray scattering in the '30's but that little was done with this observation. Guinier was at that time working in Prof. Mauguin's laboratory where Laval, also a student, had found some unusual diffuse scattering from powder specimens, using a counter and the curved crystal monochromators designed by Cauchois for spectroscopy. Mauguin asked Guinier to repeat this work with film methods. He set out to do this by working in transmission -- devising the Guinier focusing powder-camera, simply by changing the location of his specimen compared to Laval's, as shown in Fig.1. He used slits in the beams to and from the monochromator, put the apparatus in vacuum, and used a direct beam trap. The advantages at low angles were immediately apparent from the low background scattering in this vicinity.

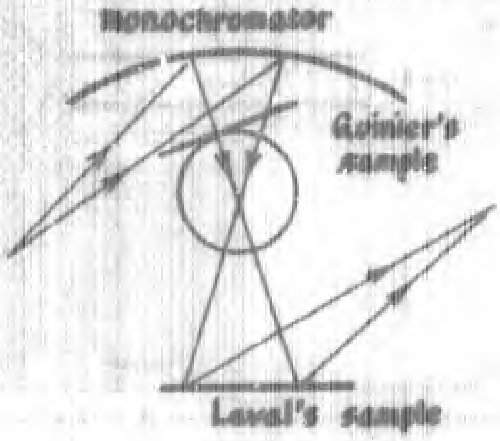

Fig. 1

At first he looked for the large-angle diffuse scattering, but found nothing. Laval had already switched to single crystal specimens, and had identified that the origin of the effect was due to thermal vibrations. Guinier then looked for uses for his camera and tried some amorphous materials, glasses and silica gel, catalytic nickel and carbon blacks. The large scattering readily observed was immediately pursued. From experiments involving increasing exposure times, it became clear that the intensity was diffuse and fell off with angle, and that any maxima was often behind the beam trap. These results led him to derive his well-known exponential law for the radius of gyration. In 1938 a metallurgical group, including Jacquet, were trying to find the reasons for the strength of age hardenable Al-Cu alloys, but even their special polishing techniques detected nothing. They gave Guinier some specimens, and the streaks he detected in these were the first evidence of effects due to shape.

Following this initial work, there were a number of important theoretical contributions. Ewald introduced the form factor and showed that at low angles the shape was the most important term, that strain in the structure or atomic arrangement was only important at higher angles. Debye introduced the convolution of the Patterson function obtained from the Fourier transform of the scattering curves, but the information from this was perhaps too general. Porod assumed two regions of different density, with a sharp interface, and could then derive more specific results from the Patterson function, such as the surface to volume ratio. Even more important, he showed that one could get this information directly from the data without inverting it.

There are problems in using Porod's technique in that it is sometimes difficult to separate the required region at a few degrees Θ from the diffuse intensity associated with a Bragg peak. Also, the theory does not apply to platelets or needles in which one dimension is much smaller than the others. Theoretically, it is still not certain if the sharp interface is a requirement of Porod's law. In the Al-Zn and Al-Ag systems, in which the zones should have diffuse interfaces, the law works for the first alloy (that is the data plotted in a certain way is a straight line as the theory says it should be) but not for the second. Quite recently, Tihouber and Müring have extended Porod's work. Assuming particles of irregular shape, they have shown that it is possible to obtain not only the average sizes of particles and pores, but also information on the size distribution functions and from the data directly. They find that the Porod "law" works if the particles are not too angular. (The problem of a diffuse interface was not treated). Their results were checked with MgO powder.

Looking into the future, Guinier felt that the development of X-ray equipment for this work had perhaps gone far enough. High resolution instruments are needed only, for example, for biological molecules which are difficult to handle individually without damage in the electron microscope (and even here, as shall be mentioned later, it appears that electron diffraction from collections of molecules is easier to use than X-ray techniques). For large particles the more complex dynamical theory must be used anyway. The X-ray method is particularly suited for very small particles, 10 Å or so in size, for which the electron microscope has insufficient resolution. (Perhaps a classic case is the detection of the GP zones in Al-Cu with X-rays. Even with present-day techniques with the electron microscope, these are still practically impossible to see.)

Guinier closed his talk by mentioning some of the modern uses of small-angle scattering theory, light scattering from astronomical figures, MeV electrons scattered from nuclei, and neutron scattering from vortices in superconductors.

The work presented in the remaining papers can be discussed under three main areas, based on technique, i.e., X-ray studies, electron diffraction and special methods. Most of the papers were in fact concerned with technique rather than results of applications.

X-ray Methods - In a study of aging of Al-20 at pct Ag, Drs. T. Healey and G. M. Leak (Manchester Univ.) used Dr. A. Franks' small-angle X-ray camera. (This is based on total reflection of X-rays to obtain a beam about 100-u in diameter.) Although no counting equipment has yet been specifically developed for this equipment, exposures are quite reasonable with films - a few hours at most - and the patterns are quite free of parasitic scattering, if some care is taken in placing the shielding.

The only difference in their results and those of Guinier and co-workers on this system is in terms of the kinetics. They found streaking before Guinier did. At about the same time, Prof. R. Nicholson (Manchester Univ.) observed platelets in an Al-16 wt pct Ag alloy (with the electron microscope).

Dr. M. Hart (Univ. of Bristol) discussed the Bonse-Hart technique of achieving a narrow direct beam without using slits, but by multiple scattering from perfect crystals. No new data over that which this group has been showing for the last year was presented, and it is still not certain that the method will provide enough intensity for, say, age-hardening systems. The digect beam intensity is the order of 10^9 cpm. During private discussions with Dr. Kratky (Siemens) he indicated that this is about 200 times the intensity that can be obtained with his camera for large particles, but that much larger intensities, perhaps 100 times, are possible with his unit with lower resolution, i.e., for smaller particles.

