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EUROPEAN SCIENTIFIC NOTES

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

31 December 1966 Vol. 20 No. 12

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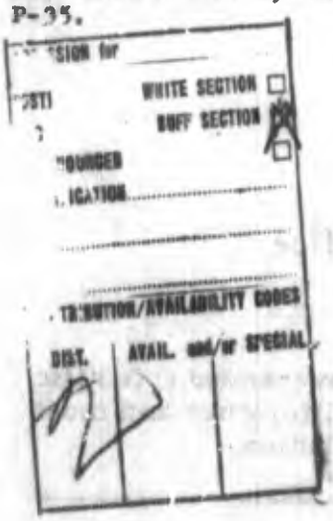


C. T. FROSCHER
Captain, U.S.Navy
Commanding Officer

MATERIALS SCIENCES

Materials Activity in the Chemical Engineering Department, Imperial College of Science & Technology, London University

The activities of this Department, directed by Prof. A. Ubbelohde, cover a broad spectrum: molecular technology, nuclear engineering, combustion, fluid dynamics, high pressure work, and solid state studies. It is the last area, which is Ubbelohde's main interest, that I shall discuss.

There are 85 undergraduate students in the three-year program, and 120 graduate students. Of these, a dozen or so are working in the area of materials, and about four PhD's are awarded annually in this field. The work is directed by Ubbelohde through three senior staff members. Ubbelohde himself believes strongly in inter-disciplinary training, and the research groups often are composed of persons trained in a variety of fields.

Dr. A.E.B. Presland, lecturer, is just beginning work on the physics of surfaces, after many years with Dr. D.W. Pashley at Tube Investments, Ltd. His main experimental tools are three electron microscopes (a Siemens I, a Metropolitan Vickers unit converted for use solely as a diffraction instrument, and a new JEM 7 unit including the attachments for scanning). Presland's research is in the following five areas:

(1) He is starting to examine the effects of alloy additions on dislocation substructure in Fe.

(2) Using the excellent synthetic graphite (prepared in this group by high temperature-pressure treatment), he is producing amorphous films and studying their graphitization.

(3) Particular attention is being given to the study of the microstructure of the polymeric form of sulfur, because it is a polymer of only one element. Thin films are prepared by melting sulfur, quenching and drawing it. Two kinds of fibrils have been observed, one 50 Å in diameter, the other 250 Å (see Nature 208 (1965), p. 1088). Additions of both P (which forms cross links) and I_2 (which adds at chain ends) suppress the formation of the fibrils, although the "why" is not clear. Polymeric sulfur can also be prepared by photochemical methods, with the obvious advantage that no orientation due to drawing will occur. Sulfur dissolved in CCl_4 polymerizes when irradiated with ultraviolet rays. The resultant suspension can then be sprayed on a carbon support film, for microscopy. Once again, both types of fibrils are formed, but the finer ones are seen to emanate from the tips of the coarser fibrils.

Using a technique developed at Cambridge, they hope to make a very thorough study of molecular weight distributions and the effects of I_2 on this, and to learn more about the reasons for the organization into fibrils. This technique consists of polymerizing sulfur photochemically in a mixture of good and poor solvents; the former must have a higher vapor pressure. As it evaporates, the polymeric sulfur precipitates in the form of spheres. The sizes of such spheres can be measured on the microscope, and the molecular weight estimated, assuming close packing in the spheres.

Some attempts will also be made to use light scattering methods.

(4) With an American PhD candidate from A.D. Little Co., Presland is examining the conditions of temperature and pressure for formation of laminar lubricant (such as WS_2) from liquid lubricants containing W. (This work is directly associated with a commercial product, but the firm that makes it is unfortunately unwilling so far to provide more support than free samples!)

(5) Grain growth reduces the surface area of catalyst materials, thereby reducing their efficiency. This might be as important as "poisons," and Presland is investigating grain growth by depositing films of Pt, Pd on carbon supports in order to watch their coagulation and coarsening in the electron microscope.

Dr. H. Wilman, a Reader, is working in three main areas:

(1) He is studying friction and wear, through experiments which are beautifully simple! A large cube under a load is rubbed on emery paper. (Certain precautions are needed such as: use of a course enough particle size to avoid clogging the emery; always rubbing on a fresh region of emery; and taking of data after a few "rubs" to be sure that it corresponds to a fully deformed surface layer of the specimen.) Friction is obtained from the ratio of force to load, and wear from the weight loss. If the load is adjusted to provide a constant depth of penetration of the abrasive into the metal, a straight-line relation exists between friction or wear and hardness. (The data includes

work on alloys. Micro hardness is used, indenting the abraded layer.) The decrease in wear and friction with increasing hardness is much more pronounced for fcc materials than for hexagonal systems. The texture produced by the wear is similar to the rolling texture, but opposite to the force by an amount roughly proportional to the friction. Age hardenable alloys are being studied now.

(2) Wilman is continuing his studies on electrodepositing single crystals. Up to 20,000 Å can be obtained with Ag deposited from $AgNO_3$ solutions. Much higher current densities were possible than in his work on Cu deposited from $CuSO_4$ solutions.

(3) He is studying the vapor deposition of Sn and Ag, and the effects of pressure, thickness, etc., on texture.

Finally, Wilman is still interested in his early love, "circular slip," but he is not now working on it. (This is a phenomenon in which slip occurs in a circular fashion under torsion, rather than in a specific direction. For some reason this is not given much attention these days, although it could be very important in the formation of kinks and deformation bands.)

Dr. G.S. Parry, Lecturer, is continuing his study of intercalation compounds of graphite; such groups as $SO_4^=$, NO_3^-, K, Rb, etc., enter between basal planes, and the graphite layers expand and shift. (Proc. Roy. Soc. A 291, 324 (1966)).

Stacking sequences such as A|A|A, A|AB|BC|CA|A, etc., occur (where the line represents the intercalating material); dislocations must be involved. Below about -20°C, long-range order sets in among the ions in the penetrated layers, and between the interrelated layers far apart. There is a wealth of information yet to be obtained with these materials, on the nature of ordering, long-range interactions, effect of periodicity or diffraction, etc.,Here again, their very good graphite is used as starting material, as they have found that compound formation is more reproducible with this material than with natural graphite. (J.B. Cohen)

Materials Research,Central Electricity Generating Board

The nationalized power industry is separated into five generating districts and 12 distribution areas. There are four research laboratories for the industry; one at Leatherhead, Surrey, concerned with conventional generating equipment, pipes, valves, turbines, etc.; another at Berkeley (near Bristol) where the main concern is nuclear reactor technology; the Marchwood Engineering Laboratories, near Southampton, which does large-scale experimental work involving large rigs and pilot plants; and the fourth, a new one just beginning operation at Capenhurst (near Liverpool and Chester), which will carry on research concerned with the distribution end of the business.

The laboratories in Surrey are concentrated in two buildings. One is quite new and modern in the usual "glassy" style, including a large pool on which "floats" an auditorium. (The water is actually used in mockups of cooling towers.) In this building, offices and small labs are on the outer walls. A large central core is used for models of pressure vessels, low-velocity wind tunnel experiments concerning the stacks which occasionally collapse over here, MHD experiments, and other large scale research. Metallurgy, however, is housed in an older building a few blocks away. The organization of this second laboratory, about 100 people, is sketched in Fig.1. The solid state group in the new building will be incorporated into this division. This group is working on MHD, and liquid semiconductors for possible use as temperature sensors in a reactor (as they are not affected, as are solid semiconductors, by radiation damage), and finally on superconducting materials. They have just developed a superconducting wire composite that will enable larger windings without troubles with "hot spots."

In metallurgy, the areas of interest, all concerned with steels, are as follows: fracture, thermal and stress fatigue, creep, oxidation, failure of the protective magnetite layer in boilers, precipitation, and high temperature strength. In addition, there is work going on on stabilized ZrO_2 for MHD generators, with particular interest in increasing electronic conductivity below 1400°C.

The labs are moderately well equipped with an electron microscope, two diffractometers, and three film units. One novel feature is a scanning electron microscope. Most of the remaining equipment is the usual.

