AD NUMBER: AD0475755

LIMITATION CHANGES

TO:

Approved for public release; distribution is unlimited.

FROM:

Distribution authorized to US Government Agencies and their Contractors; Export Control; 24 Nov 1965. Other requests shall be referred to Office of Naval Research - London, Arlington, VA 22203.

AUTHORITY

Per ONRL ltr dtd 8 Jun 1971

AD NUMBER: AD0475755

LIMITATION CHANGES

TO:

Approved for public release; distribution is unlimited.

FROM:

Distribution authorized to US Government Agencies and their Contractors; Export Control; 24 Nov 1965. Other requests shall be referred to Office of Naval Research, Arlington, VA 22203

AUTHORITY

Per ONR ltr dtd 8 Jun 1971

OFFICE OF NAVAL RESEARCH
LONDON

EUROPEAN SCIENTIFIC NOTES

No. 19-11
24 November 1965

Distributed by the
Office of Naval Research Branch Office,
London

OFFICE OF NAVAL RESEARCH
LONDON

EUROPEAN SCIENTIFIC NOTES

Edited by Bernard Epstein and Victoria S. Hewitson

24 November 1965 — ESN-19-11

OFFICE OF NAVAL RESEARCH
LONDON

EUROPEAN SCIENTIFIC NOTES

Edited by Bernard Epstein and Victoria S. Hewitson

24 November 1965 ESN-19-11

BIOLOGICAL SCIENCES

22nd Meeting of the NATO AGARD Aerospace Medical Panel

This Meeting was held 1-7 September at Fürstenfeldbruck, Germany. The Chairman was Col. B. de Vries, MC, Royal Netherlands Air Force. Very capable assistance was given by Col. G.A. Lauschner, MC, German Air Force, Host Coordinator; Lt. Col. H.W. Kirchhoff, MC, German Air Force, Project Coordinator; and Lt. Col. G. Zimmerman, MSC, USAF, Executive for the Aerospace Medical Panel.

The scientific program was divided into six technical sessions: thermal and vestibular problems; psycho-physiology; cardio-respiratory problems; environment; acceleration and vibration; and aero-medical research equipment -- a total of 34 papers. True to the Panel's name, several of the reports were space-oriented, although NATO operations are still mostly faced with the more "down-to-earth" aviation problems. Nevertheless, it can be rationalized that there is really no sharp line of demarcation between aviation and space medicine, and frequently the results of research in each field are mutually applicable.

An ONRL Conference Report will be published shortly for the benefit of those who are interested in details of the papers which were presented to the Panel.
(S.C. Dunn)

EARTH SCIENCES

Water Pollution Research

The UK Ministry of Technology maintains a modern Water Pollution Research Laboratory at Stevenage, Hertfordshire, under the directorship of Dr. B.A. Southgate. The staff of 150 had an opportunity to display the broad scope of the Laboratory's efforts during an Open House held 6-7 October.

While primary research is directed toward the evaluation and improvement of sewage treatment, extensive efforts are directed toward the related problems of pest control, erosion, effect of pollution on fish life, and control of fungus. The Laboratory has a well-equipped instrumentation section for in-house development of specific needs. Among the interesting developments are a small galvanic cell for *in situ* determination of dissolved oxygen content and the use of computer techniques in data analysis.

Considerable attention is given toward the causes, effects and treatment of industrial effluents in rivers and estuaries. These studies are usually undertaken in preliminary planning stages of new industrial installations such that adequate treatment of effluents is available from the outset. Another benefit derived from close relations with industry concerns the treatment of detergents: the only effective control of detergent wastes has resulted from voluntary changes in the manufactured product.

One of the most extensive undertakings of the Laboratory involved a complete survey of the Thames River, its tributaries and estuary. To determine dispersion of sewage in the estuary, small amounts of Br^{82} were introduced at various points of the river, then traced by traversing the stream with γ-scintillators towed at three depths by a small boat. The mathematics section has constructed a mathematical model of the Thames which is used to predict future conditions of the river.

The preceding were but a few of the many interesting displays and served to indicate the scope and sophistication of research efforts at the Water Pollution Research Laboratory.
(J.E. Bennett)

Symposium on Marine Radioactivity

A group of chemists engaged in the study of marine radioactivity met in Venice on 27 September to discuss their work. The meeting was held in the Center for Oceanographic Studies in an old building on the Grand Canal. This Center is organized under the auspieces of the National Research Council of Italy, and its principal activity is in the field of primary productivity.

The participants were as follows:

R. Fukai, I.A.E.A., Laboratory of Marine Radioactivity, Monaco
E. Duursma, I.A.E.A., Laboratory of Marine Radioactivity, Monaco
Michael Bernhard, Laboratorio per lo Studio della Contaminazione Radioattivia del Mare, Fiascherino, La Spezia, Italy
Cesare Triulzi, C.I.S.E., Laboratorio di Radiochimica, Milan, Italy
Caprade Giacoletto, C.I.S.E., Laboratorio di Radiochimica, Milan, Italy
Laura Tassi-Pelati, Istituto di Zoologia, Universita di Parma, Italy
Claude Lalou (Mlle), Centre des faibles radioactivites (SACLAY), Gif-sur-Yvette, France
R. Chesselet, Centre des faibles radioactivites (SACLAY), Gif-sur-Yvette, France
J. Thommeret, Institute of Oceanography, Monaco
Marko Braniča, Institute Ruder Bošcovič, Zagreb, Yugoslavia

Each of the participants presented a short and very informal account of the work he has been doing, and there was general discussion.

Fukai discussed some methods for the enrichment of trace elements in sea water. We now have some very sensitive methods for chemical analysis of trace elements, but when these are applied to sea water it is almost invariably necessary to concentrate the material before analysis. Fukai dealt with the case of cobalt, which may be determined spectrophotometrically by the use of the so-called nitroso R-salt. This method has a sensitivity of about 0.01 μg/liter, but for the determination of the metal in sea water the material must be concentrated at least ten-fold. This may be done by precipitating the metal with ferric hydroxide at a pH of about 8.8, but under these circumstances a large quantity of magnesium hydroxide also precipitates, making subsequent analysis difficult.

It has been proposed to precipitate with alpha-nitroso-ß-napthol, but the after-treatment in such a case is troublesome and the method is impractical. Yamagata used manganese dioxide (about 70 g of solid to 20 liters of water), which served very well. Fukai has found that the amount of solid manganese dioxide can be reduced very considerably, and by using 10 mg/liter he has been able to recover at least 90% of the cobalt. Separation and concentration of cobalt can also be accomplished by passing the water through a column of solid manganese dioxide and eluting with nitric acid.

It is of course critical that the manganese dioxide be absolutely pure, and for this purpose he prepares the material from pure manganous salt, oxidizing with bromate in nitric acid solution. Manganous ion interferes with the spectrophotometric method, but can be kept to a minimum of 5 μg in a total quantity of 200 mg. Using this method of concentration and analysis, Fukai found 0.01 μg/liter of Co in the waters off Monaco.

Braniča discussed the application of polarography to the study of the minor elements in sea water. He is particularly interested in the general physical chemistry of sea water and the ionic state of its constituents.

Polarography has two areas of application in the chemistry of sea water. The first of these is the analytical determination of trace elements. For this purpose the older and more conventional methods of polarography are not sensitive enough. The new methods of square-wave, pulse and hanging-drop polarography are suitable for direct use.

The square-wave method is capable of a sensitivity of 10^{-8} molar, depending on the reversibility of electrode reactions. The pulse method is not quite so sensitive as this. The hanging-mercury-drop procedure is very good, however, and is simple and cheap and capable of a sensitivity as high as 10^{-10} molar. However, it can only be used for such metals as form amalgams with mercury.

The second application of polarography is to the determination of the ionic state of elements. In conventional polarographic work significance often attaches to the so-called half-wave potential. The value of this potential changes, however, on changing pH or chloride ion concentration. In either of these cases the difference may often be identified as a change in the ionic state of the metal concerned, such as formation of complex ions.