Electron Scattering Techniques - Dr. R.P. Ferrier (Cavendish Laboratories, Cambridge) presented a review of techniques for obtaining the small-angle scattering pattern in the electron microscope (see for example, R.P. Ferrier, R.T. Murray, J. Roy. Microscopical Soc. 85 (pt. 3) pp. 323-335, June 1966). Regions down to a scattering angle of 10^{-6} radians or less than a second of arc can be observed by using the lenses in the scope to get a sharp beam, and to vary the effective optical path to distances of many meters (up to half a mile if necessary!). Ferrier also described some of his work at Cambridge using a phosphor photomultiplier. With a velocity selector, his group has separated the inelastic coherent and elastic coherent patterns, and the former is often predominant at very low angles by orders of magnitude. Some patience is needed (more, of course, at higher resolutions!) because the filament drifts for a few hours, due somewhat to air introduced through the airlock when the specimen is moved into position.

Some interesting applications of this technique were presented by others. R.H. Wade (C.E.N., Grenoble) showed that splitting of a diffraction spot by a domain wall in a ferromagnetic film could easily be detected, and the expected diffuse streaking between the spots could be seen. In another contribution he showed that shape transforms from dense nuclei in vapor deposited films could be observed and that useful information on the shape and distribution of nuclei could be obtained (see R.H. Wade, J. Silcox, Appl. Phys. Letters, 1966).

Dr. A. Keller (Bristol) reviewed some of the uses of this technique in studying crystalline polymers.

In another introductory lecture, Prof. R.E. Burger (Queen Elizabeth College, London) examined some of the theoretical attempts to calculate the electron scattering factor. Although the variations in the small-angle range (up to 10^{-3} radians) were only 8% (as compared to 4% for X-rays), many problems associated with these calculations remain concerned mainly with shell structure, exchange and correlation effects, lack of spherical symmetry, etc. Experimental determinations and theory are far apart at the moment.

Special Techniques - Some of the work at AERE, Harwell on detecting vacancy clusters with low-angle neutron scattering was presented. D.C.A. Taylor (University College of South Wales and Monmouthshire) showed some interesting optical transforms. Prof. A. Klug and Mr. D. de Rosier showed their technique of reconstructing the image from a biological unit with only portions of the diffraction pattern in an attempt to get rid of overlapping images and see only one side of the object. At the moment, many trials (and errors) seem to be the only way of selecting the correct spots.

Perhaps the most interesting contribution in this group of papers was that by D.C. Champeney and F.W.D. Woodhams (Univ. of East Anglia), in which they demonstrated how the small-angle pattern could be detected by using the Mössbauer effect. (A preliminary report appeared in Physics Letters, 20, No. 3 p. 275 (15 Feb. 1966), but more details were given at this meeting.) If a material which has fine particles or pores is placed between the source and absorber and rotated around an axis along the γ-ray's path, and if the rays are allowed to pass through the periphery of the spinning disc of the sample where velocities of 10^{3} cm/sec can be achieved easily at a few thousand rpm, then, for particles greater than 10^{-4} cm, the Mössbauer absorption is broadened. This occurs because the scattered γ-rays then pass through the absorber over a range of angles (the small-angle pattern) which leads to a Doppler shift in the resonance peak. The shift in energy is $\frac{\Delta E}{E} \cong \frac{V}{C}\,\theta$, where V is the transverse velocity of the scatterer. Thus, if the shape of the original absorption is removed by the usual deconvolution method, the remaining shape multiplied by $\frac{1}{\theta}$ is just the intensity distribution I (θ).

For smaller particles this cannot be done. Due to the rotation and the larger range of scattering, the total small-angle scattering is effectively removed from the Mössbauer pattern (into the background), so that by comparing the depths of the absorption with and without rotation, the total scattered intensity can be obtained. Such formulae as Warren's (Jour. App. Phys. 20, 96 (1948)) can then be used to estimate particle size: Woodhams and Chapeney have derived equations they feel are even more generally useful than Warren's. (J.B. COHEN)

METALLURGY DEPARTMENT, INSTITUTE OF SCIENCE AND TECHNOLOGY, UNIVERSITY OF MANCHESTER

The Faculty of Technology (or Institute of Science Technology) and the Faculty of Science of the University of Manchester exist as a Federation, much as do the numerous colleges of the University of London. The building complexes are separate, with those of

"Tech" being more in the center of town. Although the two are considered autonomous by the University Grants Committee, they share many facilities, and equipment to some degree. For example, Owen's Park, a residence (a bus ride from either of the two faculties on the outskirts of the city) is used by both. The MIT of the North here, has many fine new modern buildings in the otherwise grim surroundings of this industrious but depressing city where Dalton lived and worked most of his life.

There are a faculty club, dormitories, a fine student center and a classroom-lecturehall complex in addition to laboratories. Although the campus is continuing to expand, there is still not enough space for the students who wish to enter. Metallurgy occupies a floor in the original nineteenth century building. There are about 30 undergraduates each year majoring in metallurgy, and about 20 graduate students, two to three postdoctorates and 13 staff. As an example of their research, I will describe the work in the X-ray group.

Dr. W.D. Hoff works with Dr. W.J. Kitchingman primarily on computing techniques for indexing and refining lattice parameters, and Fourier analysis. (Their programs for these are available on request.)

Kitchingman is concerned with two main areas. He has succeeded in describing the sigma phase in terms of an assemblage of bcc units, which collapse across 112 planes and rotate slightly in a kind of synchro-shear. At the moment, he is studying the transformation to this phase, first with resistivity to delineate the various stages, and then with X-rays, to look for faulting. Accurate lattice parameters are being sought to examine the near neighbor distances.

He is also much involved in studies of line broadening. He recently has shown that the fault probabilities in Au and Ag base alloys are greatest at the phase boundary nearest the fcc phase, even though the electron/atom ratio may be lowest at this point in the single phase region. (See Brit. J. Appl. Phys. 17, 1039 (1966) and 16, 1311 (1965)).