Only the work in Dr. R.K. Ham's group will be described. (That of

CEGB - MATERIALS DIVISION, LEATHERHEAD, SURREY

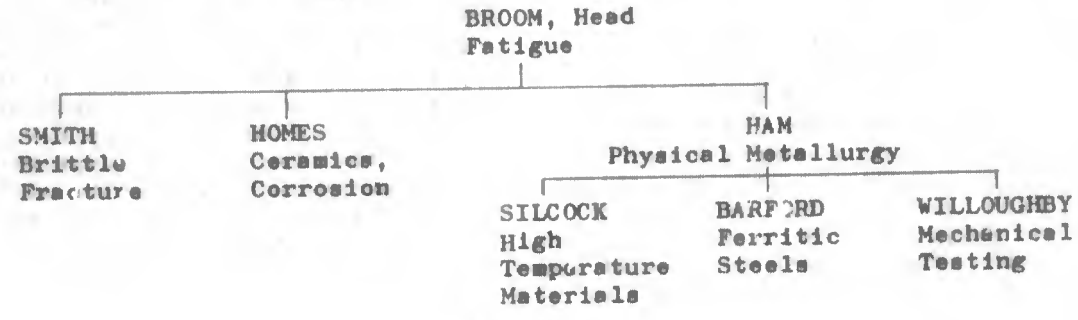


Fig. 1

Smith's section is well known, and papers have appeared recently in Acta Met.) Eighteen 12-1 austenitic steels have been causing some troubles in reactors of late, therefore some fundamental work on precipitation in these alloys has been started by Miss J. Silcock.

Niobium carbide precipitates on Frank partial dislocations, which appear to emanate as loops from dislocations decorated by precipitates. Because the carbide has a larger volume than the matrix, the precipitate nucleates at the edge of the partial and then the two grow simultaneously. The process appears to be diffusion controlled, but the activation energy is lower at high temperatures than at low temperatures. Work with VC and TaC has been started in an attempt to sort out whether this effect is due to a change in the rate controlling process from diffusion in the carbide to diffusion in the matrix. TaC forms as cubes, VC as plates. The group has been involved with Prof. P. Hirsch's group in calculating the peculiar strain contrast near the edge of the Frank partials seen in these alloys.

It has also been observed that by decreasing the stacking fault energy of the matrix, the extent of the grain-boundary region free of precipitate decreases.

In a 25 Ni - 15 Cr (austenitic) steel with 2.5% T_1, 0.25% Al, the observed properties due to precipitation of γ' are indicated in Fig. 2. The yield strength is affected most early in the aging process by the necessity to cut <u>through</u> precipitates. Later, in aging, loops form around precipitate and work hardening increases drastically. This is the usual behavior expected as precipitates grow. However, with a high nickel alloy, where there is little difference in the lattice parameter of γ' and the matrix, there is little work hardening, even though loops are observed to form. The group believes this is because the lower coherency strains enable a second dislocation to force the loop through the precipitate.

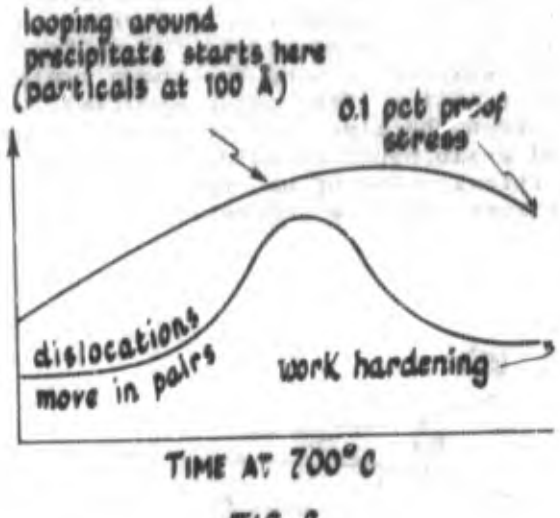


FIG. 2.

Dilatometric studies of the kinetics of precipitation of Fe-0.1 C with 0.5 V or 1.3 pct Mo are under way. For short times, the precipitate volume fraction varies as $t^{2/3}$, whereas at longer times, the exponent is close to unity. This checks with the observed morphology. At short times the precipitate forms on dislocation (presumably due to the strain field); but at longer times, when the dislocations are "consumed" or covered completely, the precipitate is growing as a cylinder. Less Mo_2C forms than VC, and softening due to coarsening starts at a lower volume fraction of precipitate in the Mo containing steel.

In Al-Cu alloys, it has been

found that at the same aging temperature θ' forms at low angle boundaries, θ at high angle ones, except for certain special boundaries, where a (100) face of one grain is at the boundary. In this case θ' forms at the boundary and grows into its neighbor, following Aaronson's suggestions. In simple tilt boundaries, the precipitate forms with the direction of maximum dilation perpendicular to the boundary, i.e., along the Burger's vectors of the dislocation array. (This is similar to the way these precipitates form on dislocations, as first pointed out by Nicholson.) All possible orientations occur in twist boundaries.

An interesting study is being made on failure in an Al-10 at pct Zn alloy. Because there is a precipitate free zone at grain boundaries whose width can be varied by heat treatment, slip can be confined to the vicinity of the grain boundary. Referring to Fig. 3, a forming crack, "C" vs "na" was measured. Using the known empirical relation (from creep studies) between the time rate of change of na and grain boundary sliding, and the critical value of na, the time to failure could be accurately predicted.

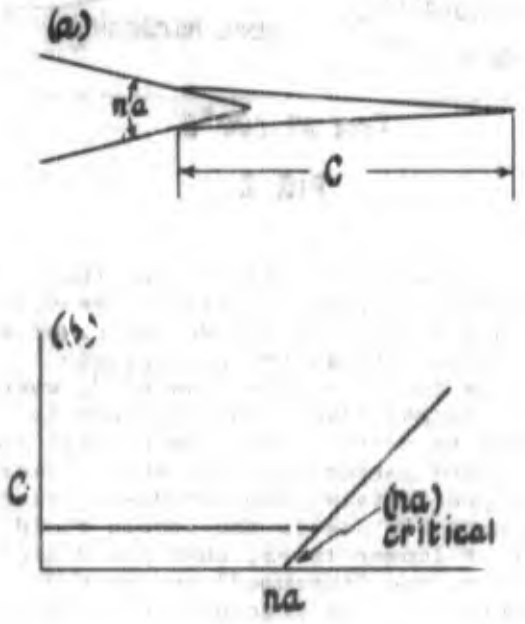


FIG. 3.

Keh and Leslie, at U.S. Steel, found enhanced dislocation density in the region of jerky flow and increased strength of mild steel. This was presumably due to pinning of generated dislocations by simultaneous carbide formation. But the group here has found that beyond the temperature for this phenomenon, where the strength is still higher than it is on testing at room temperature, there are no excess dislocations. (J.B. Cohen)

MATHEMATICAL SCIENCES

Operations Research in Italy

The status of operations research (OR) in Europe has not been reported by this Office for some time; however, an attempt now is being made to cover the military, commercial and academic centers of excellence. The information below on some OR in Italy is the first of a series of notes on the subject. Ultimately, ONRL Technical Reports will be issued on the subject and an extensive bibliography of OR practitioners in Europe will be assembled.

Statistics and Operational Research Section, Ministry of the Navy, Rome - The Statistics and Operational Research Branch (Ufficio Statistica Meccanografia e Ricerca Operativa) of the Italian Navy is headed by ADM Bruno Mazzurini, a trained statistician. He reports to the Assistant Navy Director (comparable to Vice Chief of Naval Operations). His office also reports to the Ufficio Statistica Ricerca Operativa e Automazione (Office of Statistics, Operations Research and Automation) which comes under the Technical and Scientific Council of the Defense General Staff. This latter office has a direct information link with the Italian Central Institute of Statistics.

Under Mazzurini there are four sections: The first is charged with receiving and aggregating the logistics reports of all operational units of the Italian Navy. It must be emphasized that this section is for information storage only. It initiates no studies and requests no specific data. It does report in resume when asked by competent authority.

A second section is charged with the collection and collation of all cost data from the various operational units of the Italian Navy. Again, no studies are performed nor are the cost data analyzed.

The most interesting group is the Analysis and Operations Research Section, headed by CAPT Vascello W. Bisi. Bisi is a highly-qualified practitioner who holds a Doctor's degree in Science as a statistician and actuary. He is also Prof. of Statistics, Dept. of Operations Research, Univ. of Rome, and teaches a course in Military Operations Research. He is Italy's member on the NATO Advisory Panel on Operations Research.

The Analysis and Operations Research Section (AOR) is now four years old, and in addition to Bisi employs a number of civilian consultants, mostly university professors. The group has completed 80 studies of problems stated by the Italian General Staff (Navy). None has involved a computer, although computers are available for the group's use at the Central Institute of Statistics. They will shortly have their own IBM-360 in operation.

Studies conducted have included analysis of mine sweeping operations. Some have been accepted and implemented by NATO. Three recent studies of mine sweeping operations were accepted by the NATO Technical Panel.

The AOR has also studied ASW problems: optimum screen placement and efficient barrier patrols (using surface ships and aircraft but not submarines). From this area of study, two papers were presented at the LaSpezia Symposium several years ago. It is planned to conduct ASW studies employing helicopters.

