SCIENTIFIC BOOKS

APPLIED MATHEMATICS

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THE first scientific journal entirely devoted to applied mathematics, *i.e.,* to the applications of mathematics in other branches of science and to the development of mathematical methods suited for this purpose, was founded in Germany in 1921. It has been known as the *ZAMM* (*Zeitschrift für angewandte Mathematik und Mechanik*) and was published by the Verein Deutscher Ingenieure, the German Engineering Society. This enterprise was an outcome of the long-continued efforts of Felix Klein, the famous mathematician of great productive power who devoted a considerable part of his lifetime to the task of placing the cultivation of mathematics in Germany on a sounder basis. For some historical reasons, in Germany, unlike other countries, engineering sciences had never been admitted to the universities, but were taught at strictly separate institutes of technology. The mathematicians teaching at the university were in permanent contact with physicists, chemists, etc., but almost entirely unfamiliar with engineering problems, which more and more required the application of advanced mathematical theories, as had been the case in physics for a longer period. Under the influence of Felix Klein chairs of "applied mathematics" were created at several universities, and the *ZAMM* was intended to serve as a further bridge between the university people and those interested in engineering research at the Technische Hochschulen. This explains the somewhat illogical conception of "Angewandte Mathematik und Mechanik," which emphasizes mechanics and practically excludes physics, although physics is obviously the principal and most important field of application of mathematical ideas.

The pattern set by the *ZAMM* was then followed in several other countries. In Russia, where the educational institutions are similar to those in Germany, a journal was founded in 1933 under the same title. It was later taken over by the Russian Academy of Science and is to-day by far the best periodical in this field, assembling papers of high originality and intrinsic value. In the same year a group of members of the American Society of Mechanical Engineers started the *Journal of Applied Mechanics,* which actually covers the major part of the subjects dealt with in the *ZAMM.* Two other American magazines concerned with special branches of applied mathematics must be mentioned here. In 1933, likewise, the Institute of the Aeronautical Sciences began publication of a scientific journal, which under the able leadership of J. C. Hunsaker developed into one of the foremost aeronautical publications covering all problems of fluid mechanics, dynamics and stress analysis connected with aviation. Three years earlier the Institute of Mathematical Statistics had started publishing its *Annals,* a high-ranking magazine devoted to research papers in probability and theoretical statistics on an advanced level.

Thus the situation regarding publishing facilities in applied mathematics was very different now in this country from what had been the case in Germany twenty-two years ago. First, the sharp contrast between mathematicians and physicists on one side and engineers on the other has never existed in America (nor did it in England). Secondly, care had already been taken, in a rather ample measure, of special branches, particularly of those related to mechanical engineering. Nevertheless, a distinct demand has been widely felt for a new avenue of publication, owing to the peculiar character of the research work as favored at present by American mathematicians. Except for a few outstanding men of the older generation, like Birkhoff and Veblen, the mathematicians here are almost exclusively concerned with the most abstract parts of mathematics. No geometry but topology, no analysis but theory of sets, no algebra but abstract algebras are the largely preferred subjects at meetings and in the magazines. Classical mathematics which developed for centuries in close relationship to physics are treated with a kind of disdain. In this way a new gap has been created, with the mathematicians on one side as opposed to all the people who apply mathematics, in physics and chemistry, in engineering, in statistics and economy, in biology, etc. What is needed to counterbalance this unfortunate state of affairs are efforts in a definite direction—one has to concentrate on the general aspects of applied mathematics without emphasizing any particular branch or subject, and in doing so to feel responsible for the advancement of all parts of classical mathematics, so badly neglected by the "pure" mathematicians.

It does not make the impression that the group at Brown which undertook to start the *Quarterly of Applied Mathematics* has chosen to follow this line. It seems that what they had in mind was not unlike another *ZAMM,* with a more restricted program. On the inside cover the editors simply ask for papers "which have an intimate connection with application in industry or practical science," and the whole program is focused on "tooling up mathematics for engineering." Papers on probability, statistics, economy, biology seem practically excluded. Theoretical physics and chemistry, the paramount fields of application, are not mentioned. In the board of editors, which includes Th. von Kármán, leading man in aeronautical

research, none of the country's representative mathematicians is listed. In the first two issues at least 90 per cent. of all articles are concerned with problems of mechanical engineering, and most of them could have been published in either *Applied Mechanics* or *Aeronautical Sciences*. There is of course no objection against duplicating existing facilities as long as care is taken not to lower the existing level. But it is one thing to grow a new variety in order to adorn one's own garden and another thing to fill a widely felt need and to serve a far-reaching purpose of common interest. Now it may take a long time before such a journal as had been hoped for will materialize.