Bernhard discussed the use of the autoanalyzer and the determination of nutrients by means of it. This piece of apparatus (manufactured by Technicon) has previously been referred to (ESN-19-10). Its use in oceanographic chemistry thus far has been largely confined to samples brought up by water bottles or to continuous *in situ* measurements of surface water. Bernhard described a piece of equipment used to sample the sub-surface continuously. It consists of a sort of

fish or torpedo towed at depths behind the ship and connected with the apparatus on board by plastic tubing. Water enters an opening in front and is carried up on board by means of compressed air in the torpedo. This apparatus has already been used at moderate depths and has the advantage that it can be raised or lowered while in motion, thus sampling a range of depths.

Duursma discussed the problem of determining carbonate and organic matter in sediment samples by means of ignition loss.

When a sediment sample is heated, three substances are successively lost: water, carbon dioxide, and organic matter. Sometimes the sample is treated with hydrochloric acid and carbon dioxide is evolved and, after washing, the residue is ignited and weighed to obtain the loss of organic matter.

A common routine method of analysis is as follows: The sample is first heated to 110° C and weighed. This air-dried sample still contains some water of crystallization which must be corrected for, but this amounts to something like 5% only. Then it is heated to 800° C or more. Carbon dioxide and organic matter are both lost and the sample is re-weighed. Ammonium carbonate solution is then added, which combines with the ignited calcium oxide to reform calcium carbonate. The excess ammonium carbonate is driven off and the material re-weighed. By the appropriate differences in weight one can calculate a value for both calcium carbonate and organic matter.

When samples were treated in this way, however, and heated successively from 400° to 1000° C and the calculations made as described, it was found that with increasing temperatures of ignition the apparent percentage of calcium carbonate came to a maximum and then diminished again very nearly to zero. Presumably this was due to the reaction of calcium carbonate with silicon dioxide, which would of course prevent the reformation of calcium carbonate.

The practical conclusion therefore was that calcium carbonate and organic matter cannot be determined in a sediment by means of ignition loss.

Thommeret discussed C^{14} determinations in the Indian Ocean. Samples were obtained at some half-dozen stations, both surface and deep water. Results indicated ΔC values of approximately -120 to -170 for the deep water, and his conclusion was that there was no regular indication of age difference.

Triulzi, accompanied by Miss Laura Tassi-Pelati, discussed the determination of trace elements in sea water. Concentrations from a half to one microgram per liter of uranium were found. A number of determinations were made of radioisotopes of strontium, lanthanum, manganese, antimony and ruthenium contained in sea water, plankton, brown algae and sediments. Strontium was found in all four types of organic matter. Lanthanum and manganese were found in all excepting brown algae. Antimony was observed in sea water and plankton, while ruthenium was found in plankton and in sediments.

In the upper 5 cm of sediments the following distribution of radioactivity was observed: Ce^{166} and Pr^{166} accounted for 56% of the radioactivity; Sr^{90} and Yt^{90} for 0.6%; while Pr^{167} amounted to 3.7%. The remainder, approximately 40%, was distributed among various and miscellaneous constituents.
(N.W. Rakestraw)

Water:

Although one would never suspect it from the conditions of the last summer and fall, London does sometimes have a water problem. Two items recently in the public press refer to this.

One is a proposal to augment the flow of the Thames by tapping the enormous natural reservoir of underground water in the chalk downs. It is estimated that some 5×10^{11} gallons of water exist in the chalk and limestone beds of the western Thames valley. A pilot project is planned for next spring, in which nine exploratory boreholes will be drilled. They are expected to yield about 16 million gallons a day, to be channeled into the Thames at Reading. At least a year will be required for the operation, but if this is successful, it is planned to sink a total of 248 boreholes. The total cost, estimated at eight million pounds, is considered cheap for the 270 million gallons a day of additional water.

Britain has offered to help any country in the world solve its water problem, with advice and assistance in the construction of plants for the desalination of sea water -- a field in which the British feel themselves particularly competent. An international symposium on desalination was held recently in London, and the British delegation was headed by Prof. R.S. Silver, of Heriot-Watt College, Edinburgh, who is responsible for much of the development of the flash-distillation process, the method now most widely used. The opening of a new test center for this process, at Troon, is announced for next summer.
(N.W. Rakestraw)

MATERIAL SCIENCES

Committee on Structural Steels

A vexing engineering problem that occurs with relatively low statistical frequency, but is most dramatic in its manifestations, is the brittle fracture of steels. Brittle fractures are characterized by glass-like propagation of ruptures at high velocities and the sudden collapse of structures or machinery components. The most interesting cases that have made newspaper headlines involved the splitting apart of welded ships and the collapse of welded bridges. The technical literature contains many other examples of this malaise, and even in the absence of headlines it is a factor seriously considered by designers and users of steels. Before the reader makes a quick mental note to be wary of steel structures, and particularly of ships and bridges, it should be noted that a great deal has been learned about this problem; it is possible to specify selection procedures that ensure either reasonable or complete safety. By being very conservative and accepting increased steel costs, one can assure complete safety. The remaining "bone of contention" and the remaining problem is that of achieving engineering solutions within various specified economic limits. In other words, how can reasonable solutions (what is reasonable to X may not be reasonable to Y) be provided cheaply? While it is recognized that this is not a scientific description of the problem, it is most definitive in terms of human nature. Such situations are not unique in the fields of engineering endeavor which must consider "know why," "know how," and "know what" - the last relating to the human-nature aspects of the environment in which the decisions are made. The attainment of specific engineering solutions to such delightful problems as the falling apart of steel structures would be much simplified if only the "know why" were involved, but perhaps the vocation then would become too prosaic for the daring types involved.

This highly abbreviated background serves to explain the basic central interest, the multi-faceted aims and the interdisciplinary makeup of the membership of a very important committee with a somewhat misleading title. The actual name is Navy Department Advisory Committee on Structural Steels. While the aspects that are implicit in the title are certainly involved, it is in fact a "National Committee on Structural Steels," as will be described.

The present Committee evolved from its predecessor, the Admiralty Ship Welding Committee (ASWC), which was established during the difficult days of failures of welded ships in the 1940's. A similar group was established at the same time as the Ship Steel and Ship Structure Committees of the U.S. National Academy of Sciences. It is interesting to note that while the two national groups have been reorganized, both with respect to objectives and membership, in order to represent much broader interests, the original connections with ship structures have been retained in the titles. The original objectives of the Admiralty Advisory Committee on Structural Steels (AACSS), which in 1954 superceded the ASWC, were largely realized by the introduction of notch tough steels to the Admiralty, Lloyds Register, and British Standard Specifications and by the general acceptance of the Charpy V fracture-toughness test for production control in steelmaking. Future activities of the Committee were recognized as requiring additional pursuit of more fundamental investigations in fracture. Accordingly, the Committee was reconstituted in 1963 with much wider terms of reference at the same time that the Admiralty became the Navy Department of the Ministry of Defence. Hence its title, Navy Department Advisory Committee on Structural Steels (NDACSS). The membership was widened by the addition of representatives of government and industrial research associations and of universities to the original membership of the Research Panel of the old Committee.

In addition to the decision for reconstitution, the old Committee was instrumental in influencing DSIR /Department of Scientific and Industrial Research presently the Department of Education and Science (DES)/ to increase greatly sponsorship in universities of basic research in fracture. The fostering of such research is the responsibility of the Metallurgy and Materials Sub-committee (formerly under Prof. A.H. Cottrell and presently under Dr. Mentor) of the DES Research Grants Committee.

The functions of the new NDACSS, as originally outlined in a broad sense, were "to study and apply to practice the results of DSIR (DES)-sponsored researches, to investigate all types of structural steels, and, with the help of representatives from the steel industry, to keep itself informed of current and future steelmaking practices which may improve the properties of the product." The detailed terms of reference, as developed by the membership, are as follows:

1. To provide guidance to practicing engineers on the selection of materials for welded structures and to steelmakers on the requirements of improved structural steels of general utility.

2. (a) To make such recommendations as may be effective on the research and

technical (including welding) aspects of the development and application of structural steels.

(b) To formulate the tests needed to establish the mechanical and welding properties of structural steels, having regard to design and performance requirements.

(c) To consider the engineering aspects of brittle and ductile fractures under steady, shock and cyclic loading.