Completed studies have mostly dealt with tactics, but the group has analyzed logistics flow (but not control). They have studied radar interception capabilities and have done considerable work on weapons performance characteristics and the selection of weapons from a given current inventory. The group has also been involved in the analysis of new weapons.

In October 1966, the AOR began a study of missile employment on ships. They will generate Navy doctrine on use of missiles by ships. For example, they are exploring the optimal distribution of launchings at multiple targets given a single launcher and two directors. Next they will study naval formation in conjunction with missile ships, e.g., in convoy.

The group will continue to produce personnel studies for each of the services and for the Defense General Staff; these are primarily distribution studies.

The next major effort will be to set up simulation studies and war games. (Any US assistance on methodology will be most welcome.) They will be dual programs with the machine containing the parameters (optimum threat) and the gamers (naval officers) playing against each other, not the machine. In the simulation studies the operators will be civilian scientists. The gaming will be primarily for the development of tactics for naval air battles with missiles. The simulation will be primarily to test found tactics and improve selection from a current inventory of systems. The group is beginning liaison with the services in war gaming. Other services have no war gaming facilities, but the Defense Office of Statistics, Operations Research and Automation plans to develop such facilities and to conduct joint war games.

Under Mazzurini's Navy office, there are the three groups mentioned above plus one service group which produces Hollerith cards and performs such functions as data reduction.

Operations Research at the Dept. of Defense level is performed by the Defense Office of Statistics, Operations Research and Automation. This is a very new group and no interservice studies are yet under way. The main task at present is collection of data from other services, selling OR concepts in general, organizing courses for all services, and assigning personnel (statisticians, OR practitioners, etc.) to the various service level offices. They are in the process of recruiting a top-level group of civilians for their own office. Some of the first areas the Defense level group anticipates is a study of anti-aircraft defense and the design of a war game with ground forces application.

Operations research as conducted within the Italian military is essentially statistical analysis. Some mathematical models are used, and when this is so the mathematics tends to be rigorous rather than sophisticated. OR, here, reflects a high mathematical competence but not necessarily an application of the scientific method. There is no use of Value Theory or economic methods. OR is not used for system prediction or selection. Selection remains a subject of priorities and budgetary persuasion. New systems are acquired on a pragmatic basis. OR's function in the decision

process is to take assigned problems from the General Staff or the Naval General Staff. Data are collected and analyzed and a report to the requisitioner is made. The staff decides if the study will be accepted or rejected. If accepted, results of the study may be subjected to operational test and further evaluation. Additional study based on these results may be desired and a final report submitted. The General Staff decides what promulgation or direction will then result.

Istituto Nazionale di Ricerca Matematica e Operativa per l'Urbanistica - The Istituto Nazionale di Ricerca Matematica e Operativa per l'Urbanistica (IRMOU), in Rome, is a non-profit organization founded in 1956. Its purpose is to study the problems of urban development. It claims to be the first such group in the world to apply OR to town planning.

IRMOU was founded on the professional ability and dynamic personalities of its President, Dr. Luigi Moretti (a prominent architect), and Vice-President, Prof. Bruno di Finetti (one of Italy's finest mathematicians). In addition, there is a highly competent staff of mathematicians, physicists, sociologists, architects, and representatives of other disciplines. Some are permanent staff, some are consultants.

The Institute performs its work for several agencies, among which are: the National Council for Research, the Ministry of Public Works, the City of Rome, the Ministry of Finance, the Ministry for Bureaucratic Reform (new), and the Auto Club of Rome. IRMOU does work for the last-named only in the Club's capacity as the executive appointed by the City of Rome to study the local traffic problem.

Some Studies Undertaken - A major study undertaken and completed by IRMOU was an analysis of the commuter traffic flow in and out of Rome. It involved the identification of patterns of traffic flow as a stochastic process. Twelve technically trained traffic counters determined the microphenomena in much detail. IRMOU suggested as a solution an automatic traffic routing system. The traffic is electronically analyzed and discretionary signals are displayed well in advance of decision points, offering motorists non-mandatory alternate routes. Coupled with this discretionary routing are traffic control light computers giving optimal signal times at the various intersections. The municipal authorities are just beginning to utilize the results of this study and have formed a Commission for the Scientific Study of Traffic.

Another study of twofold mathematical interest was the design of a stadium for optimum spectator visibility, utility and traffic flow, and the layout of the stadium's environs for optimum traffic flow. The two mathematical disciplines primarily exercised were topology and network theory.

Still another study developed a linear program to model the intradependence of small urban centers.

A unique continuing project of the Institute is the scientific development of urban law. Its objective is to measure the real world -- in this case, Roman traffic -- and evolve a set of legal norms which regulate the real traffic situation effectively. Methodology employed includes value theory.

The most interesting area described during this visit was a series of studies to determine the utility (value yield) of public works. This subject is very near the planning confrontations of the US Defense establishment. In brief, the present methodology is a culmination of di Finetti's lifework in subjective decision-making, and is the extension of his Bayesean viewpoint which was first expressed in 1935. This view underlies much of Dr. Leonard Savage's work in the same area.

Other studies analyze the migration of permanent residents into cities. Rome accommodates an additional 50,000 persons each year. What are the economic benefits of such influxes? The economic costs? Social costs (these new urbanites have much higher suicide rates than the older populations)? How then are all these measures equatable?

Last, the Institute is designing a system of statistics collection and retrieval which can best be described as a broad public utility providing information to public and private bodies and extracting data at the optimal transaction point.

Problems faced by IRMOU are the expected ones, involving acceptance of their output as valid. Even when the results are accepted, they are all too infrequently implemented. Since the Institute operates in an environment replete with perturbation, its staff

prefers to provide the best answer available now and utilize feedback to evolve self-generating future answers. The pressures are to provide one final answer which must stand the test of time.

Much of the Institute's time, therefore, is absorbed in the production of propaganda to get OR accepted and in the presentation of demonstrations of "what could be accomplished." This constant "sell OR" is made even worse by the relative instability of the Italian Government, at local and national levels. Established lines of communication are obliterated overnight and new, grandiose programs originate without inputs from the scientific experts.

The Institute must compete with non-scientific experts who offer empirical solutions in a "greenwave" where no one can be identified as responsible for an *ad hoc* solution.

IRMOU is not just another OR effort. The quality and size of its staff, coupled with past performence, presage major impact by this organization in the general field of OR as well as in city planning.

Operations Research at the Univ. of Rome - The Scuola di Perfecionamento in Ricerca Operativa, directed by Prof. Guiseppe Pompilj, is a prime indicator of Italy's increasing awareness of the value of OR as a discipline to be emphasized. The two-year postgraduate program offered at the Scuola is the only course in Italy which results in the title, "Specialist in Operations Research." The program is now two years old and none of the 20 students enrolled has yet passed the final examination. In addition, a thesis must be completed. The Department is determined to develop a quality product, and it would therefore appear that the two-year course will take a minimum of three years.

Courses and professors are listed below. Two unique factors stand out. First, all courses are thoroughly based in advanced mathemtics and should result in the graduates' having a depth which will add significance to results of their studies. Second is the inclusion of Bisi's course on Applications of OR to Defense Problems. Bisi's practical experience as Head of the Italian Navy OR Studies Branch, coupled with his PhD in mathematics, make him a teacher who is well qualified to cover this very important subject.

Program of Courses

First Year

Methods of Mathematical Optimization
Prof. A. Hertzel

Application of Mathematics to Economics
Dr. E. Zaghini

Theory of Games and Decision Making
Prof. G. Dall'Aglio

Statistical Processes and Queuing Theory
Prof. G. Ottaviani

Applications of Operations Research to Economic Problems
Prof. B. Barberi

Second Year

Applications of Operative Algebra and the Theory of Graphs
Prof. C. Berge ox
Dr. U. Colombo

Applications of Operations Research to Logistics Problems
Dr. F. Giusti

Methodology of Operations Research
Dr. G. Ferrara
Dr. S. Passeggieri

Applications of Operations Research to Military Problems
Dr. W. Bisi

Applications of Operations Research to Problems of Business Management
Dr. L. Lombardi

Staff publications cover a broad spectrum of subjects ranging from military applications to graph theory.

The Univ. of Rome program is indicative of the rapid increase in the utilization of highly sophisticated OR techniques by Italy.
(J.W. Hemann & P.D. Maycock)

PHYSICAL SCIENCES

Bio-Acoustics?

The program at a recent performance of the London Symphony Orchestra in the Royal Festival Hall contained a resume of current research in bio-acoustics. It indicated that during a recent test in the Hall, a note played mezzoforte on the horn measured approximately 65 dB of sound. As a reference point it noted that a single "uncovered" cough gave the same reading. Presumably in the interest of avoiding competition, the resume concluded with the request that when one needs to cough one takes the precaution to muffle the sound. It did not make recommendations for the horn.
(J.D. Costlow, Jr.)