Each one of the first two issues includes an expository article, both of high value. H. L. Dryden reports on the modern theory of turbulence, and it is very interesting to realize the progress made since, ten years ago, the *Journal of Applied Mechanics* started its first issue with a review on the same subject. In the second issue K. O. Friedrichs and J. J. Stoker outline some aspects of non-linear mechanics in a particularly comprehensible form. The most interesting contribution so far is undoubtedly the paper of L. Bers and A. Gelbart, on certain differential equations in mechanics. It has been known for a century that the problem of finding the two-dimensional potential flow of an incompressible fluid can be solved by means of complex variables: To each analytic function of a complex variable corresponds a particular solution of the potential problem and *vice versa*. Several years ago Stefan Bergman discovered that essentially the same is true for a vast class of partial differential equations which includes the potential equation as the simplest case. Bergman gave explicit formulae which allow a solution of a given differential equation to derive from an arbitrarily chosen analytic function (in some instances from a pair of real functions) and proved that all solutions can be derived in this way. Now, two of Bergman's pupils, Bers and Gelbart, found that in a special case the analogy can be carried much farther. They consider a special type of differential equation, yet more general than the potential equation, and build up a system of solutions in close analogy to the procedure followed in the theory of analytic functions. Fortunately, this restricted type includes the problem of a two-dimensional flow of a compressible fluid which is to-day in the center of interest in aviation. Though all solutions obtained by Bers and Gelbart can be derived by Bergman's methods also, it must be expected that the new approach will prove very useful.

The quality of papers in a magazine can not possibly maintain a uniformly high level and a large allowance must be made for unavoidable deficiencies. In the second issue a kind of mischief happened with an article on the flow around an airfoil with flap. The author tries to compute the point on the flap where the flow separates, forming a dead-air region. But he overlooked that according to the very formula he applies the flow must have already separated at the corner before reaching the flap at all. If the corner is rounded off, the separation point will travel along the flap and its position will be determined by the radius of curvature so that the proposed solution, also in this case, gives no answer to the real problem.

Such an accident must not be taken too seriously and by no means blamed on the editors. On the contrary, it is the opinion of this reviewer that many editors feel too often inclined to act like schoolmasters examining the papers submitted for publication as though they knew all answers beforehand. This teacher-to-pupil relation takes a particular form in the *Quarterly*, where a large number of articles are marked as "suggested" or "encouraged" or "directed" by an editor. That more of this must be expected can be concluded from an article in the *Mathematical Monthly*[1] in which Dean R. G. D. Richardson, of Brown University, illustrates the background of the new magazine. The author proudly reveals that "more than twenty-five research papers have been completed" within a short period in the School of Advanced Mechanics at Brown. It seems that here the borderline between research work and the type of results which usually grow out of the problem sections in a graduate school is somewhat misplaced. In fact, nothing would be more detrimental for the development of applied mathematics as a genuine branch of science than to propagate the idea that in this field papers can be turned out to order. History has taught that the best, if not the only, way to promote scientific achievements is to leave people who are able to do creative work to themselves and to protect them as far as possible against all kinds of organizers and inciters.

All this criticism should not discourage a reader who wants to be currently informed about certain aspects in the progress of engineering mathematics. He will certainly find much useful and interesting material in good shape. Nor is the criticism meant to underrate the merits of the men who have spent considerable time and labor to create the new periodical and to keep it going. After all, there are many roads that lead to the same goal and nobody knows which is the best. Brown University has undoubtedly made great sacrifices in bringing forth the journal at the present time and under actual difficulties. The format is irreproachable. If wisely conducted, the *Quarterly of Applied Mathematics* will achieve a notable place among the other American publications in this field.

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[1] *Math. Monthly*, Vol. 50, p. 415, 1943.