At the moment he is working on deformation of solid specimens of Nb-Ti, Nb_3Sn, Nb-Zr, in an attempt to relate the effects of deformation on the critical current in these superconductors. He also plans to look at the deformation of CsCl structures. (J.B. COHEN)

MATHEMATICAL SCIENCES

ECONOMIST INTELLIGENCE UNIT REPORT SHAKES FLEET STREET

In its controversial, hard-hitting report on the efficiency of British newspapers (see The Guardian, 4 January 1967), the Economist Intelligence Unit (EIU) placed major emphasis on the lack of professionalism in newspaper management. Restrictive trade union practices were not seen as the fundamental weakness of the industry, but as "the outward symptoms of more serious and deep-rooted faults." The EIU team, headed by Mr. Geoffrey Browne, estimates an available manpower saving of 4000 men and a labor cost reduction of £4,875,000.

This timely report, requested by newspaper proprietors and trade unions, is indicative of the valuable output of one of England's most sophisticated users of advanced statistical mathematical analysis. The EIU is a UK consultancy organisation operating on an international economic and business research scale. It was started in 1946 and is a subsidiary company of The Economist, but now operates separately and is completely independent of outside control.

EIU operates through two major sections, the Statistical Advisory Service and the Management Advisory Service. Marketing advisors and international specialists are also available.

During a recent visit by ONRL staff, Dr. William Buckland, Chairman of the Statistical Advisory Service, described the broad spectrum of projects ranging from detailed analysis and planning of the "new" cities to developing the statistics of an industry segment -- such as newspapers. Other subjects include National Health Service data, Social Security data, and traffic analysis.

The Statistical Advisory Service guides clients in the use of the most appropriate statistical techniques for the understanding and solution of their problems. These include: operations research, data collection using sampling techniques and statistical prediction, forecasting acceptability of purchased raw materials and components, stock control stores accommodation and use, quality control and inspection, life testing and reliability of products in service, and maintenance and renewal of equipment. Cooperation with clients extends to staff training at all levels in statistical methods as well as advising on the use of computers and data processing equipment. For the most part, the techniques used are classic applications of statistical analysis -- the correction of data, often by sampling, and the projection of this history as the probable future.

The Management Advisory Service involves all phases of management, ranging from an immediate crisis solution to a long-range plan which can involve a complete reformulation of the company's future business. Also consultants are provided for assisting with specific areas such as sales, production, distribution and finance. The staff is oriented toward traditional Operation and Management with a strong quantitative bias.

In addition to the special studies for clients, the Unit publishes a series of highly regarded technical-economic analysis bulletins. Current quarterly publications of the Unit include: Quarterly Economic Reviews on over 120 countries; Motor Business, devoted to the problems of the international motor industry; Rubber Trends, review of production, markets, prices, etc.; Hard Fibres, review of production, markets, prices, etc.; Paper Bulletin, review of production, markets, prices, etc.; European Trends, the EEC and EFTA in perspective. Monthly publications include: Retail Business, British markets for consumer goods; and Marketing in Europe, European market for consumer goods.

The front-page headlines, Government reaction and subsequent action based on the EIU report on newspapers is indicative of the impact and acceptance that quality research using statistical and mathematical techniques can provide. Although not so deeply involved in sophisticated mathematical techniques as IRMOU in Rome, the EIU is another prime example of applied OR in action. Moreover, this application is being "bought." (P.D. Maycock and J. Hausman)

THE NATIONAL COMPUTING CENTRE BLOWS A FUSE

During a recent meeting with ONRL representatives, Prof. Gordon Black, BSc., PhD., DIC, Director of the National Computing Centre (NCC), Quay House, Quay Street, Manchester, discussed the objectives, present status, and long-range plans of the Centre with rehearsed precision and clarity. He even admitted that the turning on of their ICT 1904 computer had knocked out the power for blocks around their facility. This minor quirk was soon mastered and the Centre took another important step toward viable reality.

The establishment of the NCC is just one of many actions taken by the Labour Government in its attempt to revitalize the British computing scene and indirectly, in the long term, to affect favorably the balance of payments. Initially, the Centre was financed by public funds. The inaugural council, representative of users, manufacturers, educators and local and national government, has been appointed by the Minister of Technology. The Centre is an independent, non-profit-making company, limited by guarantee. Fee-paying members are being accepted, and nominal service charges will be made.

The primary aims of the NCC are to assist in expanding the field of computer application, speeding up the preparatory work necessary before a computer can be used, and increasing the supply and quality of personnel trained in computer usage. Specific activities will include:

- Acting as a center of information about computing and data processing, and providing guidance to potential users; - Collecting and making available appropriate information about existing computer programs; - Developing and sponsoring generalized programs and systems designed to serve users having closely similar tasks; - Assisting in the provision of appropriate computer training, including training in systems analysis, programming principles, and appreciation courses for top management; - Promoting research into methods of programming and operating computers and into the influence of these on the design of computing systems; and - Developing new areas of computer application, sponsoring development in these areas.

At present, Black has a staff of 45. His goal for the end of 1969 is 250, of whom about 130 will be potential systems analysts with an Honours Degree or equivalent. Because of the limited supply of men knowledgeable about industrial use of computers, the Centre will accept individuals who are trained in computers and let them start in an "on the job" mode to obtain experience with industry. The Centre can pay salaries on the British AEC scale which is high enough to attract the best talent.

At the end of 1966, some 30,000 invitations to join the Centre were mailed. Applications are being received in numbers which please Black. For example, all major British banks have joined the Centre. Membership is open to any person, association or body engaged in or connected with the manufacture, sale or use of computers; those concerned in education or research with computers or their use; or those with commercial, scientific or professional interest in such use. The three classes of membership are:

	Annual Cost
Class A: Manufacturers and/or Vendors of Computers	£5000
Class B:	
a. Users of computers 1-1000 employees	100
1001-10,000	250
Over 10,000	500
b. Computer consultants per 25 computer staff	100
c. Local authorities Inhabitants less than 100,000	50
100,001-750,000	100
Over 750,000	150
d. Educational Establishments (not maintained by local authorities)	100
Class C: Other persons or bodies	50

Despite the dramatic interest in being a member of the Centre, there is no goal to make it self-supporting, since the Centre reasons that "you couldn't be doing a support to industry if you were making a profit." Be that as it may, the Centre will consider bringing in as much as 50% of its annual expenditure.