British Acoustical Society

The newly formed British Acoustical

Society held its inaugural meeting, A Symposium on Aircraft Noise, 5-6 May 1966 at the Imperial College of Science and Technology, London. Six additional meetings were held during this year in London, Southampton, Birmingham and Manchester.

In December 1963, the Royal Society designated a committee to explore the possibility of setting up a single society which would cater adequately for all shades of opinion and interests within acoustics. Sir Gordon Sutherland, Chairman of the British National Committee for Physics, acted as chairman of this committee which reported favorably upon the proposal in March 1965. The committee, with the exception of the chairman, constituted a provisional council of the British Acoustical Society under the chairmanship of Dr. A.J. King. King is on the staff of Associated Electrical Industries Ltd., Research Laboratory, Manchester, and the Physics Department of Manchester College of Science and Technology. His duties as council chairman ended with the election of officers and a council in November 1966. The new officers, elected for two-year terms, are Prof. R.E.D. Bishop (Univ. Coll. London) as President; Prof. E.J.Richards (The University, Southampton) as Vice-President; Prof. E.C. Cherry (Imperial Coll. of Science and Technology, London) as Vice-Pres.; Mr. W.A. Allen (Associated Architects and Consultants, London) as Vice-Pres.; Dr. A.J.King (Past President) as Vice-President; Dr. P.Lord (Royal College of Advanced Technology, Salford) as Hon. Secretary; Dr. R.W.B. Stephens (Imperial College of Science & Technology, London) as Membership Secretary; and Mr. I.J. Sharland (The University, Southampton) as Hon. Treasurer. Members of the Council elected for three years, one-third retiring each year, are Dr. D.E. Broadbent (Pembroke Coll., Cambridge and Fellow of the Acoustical Society of America), Mr. P.E. Doak (The University, Southampton and editor of Journal of Sound & Vibration), Dr. C.L.S. Gilford (BBC Research Department, Tadworth, Surrey), Mr. F.B. Greatrex (Chf. Engineer at Rolls-Royce, Ltd.), Dr. W.Taylor (Queen's College, Dundee, Scotland) and Prof.D.G.Tucker (Univ. of Birmingham). Tucker is also the Society's Program Chairman. The junior member of the council is Mr. P.G. Vaidya (The University, Southampton).

At the meeting in Manchester, 15 November, King announced the results of the election and that the Society now has 292 members, 21 of whom are from abroad. In ESN 19-4, it was stated that the committee was considering whether to make the Journal of Sound and Vibration the official publication. This did not happen; however, nine of the newly elected officers and council members are on the editorial board of the Journal. Moreover, the announcement of the newly formed Society in the Journal, March 1966, offered "the full services of the Journal of Sound and Vibration as a medium for publication of papers, and of announcements and news of Society affairs."

The constitution and rules, as approved Oct. 1966, state "The purpose of the Society is to promote and disseminate knowledge of acoustics, which shall be deemed to include all aspects of the science and technology of Sound, Hearing and Vibration." There are five memberships; member, associate, junior member, honorary member and sponsor member. Members and associates pay £3, junior member £2 per year.

A meeting of the Society was held at Imperial College, London, 20 October on "Investigation of Defects in Solids Using Acoustical Techniques." Dr. G. Bradfield (recently retired from the Physics Division, National Physical Laboratory) properly opened the meeting with a tutorial paper entitled, "Reradiation from Singularities in Solids." A similar paper was read by Bradfield at the ICA meeting in Stuttgart in Sept. 1959. Mr.G.J.Curtis (Imperial Coll.) discussed "Ultrasonic Energy Transfer Across Thin Gas Layers." He used a disc of PZT-5 backed with a mixture of tungsten powder and araldite to measure the transfer across an air layer between glass flats. Negligible transfer occurs for a layer thickness of 2.1×10^{-6} cm according to the Hirschfelder model, 3×10^{-6} cm according to the Levi Tonks model, and 2.2×10^{-6} cm for the Feze Gurzey model. His data agreed with the last model. Dr. D.I. Crecraft (Lanchester College of Technology, Coventry) presented several curves without numerical coordinates on "Detection of Residual Stresses in Metals by Ultrasonics." He plotted the propagation velocity for shear waves parallel and perpendicular to the stress and longitudinal waves. He said, during the questions, that the variation is 1 part in 10,000

in steel for 1 ton/in^2. Mr. A.A. Pollock (Imperial Coll.) discussed "Acoustic Emission During Deformation." He used a thermal load mechanism to reduce ambient noise and detected no sound emission before brittle fracture.

The meeting on 15 November at The Royal College of Advanced Technology, Salford (Manchester) was called "Reverberation Time and Transmission Loss Measurement." Papers were presented by Mr. E.N. Bazley (National Physical Laboratory), Mr. B.F.Day (Royal Coll. of Advanced Technology, Salford), Dr. K.A. Mullholland (Liverpool Univ.) and Mr. A.N. Burd (BBC Research Lab., Tadworth). Bazley described the "General Problem of Reverberation Measurement," showed the characteristics of the reverberation room at the National Physical Laboratory, and presented curves of the reverberation time T vs humidity and frequency, the edge factor vs panel size for absorption measurement and the effect of diffusers in panel absorption measurements. Sound level measurements are made at five room positions at high frequencies and at 20 for low frequencies. Day discussed his measurements of reverberation in scaled models. Polystyrene foam is used to represent the seats, and squares of cardboard represent people's heads. The gain of the amplifier increases with time to compensate for the greater sound absorption in the air at the scaled frequency. The average of 30 or 40 growth curves for pulses of different length is used rather than the decay curve. Data is obtained from the slope at the midpoint of the first 10 dB of the growth curve. Comparison of the two models of the Oslo Concerthaus, one with a flat roof and the other with a coffered roof, showed a 40 to 50% higher reverberation time for the coffered roof.

Mullholland's paper, "Transmission Loss of Materials with Low Sound Insulation," compared theory and experiment for the transmission loss of a wall, consisting of two aluminum sheets separated by air, for normal and random incidence of sound. An absorbing coat on the inner wall, 12-inch separation, showed little change in transmission loss at 500 Hz, but showed a marked increase at 4 kHz.

Burd's paper was entitled "Measurement of Sound Insulation in the Presence of Flanking Paths." He analysed several methods for separating the various transmissions by determining the delay time. The correlation technique gives good data in a low signal-to-noise but requires laboratory processing after the data is obtained. Pulsed sound measurement is limited by the signal-to-noise ratio but can be processed during the test. Accelerometer measurements on a panel are time consuming if sufficient position points are taken. A revolver-shot method requires frequency analysis in the laboratory after the tests have been made. A gradient microphone can be used as a substitute for accelerometer measurements. In the correlation technique Burd used signal plus fixed delay representing the direct transmission path and signal plus variable delay. Random white noise with a sweeping octave filter gave the sharpest correlation function.

A joint conference sponsored by The Institution of Electrical Engineers, Institution of Electronic and Radio Engineers, the United Kingdom and Eire Section of the Institute of Electrical and Electronics Engineers, the Institute of Physics & the Physical Society, and the British Acoustical Society will be held at The Institution of Electrical Engineers, Savoy Place, London, 23-27 January. The subject is Acoustic Noise and its Control. Sessions have been arranged on Subjective Effects, Measurement Analysis, Machines and Noise in Buildings. Three tours are planned for 27 January: (1) Building Research Station, Gurston, Watford and Standard Telecommunications Laboratories, Harlow, (2) National Physical Laboratory, Teddington and London Airport, (3) Institute of Sound and Vibration Research, University of Southampton.

The first annual dinner of the British Acoustical Society will be held at Imperial College of Science and Technology on 24 February. Other meetings planned are: March, at the Institute of Sound and Vibration, Southampton on Helicopter Noise; April, at Glasgow on Medical Acoustics; May, at Rotterdam Concertgebouw on Criteria for Good Acoustics (held jointly with the Acoustical Society of the Netherlands); June, at Lanchester College of Science and Technology, Coventry, on Plant Noise; and July, at the Institute of Sound and Vibration, Southampton, title, Congress on Audiology.

