INTERNATIONAL SYMPOSIUM ON BOUNDARY LAYER RESEARCH

AN International Symposium on boundary layer research, sponsored by the International Union for Theoretical and Applied Mechanics, was held from August 26 to 29, 1957, under the Presidentship of Prof. H. Görtler at the Institute of Mathematics in the University of Frieburg, Germany. It was a fitting tribute to the memory of Prandtl's pioneering work on boundary layer. One hundred delegates from seventeen countries registered for the Symposium. They included Th. Von Kármán, F. K. G. Odqvist, H. L. Dryden, G. I. Taylor, G. Temple, A. A. Townsend, J. Kampe de Feriet, R. Timman, B. R. Seth, I. Tani, M. Lunc, H. Faxen, J. Ackeret, C. C. Lin, ch. A. Rachmatulin, G. N. Patterson and O. Wehrmann. Thirty invited papers were read and discussed in four days. Films were shown depicting the behaviour of the thermal boundary layer, formation of horse-shoe vortices in boundary layer motion and in the wake behind three-dimensional obstacles. All the invited papers together with the discussions will be published by Springer-Verlag in Berlin.

On August 26, the first sitting began with welcome speeches by Prof. Görtler, Prof. Tellenbach, Rector of the University of Frieburg, and Dr. H. L. Dryden, Vice-President of the International Union for Theoretical and Applied Mechanics.

The papers that were read dealt with the mechanism of turbulent boundary layer flow. A. A. Townsend gave results of two experimental studies on the structure and motion of the large-scale eddy motion in the outer part of the turbulent boundary layer and the flow in the immediate neighbourhood of the free edge of a flat plate of finite aspect ratio. It was found that, while certain properties of the flow in the constant stress region might be uniquely determined by the wall stress and the fluid viscosity, others depended on the whole flow, and varied from one wall to another.

For a flat plate with fully developed turbulent flow at effective Reynolds number over one million, well developed eddies were found with their axes parallel to the edge and one on each side of the plate.

O. Bjφrgum gave a mathematical theory of shear flow turbulence based on the following assumptions :

(*i*) Navier-Stokes' equations are valid ;

(*ii*) Steady-state turbulent flows exist.

His method and conclusions had some defects which were pointed out by Kampe de Feriet and C. C. Lin.

The second sitting was devoted to the exact and approximate calculations of boundary layer flows. J. Ackeret spoke on boundary layer effects in straight and curved diffusors.

B. R. Seth showed how the synthetic method could be used to get generalised forms of the boundary layer thickness and the drag coefficient. In this method the field equations are exactly solved by introducing a constraining force depending on a parameter n. As n becomes large, this force tends to vanish throughout the field if the Reynolds' number, R, is proportional to $n^2 + \lambda (\lambda > 0)$. The boundary conditions are all satisfied and by taking the cases of a flat plate, a circular cylinder and a sphere, it is shown that the generalized forms of the boundary layer thcikness and the drag coefficient are proportional to $R^{-k/2+\lambda}$ and $R^{-k(1+\lambda)/(2+\lambda)}$ respectively, where $0 < k < 1$.

K. Stewartson showed that Howarth's conjecture that in the case of a rotating sphere, the two boundary layers occurring at the poles, collide at equator, was true. If the sphere was at rest and the liquid rotated, the boundary layer started at the equator and converged on the poles. In the case of a semi-infinite circular cylinder with a hemispherical boss, the boundary layers reaching the equator continued along the cylindrical portions and three regions could be distinguished.

M. B. Glauert showed that his results for the incompressible wall jet could be used for the compressible case if the coefficient of viscosity was proportional to the temperature. For unit Prandtl number a number of simple solutions could be obtained. Some departures from his similarity solution were also given.

