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Meetings

Third Symposium on Cosmical Gas Dynamics

LIKE the two preceding symposia on the same subject (Paris 1949, and Cambridge, England, 1953) the present one (Cambridge, Mass., June 24-29, 1957) was organized by a committee appointed by the International Union of Theoretical and Applied Mechanics and the International Astronomical Union. Its purpose was to bring together a limited number of experts in order to discuss present problems concerning the motion of the interstellar gas. The arrangements were in the hands of Professor J. M. Burgers of the Institute for Fluid Dynamics and Applied Mathematics of the University of Maryland and Dr. R. N. Thomas of Harvard College Observatory. Hospitality for the Symposium was offered by the Astrophysical Observatory of the Smithsonian Institution, Cambridge, Mass., through the Director of the Observatory, Dr. Fred L. Whipple, and the Secretary of the Smithsonian Institution, Dr. L. Carmichael.

Participation in the Symposium was by invitation. There were about 90 scientists from the United States and Canada and 21 scientists from abroad (Great Britain 10, France 2, Germany 2, Netherlands 3, USSR 4). The total number was at the limit of what can permit a lively general exchange of opinions. Somewhat over thirty papers, distributed over nine sessions, were accommodated in the program; care had been taken to make the schedule not too strict and to leave ample time for discussions. In this respect the Symposium proved to be a great success: there were many discussions in which critical remarks, new contributions, questions, and replies went back and forth with great rapidity. Many of the participants were struck by the continuity which could be observed in the work covered by the three successive symposia, while at the same time every symposium has brought forward new points of view. It was also very gratifying to see how important contributions came from younger people.

Thanks to the help by Major G. D. Colchagoff from the ARDC and to secretarial assistance offered by the Observatory as well as by the Avco Research Laboratories, wire recorders could be used, while at the same time stenographers made records of all that was brought forward. Every speaker participating in a discussion was asked to come to the front and to speak close to a hand microphone (always mentioning his name first); this proved to give no inhibition to the discussion, while at the same time it provided the little intervals which for everybody made it more easy to follow what was said.

During the meetings and in the evenings the records of the discussion were transcribed and subjected to a first correction by Major Colchagoff and by Miss Dexter of the Observatory, after which they were made out in a sufficient number of copies in order to give one to each speaker who had taken part in a discussion. Thus the recording team succeeded already during the meetings in getting out the text of the discussions of Monday, Tuesday, most of Wednesday, and part of Thursday, and the speakers returned their corrected copies before leaving. The text of the remaining parts of the discussions will be mailed, with request for immediate return. In that way much of the personal character of the discussions can be preserved. Although some amount of cutting may be necessary in order to prevent certain repetitions, it is hoped that a great deal can be published. The performance of this work required the utmost devotion of all who cooperated in the recording, a fact for which one cannot be too grateful. On the whole participation in the Symposium required great attention and endurance of all scientists present (the heat during the first days of the meeting did not make this easier), but at the end one could have the feeling that real work had been performed. The publication of the main papers will be based upon the manuscripts of the speakers, about two-thirds of which were handed in during the Symposium itself, while the rest has been requested before August. Wire recordings of the papers have been taken, but recourse to them will only be made in cases where there are uncertainties or additions.

After the session of Tuesday afternoon some of the organizers felt that a number of questions had not been stated with sufficient clarity. It was decided therefore to interrupt the order of the program and to interpolate a revision of the main problems. Dr. van de Hulst (Leiden, Netherlands) undertook this task in the session of Wednesday, followed by a contribution from Dr. Thomas. A set of seven important questions was framed, some of which could be discussed in the same session, while the rest was deferred to the session of Friday afternoon where a blank had been left in the program. This procedure of taking stock proved to be of great use. Moreover the speakers were not afraid of returning to a question more than once, which brought the advantage that the subject could be seen as a whole, and was not a collection of disconnected topics. Following a custom introduced in the earlier symposia, a great part of the last session was devoted to talks of a summarizing nature or giving impressions from the discussions (by J. M. Burgers, H. W. Liepmann, H. C. van de Hulst, F. D. Kahn, M. J. Seaton, and J. C. Pecker; with a general summary by L. Spitzer, Jr.). This was again followed by discussions.

Some of the outstanding problems may be mentioned briefly:

(1) Turbulence in a rotating mass of compressible gas, subjected to a gravitational field, has not yet found adequate treatment. There is an old criterion for the stability or the instability of the rotation, but much more is needed.