Members receive information on short courses and symposia in the area of acoustics not sponsored by the Society. Announcement has been

received of the Second British Academic Conference in Otolaryngology to be held in Oxford 30 July - 4 August covering Sensori-Neural Deafness of Peripheral Origin, Conservative Surgery of the Larynx, Chemotherapy in Head and Neck Cancer, Facial Paralysis and The Catarrhal Child. Correspondence should be addressed to L.F.W. Salmon, Keat's House, Guy's Hospital, London, S.E. 1 (W.J. Trott)

The New Campus for Physics at the ETH, Zurich

The postwar emergence of science and academic education as a matter of national concern has involved the countries of Western Europe irrespective of their size. Industrial development definitely was not curtailed during WWII in Switzerland. However, the country has realized in the last few years that its facilities of higher education must drastically be expanded in order to maintain her position in the technological race. In a previous issue of ESN (19-10, p.168) B. Epstein reported on a message from the Swiss national executive council (Bundesrat) to the national assembly (Bundesversammlung) which proposed a plan for improving and extending the facilities of the ETH (the Swiss Technical University). The message included a request for appropriation of 444 million Swiss francs (about $103 million) to meet the costs. Since then, the proposition has been approved and the expansion is well under way.

This note reports on the share of physics in this expansion project. It is a large share, indeed, and emphasizes the importance of physics as the basic science in an institution of mainly technological orientation. Two hundred eighteen million francs, or nearly 50% of the total allocation, is earmarked for a move of the physics faculty to an entirely new campus outside Zurich, on the Höenggerberg. The work is to be completed within the next three to four years, placing a considerable strain on the limited financial resources of this small country. If the total project would be measured in fractions of the gross national product, it would represent an investment of the order of $10 billion in the US, to be spent over a relatively short time. The allocation of nearly half of the expansion project to physics takes into account the almost explosive growth of this discipline inside the total spectrum of science as represented in the University. If the year 1922 is taken as the reference point, the last year in which buildings were added to the University complex on a large scale, the total number of students has grown from 1845 to 5436 in 1965, enlarging the student body by a factor of three. In the same interval the number of students in the Department of Mathematics and Physics has grown nearly ten times as rapidly (from 24 in 1922 to 624 in 1965). That this is not just a general university trend, but reflects a very peculiar interest in physics, is shown by comparison with the chemistry Department. The number of students in this closely related sister science has only grown from 290 to 481, not even reaching the gradient of the total growth.

Most European universities established a century ago, were integrated into the cities at a very early date, long before the limitations on expansion and the interference of modern traffic were any argument against a downtown location. Accordingly, such universities are faced with the problem of what to do about moving the fastest growing and most sensitive part of their facilities out of town. With the exception of the Sorbonne, which has a giant construction project under way right in the downtown area of Paris, these universities have started to build new campuses at the periphery of the cities. The old buildings in town are left to the administrators and/or the faculties which are less affected by the mechanical and electrical interference of modern city traffic.

It is possibly worthwhile to mention the manner in which these remaining facilities in downtown Zurich are being expanded in a cheap and clever way. Like many of the public buildings in Europe conceived around the turn of the century, the main building of the ETH consists of a number of huge squares of wings which enclose a small court necessary to let light into the rooms on the inside of the square. Modern ventilation techniques have eliminated the need for windows, consequently the area of these square courts is available for expansion. At the same time, the outside of the building is left untouched, which is important in this case since the main building of the ETH is considered an art treasure.

It was designed by Semper and is listed in the guidebooks on Zurich. The huge green-domed building, halfway up the hills, is a beautiful landmark that can be seen from most parts of the city. The planned expansion will not spoil this sight. The basements of the courts are to be filled with power plants and ventilation machinery with lecture theaters in the middle stories. This is topped off by additional rooms on the upper floors for the Central Swiss Technological and Patent Library.

Two further aspects of this downtown project are possibly typical of the change in European academic life. The present student restaurant is entirely inadequate for the increased number of students and the increase in the portion of their working time which is now centered in the laboratories. A generous expansion shall take this into account. Secondly, the present "Auditorium Maximum" is to be converted so as to service more useful function. These huge halls which exist in most European universities as a center of the cermonial climaxes of academic life, usually remind one more of royalty and the opening of parliament than of the communication and discussion of science. The things the Swiss plan to install in their Auditorium Maximum clearly indicate its present defects. The hall will have a blackboard, projection facilities, new chairs with small tables, microphone and loudspeaker system, as well as an adequate illumination and ventilation system. Thus, it will become a multi-purpose lecture theater and not just a room for ceremonial representations.

The major part of the University expansion project involves the relocation of the Physics Department from its present scattered downtown locations to a brand-new campus, which is in the process of being built on a hilltop approximately two miles west of the city. The new buildings will eventually accommodate the different institutes that form the Physics Department: Laboratory for Nuclear Physics, Laboratory for Solid-State Physics, Seminar for Theoretical Physics, Institute for Technical Physics, Institute for Molecular Biology and Biophysics, and the Institute for Geophysics and Physics of the Atmosphere. Within the Physics Department, the directors of the six institutes form a democratic body and each serves a two-year term as the head of the Department. This position is responsible for all the facilities that the six institutes have in common, such as administration, the machine shop and the largest part of the teaching facilities. Inside the individual institute, of course, a more autocratic structure prevails, and the whole system is not quite an equivalent to the American Departmental structure.

The new campus can roughly be divided into three separate complexes. In the first are buildings for the six institutes. Only the building for nuclear physics containing the largest machine - a Van de Graaff accelerator - has been completed. The building for technical physics will have a separate tract for the so-called Department of Industrial Research (AFIF), an organization resembling the Battelle Institutes but opening their facilities for contract research to the graduate students of the University. The building for theoretical physics (a group which had such names as Clausius, Einstein, Weyl, Schroedinger and Pauli on their payroll at one time or another) also houses the central physics library for the campus.

A second complex on the campus represents the facilities which are used jointly by all six Institutes, mainly the power plant, the helium liquefier and the central machine shop.

The third complex has evolved from the belief that teaching and research should be separated. The part close to the entrance of the campus is exclusively devoted to teaching facilities, which are used by all six groups in common. An 11-story building houses different kinds of work rooms and small lecture rooms in addition to the rooms for laboratory courses, the "Praktika." A large, octahedral, low building accommodates the big lecture theaters.

The campus is too far out to permit the students to lunch in town. A large restaurant near the entrance will take care of this and also cater to the permanent staff. It is somewhat unusual for a European university to plan residential facilities for the students, but it has been done for this project. The residential area will eventually provide 800 - 1000 beds and is even being given priority over other parts of the

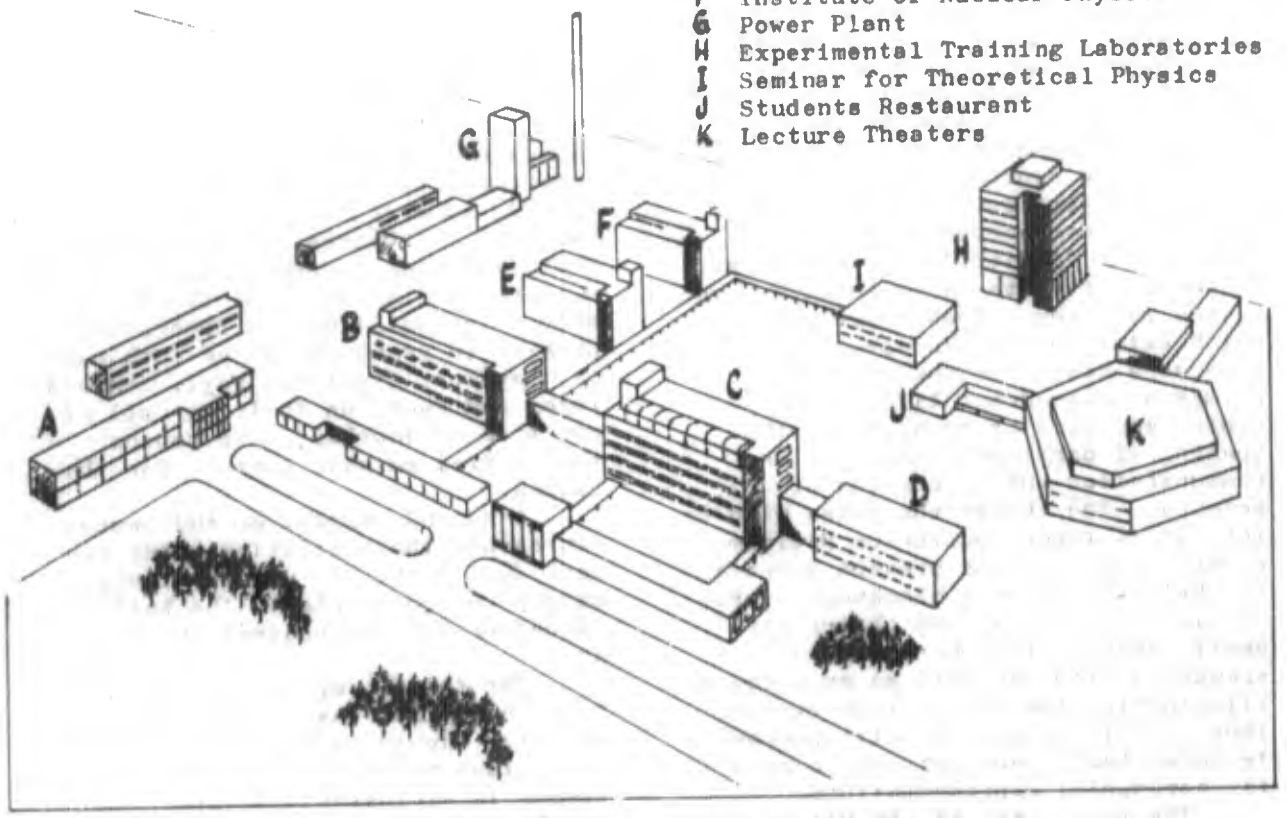
program.