(d) To maintain liaison with other bodies, such as the Central Electricity Generating Board (CEGB), and the British Iron and Steel Research Association (BISRA) Civil Engineering Committee, and in particular the Materials and Metallurgy Sub-committee of the DES Research Grants Committee.

The "Navy" aspects entail sponsorship of the Committee and utilization of its recommendations that are applicable to naval construction.

The Committee Chairman is naval constructor (architect) W.G. Perry, RCNC, Deputy Director of Naval Construction-X (Experimental) of the Director General Ships headquarters at Bath. The chairmen of three principal ad-hoc sub-groups are Mr. R.W. Nichols (UKAEA, Reactor Materials Laboratory, Culcheth) for the Cooperative Research Working Party, Mr. G.M. Boyd (Lloyds Register of Shipping) for the Interpretative Report Working Party, and Mr. P.R. Christopher (Naval Construction Research Establishment) for the Evaluation of Steel Properties Working Party. The work of these three groups is of considerable interest and will be described. The Committee membership includes Research Associations (3), Steel Industry (2), Universities (5), Industry (6), Government (9), Classification Society (1). The Government membership includes the Chairman and the Secretary, Mr. L. Wortley of the Department of Materials Research - Naval.

The Interpretative Report Working Party is responsible for producing reports which will interpret the significance of existing and new knowledge of the properties and behavior of structural steels in terms which can be understood and used by designers and engineers. The present activities of this group are centered on the development and publication of a guidance text for engineers - aimed for issue as an authoritative text in 1966. The Cooperative Research Working Party consists of members actively engaged in research work connected with engineering properties and behavior of structural steels. The activities of this second group have centered on the development of advanced research programs and interaction with the scientific community. The Evaluation of Steel Properties Working Party is a new group which consists of a number of members of the Committee or their nominees. Its prime objective will be to formulate and execute a collaborative program of materials testing of newly developed structural steels in order to assess the materials' performance from the viewpoint of the user. Consequently, the types of test would not only include normal small-scale laboratory tensile and impact tests but also larger-scale testing in which the emphasis would be on the behavior of weldments. Such a group is unique and should provide an interesting experiment in collaborative approach to the problems involved.

In practice, the operations of the Committee are such that each member is assigned ad-hoc studies and analyses of a wide variety of special items. These may include new research papers from any national source, assessment of state-of-the-art or-science, critiques of proposals for engineering solutions, etc. It is most evident that all members of the Committee are "working members" - there are no free rides of Committee membership! Because of the great variety of talents and the uniformly high technical caliber of the members, the minutes of the meetings for the past year provide fascinating and instructive reading which augurs well for the future published work planned by each of the groups.

The Committee may also include liaison members selected from temporary, non-British residents in the UK having common interests. The writer has been privileged to receive such membership.
(W.S. Pellini)

MISCELLANEOUS

The University of Nottingham

The University of Nottingham has made good progress toward the completion of its major post-war building program, with the exception of the medical school complex, which is yet to come. It now creates a most favorable image of what the "red brick" universities are striving toward. To be sure, many Englishmen look upon Nottingham as a city without culture, in the heart of the Midlands, an "industrially-oriented" area with all of the innuendoes implicit in this term. However, the University is favorably located on 300 acres of land at the edge of the city.

The Royal Charter granting Nottingham its University Status was dated 20 August 1948, although the college from which it

has developed goes back to the late 19th century. Since WWII it has grown both in quality of student body and in number of students. In 1964-65 the enrollment was 3,500, 60% of whom are resident students.

As is true for all universities in England, students must apply for admission through the Office of the Universities' Central Council on Admissions in London. However, Nottingham attempts to interview personally all students prior to acceptance. In addition, while it is the university which grants admission to a student, a student is, in fact, actually admitted to study in a department. Thus, in a real sense, the departments control admissions in accordance with the number of students they can handle.

An individual wishing to be admitted to a course of study leading towards a BSc in chemistry is admitted as a student in the University of Nottingham, but also specifically in the Department of Chemistry. The course for such a degree encompasses three years. During the first year, the student normally studies mathematics and physics in addition to chemistry. During the second and third years, he studies chemistry only. This is indicative of the degree of specialization which is enforced even at the undergraduate level in British universities. It is possible to take a joint degree, but no significant percentage of students do. Degrees are classified as either Honours Degrees (1st, 2nd or 3rd) or Ordinary Degrees.

Each student is assigned to a tutor who, in addition to any tutorial teaching, is able to advise about general academic matters or even personal affairs. The tutor is a member of the staff in the department to which the student is admitted.

The organization into living units on campus is the most impressive feature of the "new Nottingham." There are eight Halls of Residence for men and four for women on the campus proper. The organization of a typical Hall of Residence will be considered in detail since it is felt that the overall effect on the undergraduate must be impressive.

A sketch plan of Rutland Hall is shown below. The Hall accommodates 210 male students. Both within the hollow square and without (looking out on other parts of the campus) the lawns and gardens are beautifully kept, as is possible only in such a climate. It is argued that the expenditure of effort necessary to maintaining such beautiful surroundings is wasted on youth who often pass it by unnoticed, but its impression on the student must be lasting and beneficial.

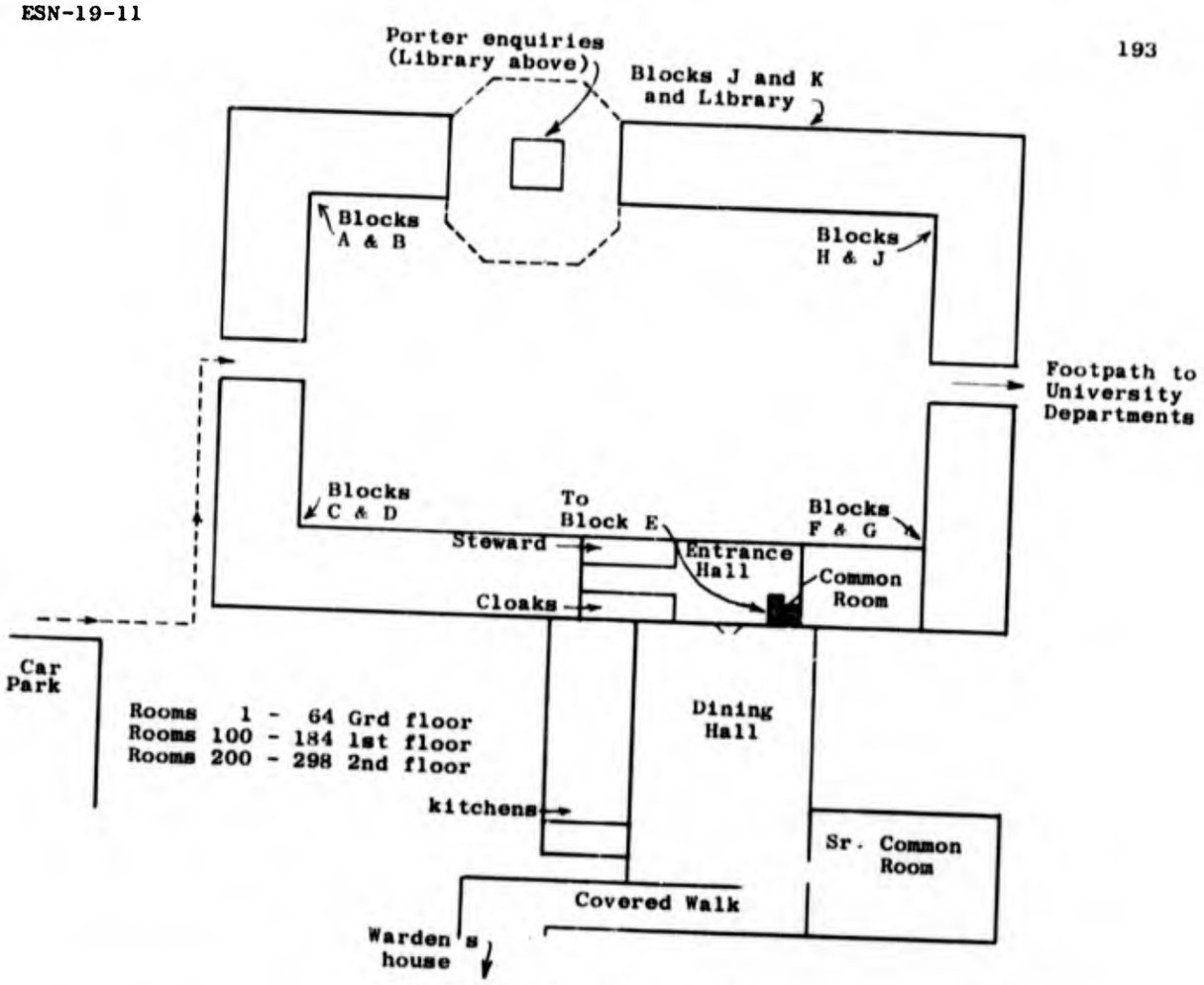
Each hall is the charge of a warden. Uusually he is a member of the senior staff of the university faculty. The warden is responsible to the university for the overall operation of the hall. He lives with his family in a house which has been built as a part of the hall. He, in conjunction with the other wardens, decides on the assignment of students to halls of residence. Every effort is made to have a cross-section of academic interests represented in each hall.

