AUERBACH ON MATHEMATICAL PHYSICS

Die Methoden der theoretischen Physik. By Felix Auerbach. Leipzig, Akademische Verlagsgesellschaft, 1925. x + 436 pp.

The book to be reviewed is written by a physicist for students of physics and is meant as an introduction to theoretical, i. e. mathematical physics. The author's program is to present the underlying notions and principles as well as to give a compendium of the mathematical devices which the student is likely to need in a more profound study of the subject. The following extract from the table of contents will show that the ground covered by the author is very extensive:

I. Notions and principles, 27 pp. II. Formal methods, 14 pp.* III. Elementary equations, 26 pp. IV. Difference, differential, and integral calculus, 57 pp. V. Ordinary differential equations, 56 pp. VI. Partial differential equations, 125 pp. VII. Integral and functional equations, 23 pp. VIII. Theory of molecules; Statistical methods, 47 pp. IX. Geometrical, graphical, and vector methods, 51 pp. X. Concluding remarks, 6 pp. Index, 4 pp.

It is rather obvious that the task of treating such a wide range of ideas in an adequate manner is a very trying one. The best parts of the book are those where the author is concerned with the applications of some special theory to particular problems. In fairness it must be said that such problems occupy the greater portion of the book. The examples are usually well chosen and the calculations are carried out in quite an elegant manner. But every now and then we encounter a piece of a general mathematical theory which is presented in an awkward and doubtful manner. The reviewer is perfectly aware of the fact that mathematical rigor can not and perhaps should not be the primary concern of the physicist. But in a book which is meant to introduce a young student into the realm of theoretical physics where he is going to use mathematical tools in all his work, it is only fair to the student to tell him something about the limitations of these tools as instruments of research. This of course applies essentially to questions involving some kind of infinite process or limiting passage where the student needs a timely warning. The author's habit of stating results without mentioning the conditions under which these results hold, is deplorable; it makes the value of the information imparted illusory, and it is scarcely conducive to sound mental habits

* *Wortsprachliche Methodik.* What is meant is methods based upon reduction to general principles by means of qualitative discussion without the use of calculations.

in the student. Occasionally the statements are wrong or at least misleading.

Examples of such failings are plentiful; the theory of series supplies several. Here are a few samples. On page 95 we are told that in order that the series Σu_n shall be convergent, the limit of u_{n+1}/u_n must be less than unity for sufficiently large values of n. The continuation takes care of the case when the limit is unity but adds other deep mysteries. On page 98 we are told that a series with alternating terms is always convergent if the absolute values (Betrag) of the terms converge to zero with increasing values of n. The treatment of power series on the same page is not very satisfactory: the series $\Sigma a_n x^n$ converges when x lies between $-1/\beta$ and $+1/\beta$ where β is the limit of a_{n+1}/a_n. Apply the rule to the case $a_n = \sin n\alpha$, please! On the next page the author says that for values of x which are greater than one it is better to expand functions according to descending powers of x, because of considerations of convergence. Such considerations do not bother the author on page 278. Here he wants to justify the restriction of the parameter in Legendre's equation to integral values as follows: Wenn nun n keine ganze Zahl ist, gehen die Reihen ohne Ende fort, und für $\mu = 0$ werden beide Reihen selbst unendlich, was nicht sein darf. These series are power series in $1/\mu$ and only convergent for $|\mu| > 1$.

Only five pages of the seventh chapter deal with integral equations in the technical sense of the word. Evidently our author does not like these equations; he begins by saying that they have not completely come up to expectations, and ends the discussion by remarking that the use of integral equations has not proved to be a great positive gain for physics since in all cases which cannot be solved by other means, the application of integral equations usually encounters difficulties or is wanting in lucidity.

It is hard to estimate the value of the book for the particular class of readers to which it is directed, and it is scarcely fair for a mathematician to judge in this matter. The book does give a great amount of useful information. As to the misinformation, perhaps the habit of slurring over everything abstract that characterizes the average young student will preserve the purity of his mind until he reaches the years of discretion.

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