When completed in approximately two to four years, the new campus will give research and teaching in physics at the Swiss Technical University an adequate and sufficient home for some time to come. If Swiss industry decides to give the graduates from this renowned and excellent facility of higher education the proper and challenging opportunity to work, Swiss research in physics cannot fail.

(B.O. Seraphin)

Legend:

A Central Machine Shop
B Solid State Physics
C Department of Industrial Research
D Institute of Technical Physics
E Institute of Molecular Biology
F Institute of Nuclear Physics
G Power Plant
H Experimental Training Laboratories
I Seminar for Theoretical Physics
J Students Restaurant
K Lecture Theaters



THE NEW CAMPUS FOR PHYSICS AT THE ETH ZURICH

Radar Measurements on Sea Targets at Flensburg, Germany

Eltro GmbH Company is a private corporation employing 600-700 people with headquarters in Heidelberg. The company specializes in the fabrication of absorbing materials for radio frequencies, microwaves and infrared, and in measurements equipment of these wavelengths.

Dr. Gerhard Beck is in charge of an Eltro field site which employs 90 people and is located in Flensburg on an estuary of the Baltic Sea. He has recently completed an extensive measurements program on the range dependence of echo power from sea targets at the Flensburg site, where one can see the Danish coast just two miles away. The measurements were made simultaneously at S, C and X-bands for ranges of a few hundred meters to 10,000 meters. Targets investigated included simple reflectors, small boats and ships. Because of differences in the range dependence of signal strength for various sizes and shapes of targets and for the

various wavelengths, no attempt has been made by Beck to report the data in the form of radar cross section. In other words, the primary objectives of the program were to determine the effects of the sea and the atmosphere on echo strength.

Field Sites and Instrumentation - Most of the measurements made by Beck have been over water for ranges between 400 and 10,000 m, but limited measurements have been made over land and ice. The measurements over ice and water were made at S, C and X-bands on the Inner Fjord at Flensburg, but the land measurements were made at S-band only on an airfield runway. All azimuthal beamwidths used were between 1^{o} and 2^{o}, pulse lengths were approximately 0.1 μsec, and the wavelengths were 3.2 cm, 5.5 cm and 9.35 cm. Polarization was horizontal. Transmitters were synchronized so that measurements could be made simultaneously, and the pulse repetition frequency was approximately 1000. The equipment was built specifically for measurements and analysis; for example, antennas are synchronized and targets were tracked via television. Antenna gains were between 25 and 30 dB, and dynamic range of each system was approximately 65 dB. Elevation beamwidths were broad, therefore tracking in elevation was not required.

Background - If spherical waves are reflected from a sufficiently large plane surface, the backscattered wave appears to come from a virtual image of the transmitter antenna. In this case, received signal power varies with range R as $(2R)^{-2}$. Therefore, backscattered power from a large flat reflecting surface, say from the side of a ship, might be expected to vary as $(2R)^{-2}$ at short range. The transition range between which one would observe the usual R^{-4} dependence and the $(2R)^{-2}$ dependence would be strongly influenced by surface shape. For a disc of diameter D and an antenna of diameter d, one would expect the transition range to be in the neighborhood of $2(D+d)^2/\lambda$. The reader will recognize this expression as that from antenna theory which is used to determine the transition between the Fresnel and Fraunhofer zones.

For studies of targets over a reflecting surface, combinations of the two distinct paths must be considered: (1) the most direct path between antenna and target, and (2) the most direct path between antenna and target and for which the wave is reflected off the water. Paths (1) and (2) will be referred to below as simply "direct" or "reflected," respectively.

At ranges for which backscattered power would vary as R^{-4} in free space, the effect of interference (cause by the difference ΔR in path lengths between the direct and reflected waves) is sometimes observed. For a corner reflector at constant height above water (or other target for which prominent scattering elements are confined to a small volume), nodes and antinodes are observed in received power as a function of range. For horizontal polarization, the reflection coefficient for a smooth water surface has a magnitude of essentially one and a phase shift of 180^{o} for all angles of incidence. Therefore, the envelope of the antinodes would, in principle, vary as R^{-4}.

At still greater ranges such that ΔR is less than $\lambda/2$, but for ranges shorter than that to the optical horizon, target power is expected (in principle) to vary as R^{-8} because of the interference effect. Examples of experimental data that depict transitions between the R^{-4} and R^{-8} zones may be seen elsewhere (L.N.Ridenour, Ed., Radar System Engineering, McGraw-Hill, New York, 1947, p. 51).

The above discussion neglects effects of the earth's atmosphere and its curvature. Electromagnetic waves propagating within the earth's atmosphere do not travel in straight lines but are generally refracted. One effect of refraction is to extend the distance to the horizon, thus increasing radar coverage; another effect is the introduction of errors in the measurement of elevation angle. The classical method of accounting for atmospheric refraction in computations is to replace the actual earth of radius a by an equivalent earth of radius ka and by replacing the actual atmosphere by a homogeneous atmosphere in which the waves propagate in straight lines. It is customary to use a value of $k = 4/3$ as simply a convenient means for approximating effects of refraction.

Measurement Results - The results presented below are based on data measured simultaneously at S, C and X-bands:

Simple Reflectors - The effects of interference were studied by

observing the received power, as a function of range, from radar reflectors that were maintained, by means of a raft, at several meters height above the water.

a. For ranges of 3000 m and less and for antenna and target heights small compared to range, received power varies as R^{-8} in the region where the path difference ΔR applicable to a curved earth surface is less than $\lambda/2$.

b. For ranges greater than 3000m, it was necessary to include effects of refraction due to the troposphere in order to account for echo power versus range. The value of k of 4/3 showed up as a useful average for effective range calculations, but effects of the atmosphere caused received power to vary between R^{-4} and R^{-12} for ΔR less than $\lambda/2$.

c. If $\Delta R > \lambda/6$ (calculated for normalized earth radius of 4/3), the received power varied as R^{-N}, where $N < 8$; if on the other hand $\Delta R < \lambda/6$, it was found that $N > 8$ with maximum N approximately 12. Changes in N are attributed to changes in beam curvature caused by variation in meteorological conditions.

d. For path length differences greater than $\lambda/2$, nodes and antinodes were observed as a function of range. The measured positions of the nodes and antinodes depend on transmitter wavelength, and occur at the positions predicted by ray theory and a smooth dielectric surface (for the sea). The envelope of the peaks in the interference pattern vary as R^{-4}, in accordance with theory.

e. The dielectric properties of the ground, the ice, and the water surfaces had no recognizable effect on received power, presumably because the heights of the antennas and the targets were small in comparison with the test range. Even the choppy water in the Flensburg Inner Fjord had practically no effect on the curve of received power versus range for low antenna heights and ranges of less than 10,000 m.

Ships - For ships (geometrically complicated reflector shapes), the dependence of received power on range was found to be strongly influenced by ship aspect angle. The following observations were made for ranges of 500-10,000 m on a 3000-ton vessel illuminated from astern.

	Range Dependence		
	R^{-2}	R^{-4}	R^{-8}
S-Band	R<1500m	1500m<R<5000m	R>5000m
C-Band	R<1500m	1500m<R<7000m	R>7000m
X-Band	R<1500m	1500m<R<10,000m	--

An R^{-2} dependence has been observed in the received power from several small boats and ships. When it exists, it seems to be associated with aspect angles for which back scattering from flat surfaces would tend to be prominent. The wavelength dependence for the transition between the R^{-4} and R^{-8} regions above is, in general, consistent with theory; that is, for a decrease in wavelength, other conditions being equal, the ranges between the regions of differing range ratios are expected to become longer.

Future Programs - The previously decribed measurements program was supported under contract with the West German Navy, and Beck is currently seeking support for further radar measurement studies. He is, however, performing studies in connection with obtaining refinements in radar absorbing material to further improve the Eltro product line.