A very considerable staff is necessary to run the hall. A resident steward (who is furnished a commodious flat in the hall - he may be married with children, in which case he usually lives out) is in charge of the daily routine of the hall. He prepares menus, dispenses wages, orders food and supplies, etc. There are five chefs one head chef, another experienced chef, and three apprentices. All live in the hall. There are nine waiters, young boys (often training to become professional waiters), all of whom also live in the hall. (It must be realized that 70% of the students in England leave school by the time they are 16 years old). Approximately six part-time kitchen helpers are employed, but they do not live in.

A resident Matron is in charge of housecleaning. She also acts as assistant to the steward. In addition, she may be called upon to act as a nurse for minor injuries to hall residents. Approximately 16 women are employed under supervision for about four hours a day for housecleaning purposes. The general "factotum" of the hall is the porter. He must live in and is therefore furnished a commodious apartment also. He sees to minor building repairs, mail distribution, securing the hall when necessary, etc. He runs a little kiosk for hall residents, escorts visitors, assists with luggage, and in general knows more about the individual hall residents than any other single person. It is very desirable that the porter command the respect of and enjoy the goodwill of the hall residents.

The charge per hall resident for the three terms of ten weeks each is approximately $500. The students must furnish their own linen, but the fixed fee covers room, board, and laundering of linen. Washing machines and irons are maintained in the hall for the use of the students in doing their personal laundry (and they are used extensively).

The use of a hall by summer and other vacation period conference groups is often of assistance to the warden in meeting budget and maintaining permanency of staff.



SKETCH PLAN OF RUTLAND HALL

Five apartments are reserved in the hall for bachelor resident tutors (they are usually junior faculty members, or occasionally, junior members of the administrative staff of the University). While it is not easy to find appropriate bachelors for the male halls of residence, the problem of finding spinsters for the female halls of residence is far more acute. The resident tutors, together with the warden, act as advisors to the hall residents. In addition, the warden selects several non-resident tutors for his hall, who, with their wives, eat in about once a week. These are, of course, members of the staff also. Each non-resident tutor is expected to have his group of students to his own home occasionally.

All hall residents eat in the main dining hall. (There is a separate smaller Senior room in which the warden can entertain guests.) Some students dine with the senior staff at the "High Table" in the main dining hall.

A "Common Room" fund is maintained by the residents. With it, daily newspapers and weekly news magazines are purchased and placed in the Common Room. These funds are also used to purchase sports equipment for inter-hall competition, table tennis, TV, and to equip a photographic dark room. There is no compulsory physical education at the University. There is an inter-hall cup for which the halls compete vigorously. There is a hall library containing general reading material.

The hall has two guest rooms. Residents may lodge guests there for a charge of 10 shillings ($1.40) for room and breakfast. The guest rooms are insulated from the boys' rooms by the porter's flat. In addition, hall residents may have guests at any meal (on a paying basis). Girls may visit in student's rooms until 10:30 pm and in public rooms until 11:00 pm.

At the table stainless-steel cutlery, embossed with the crest of the hall, is used. Also, the crest is printed on the

paper napkins which are standard. Many such little things are in evidence of the attempt to give the hall residents an esprit de corps. The rooms are single or double, mostly single, and a bath is located between two such rooms on the ground floor. Baths are not quite so numerous on the upper floors. The rooms are large by American standards, but somewhat sparsely furnished. As an example, wall hooks, whether on the walls of the room or on the inside of a closet door, are conspicuous only by their absence.

The salary of the warden comes from the University budget. In addition, the University furnishes gardeners for all halls, but all other parts of the hall operation must be self-sustaining. The warden's house, which is of ample size and well appointed, is attached to the main hall of residence by a covered walkway. It is completely equipped for housekeeping, even though most of the family meals are taken in the dining hall with the students.

Obviously, the warden cannot be also a fulltime member of a departmental staff. He assumes a reduced teaching load, but is still (in the case of Rutland Hall) an active member of the senior staff of the Chemistry Department.

One is impressed by the commitment which the University has made to the students' overall welfare. The size and design of the residence hall is such as to avoid the impersonality which one sees so often in the larger dormitories coming into vogue in the United States. In addition, serious efforts are made to bring students and faculty into close contact outside the classroom.

Rather obviously, the warden is the key to the success of this endeavor to reach the "whole" student. In summary, one can only express admiration at this new-style "red brick" university structure. It cannot help but have a positive, lasting influence on the students.
(S.Y. Tyree, Jr.)

Beer!

Armadas of beer ships from Denmark, Holland, Germany and Britain converged on Sweden and discharged their cargoes in the free ports, for public distribution on October 1. On this date a new law went into effect, under which 3.6% beer became legal instead of the older 2.8%. A price war immediately developed, in which Swedish brewers were handicapped, for the new beer did not legally exist before the deadline and not a bottle could be budged. But in the few hours after midnight, it is estimated that 50 million bottles were moved -- some by airplane!

The new law was enacted against the strong opposition of the temperance movement, notwithstanding that it was urged as an inducement to the Swedes to drink more beer and less spirits.
(N.W. Rakestraw)

A Technological Career?

A report from the Federation of British Industries concerns itself with the shortage of students who are preparing themselves for technological and industrial careers. Engineering has a relatively poor public image in Britain, and the blame for this is put largely upon teachers "who have little knowledge or experience of the careers for which many of their pupils should be preparing." Among the other factors leading to this unfortunate situation are mentioned the lack of clear and objective career information, the shortage of mathematics and science teachers, and students' reluctance to decide in good time on a career.
(N.W. Rakestraw)

PHYSICAL SCIENCES

Conference on Optics in Space, Univ. of Southampton, 27-29 September 1965

On 24 March 1964 the European Space Research Organization (ESRO) was launched (see ESN 18-5, May 1964). A cooperative endeavour of ten European nations anxious to participate in an effort distinctly separate from that of the Americans and the Russians, ESRO is headquartered in Paris but decentralized to a considerable degree. Initial plans for the first eight years of operation include the launching of 400 sounding rockets, six small satellites, eight medium-sized satellites, seven space probes, and one large orbiting astronomical observatory. Not encompassed within this program is the actual development of sounding rockets and launching vehicles themselves, it being the intent of ESRO to draw upon the British Skylark, the French Centaur, or possibly some vehicle from the US for this portion of its program.

Now, some 18 months and $39 million later (assuming that one-half of the first three years' budget ceiling of $78 million has been spent), much has been accomplished. Having decided upon the types of experiments to be carried out (solar X-ray and ultraviolet measurements being among the first on the list) ESRO charged its experts with the responsibility of inviting design studies from European laboratories, evaluating these and (just as we often do at home), throwing out all original designs, modifying specifications, and, finally, letting actual hardware contracts.

It was, therefore, an active and enthusiastic group of some 200 researchers

(including two from as far away as Red China) who chose three lovely fall days in the midst of verdant hills and colorful forests, to report, compare and review their work in space optics. The Conference was under the general chairmanship of O.S. Heavens (Professor of Physics, York Univ. and current President of the Optical Group (a body corresponding to our own Optical Society)) and was supported by the Institute of Physics and the Physical Society. Thirty-seven papers covered the gamut from radiation damage in interference filters to moon-based survey parties. Throughout the Conference, however, ran the underlying theme of planning for the large orbiting astronomical satellite eventually to be launched by ESRO.