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(2) Another problem which still awaits treatment is that of compressible turbulence in a gas under conditions of density as are found in interstellar space, the gas being subjected locally to powerful radiation from hot stars, while small percentages of particular ions are acting as effective cooling mechanisms, the amounts of these ions being influenced by the density and the temperature of the gas. The details of the individual processes of excitation, absorption, and emission of radiation are now understood rather well, and Dr. Seaton gave an important summary of what is known about the relevant cross sections.

(3) The energy balance of the interstellar gas, the amount of energy it derives from gravitation, from differential rotation, and from hot stars, and the dissipation of energy through turbulence, together with the final loss of energy by radiation into space, was discussed on several occasions, but satisfactory numerical data for all features are not yet available.

(4) Observational data on the turbulence in certain gaseous masses (e.g., the nebulae in and around Orion) have been extended greatly in the last years and now make possible a thorough statistical analysis. One outcome seems to be that the statistical law for the relation between velocity fluctuation and distance, which had been derived from the theory of incompressible turbulence, does not give a proper description of the results.

(5) Also the observational data on bright rims of gaseous nebulae have been extended greatly, so that theories concerning the origin of these rims and of their peculiar forms can be tested in a better way.

(6) The picture of the distribution of the interstellar gas in our Galaxy has obtained more relief through the data on the spiral structure of the Galaxy deduced from measurements with the aid of 21 cm radiation, combined with the results of other investigations. The interstellar "gas clouds" must be accommodated into this structure. Also data have been obtained concerning the existence of a gaseous halo extending outward from the Galaxy in the form of a nearly spherical mass; this subject was treated by Dr. S. B. Pickelner from the USSR.

(7) The problems of the interstellar magnetic field have become much more urgent. Great attention was given at the Symposium to magnetohydrodynamic questions, amongst which one can mention: the importance of the magnetic field in the balance between the forces acting on the gas in the halo, and on that in the spiral arms of the Galaxy; the question of whether the presence of a magnetic field can decrease the dissipation of large scale motion through turbulence; the problem of the partition of energy between turbulence and irregular magnetic fields.

(8) Finally it should be mentioned that experimental research is now making great progress towards realizing conditions existing in the interstellar gas. Already at the Symposium of 1953 it was known that shock waves can produce temperatures reaching $10\,000^\circ\text{K}$; nowadays temperatures of $100\,000^\circ\text{K}$ and $1\,000\,000^\circ\text{K}$ have become possible, while Dr. Bostick in his experi-

ments on the motion of plasmoids has reached gas velocities of 10^7 cm/sec.

In a special discussion arranged at the end of the Friday afternoon session the future development of these symposia was considered. It was unanimously agreed that further symposia bringing together scientists from astrophysics and from aerodynamics were greatly needed, but it seemed desirable to make some shift in the underlying topic, and it was thought that *stellar atmospheres* would form a promising theme for at least two further symposia. The two International Scientific Unions which have sponsored the present Symposium will be asked to take steps for making possible future meetings; as a possible date 1960 or 1961 was mentioned, and as a possible place of meeting the Netherlands. In order to preserve the peculiar character of these symposia, it will again be necessary to limit participation to a number of the order of, say, eighty scientists, in order to retain the possibility of general discussions.

As with the former symposia, the Organizing Committee received important financial help from the two Unions for covering traveling expenses of participants coming from abroad. For this purpose the Unions had received financial assistance from Unesco, to which some money from their own funds had been added. For the present Symposium valuable financial help for transportation expenses and for some other expenses connected with the meeting and with the recording was also received from the US National Science Foundation. The NSF and the National Academy of Sciences of the US, moreover, gave important assistance in the matter of visas for overseas scientists. The Air Force Office of Scientific Research gave very welcome help by making possible the transportation of twelve scientists coming from Europe by the Military Air Transport Service. Finally the Smithsonian Institution has offered a sum of money in order to make possible the publication of the proceedings of the Symposium.

J. M. Burgers

University of Maryland

Army Science Conference

THE first Army Science Conference was held June 26-28 at the US Military Academy, West Point, N. Y., under sponsorship of the Chief of Research and Development, Department of the Army, Lt General James M. Gavin. Although frequent conferences of lesser magnitude are held each year by the Army's Technical Services, this was the first all-Army research conference. This meeting highlighted the breadth and scope of the Army research and development program and emphasized the presentation of papers on classified work being done in the Army laboratories.

Among the more than 400 conferees were representatives from England and Canada, as well as from the Navy, Air Force, Department of Defense, and other governmental agencies. They heard and discussed 101 papers which were presented over the three-day period. A highlight of the conference was a talk by Dr. C. C.

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