At present, the educational aspect of the Centre is in a very formative stage. One seminar on computers (four to five days) for board-level industrialists is scheduled. A working group is due to report in April on the manner in which the academic program should develop. Direct support will also be given to the new British management schools to enhance the training of computer technology to potential managers.

One important program is the establishment of the National Program Index. This will make available, on the widest possible basis, information about existing computer programs. Working parties are now scouring the country soliciting programs from all sources in virtually all disciplines.

Projections for the Centre include a vast computing complex of the order of magnitude of an IBM system 360-91 coupled to a 360-67. The time frame for a complex of this character is in the early 70's. To date, no decisions have been made as to the maker of the machine or its specifications. These needs are certainly being used as a big carrot for the British computer industry. In addition to the large center, a national mesh of smaller machines is not out of the question. However, for the time being, administrative offices of the NCC throughout UK will suffice. The first such field office has been set up in Scotland.

The NCC has been heralded with a blare of trumpets by the British press. Through the guidance of such an able scientist and administrator as Black, and with continued Ministry of Technology support, it would appear that the Centre is assured of success. (Paul Maycock and John Hemann)

1966 EUROPEAN MEETING OF STATISTICIANS

This Meeting, jointly sponsored by the Royal Statistical Society, the Institute of Mathematical Statistics, and the International Statistical Institute, was held at the Imperial College of Science and Technology, 5-10 September. Approximately 400 mathematicians and statisticians from the major western and eastern countries attended. The conference was very well organized, there being two sessions each day, each consisting of two or three related one-hour talks. The ten-minute contributed papers, which are less informative and usually of limited value to participants, were relegated to a single afternoon. The central themes around which the daily sessions were organized were: Foundations of Probability, Empirical Bayes Methods, Stochastic Processes and Statistical Analysis of Physical Problems, Some Approaches to Statistical Inference, Reliability Theory, Multivariate Analysis, Dynamic Programming, Sampling Inspection, Hypothesis Testing, and Process Control.

It is not feasible in the limited space available for this report to summarize the many interesting papers devoted to the topics listed above. I will therefore limit myself to a description of an invited address by Alfred Rényi of the Mathematical Institute of the Hungarian Academy of Sciences, and to brief remarks on two other invited addresses.

Rényi's address, called "Statistics Based on Information Theory," was designed to stimulate interest among statisticians in applying concepts of information theory to problems of statistical inference. Rényi illustrated the possibilities in this direction by using the notion of the amount of information in one random variable about another random variable to study a simple estimation problem. His approach is to analyze statistical data by preparing an account of how much information concerning an unknown probability distribution is missing prior to the performance of an experiment, how much is gained or lost by the experiment, how much information is still missing after its performance, and so forth. This point of view enables the statistician to compare various available tests, decisions and so forth on a simple numerical scale.

The precise problem considered by Rényi is the following: Let θ be a parameter to be estimated, where θ is regarded as a discrete random variable. The *a priori* distribution of θ is denoted by

$$p_k = P\left\{\theta = \theta_k\right\}, \quad k = 1,2,\ldots,r.$$

The unconditional entropy of this distribution is given by Shannon's formula,

$$H(\theta) = \sum_{k=1}^{r} p_k \log_2 \frac{1}{p_k}.$$

This quantity is interpreted as the amount of missing information about θ when only its *a priori* probability distribution is known. Let ξ be a random vector of observations on θ and put

$$p_k(\xi) = P\left\{\theta = \theta_k \mid \xi\right\}.$$

The conditional entropy of θ given ξ is defined by the random variable

$$H(\theta \mid \xi) = \sum_{k=1}^{r} p_k(\xi) \log_2 \frac{1}{p_k(\xi)},$$

whose expectation, $E\left[H(\theta \mid \xi)\right]$, is interpreted as "the amount of missing information about θ after observing the sample ξ." It is then natural to define the amount of information about θ in the sample ξ as the difference

$$I(\theta, \xi) = H(\theta) - E\left[H(\theta \mid \xi)\right].$$

An estimate of θ based on ξ is a decision function $D(\xi)$ which takes values in the set $\theta_1, \ldots, \theta_r$. The "error" $e(D)$, of a decision function D is the probability that the decision is wrong, i.e.,

$$\varepsilon = P\left\{D(\xi) \neq \theta\right\}.$$

The "standard decision" is defined by Rényi as the decision in favor of the hypothesis $\theta = \theta_k$ which has the largest conditional probability given the value of ξ. It is easy to see that no decision can have a smaller error than the standard decision.

One of Rényi's most interesting results is an estimate of the error of the standard decision in terms of the amount of missing information. If ε denotes the error of the standard decision and $M = E\left[H(\theta \mid \xi)\right]$ the amount of missing information, then

$$(1) \qquad \varepsilon \leq 1 - \frac{1}{2}M$$

Thus the error of the standard decision tends to zero as the amount of missing information tends to zero.

An upper bound for the amount of missing information in terms of the error of the standard decision is given by the inequality

$$(2) \qquad M \leq C_r \sqrt{\varepsilon}$$

where C_r is a positive constant depending only on r.

It follows from inequalities (1) and (2) that if $\xi_1, \xi_2, \ldots$ is an infinite sequence of observations, and if ε_n and M_n denote, respectively, the error of the standard decision and the amount of missing information based on the first n observations, then

$$\lim_{n \to \infty} \varepsilon_n = 0$$

if and only if

$$\lim_{n \to \infty} M_n = 0.$$

Thus the information-theoretical point of view is consistent with the usual point of view of statistics.