A conference of this nature cannot be summarized with brevity, since for some readers engineering design details may be of considerable practical importance, while for others emphasis on the more fundamental and, hopefully, newer applications might be preferred. For subject matter which ranges over the fields of cosmology, nuclear physics, astrophysics, geometric and physical optics, quantum electronics and computer programming, no sufficiently coherent theme could be found on which to base a genuine summary. For this reason, and because it is the expressed intent of the Conference not to publish proceedings, an ONRL Conference report is planned for early publication. We should like, however, to call attention to four papers of general interest which were especially well received by the audience.

Dr. K.E. Kissell (Aerospace Research Laboratories, Wright-Patterson AFB), in a paper entitled "Precision optical tracking of artificial satellites for photoelectric photometry and laser experiments," described a 4-axis tracker using a 24-in Cassegrain optical system. Spacecraft at altitudes from 200 to 5000 km were tracked with an accuracy, for example, in excess of ± 60 arc-seconds for 75% of the track on targets at 200 km. Among the advantages of a 4-axis system is a reduction in power requirements, since the mass to be accelerated during tracking is minimized.

Attracting considerable interest were Kissell's photometric light curves, making it seem almost feasible to identify vehicles from their unique signatures as recorded by photoelectric photometry, which at present is capable of continuously recording targets ranging from -3 to +10 stellar magnitudes.

In a paper entitled "Detailed star charts from a computer," Dr. E. Eisner reported on his work with D.M. Romain at Bell Laboratories. His programs select those stars, contained in a 260,000-star catalogue on magnetic tape, that would appear in the field of view of a given camera. The positions of these stars are then accurately updated and a diagram on microfilm and a printed table of the positions of those stars to be seen within that field of view are produced. The sizes of the plotted stars in the diagram correspond to their magnitudes, and an additional diagram is produced in which the stars are numbered to correspond to their positions in the printed table.

While to Eisner the real point of his achievement is his newly-developed technique for handling enormous amounts of data, to the audience the resulting ability to print out a film overlay for a specific field of view and time of day seemed more striking. Into an IBM 7094 Model II with disc file, Eisner has fed the classical equations of motion, taking into account diurnal rotation, precession, nutation, annual and diurnal aberrations and, optionally, atmospheric refraction. In general, the difference between computer-predicted and actual star positions turns out to be less than 0.02 seconds of arc, which is beyond the precision to which star locations are known.

As a trivial exercise for this computer technology, the machine had been asked to print out the sky of 3000 BC. History records that Pharoah Khufu's sailors navigated around Africa with reasonable accuracy merely by keeping Ursa Major to their right. Eisner's program graphically shows that such a technique was adequate then but would provide quite an erratic path under today's rather different celestial appearance.

A third paper, entitled "A multiplex grating spectrometer for the infra-red," was delivered by J.F. Grainger (Hull Univ.), who reported on work, performed under an Air Force Cambridge contract, concerning the spectrum of Venus in the 1 - 3μ region. The earth's contribution to the spectrum of Venus can be compensated by a simultaneous moon scan. Employing a multiplexing technique, Grainger has been able to use a single detector to analyze the entire spectrum simultaneoulsy. The essence of the system is a "chopper" which modulates the individual spectral elements. In appearance, the chopper is a circular checkerboard with 16 circular zones, each containing alternate black and white "squares" which make up the coded disc. Each channel has one more light or dark square than the one lying nearer to the center. With 1% photometry, conventional detection would require three-hour integration per line, or 20 years for the entire spectral analysis!

Finally, Dr. E.J. Sternglass (Westinghouse Research Laboratories) presented a paper entitled "The application of transmission secondary emission and conduction to astronomical imaging." He examined the potential uses of transmission secondary emission and secondary electron conduction for astronomical observations from above the earth's atmosphere. Basically, Sternglass' system employs low-density (about 2% of solid) KCl "smokes" for image detection and storage, which in principle replace thousands of photomultipliers and give a large dynamic range coupled with high gain and resolution. Not noted for his pessimism, Sternglass concluded by remarking that, with the coming development of direct computer-coupled photometry of

extended objects, it will be possible to analyze spectrally the entire stellar distribution in the course of one night!

A versatile individual, Sternglass will also be remembered for his paper in Nuovo Cimento 35, 1, 227-260 (1965), in which he presented his model for charged meson and pion resonances - a model not readily acceptable to all workers in this field. It did stimulate sufficient interest, however, to obtain for him an invitation to spend the academic year 1966-67 at Stanford University working with Prof. Robert Hofstadter, who will have returned from his present sabbatical year at Imperial College. (E.H. Weinberg)

Lasers Here and There

All That Glitters is not Old - But it may not be as new as we think, either. With the advent of the first gas laser (1) in 1961, a flood of observations on a purportedly never-before-described phenomenon were made.(2,3,4,5,6) While popular magazines were paying due homage by publishing articles with such titles as "The Laser's Dazzling Future,"(7) serious scientists were attempting to explain the now-well-known granular appearance of the spot on the laboratory wall illuminated by a gas laser. This granularity, glistening and sparkling rather than dazzling, has come to be called laser sparkle, and is caused by simple interference of light coming from the finite region which the eye is unable to resolve and arriving at a given point on the retina. Thus, as one's eye scans the spot, a snow-flake effect appears. Clearly the primary requirement is coherence - abundantly provided for the first time by gas lasers.

Meanwhile, back at the Institut für Hochfrequenztechnik der Technischen Hochschule in Vienna, G. Schiffner and O. Hintringer, in their July 1965 report on plasma research oriented toward communications, duly note a vintage year for sparkling coherence far earlier than 1962. Indeed, they call attention to an article, published by M. von Laue in 1914 (8), reporting on this same effect. As it turns out, although v. Laue was using a pinhole source at a large distance to assure the maximum possible spatial coherence, the effect he observed was not identical with that later obtainable with lasers. Thus, the explanation which he offered, based on a degree of coherence and monochromaticity which he did not, in fact, have, foreshadowed the 1962 observations.

References:

1. A. Javan, W.R. Bennett, Jr., and D.R. Herriott, Phys. Rev. Letters 6, 106 (1961).
2. J.D. Rigden and E.I. Gordon, Proc. Inst. Radio Engrs. 50, 2367 (1962).
3. B.M. Oliver, Proc. Inst. Radio Engrs. 51, 220 (1963).
4. C.C. Cutler, International Science and Technology 2, No. 21, 54 (Sept 1963).
5. L. Allen and D.G.C. Jones, Physics Letters 7, 321 (1963).
6. J. Braunbeck, Naturwissenschaften 50, 325 (1963).
7. Fortune Magazine, p. 139, June 1963.
8. Laue, M.v., Sitzungsberichte der Preussischen Akademie, 1144-1163 (1914).

CW Lasers - K. Gürs (Siemens Halske Research Laboratory, Munich) has recently published two papers on the subject of continuously emitting ruby lasers. In the Zeitschrift für Naturforschung 20, 5, 740 (1965) he has described spike-free emission obtained with a PEK mercury capillary lamp, type A-1679, employed in the football-shaped cavity configuration noted in last month's ESN. Utilizing a similar arrangement, Gürs reported in Physics Letters 16, 2, 125 (1965) some 45 mw obtained with 4000-w lamp input. Since the object of this game is to achieve continuous laser operation with the minimum pump-lamp power possible, we should like to call attention to his mid-October results. Specifically, CW operation was maintained with 1200 and 1700 w on two-inch and three-inch ruby crystals, respectively, the general configuration remaining as described in the referenced articles.