Several radar measurement systems are presently under development for the German Ministry of Defence, and Beck hopes to expand the market for these systems. There are three quite flexible types of systems under development: one that is truck mounted for ground measurements, another for ship use and the third for aircraft installation. Each system provides for simultaneous measurements at S, C and X-bands with horizontal polarization. The radars include A-scope and PPI presentations and facilities for read-out of pulse counts versus range. Statistical processing equipment is available so that average values can be automatically printed out as a function of range. Antenna speeds, as I recall, are variable and operate between approximately 2 and 20 rpm. Instrumentation is included for recording humidity, temperature, wind speed and wind direction automatically on the radar data sheets. (M.W.Long)

PSYCHOLOGICAL SCIENCES

Chairman's Address, Occupational Psychology Section, British Psychological Society

The annual General Meeting of the Occupational Psychology Section of the

BPS is marked primarily by announcement of newly elected officers and a major address by the outgoing chairman (president). This year's meeting was held at Birkbeck College, London University, on December 2nd. Dr. Alec Martin, a psychologist at the Ministry of Labour, was installed as Chairman for the coming year; and, Professor Albert B. Cherns gave the Chairman's address, entitled "Putting Psychology to Work."

Cherns, who is one of England's more influential psychologists, until recently has been head of the British Social Science Research Council. He now has assumed a newly established Chair in Social Science at the University of Technology, Loughborough, Leicestershire. The timing and content of Cherns' paper was particularly appropriate, as he discussed a problem area in psychology which will form the basis for his new research unit at Loughborough. In essence, Cherns is concerned with the failure of social scientists to apply or utilize fully their fund of technical knowledge in the real world. His concern is not with fostering applied research, per se. Rather, the basic issue is that there are few social scientists engaged in what corresponds to the "engineering or development" function of the physical sciences, and that there is no provision for training individuals in this area. Two separate dimensions of this problem were discussed at some length.

First, it is Cherns' contention that applied work in psychology often fails to make the contribution which it might because of a failure to give sufficient consideration to the total system in which the results are to be utilized. He illustrated this point with an example drawn from his own research experience. Here, a study of training attrition in the RAF was carried out which resulted in recommendations for change in the organizational structure of a large training command. The study was technically sound, and the recommendations highly appropriate at the level of the training station. However, the recommendations could not be implemented as they would have created an even greater problem for the RAF as an organization by throwing the career ladder for instructors out of line. Thus, the failure of this research effort was due to a lack of attention before the study was started to the boundaries or basic perimeters of the system concerned. While this point should be self-evident, Cherns presented ample corroboration of its neglect to date in industrial psychology.

Beyond the problem of selecting the proper frame of reference or system in which to undertake social science research, Cherns advocates further systemic work on the mechanisms of applying research results. He sets forth three ways in which results of psychological research are applied or used: (1) by change in the climate of opinion, (2) by diffusion, and (3) by deliberate planned application.

As a classic example to illustrate the impact of "change in the climate of opinion" on the application of psychological research findings over the years, Cherns reviewed developments in the area of industrial productivity since 1915. A report of the Health of Munitions Workers Committee was issued at that time which disclosed that there was not a linear relationship between hours of work and output. Cherns considers this report (startling at the time) had sufficient influence on attitudes and opinion to pave the way for much of the industrial psychological research which underlies what is now traditional management practice. The most common means at present of implementing social science research findings by means of "climate change" is through courses for managers in business and industry. However, without question, this is a time-consuming and drawn-out process.

"Diffusion" is seen as a more rapid but also more dangerous mechanism for implementing applied social science research. Diffusion occurs through mobility of managers, supervisors, etc., in industry. Procedures and programs which have worked in one setting are applied in a new organization. Unfortunately, a program developed within the total system complex of one organization may be quite inappropriate when lifted out of context and established in another. It is here that Cherns sees the most common misapplication of social science research.

To date, "deliberate action" in application of research results is considered, for the most part, to have taken place only under an unusual set of circumstances. Cherns traced the development of five fields of

psychological research - ranging from large-scale aptitude and ability testing through human factors - which are highly active today in industrial settings. In each case, the development and application of fundamental psychological knowledge in the specific research area was precipitated by a significant wartime need. Thus, it would appear that the optimal conditions for deliberate application of research in the past have been: (a) a crisis of national proportions, such as war, (b) an adequate supply of trained persons to undertake the required research, and (c) an identity of the sponsor and user so that the investigator assumes an integral role in the organization or system. However, the transition of the wartime advances to industry typically has occurred through the processes of "change in climate" and "diffusion." Cherns quite obviously is of the opinion that this need not and should not be so.

In a parenthetical diversion during the paper, Cherns gave some of his notions on the basic research - development dichotomy. Not only does he consider the familiar research - development - production model to be an improper conceptualization of the process through which psychological research is applied, he points out that studies have shown that this model does not truly describe the process in any area of industry or technology. In the same vein, he rejects the argument that social science research cannot be applied because the significant fundamental studies have yet to be carried out. It would appear that Cherns advocates a blending of basic and applied research with a continual feedback which is not handicapped by artificial dichotomies.

Cherns' address was well prepared and extremely well delivered. The message he wished to convey came through not so much because of startling new ideas, but through his organization and logic. The very putting together of facts "everyone knows" outlines an important and neglected problem which must receive far more formal attention than it has in the past if psychology is to make the contribution which many believe is possible. Cherns and his new unit are devoted to a calculated effort in this direction.
(J.E. Rasmussen)

MISCELLANEOUS

The Engineer's Day

The problem of attracting capable young men and women into the engineering profession seems to be as critical in the UK as in the US, judging from the size and quality of "The Engineer's Day" program at the Science Museum, London. This two-months-long "careers exhibition" is being presented by a group of nationalized bodies and British Government departments with the cooperation and support of the Council of Engineering Institutions and the Confederation of British Industry.

On the Museum's ground floor, over 7000 ft^2 have been given over to the exhibition. A series of displays presents the lives led by engineers of all kinds against the background of their work. Civil, mechanical, electrical, transport engineers, etc., are depicted as constantly dealing with people and their needs. Some examples of the displays are given below.

A transparent model of the reconstruction now under way of the Oxford Circus Station to accommodate the new Victoria (subway) Line is exhibited next to a series of photographs which show the progress in various aspects of tunnel construction. An experimental line of twin tunnels, one mile long, is shown wherein two types of tunnel construction were tested. In one, the tunnel wall is lined with a form of flexible-jointed cast-iron lining which requires no bolting or grouting. The other type is lined with concrete segments. Both wall liners are expanded under pressure against the clay.

The engineer in medical research is illustrated by a series of slides on "Myoelectric Control of an Artificial Hand." An accompanying commentary describes work done by the Medical Research Council at West Hendon Hospital and at St. Thomas' Hospital which led to the development, at the Atomic Weapons Research Establishment, Aldermaston, of a miniaturized control circuit and artificial hand. The hand is controlled by myoelectric currents -- the currents which normally stimulate muscle. Operating signals are taken from muscles remaining in the forearms of amputees by surface electrodes in the socket encasing the stump. The system consists of the artificial hand, an electronic control

unit, and a rechargeable battery.

The National Coal Board has constructed a surface control room for the automated coal mine of tomorrow. An operator sits at a console at the exhibit, surrounded by TV screens, control buttons and telephones. As the activities in the mine proceed on the TV screens, the operator performs a sequence of control functions for the benefit of the audience.

In general, the exhibit consists of hardware, films and slides with commentary, and working models. Each exhibit is staffed by one or more engineers who answer questions and hand out well-prepared brochures on opportunities with his service or department. In all, there are about 17 exhibits.

After viewing the regular exhibits, the visitor reaches the "Hall of Industry," where there is time for thought and questions before leaving. Amid displays showing particular products selected for their interesting technical features and good design (e.g., a precast unit of structural concrete, a ship's propellor, an auto chassis, a segment of the cast-iron type of tube lining for the Victoria Line), representatives of such bodies as the Central Youth Employment Executive of the Ministry of Labour and the Council of Engineering Institutions are available to discuss career opportunities. Advice and information on the various routes by which one can become a professional engineer are also available.

The exhibition was augmented by a series of lectures and films in a nearby auditorium. A typical lecture title was "Building the Channel Tunnel." Included in the films presented every 30 minutes were: "Men of Power" (work and training of engineers in the electrical supply industry); "Forest Products Research" (Government research in timber technology); "Test Flight 263" (research behind high-speed test flights); "Creativity at School" (technology projects at Sevenoaks School); and "New Minds for a New World" (national attitudes to science and technology).