The third sitting on August 27 was devoted to a discussion of stability of laminar boundary layers and transition to turbulent flow. G. B. Schubauer presented some experimental work being carried on at the National Bureau of Standards, Washington. By employing the vibrating ribbon technique to obtain waves of controlled frequency and intensity, he concluded that the origin of turbulence lay in the existence of some 'turbulent spots'. Then came the joint paper by H. Görtler and H. Witting on the theory of secondary instability of laminar boundary layers. A. Zaat discussed some numerical methods for stability problems.

C. C. Lin considered the effect of Reynolds' stresses on the growth of small disturbances

and found that it is often possible to produce a finite disturbance of definite amplitude resulting in distorted mean flow. These considerations are useful in determining the instability of laminar boundary layers, especially in high speed flow. The joint paper of E. A. Eichelbrenner and R. Michel on the phenomena of transition in three dimensions was the next to be presented in the fourth sitting. H. Bergh gave a method for visualizing periodic boundary layer phenomena. This method could be useful for determining more detailed experimental information about periodic boundary layers.

In the fifth sitting S. Ostrach, H. Schuh, S. A. Schaaf and L. Talbot, and M. Lunc presented their papers on thermal boundary layers and boundary layers in a rarefied gas. Ostrach studied the problem of forced and natural-convection fully developed laminar flow between two parallel planes oriented in the direction of the body force. The problem has its applications in the fields of jet propulsion, nuclear power and hypersonic flight.

The sixth sitting was occupied by papers on the interaction between shock waves and boundary layers. G. E. Gadd surveyed the occurrence and nature of the interaction. H. Mirrels described the wall boundary layer behind a moving shock wave.

The concluding day was devoted to unsteady and three-dimensional boundary layers. The seventh sitting opened with a paper by F. K. Moore on the separation of unsteady boundary layer. The problem could be split into two parts:

(*i*) A boundary layer which has a fixed separation point in the *quasi*-steady approximation; and

(*ii*) A steady boundary layer over a moving wall.

The separation point has been defined where velocity and shear vanish simultaneously. Obviously, if the wall is moving, this point cannot be at the wall. The paper was followed by L. N. Persen on the applications of integral transforms to non-stationary boundary layers. W. Wuest presented his paper on periodic boundary layers.

The contributors for the last session were R. Timman, K. Oswatitsch, I. Tani, and O. Wehrmann and R. Wille. The subjects included three-dimensional boundary layers, and experimental investigation of flow separation over a step.

B. R. Seth.

NOBEL PRIZE FOR CHEMISTRY

THE Nobel Prize for Chemistry has been awarded to Sir Alexander Todd, F.R.S., Professor of Organic Chemistry, University of Cambridge, for his contributions to the chemistry of nucleotides. The term nucleotide was originally confined to the phosphates of the N-glycosides of certain purines and pyrimidines known as nucleosides which are obtained by hydrolytic breakdown of the nucleic acids. Its scope has now widened and includes not only the phosphates but also the polyphosphates of N-glycosides of a variety of heterocyclic bases and it embraces also the nucleic acids or polynucleotides. Phosphorylated derivatives of riboflavin though fall outside the scope of the above definition are commonly included because of their close relationship to the main body of natural nucleotides. Professor Todd and his colleagues have been engaged in chemical investigations of nucleotides for the past fifteen years and have made outstanding contributions to the elucidation of the structure and synthesis of these biologically very important chemical substances.

Employing methods of organic chemistry mainly along two lines, one concerned with the structure of nucleic acids and the other with the complex nucleotide derivatives which exercise coenzyme function in many biological systems, they have developed new methods of synthesis which would be flexible in operation and mild enough, not to damage sensitive molecules such as those of the nucleotides.

In the Bakerian Lecture to the Royal Society delivered on 17th June 1954, Prof. Todd under the title, "The Chemistry of the Nucleotides" presents a survey of the subject. Professor Todd has a multitude of other honours to his credit and the award of the Nobel Prize comes fittingly, in recognition of his monumental work in the above field of organic chemistry.