Meanwhile, at the Atomic Weapons Research Establishment, A.C. Selden will shortly be submitting for publication his theoretical analysis of a high-power CW 4-level laser. Taking into account the thermomechanical properties of the host material, as considered for example by Prindle and Woodcock at American Optical Company (ONR Contract Nonr 3835 (00)), and the host loss coefficient, Selden concludes that Nd^{+3} in glass should be capable of producing some tens of watts. In principle, a 15-cm by 2-mm glass laser, uniformly pumped, with host loss coefficient of 0.1% per cm should achieve 20 w, a figure which drops to only 0.18 w for an absorption coefficient of 0.8% per cm. Selden assumes that "athermalized" glass will be available to overcome the optical distortion and birefringence created by the absorbed heat. Other possible corrective techniques might also be considered. Over a range of pump intensities, host lengths and losses, and mirror transmittances, the laser emission to be expected has been calculated through the use of a computer program developed on a phenomenological model and compared with Selden's linear theory. Good agreement was obtained, although the range of variables is perhaps not sufficiently extensive for significant conclusions to be drawn. For greater

power outputs it is also evident that other host materials such as sapphire or silica must be employed for the 4-level dopant.

A Hole in One (Diamond) - In the 2 October issue of Nature, P. Whiteman and G.W. Wilson [Nature, 285, No. 5005, 66 (1965)], working at the International Research and Development Co., Ltd., Newcastle upon Tyne, report their efforts to drill small holes through transparent material -- clear diamond in particular. Using a 0.3-joule 10-Mw ruby Q-switched with kryptocyanine, they succeeded in producing some graphitization on the front surface, but, as reported earlier by other observers [Appl. Phys. Letters 7, 137 (1964)], the primary damage occurred at the rear surface only. Such data conform nicely to the theory of R.Y. Chiao and C.H. Townes [Phys. Rev. Letters, 13, 592 (1964)], in which stimulated Brillouin scattering of the laser light generates acoustic phonons which travel in the forward direction and damage the far surface of the transparent medium.

All would have been well had the Newcastle group not implied that drilling holes in transparent materials with a laser beam is therefore impossible. Of all the glorious uncertainties of science, one caveat dominates - namely, what is impossible today will be routine tomorrow. At Royal Holloway College of the University of London, D.J. Bradley and his co-workers have recently drilled the "impossible" hole. Employing a ruby laser in relaxation oscillation with an output of only 0.2 joule and a beam divergence of 3 milliradians, they produced a hole in two shots. Whether a hole-in-one is par for the course remains to be seen. The existence of the hole is, however, quite irrefutable, as one looks at the fine wire threaded through a 40-μ-diameter hole in a diamond plate 0.5-mm thick cut parallel to the (110) plane. Similar holes have been drilled also in silicon carbide with a single 0.2-joule relaxation-oscillation beam. Contrary to other reports, this group also finds it possible to damage either the front or back surface of glass plates, depending upon the position of the focus.

Interferograms of diamond plates which have been shattered using a similar set-up reveal a number of different types of damage. Interpretation and further experimentation is continuing with collaboration of the Department Head, Prof. S. Tolansky, an outstanding authority on multiple-beam interferometry. It is possible that the always risky business of cleaving diamonds with a jeweler's hammer may be replaced by a risky laser process instead.

Money for research comes from many sources, and it may be of some interest to note that Royal Holloway College was built with the generous contributions of Thomas Holloway, whose fortune was made through the sale of a patent laxative especially recommended for sea voyagers. Endowed originally as a college for women and opened by Queen Victoria in 1886, it has just this fall opened its undergraduate doors to men as well. Close to Windsor and Runnymede and about an hour from London, the College is in an attractive setting. The main building is said to be the handsomest example of French Renaissance in the UK. Currently housing some 330 undergraduates, Royal Holloway plans to accommodate about 1000 by 1967-68, an expansion which is equally reflected in its increasingly significant graduate research program. (E.H. Weinberg)

Summary of Laboratories in the German Federal Republic with Research Programs in MHD Electrical Power Generation

In spite of the many stumbling blocks that are continually cropping up in the development of magnetohydrodynamic (MHD) electrical power generators, there is, nevertheless, a rapid increase in the number of laboratories directing some effort toward this form of energy conversion. The reasons are rather obvious when one first examines the fuel bills for various countries and then learns (perhaps from overly-optimistic MHD-conversion scientists) than an MHD-conversion system may be capable of 10% or even 15% increases in efficiency compared with any foreseeable competitors (except, perhaps, for gas-turbine systems).

In the Federal Republic of Germany there are four laboratories with some MHD-conversion research in progress, and in some of these more extensive programs are planned. At Siemens Company in Erlangen (Abt. EL5, Siemens-Schuckertwerke AG, 852 Erlangen) a program of MHD-conversion research is in progress with a combustion system. The scientist directly concerned with these experiments is Dr. Fritz Burhorn.

A second German laboratory working on MHD-conversion is the Nuclear Research Laboratory of the Institute for Technical Physics in Jülich (Institut für Technische Physik, Kernforschungsanlage Jülich des Landes Nordrhein-Westfalen e.V., Postfach 365, 517 Jülich). Without ever having built a small system, they are presently completing the construction of an MHD-conversion test system that will use argon and produce a mass flow rate of 2 kg/sec. Dr. Thomas Bohn heads the MHD Group which works on this project. At present only an iron-core magnet is

available, and the magnetic fields will be limited to values below 25 kgauss. It is expected that experiments may begin next spring.

At the Institute for Plasma Physics in Garching near Munich (Institut für Plasmaphysik, 8046 Garching) there are also programs of research on MHD-conversion. These have been described in some detail in an ONRL report /ONRL-50-65: "Max-Planck-Institute for Physics and Astrophysics (Munich) and the Institute for Plasma Physics (Garching near Munich). See also ESN-19-10/. In a Division headed by Dr. R. Wienecke two groups are working on MHD-conversion problems. In one group, headed by Dr. G. Brederlow, seeded noble-gas plasmas are produced with arc heaters giving flow rates as large as 16 g/sec. There is an emphasis on the experimental investigation of non-equilibrium enhancement of ionization levels. (This phenomenon is discussed briefly in the next article.) In the second group, headed by Dr. H. Muntenbruch, the emphasis is on the study of the dynamics and properties of the magnetic field/plasma interaction under MHD-conversion conditions. There are plans to construct an MHD-conversion test system (in Brederlow's group) as a complete closed-loop system with an argon flow rate as large as 100 g/sec. However, the completion of this closed-loop system is contingent on the successful solution of the seed recovery problem. The latter problem is receiving some attention at Garching.

Finally, the fourth laboratory is in the Institute for High Temperature Research at the Technical University in Stuttgart (Institut für Hochtemperaturforschung (IHT) der Technischen Hochschule, 7 Stuttgart N, Hedweg 51). Prof. Karl-Heinz Höcker, a theoretical physicist, and Prof. Werner Kluge, an experimentalist, are Co-directors of the IHT. The Institute has three divisions, as follows:

Inst. for High Temp. Res.
Directors: Höcker and Kluge

MHD-Conversion	Magnetoplasma-dynamics	Diagnostic and Electronics
Head: H. Burkhardt	Head: H.J. Kaeppeler	Head: H.H. Maier

A more detailed ONRL report on this laboratory is in preparation. Some preliminary steps toward establishing a more or less complete MHD-conversion test program have been taken. The intention is to use a noble-gas plasma in a system with an overall cost limitation set at about 1,000,000 DM (~$250,000). An Institute for the Study of Special Materials is carrying out an investigation of possible wall materials for MHD channels. In an Institute of Gas Discharge Physics and Photoelectronics (headed by Kluge), where extensive investigations of photoelectronic phenomena have been carried out, some work is in progress on the electrode problem for MHD-conversion. Theoretical analysis for MHD-conversion problems are carried out by Kaeppeler's Division. (In the article below, some interesting results from theoretical studies by Kaeppeler and associates of the non-equilibrium ionization problem are described.)
(E.L. Murphy)

Effect of Excited Levels on the Relaxation Length for Production of Non-Equilibrium Ionization in an MHD-Channel (Program at the TH, Stuttgart)

At the Institute for High Temperature Research in Stuttgart (see preceeding article) a Division headed by H.J. Kaeppeler is concerned primarily with the theoretical analysis of magnetohydrodynamic phenomena. One problem, in particular, for which extensive analysis and numerical calculations are being carried out is the production of so-called non-equilibrium ionization in MHD channels. This phenomenon is especially interesting to scientists trying to develop closed-cycle MHD electrical power generators using alkali-seeded noble-gas plasmas. (The plasma is the electrically conducting working medium that is made to flow, at velocity $\vec{u}$, through a magnetic field $\vec{B}$ to produce an emf by the $\vec{u} \times \vec{B}$ Faraday interaction.) Non-equilibrium (also referred to as "non-thermal") enhancement of ionization levels in the working medium for MHD power conversion is a phenomenon that could have very significant consequences. However, many difficulties continue to arise in attempts to exploit or even to produce the effect. Analysis of the MHD-conversion process indicates that gas conductivities (electrical) greater than 10 mhos/m will be required to produce significant power. If the corresponding ionization levels are to be attained by thermal heating of the gas, temperatures of more than 2500° K are necessary (even when easily ionizable materials such as cesium or potassium are added as "seed" to the main fluid). Both the high temperatures and the corrosive effects of the seed materials produce an environment with conditions beyond the limits of present wall and electrode materials (unless these are water-cooled, but this forces one to a system of very large volume in order to decrease the significance of heat losses through the walls; however, some laboratories, particularly those working with open-cycle combustion systems, are using water-cooling). If by some mechanism other than thermal

(equilibrium) ionization, sufficient conductivities could be attained without such high temperatures, then the materials problem might be surmountable (ceramics, etc., might be developed to survive, hopefully, at temperatures as high as 1800° K).