Finally, it should be noted that an excellent brochure had been prepared for each visitor, which describes the reasons for the exhibition, presents some photographs of engineers at work, mentions their accomplishments, and quotes opinions on the profession by many noted professional engineers. (H.E. Williams)

Politics in Education

Two situations have occurred in recent months on this side of the Atlantic which illustrate extremes in the spectrum of politics in education. On the one hand, students in Sweden were without teachers when the Government locked out the faculties (they are civil servants) in retaliation against a teachers' strike primarily in the gymnasiums (advanced high schools). At Stockholm's Royal Institute of Technology, this meant that the faculty could not get into their offices and students could attend laboratories only when student assistants were in charge. At the grade school level, students were required to spend regular hours in the classrooms, but could do as they pleased. Listening and dancing to music from transistor radios were very popular. In the end, the gymnasium teachers got a little more pay and the doors were unlocked. Several weeks later, the Swedish Government still had not decided whether the teachers were expected to make up for lost time or simply cover a little less material this year.

On the other hand, in Israel, undergraduate students at the Technion went on strike over a proposed increase in fees of about ten percent. While student leaders met to discuss the issues, the rest went on vacation. When the faculty threatened to force all to repeat the semester unless they returned in time to fulfill a minimum requirement of lectures and laboratory sessions, the students decided to return, but not until they had taken their annual, two-day Hanukkah holiday! (H.E. Williams)

NEWS AND NOTES

At the annual Anniversary meeting of the Royal Society, the President, Prof. P.M.S. Blackett, predicted that British science should benefit from the growing number of contacts between the Society and the Government. He said he would welcome the extension of these working contacts; however, it was equally important that the Society should possess a strong independent base from which to operate, with adequate financial support from private sources. Following the move last year to open the ranks of the Society to applied scientists, Blackett

announced the award of three medals for work associated with engineering design. These go to Sir William Penney (Chairman, UK Atomic Energy Authority), Mr. Christopher Cockerell (inventor of the Hovercraft), and Mr. Alec Issigonis (Technical Director, British Motor Corporation, and designer of the "Mini" and "1100" automobiles). A new gold medal and prize of £1000, to be awarded annually for an "outstanding contribution to the advancement of science, engineering or technology leading directly to increased national prosperity," was also announced. A sum of £20,000 has been donated by the Mullard Company for this purpose.

The French and German Governments have come to an agreement to build a high flux nuclear research reactor at Grenoble. The cost, estimated at 160 million francs ($32 million) will be jointly shared by the two countries, and it is contemplated that the reactor will begin operation in 1970.

Sweden and Britain have just completed joint experiments in the evaluation of "head-up" displays in aircraft, at the Minerva Laboratories, Treforest. The British equipment has been developed by Specto Aviation, Feltham, and Elliott Flight Automation, Rochester. The Swedish companies participating were Svenska Radio and the SAAB company.

The French Coralie rocket has had a second experimental firing in the Sahara and reached a height of 35 miles. The rocket will be the second stage of the combined Europa I space rocket.

The Royal Military College of Science, at Shrivenham, Wiltshire, is seeking the right to confer its own degrees, which now are granted by London University. If this autonomy is achieved, the College plans to slant its syllabus towards subjects of practical army application. A pass degree has been substituted for the Higher National Diploma as the minimum qualification for associated membership of the Institution of Mechanical Engineers, and the Institution of Electrical Engineers, for which officers of the Royal Electrical and Mechanical Engineers (REMEs) must qualify.

A grant of £32,000 (£1=$2.80) has been made to the Hatfield College of Technology for the establishment of a National Reprographic Center for Documentation. The Center will be concerned mainly with photographic methods of reducing original documents to microforms for storage, handling, retrieval and enlargement.

Hawker Siddeley Dynamics is manufacturing receiving stations for taking pictures fromweather satellites. The British Meteorological Office have bought five of these stations; and, Cyprus, Singapore, and the Maldive Islands also have installed them. The receiving apparatus is housed in a 10 ft^2 wooden hut, weather-proofed for any climate, and only one operator is needed to point the corkscrew aerial on the bearing over which the satellite will pass. The satellite's signal switches on a photoduplicating machine which will show cloud formations over a 400,000 mile^2 area of the earth's surface.

An inter-university link is being established between the Universities of Lancaster and Sussex with the proposal to establish a joint center of Operational Research. The plan is that OR departments at both universities should share staff, and work jointly in the North and the South on research projects. Some of the plans presently under discussion are that specialist staff should lecture at both universities, that students who earn their Master's degree at one University should earn their PhD at the other, and that research projects where national problems are involved might be shared.

A Chair of Telecommunications Systems is to be established in the Dept. of Engineering Science, Univ. of Essex, after an agreement between the University and the General Post Office.

A full-scale model of the Concord supersonic airliner is under construction for exhibition at the Paris Air Show next May. Costs are being borne by the four main companies engaged on the aircraft - British Aircraft Corporation, Bristol Siddeley Engines, Sud Aviation and Snecma - together with other sub-contractors. The Ministry of Aviation, on behalf of the Royal Navy, has placed an order of £24 million with Westland Aircraft for the development and supply of

Westland twin-engined helicopters, scheduled for service early in 1969. The new helicopter is a version of the Sikorsky Sh-3D or "Sea King," powered by two Bristol Siddeley Gnome 1400 gas turbines. It has a heavy load carrying capacity, which will make it suitable for carrying 20 fully equipped troops as well as for an anti-submarine weapon system and other naval tactical tasks.

Sir William Penney, Chairman of the United Kingdom Atomic Energy Authority, will leave his present post in October to become Rector of the Imperial College of Science and Technology, London, a position which has been vacant since the death of Sir Patrick Linstead three months ago.

Prof. Sir Willis Jackson, FRS, Head of the Department of Electrical Engineering, Imperial College of Science and Technology, London Univ., heads the New Year's Honours List. He will be a baron in recognition of his services to technology. Other names of interest in the scientific field honored in the List are Frederick Bawden, Director of the Rothampsted Experimental Station (Knight); Michael Perrin, Chairman of the Wellcome Foundation (Knight); and Prof. Ronald Tunbridge, Professor of Medicine, Univ. of Leeds (Knight).

Dr. M.R. Sampford, presently senior principal scientific officer in the Agricultural Research Council Unit of Statistics at Edinburgh Univ., has been appointed to a new Chair of Mathematical Statistics.

A. Kesselring, the Swiss managing director of the European Centre for Space Technology, at Delft and Noordwijk, has submitted his resignation which will be effective 1 January. He is reported in the London Times to have declared that he cannot work with the funds available.

Air Commodore H.L. Roxburgh, Consultant adviser in aviation medicine at the RAF Institute of Aviation Medicine at Farnborough, has been appointed Professor in Aviation Medicine there on the recommendation of the Royal College of Physicians of London. This is the first professorship awarded to an RAF medical officer. The appointment follows a decision to increase both the extent and the standard of training in aviation medicine of RAF medical officers. Seven-month courses are to be held at Farnborough, and a new designation - "flight medical officer" - will be used by successful students.

Dr. Daphne Jackson, lecturer in physics at the Univ. of Surrey, has become the youngest Fellow of the British Institute of Physics. She worked for a year as a Research Assistant Professor at the Univ. of Washington, Seattle.

Dr. Brian Warner, a research fellow in the Dept. of Astrophysics, Oxford Univ., is to leave for the US next year to join the Macdonald Observatory team studying Mars in preparation for a landing on that planet.

Dr. D. Brandon has taken a position as Associate Professor in the Institute of Metals, The Technion, Haifa, Israel.

Prof. B.A. Bilby has formed a new department - Theory of Materials - in the Faculty of Metallurgy, Sheffield Univ. With him are Dr. J. Eshelby (Reader), Brian Gale, on leave from NPL, and two senior research fellows. An MSc program will start next fall.

Prof. E.M. Wright, Professor of Mathematics at the Univ. of Aberdeen, has been appointed Principal of that 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, NY 09510.

ONRL-51-66 Psychology at the Technical University of Norway, Trondheim, by J.A. Rasmussen

ONRL-52-66 Services Electronics Research Laboratory 21st Anniversary Open Days, by P.D. Maycock

ONRL-53-66 Some Notes on Medical Education in Great Britain by I.N. Mensch (U LA, reserve training with ONRL)

ONRL-54-66 Some Solid State Physics in Basel, Freiburg and Strasbourg, by B.O.Seraphin

ONRL-55-66 Some Research in Materials in Birmingham, by J.B.Cohen

ONRL-56-66 Jet Engine Exhaust Smoke, by H.L.Seligmiller

ONRL-57-66 Studies in West Germany on Microwave Propagation and Scattering Over Water, by M.W. Long

ONRL-58-66 Psychology at Gotenborg, Sweden: The Institute of Education, The Psychotechnical Institute, by J.E. Rasmussen

The following conference reports are releasable to European scientists:

ONRL-C-28-66 XXth Plenary Congress of the International Commission for the Scientific Exploration of the Mediterranean Sea, by J.D.Costlow, Jr.

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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.

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