An invited address by Y.V. Linnik (Mathematical Inst., Leningrad) described some of the recent results of the Leningrad statisticians concerning minimax tests, unbiased estimation, and similar tests. Another invited address, by M.S. Bartlett (University College, London) was a review of the spectral analysis of time series, and included a discussion of estimation of the spectral density function, testing for mixed spectra, eliminating a trend, cross-spectral analysis, and non-normality. Bartlett also described some recent extensions of spectral analysis to point and line processes.

Preprints of most of the talks were available at the meeting, and some may still be obtained by writing to the International Statistical Institute, 2 Oostduinlaan, The Hague, Netherlands. (Warren M. Hirsch, Courant Inst. of Mathematical Sciences, New York University, New York)

MECHANICS

LECTURE SERIES BY PROF. W.T. KOITER

A series of eight lectures on "The General Theory of Elastic Stability" was presented 3-5 January 1967 by Prof. W.T. Koiter, under the auspices of the Dept. of Civil Engineering, University College, London. The presence of this notable professor from the Technische Hogeschool, Delft, served to draw specialists from all over the UK. The formidable display on the blackboard was received by the audience with an enthusiasm usually found in typical freshman physics students. Professors of mechanics were seen furiously taking notes and remarking that they hoped that they did not evoke similar reactions from their students.

The series of lectures was actually an exposition and defense of the Energy Criterion of Stability, followed by examples in the field of Plates and Shells. Though Koiter referred only to his thesis[1] and two other references[2,3] in the course of his lectures, much of the material could also be found in a more recent paper[4]. Further references to his work can also be found in Reference 4. It could be remarked that even though some of Koiter's more recent work has been in the form of a summary of parts of his thesis, it would be invaluable to research workers and students alike if a translation into English were available.

Topics discussed during the sessions were: The energy criterion of elastic stability; Neutral equilibrium-validity of criterion of second variation as a necessary and sufficient condition for stability; Stability at the critical load; Post buckling behavior; Effect of imperfections; Application to plates and shells - Simplification for shallow buckling modes; The cylindrical shell under axial compression; The spherical shell under external pressure.

It was amusing that Koiter closed this remarkable series of lectures by reading a paragraph from a recently published series of volumes on nonlinear mechanics which very curtly dispensed with both the validity and veracity of past work and workers in the field of elastic stability. Koiter charitably commented that this must have been written in haste.

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MISCELLANEOUS

THE BRITISH EDUCATIONAL SYSTEM: SOME ABSOLUTE MAYBES

There are few subjects so fraught with emotional content as education. Few educational systems are attacked and defended as vigorously as that of Britain. Perhaps one's enemy should not write a book but rather be encouraged to draft a note on a controversial subject such as this. However, it is impossible to have a clear idea of the British social complex without some understanding of its educational system. This system predetermines much of what will be accomplished by Government, industry, management, the research community, etc. During the process of education, biases are built, class lines drawn, and capabilities defined. So this is submitted: generalities on a subject which is actually kaleidoscopic, and while this may not be the world as it is, this is how we see it.

Throughout the British educational system, there are two basic kinds of schools: those operated at public expense and those funded privately.

Independent schools in England and Wales must be registered with the Department of Education and Science so that they can be shown to conform to minimum standards. Schools achieving certain higher standards may apply for recognition as "efficient"; independent schools so recognized contain about two-thirds of the private pupils. Similior requirements to so register schools also exist in Scotland and Northern Ireland. Fees at these independent schools, for tuition and boarding, range from between £300 - £550 a year, give or take a few pounds. However, a number of them offer scholarships. The largest and most important of the independent schools in Britain are known as "public schools," although not all those classed as public schools are independent (those which are not are most of the direct-grant schools). Public schools form only a minority of all independent schools. Note: These schools should not be confused with the State-supported public schools in Scotland.

The schools supported by private funds vary widely in quality, but those with the highest academic standing are as good as any in the world. Public schools for boys have made a notable contribution to English education and many of these date from at least the 16th century. The public school today is characterized by high staffing ratio and a high portion of pupils doing advanced work, and is often, although not always, a boarding school. The usual age of entry to the independent school for boys is 13, and the leaving age about 18. There are some girls' public schools modelled to a certain extent on those for boys.

Independent schools also include preparatory schools, many of which are boarding schools for boys aged from about 8 to 13, most of whom are intending to enter public schools; a few similar schools for girls; and wide range of other day and boarding schools covering every age group and grade of education and many educational types of method. Some of these schools are owned and managed, often under a trustee, by independent non-profit making bodies. Others are privately owned by proprietors for whom the running of the school involves a profit or at least a living.

In addition to this high standard, however, other considerations should be taken when observing the independent schools. Because most educators tend to perpetuate their own kind of learning and because for generations "the best minds" have been encouraged to pursue an education in the classics (i.e., Greek and Latin), this is the path the "top" students at these institutions are usually encouraged to follow.

The Government has stated that it intends to study how the independent schools may best be integrated into the State system of education. The social forces at work in the UK are such that the very existence of these privately financed schools is threatened. No doubt, before very much longer, these schools will be subject to greater and greater Government control. Selection of students will become even wider. Still, regardless of who attends these schools, they are considered by many as the breeding place of rigid class lines in Britain. Because of this, many people believe that such schools should cease to function.

The vast majority of students, over 90% of the school children, attend schools which are publicly financed. These students start at the primary level in schools which purport to be roughly equal, disregarding differences which may be due to neighborhood, teacher availability, etc.

There are some nursery schools which provide informal education and play facilities for children between 2 and 5 years old. At five, the age at which education becomes compulsory, children in England and Wales go to Infant Schools or departments until they are seven and then on to Junior Schools until the age of about eleven (the same in Northern Ireland, but twelve in Scotland).

In England and Northern Ireland, it is usual for boys and girls to be taught together in Primary Schools. In England and Wales less than half of the secondary schools are for boys or girls only, but in Northern Ireland over half are for single sexes. Mixed schools are more common in Wales than in Scotland, where all but a few city schools take both boys and girls. There are a few co-educational independent schools, including those with classes for small children, but the majority are for either boys or girls.