When an electric field is applied to an ionized gas, the electrons, which have a considerably higher mobility than the ions, can by means of preferential ohmic heating attain a higher temperature than the ions or neutral particles of the gas. The difference can be considerable (perhaps as much as a few thousand °K) provided the additional energy is not too rapidly transferred to the neutral particles by collisions.

Two types of MHD-conversion systems are under investigation. On the one hand, there are open-cycle systems (exhaust gas escapes) which usually use combustion gases as the working medium. On the other hand there are closed-cycle systems which use monatomic noble gases (which are expensive, so the system is "closed") for which electron/neutral-particle collision cross sections are small, so that electron mobility and, in turn, the electrical conductivity will be high.

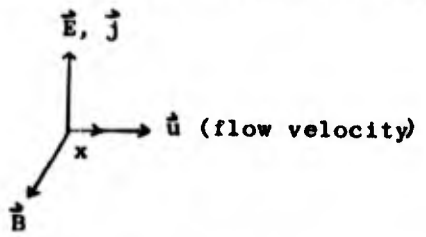
It is only with the noble gas system that one can hope to obtain significant non-equilibrium elevation of the electron temperature and, hopefully, of the ionization level. Because of the small electron/noble-gas collision cross section, it is possible to heat the electrons preferentially to temperatures well above the neutral gas temperature, and this has been attained in experiments with applied electric fields. The hotter electrons can, in turn, on collision with the seed particles, produce more than the thermal equilibrium amount of ionization.

Although it has been demonstrated that an applied electric field can produce a significant enhancement, the idea for MHD-convertors is to produce such an effect not with an applied electric field but through ohmic heating by the $\vec{u} \times \vec{B}$ induced emf itself. Schemes to bring this about have not yet been successfully developed. Aside from the many difficulties that have come to light (see, e.g., ESN-19-3, page 46: "Reassessment at Saclay in Plans for 40-Kilogauss Magnet for MHD Conversion"), the important question arises as to the relaxation time for the phenomenon, that is, the time or distance required for the non-equilibrium enhancement to develop after the ionized gas enters a magnetic field. One would hope that this relaxation length would be small in comparison with the lengths of MHD channels required for significant power generation (of the order of meters).

Computer programs have been developed in Kaeppeler's Division for calculating the relaxation lengths (defined, in this case, as the distance, measured from the point where the plasma enters the magnetic field, required for the degree of ionization to reach a level corresponding to thermal equilibrium at the elevated temperature of the electrons). A feature of the Stuttgart program that is especially significant is that it can include as many as four excitation levels and one-step or two-step processes for ionization (of the seed atoms by the hotter electrons). The present machine program grew out of a variety of earlier efforts. For the study of shock structure for purely hydromagnetic shocks, Kaeppeler and his associates had programmed the full equations for a plasma in a transverse magnetic field, first with viscosity and then without viscosity but including ohmic heating. W. Geiger, in a continuation of this work, developed a program for calculating the structure of shock waves with chemical reactions included, but without a magnetic field. Later, the programs were combined so that calculations could be carried out with both an applied magnetic field and chemical reactions included. At this point, therefore, it became possible to attack some of the MHD-conversion problems, and an investigation of non-equilibrium enhancement of ionization levels was begun. The formulation begins with the Boltzmann equation and appropriate moment equations are formed; only ohmic dissipation, diffusion of species, and the effects of reactions of the various species are included. Four species are considered, namely, non-reacting and reacting neutral components, and electrons and the corresponding ions. Reaction rates are determined through curve fitting to experimental collision cross section curves.

Until recently only the ground state and a one-step process for ionization were included in the program. However, the program has now been extended so that it can include as many as four excitation levels and two-step as well as one-step processes for ionization. Calculations have already been carried out (for field configurations and parameters appropriate to MHD-converters) including one excitation level, and the results are being prepared for publication. The significant feature of the new results is that the relaxation time (or length for development of significant non-equilibrium enhancement of ionization levels) is reduced by more than an order of magnitude when one excitation level is included. A brief review of some of the numbers will help to show the significance of this result. First, however, the earlier calculations without excitation levels will be summarized. /H.E. Wilhelm and R.T. Schneider, Allison Division, General Motors Corporation, Indianapolis, Indiana,

are carrying out similar investigations. See, for example, paper No. 25, presented at the International Symposium on MHD Electric Power Generation, Paris, 6-11 July, 1964. There has, I believe,been some form of collaboration or interchange between the groups (Kaeppeler has spent some time at Allison) and, in fact, a related paper by Kaeppeler, M. Schindler and H.J. Siegert (Paper No. 31) was scheduled for presentation at the Paris Symposium, but was subsequently withdrawn./ The calculations were carried out for He-Cs, He-K, and Ar-Cs mixtures. The initial temperature of the gas was taken as 2000° K and it was assumed that it entered a magnetic field which increased as a step function, at x = 0, from 0 to 15,000 gauss. A simple electrode configuration was considered (for example, very narrow electrodes which could be considered as one pair in a set of segmented electrodes) such that the current is parallel to the electric field (no Hall component) as indicated in the diagram below. With their program they assume a given load R_L and a given



electric field $\vec{E}$. It is also assumed in the calculations that the continuum radiation from the gas escapes, while the resonance radiation is completely trapped. The calculations are continued for increasing x to follow the increase or enhancement of electron temperature through ohmic heating and the enhancement of ionization levels by the hotter electrons. The results of these calculations show that the distance required for the ionization level to approach a value corresponding to the increased electron temperature is of the order of 10 meters! If this were actually the situation, then for practical convertors (lengths of the order of meters) enhancement would not be expected. At the Paris Symposium (see ONRL-C-18-64) Schneider suggested that perhaps this was a reason why no non-equilibrium ionization was observed in experiments at Allison with a channel only 4-cm-long. (However, at the Paris Symposium and subsequently many other difficulties have come to light as stumbling blocks in the production of non-equilibrium ionization.)

In the more recent calculations at Stuttgart,with one excitation level included and with a magnetic field value increased to 40,000 gauss, the calculated relaxation lengths were of the order of 10 cm (a report is in preparation: Inst. für Hochtemperaturforschung, Report 3-7). Although the presence of the excitation level is a sink for some of the electron energy and results in an electron temperature 2% lower than the 3000° K attained without this level, the ionization is nevertheless significantly increased. It will be interesting to have results from calculations with more excitation levels and with a two-step ionization process. However, these additional levels may be a sufficient sink for electron energy that the order of magnitude gain exhibited by the one-level results may be all that can be hoped for.
(E.L. Murphy)

NEWS AND NOTES

The "science" of merchandising must have students the world over. In the dollar area we are familiar with the $9.99 bargain. In the sterling area one of my daughters has just found a "darling" dress for "under four pounds." When it clears I think I'll frame the check for her: £3.19.11.

However, I have always suspected that the serious student of pricing merchandise should repair to the automobile dealer's office. In England evidence supporting my hypothesis is more abundant than I could have hoped for. A prominent auto dealer, advertising in the Times for 3 Nov 1965, offers a Rolls-Royce Phantom V Touring Limousine by James Young at £10,065.16.0. One might presume that the odd 65 quid was added to pay for the cocktail cabinets. Perhaps the 16 bob was used to replace a decanter top which turned up missing. But I'd really like to know what is responsible for that last sixpence. As I see it, someone has calculated the price to a precision of 1 part in 402,600. One can only wonder if this is the place at which the haggle starts or if this is a firm price. If haggling is in order, are the units pounds, shillings, or pence?
(S.Y. Tyree, Jr.)

- - - - - - - - - - -

A top level advisory committee to the British Government under the chairmanship of Prof. Herman Bondi of King's College has completed its inquiry and report on the UK's military interest in space. The report, which was submitted to the Secretary of State for Defence, is classified. It is not yet clear to what extent, if at all, the contents of the report will be made public after final Government action upon it.
(B.I. Edelson)

- - - - - - - - - - -

The Optical Group of the Institute of Physics and the Physical Society is planning a Conference on Non-Linear Optics and Electromagnetic Scattering. Prof. Oliver S. Heavens is scheduling the meeting at York University for 4-6 April 1966.
(E.H. Weinberg)

- - - - - - - - - - -

"Cyclops," an automatic reading machine developed at the National Physical Laboratory, Teddington, was introduced at a meeting of the British Computer Society at Northampton College, London, on 10 November. Its use is primarily the reading of numeric data, but at speeds of up to 3000 characters a second, and it will accept characters of poor printed quality. E.A. Newman and J.R. Parks of the National Physical Laboratory made the presentation and described the machine's range of possible application.

- - - - - - - - - - -

Personal News

Dr. J.V. Dunworth has been appointed Director of the National Physical Laboratory, Teddington. In announcing this appointment the Minister of Technology said he had also decided to replace NPL's Executive Committee by a smaller steering committee, chaired by Prof. B.H. Flowers, FRS, Langworthy Professor of Physics at Manchester Univ.

Dr.Francis A. Vick, former Director of the Atomic Energy Research Establishment, Harwell, has been appointed Vice-Chancellor of Queen's University, Belfast.

Dr. W. Sluckin, Reader in Psychology, has been appointed to a personal Chair in Psychology at the Univ. of Leicester.

Dr. R. Duncan Dallam, Associate Professor of Biochemistry in the School of Medicine, Univ. of Louisville, will be a Senior Visiting Fellow in the Dept. of Biochemistry, Univ. of Leicester, for the session 1966-67.

Prof. Sir Nevill Mott is resigning as Master of Gonville and Caius College, Cambridge. He retains his post as Cavendish Professor of Experimental Physics at Cambridge Univ.

Prof. J. Small has resigned from the James Watt Chair of Mechanical Engineering at Glasgow Univ. from the end of this year.

Dr. R.A. Shaw has been appointed Professor of Chemistry at Birkbeck College, Univ. of London.

Prof. A.L. Cullen, Dept. of Electronic and Electrical Engineering, Univ. of Sheffield, has recently been appointed Dean of Engineering. He retains his former post as well.

Also at Sheffield is Gordon Troup, Lecturer in Physics at Monash Univ. Victoria, Australia, and author of a Methuen Monograph on Masers (1959), revised to include Lasers as well (1963).

O.S. Heavens, another author of a Methuen Monograph - Optical Masers (1964) - and currently Chairman of the Optical Group, has recently left Royal Holloway College to accept an appointment as Professor of Physics at York Univ. Leaving Imperial College to assume Heaven's duties at Royal Holloway is D.J. Bradley, whose present laser interests include their application to plasma diagnostics. In this latter area, Bradley also serves as consultant to the Culham Laboratory.

Dr. J.M. Naish, originator of the head-up display (HUD) system for aircraft, has left the Royal Aircraft Establishment, Farnborough, to take a position with the Douglas Aircraft Company, Los Angeles.

Mr. W.B.H. Lord has been appointed Assistant Chief Scientific Adviser (Research) at the British Ministry of Defence.

Dr. John A. Saxton, formerly Deputy Director of the Radio Research Station, and for the past year Director of the UK Scientific Mission in Washington, has been appointed Director of what is now called the Radio and Space Research Station at Slough. He replaces J.A. Ratcliffe.

Dr. F.J. Hyde has been appointed to the Chair of Physical Electronics in the School of Engineering Science at the University College of North Wales, Bangor.

Prof. C. Kemball, FRS, Professor of Physical Chemistry at Queen's Univ., Belfast, has been appointed to the Chair of Chemistry of the Univ. of Edinburgh, which will shortly fall vacant after the appointment of Prof. T.L. Cottrell as first Principal of Stirling Univ.

Prof. O.V.S. Heath, of Reading Univ., has been appointed a member of the British Agricultural Research Council, to fill the vacancy caused by the retirement of Prof. Sir Hans Krebs.

Prof. E.A. Guggenheim retires from his position as head of the Chemistry Department at the Univ. of Reading, effective as of the end of the current academic year. From then the Department will have three professors (in conformance with what seems to be a growing custom in the British chemistry departments), one in physical, one in organic, and one in inorganic. Dr. H.M. Frey, as already announced, has been appointed Professor of Physical Chemistry effective 1 Oct 1966. Dr. D. Bryce-Smith has taken up his position as Professor of Organic Chemistry, effective June 1965, and Dr. G.W.A. Fowles will become Professor of Inorganic Chemistry effective 1 Jan 1966.

Dr. J.A. Elvidge has been appointed the second Professor in the Department of Chemistry at Battersea College of Technology (soon to become the University of Surrey). He is an organic chemist, interested in heterocyclic chemistry and the application of proton nmr to structural problems in the determination of aromaticity. He comes to Battersea from his present position as Reader in Organic Chemistry at the Imperial College of Science and Technology.

TECHNICAL REPORTS OF ONRL

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

ONRL-48-65	NATO Science Committee Conference on Operational and Personnel Research in the Management of Manpower Systems, 17-20 August 1965 by J.E. Rasmussen
ONRL-49-65	The XXth Congress of the International Union for Pure and Applied Chemistry in Moscow and a Post-Congress Tour to the Uzbek Soviet Socialist Republic by B. Bartocha
ONRL-50-65	Max-Planck-Institute for Physics and Astrophysics (Munich) and the Institute for Plasmaphysics (Garching near Munich) by E.L. Murphy
ONRL-51-65	Some Biophysics Facilities in Sweden by E.A. Edelsack
ONRL-52-65	Some Solid State Research at the Royal Radar Establishment, Great Malvern by B.O. Seraphin
ONRL-53-65	MHD Research at the Institute for High Temperature Research (TH, Stuttgart) by E.L. Murphy
ONRL-54-65	Lasers in the UK, Part I: The Royal Radar Establishment (RRE) Great Malvern, Worcestershire by E.H. Weinberg

The following conference reports are releasable to European scientists:

ONRL-C-19-65	Conference on Optics in Space, University of Southampton 27-29 Sept 1965 by E.H. Weinberg
ONRL-C-20-65	Twenty-Second Meeting of the AGARD (NATO) Aerospace Medical Panel, Fürstenfeldbruck, Germany by S.C. Dunn
ONRL-C-21-65	Report on European Radiobiological Society Meeting by E.L. Alpen
ONRL-C-22-65	53rd Annual Session of the Federation Dentaire Internationale, Vienna, 26 June-3 July 1965 by C.E. Meyers
ONRL-C-23-65	Conference on Nuclear and Particle Physics, 15-17 Sept 1965, Liverpool by J.G. Brennan
ONRL-C-24-65	The Autumn Meeting of the Chemical Society, 21-22 Sept 1965 by S.Y. Tyree, Jr.
ONRL-C-25-65	Seventh Colloquium on Marine Radioactivity, Rovinj, Jugoslovia by N.W. Rakestraw
ONRL-D-10	Directory of Acousticians in Western Europe by D. Ross
ONRL-D-11	Directory of Solid State Scientists in Western Europe: Part I, United Kingdom and Eire by B.O. Seraphin

Prepared by the Scientific Staff
Submitted by P. King

W.W. SCHAEFER
Captain, U.S. Navy
Commanding Officer