When these students reach about eleven years of age, they are given a selective examination (the "eleven plus"), which is perhaps, next to the occasion of their birth, the most important happening in their lives. This procedure can determine what the next phase of their education will be, and that decision begins to shape the rest of their lives.

The public or state system of education aims to give all children an education suited to their particular abilities. A change in the means by which this should be achieved in England and Wales was announced by the Government in November 1964, when it was stated that, as a matter of national policy, all secondary education would be reorganized gradually on a comprehensive basis.

"Comprehensive schools", which are not selective, will provide all types of secondary education for all or most all children in the district. This means they will offer a far wider range of courses than the schools they will replace, mainly "grammar schools" and the "secondary modern schools." Comprehensive schools can be organized in a number of ways. Some take the full secondary-school age range from 11 to 19; others, such as those found in parts of Leicestershire, are "two tier," with a junior high school for pupils between 11 and 14 and an upper school for pupils guaranteeing to stay there for at least two years.

The traditional Grammar Schools, for children who are successful in the selection procedures at the age of eleven (hence the term "eleven plus"), provide an academic education oriented toward university entrance. Secondary Modern Schools were originally designed to give a general education with practical bias. There are also a few Secondary Technical Schools offering a general education related to industry, commerce and agriculture. There are also schools providing all three or any two types of education, in separately organized streams. These are known as "multi-lateral" or "bi-lateral" schools. Most Grammar School pupils remain at school until they are sixteen and the rest leave between the ages of 17 and 19. Although the majority of Secondary Modern School pupils leave during the year in which they are fifteen, nearly one-fifth (17.5% in 1963-1964) stay on for another year or longer. In Comprehensive Schools, 16.7% of all pupils were over statutory school leaving age in January 1964. Some 62% of the 15-16 year old age group in England and Wales are in full-time schools or colleges for further education, but only 29% of the 16-17 year old age group still remain in schools of any kind. From these statistics, it is clear that a very large percentage of British school children leave school forever at the age of 15. About 85% of them have completed their education by the time they are 17. (Statistics vary and some often cited sources claim that 85% of the students leave school at15 years of age.)

The system of allotting children to different types of schools at the age of eleven and the selection method used have provoked much public discussion and critical thought. Also, it has become increasingly clear that many students want and benefit from a more academic type of course, and therefore many schools have been providing courses of the grammar and secondary type. When the Government announced in 1964 that it favored a comprehensive policy, many local authorities had already implemented or were already planning to introduce comprehensive systems.

Scottish secondary schools fall into two main categories, those providing courses extending normally to three years, generally called Junior Secondary Schools, and those providing courses of four to five years, known as Senior Secondary Schools. In each type of school courses are intended to provide general education. They are differentiated in character to suit the varying needs and abilities of the pupil and include literary and commercial boys', technical, domestic and rural courses. About 45% of the schools are Junior Secondary and 55% are Senior Secondary; of the latter about 75% are comprehensive, a type traditional in Scotland. Over one-third of all the pupils go on to senior secondary courses on reaching secondary school age. Pupils are transferred to the different types of secondary school on the basis of teachers' estimates of attainment, intelligence tests, achievement tests, and due regard to the wishes of the parents. There is a provision for an appeal to the Secretary of State for Scotland in the event of a dispute between the education authority and the parent and also for the reconsideration of original allocations at a later date.

In Northern Ireland there are Grammar Schools, Secondary (intermediate) Schools, which are the equivalent of the Secondary Modern Schools in England and Wales, and Technical Intermediate Schools, which offer the same facilities as the Secondary Technical Schools in England and Wales. Some changes of organization in educational development in Northern Ireland are likely as the result of the 1964 White Paper.

There is no national examination in England or Wales upon the completion of Secondary School, but these pupils (and candidates not attending school) may take the General Certificate in Education (GCE) or the Certificate of Secondary Education (CSE). The GCE, which is on a single subject, and not a group subject basis (that is, no subject is obligatory and the individual subjects may be taken at different times), is conducted at "ordinary" and "advanced" levels. These are more familiarly known as the "O" and "A" level. Most of the candidates for the "O" level are about 16 years of age, although many take it earlier at the discretion of the head teacher. Most direct-grant and independent school pupils and an increasing number from other secondary schools take the Ordinary examination, and passes in the various subjects are widely accepted for entry courses for vocational training. The advanced examination is at the university entrance level, supplemented since 1963 by special papers to help the university authorities in selecting students, and is accepted also for the purposes of entry into many forms of professional training.

The CSE, instituted in 1965, is designed for pupils who have completed five years of secondary education, but who are not taking GCE; it is also on a single subject basis and is controlled by teachers who are serving in the schools providing candidates. The highest grade of pass in the CSE is intended to be of the same standard as the pass in the GCE "O" level.

In Scotland, the Senior Secondary Schools lead to examinations conducted by the Scottish Certificate of Education Board. School pupils in the fourth year of secondary courses sit for examination at sixteen years for the award of passes on the "Ordinary" grade for Scottish Certificate of Education, and pupils in their fifth year can obtain passes on the "Higher" grade of the Scottish Certificate of Education. Examinations at both grades are open to candidates who have left school.

In Northern Ireland, candidates may take the Junior Certificate Examination at about the age of 14, and the Northern Ireland General Certificate of Education at about the age of 17.

In England and Wales, local education authorities maintain about 500 colleges which provide technical and commercial courses at every level, and a number of GCE courses. These and the entire system for higher education will be discussed in the February issue of ESN. (J.W. HEMANN)

PHYSICAL SCIENCES

THE INTERNATIONAL BOAT SHOW

The International Boat Show was held at Earls Court, London, 4-14 January. One has to attend this show to comprehend the extent of boating enthusiasm in this country. Sailboats seemed to outnumber power boats. Special features were: English Rose III and her crew, Ridgway and Blyth, who rowed from Boston to Aran Isle in 92 days last summer; a demonstration of helicopter rescue by the RAF Coastal Command; the Lady Helsman catamaran that won the Little America's Cup; and a figurehead sculptor carving a 7-ft mermaid. In the unique craft category is a waterborne motorcycle on two hydrofoils that is 9 ft long and capable of 30 mph; and the Miniscaphe, a two-man submersible that travels only a few feet below the surface.

I was particularly interested in the number of echo sounders available for small boat owners. On display were three of the light-indicating type, five of the meter-indicating type, and three graphic recorders. The light-indicating type, ranging in price from £23 to £52 (£ = $2.80), are produced by at least five manufacturers. One unit, weighing 3½ lbs, with a self-contained battery has two ranges, 0-60 ft and 0-60 fathoms, accuracy 3% and sells for £23. A meter-indicating sounder with the same ranges and accuracy has an audible depth alarm adjustable for depths between 4 and 10 ft. It sells for £36. There are also at least five manufacturers of the meter-indicating sounders. Of the three graphic echo sounders displayed, one priced at £60, has three ranges, 0-60, 60-120 and 120-180 ft. It uses two transducers and operates at 143 KHz. All but one of the sounders uses ceramic transducers operating above 100 kHz; one graphic recorder uses a magnetostrictive transducer operating at 30 kHz. (W.J. TROTT)

NEWS & NOTES

Central Advisory Council for Science and Technology - The members of a new Central Advisory Council for Science and Technology, formed to advise the British Government on the most effective national strategy for the use and development of the country's scientific and technological resources, have been named by the Prime Minister. Under the chairmanship of Sir Solly Zuckerman, FRS (Chief Scientific Adviser to the Government), they are: Sir Eric Ashby (Master of Clare College, Cambridge), Prof. P.M.S. Blackett (President of the Royal Society), Dr. A.H. Cottrell (Chief Adviser (Studies) to the Secretary of State for Defence), Mr. Frank Cousins (General Secretary, Transport and General Workers Union, late Minister of Technology), Dr. F.S. Dainton (Vice-Chancellor, Nottingham Univ.), Dr. F.R. Jones (Managing Director of Mullard Ltd.), Sir Harrie Massey (Quain Professor of Physics, University College, London), Prof. A. Brian Pippard (John Humphrey Plummer Professor of Physics, Cambridge Univ.), Sir Hugh Tett (Chairman, Esso Petroleum Company), Prof. Bruce R. Williams (Stanley Jones Professor of Political Economy, Manchester Univ.), and Mr. R.D. Young (Deputy Chairman, Alfred Herbert, Coventry).

A NATO Advanced Study Institute on Stochastic Problems in Underwater Sound Propagation has been organised. The Institute, sponsored by the Italian Navy, will be held in Lerici (La Spezia) 18-23 September 1967. The scientific director will be Prof. Maurizio Federici; the local organisation will be provided by USEA (Ufficio Studi Elettro Acustici) under the direction of Prof. Giuseppe Pazienza. USEA is a contract laboratory operated by Finmeccanica for the Italian Navy. Twenty-five lectures have been announced under four subject areas: Phenomena of sound propagation in a random medium; Structure of signal noise and reverberation; Detection problems; and Oceanography. Papers will cover shallow-water propagation, spatial structure, fluctuations and coherence, signal processing, and cavitation. Lecturers are from Italy, France, Germany, US, Canada, UK and Japan. Information requests should be addressed to Prof. Maurizio Federici, USEA, Via P. Mantegazza nr. 23, San Terenzo (La Spezia), Italy. (W.J. TROTT)

A Hovercraft Unit is to be established at the National Physical Laboratory, Teddington. It will take over the work presently being done by the Hovercraft Technical Group at Hythe, near Southampton, and will deal with all forms of hovercraft and other applications of the air-cushion principle, including hovertrains. Hovercraft Development Ltd. will not come within this new unit and remains a subsidiary of the National Research Development Corporation, with Christopher Cockerell, the inventor, as consultant.

The National Electronics Research Council, established in 1964 to coordinate pure and applied research in electronics, is to change its function. It will be re-named the National Electronics Council and will be responsible for advising the British Government on the impact and the application of electronics in national life. If the need to promote research or encourage some other activity is seen to exist, the new body will be empowered to take the initiative either directly with the Ministry of Technology or with other organizations in the electronics field. Earl Mountbatten will continue as Chairman.

Described as "only as big as a tin can", a French invention has been developed to produce drinking water from the sea. It was designed by Société de Recherches Techniques et Industrielles, 111 rue de la Boëtie, Paris VIII, a company in which CSF (Compagnie Générale de Télégraphie sans Fil) has an interest. The principle of the invention is that of reverse osmosis in which saline water is forced through a semi-permeable membrane at high pressure, leaving its salt content on one side. A considerable amount of research is in progress on this technique at present because of the great simplicity it offers and the possibility that even small plants based on it will be economic to run.

The Wolfson Foundation has made a grant of £10,000 (£ = $2.80) to the Univ. of Exeter to provide an Zoological Laboratory for the Dept. of Zoology. This new laboratory will enable the Department to extend its field of research in ecology and animal behavior, with particular reference to post-graduate studies.

Grants totaling £222,000 from London Univ. and the Ministry of Health have been made for the purchase of premises in Foley Street, London, near the Middlesex Hospital Medical School. They will house new and expanded departments of the Bland-Sutton Institute of Pathology, under the direction of Prof. G.W.A. Dick. New laboratories for hematology, virology, bacteriology, and experimental pathology will be built as early as possible, and the plan provides for data processing and central counting units.

A new Institute of Computer Sciences and Cybernetics, with headquarters in London, is being planned. It will be concerned with programming, systems analysis, information storage and retrieval - everything except hardware. Dr. J. Rose, Principal of Blackburn College of Technology and Design, is chairman of the organizing committee.

The following news items have been brought to our attention by colleagues in Scandinavia.

The formal opening of the European Space Research Organisation (ESRO) Sounding Rocket Launching Base (ESRANGE) was held on 24 Sept. ESRANGE is located 45 km east of Kiruna, in northern Sweden. (Svenska Dagbladet/Dagens Nyheter, 25 Sept 1966, Sweden)

Lund University's new observatory located at Romeleåsen, 18 km from Lund, was opened recently. Construction of the observatory was started in Feb 1965 and has cost more than Swedish Kr 1 million (Skr 1 = $0.193). At 145 m above sea level, the observatory is the highest in Sweden. It uses a mirror telescope, the mirror of which has a diameter of 61 cm. (Svenska Dagbladet, 28 Sept and 3 Oct 1966; Dagens Nyheter, 1 and 2 Oct 1966, Sweden)

<u>Prof. Jöran Ramberg</u> will serve as assistant director of the European South Observatory presently under construction on La Scilla mountain in Chile. It has been reported that Ramberg last summer declined the top post at Stockholm observatory in Saltsjöbaden in favor of the assignment in Chile. The Stockholm post was offered to him after the death of the observatory's former director, Prof. Bertil Lindblad. (Svenska Dagbladet, 5 Oct 1966, Sweden)

A "radiation factory" which may become very important for the fishing industry is being constructed in Herstedøster, outside Copenhagen. It is said to be the largest one of its kind in the Nordic countries, and it will be put into use next year. Detailed information about the project can be found in the Danish Atomic Commission's annual report. Fresh fish which are irradiated can be kept twice as long as usual. (Svenska Dagbladet, 26 Oct 1966, Sweden)

The Danish AEC sub-committee on nuclear power production has submitted a report to the Minister of Education in which it is recommended that a project for a Danish nuclear power plant be prepared before 1970. The committee envisions the construction of eight to ten nuclear power units in Denmark within the next 15 years. The committee reports on the initial research begun by Danish industries such as the Burmeister & Wain and Helsingør shipyards, and expects that Danish industries may contribute significantly to the eventual construction of Danish power reactors. (Børsen, 9 Sept 1966, Denmark)

The official opening of a new Danish university was celebrated in Odense on 15 Sept. The university starts modestly in premises rented from the Odense Technical College. The faculty comprises 12 professors and some 20 research and educational assistants. 180 students are enrolled. The president is Prof. Mogens Brøndsted. (All papers, 16 Sept 1966, Denmark)

At ceremonies attended by Finland's President Kekkonen and the chief of the Finnish industrial firm, Outokumpu Oy, a new Outokumpu research facility was opened at Esbo. The facility has 4130 m^2 of floorspace, will employ a staff of 43, and will support the company's activities in the field of manufacturing instruments and machinery for the mining industry.

The Swedish Royal Academy of Science has appointed <u>Assistant Prof. Per Olof Lindblad</u> as head of the Stockholm Observatory, beginning 7 Nov 1966. Lindblad has been at the Observatory since 1951 and has made study and research trips to the US, the Netherlands, Germany, Italy, and the Soviet Union. His most important work has been in stellar dynamics and radio astronomy. (Svenska Dagbladet, 27 Oct 1966, Sweden)

Dr. Denis Taylor, Head of UNESCO Mission, Faculty of Engineering, University College, Nairobi, has been appointed to the new Chair of Electronic Science and Telecommunications in the School of Electrical Engineering, Univ. of Strathclyde, as from 1 April 1967.

Mr. L.F. Rutterford has been appointed Secretary of the Computer Board for universities and research councils. He previously served in the Computer Advisory Service of the Ministry of Technology.

Dr. H.G. Hopkins, formerly at the Royal Armament Research and Development Establishment, is now Professor of Mathematics at the Univ. of Manchester Institute of Science and Technology.

Dr. L. Hough, Reader in Bristol Univ., has been appointed to the Chair of Chemistry, Queen Elizabeth College, London Univ.

Dr. Peter Alexander has been appointed Professor of Radiobiology at the Institute of Cancer Research, Royal Cancer Hospital, London.

Dr. D.F. Cheesman has been appointed Professor of Biochemistry at Bedford College, London Univ.

Dr. D.R. Hughes has been appointed Professor of Mathematics at Westfield College, London Univ.

Dr. J.F. McGhie has been appointed Professor of Organic Chemistry at Chelsea College of Science and Technology, London.

Mr. J.G. [illegible] has been appointed Director, Electronics Production (Telecommunications) in the Ministry of Aviation, in succession to Mr. H.R. Reid, who has retired from the public service.

Prof. W.A. Campbell Stewart, presently Professor of Education at Keele Univ., has been appointed Vice-Chancellor of Keele Univ., in succession to Dr. Harold Taylor, who retires this year.

Dr. M.H. Loretto has joined the staff of the Department of Physical Metallurgy, Birmingham Univ., as a lecturer.

Dr. G. Meyrick, Metallurgy Division, National Physical Laboratory, Teddington, will leave this spring to join the staff at Ohio State Univ. He has been to the US once before, working at Carnegie Tech. His specialty is field-ion microscopy.

Dr. A. Preistner, with National Physical Laboratory's Metallurgy Division these last 18 months (after 4½ years at US Steel's Research Center) will this spring become senior Lecturer in the Metallurgy Dept. of Manchester Univ.'s School of Applied Science and Technology.

Prof. C.F.A. Pantin, FRS, died on 7 Jan at the age of 67. He was Professor of Zoology at Cambridge Univ. from 1959 to 1966. His research was on various invertebrates and while on the staff of the Marine Biological Association Laboratory at Plymouth in the twenties he worked on the locomotion of amoeba. His work on sea-anemones was particularly noteworthy and he recently studied land nemertines.

Technical Reports of ONRL

The following report has 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.

ONRL-1-67 Polarization Characteristics of Radar Echoes by M.W. Long

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13. ABSTRACT

This is a monthly publication presenting brief articles concerning recent developments in European scientific research. It is hoped that these articles (which do not constitute part of the scientific literature) may prove of value to both American and European scientists by disclosing interesting information well in advance of the usual scientific publications.

The articles are written by members of the scientific staff of ONRL, with an occasional article contributed by a visiting stateside scientist.

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