attached to an algebraic curve (1826, 1857) has been ever since the object of intensive study by analysts and geometers alike (Poincaré, Picard, Castelnuovo, Enriques, Severi, etc.) who were attracted to it either by its profound analytical content or by its power as a tool for the discovery of geometric properties of algebraic varieties. The theory gives rise to many difficult questions, and the difficulties increase with the dimension of the variety. Thus, while the theory of abelian integrals is almost a finished chapter in the case of algebraic curves and is a richly developed chapter also in the case of algebraic surfaces, it is on the whole unexplored territory in the case of varieties of higher dimension. The unsolved problems in which it abounds have to do mainly with the *classification* of the abelian integrals according to their singularities and with the properties of their *periods*. By the period of a *multiple,* say *m-fold,* abelian integral is meant its value which we obtain by integrating along an m-dimensional *cycle* of the variety (cycle = a closed m-dimensional region; a closed curve, if $m=1$; a closed surface, if $m=2$; etc.).

A typical and important problem, which remained unsolved for a long time, was the following: do there exist integrals which have no singularities and whose periods are all zero? Hodge was the first to prove that such integrals do not exist. This proof marks the beginning of a long series of investigations by Hodge which have materially contributed to a new and substantial progress of the theory of abelian integrals. One of the most significant aspects of these investigations is the diversity of the methods used. In addition to the purely analytical and algebro-geometric methods, topology and differential geometry come effectively into play.

Topological methods, already used by Poincaré in questions of the theory of algebraic surfaces, have been developed in this country by Lefschetz. The topological point of view in algebraic geometry plays an essential role in Hodge's solution of the problem mentioned above. Topology also forms the basis of de Rham's theory of integrals on arbitrary topological manifolds, a theory which is in close connection with Hodge's theory of harmonic integrals.

However, it is the adaptation of the methods and ideas of differential geometry (Riemannian geometry) to the theory of abelian integrals that best reveals the originality of Hodge's theory. Here the central concept is that of a *harmonic integral.* This is not the place to discuss this concept in any detail. It will suffice to say that the concept of a harmonic integral is more general than that of an abelian integral, but is more concrete than the concept of an integral attached to an arbitrary topological manifold. The fruitfulness of the concept of a harmonic integral lies perhaps just in its being a "harmonious" mixture of the right amounts of generality and concreteness.

The mathematical reader will find in Hodge's monograph a very well-written and highly stimulating account of a young and active mathematical theory. He will find ample evidence of the diversity of methods which we have mentioned above. As an ingenious blend of algebraic geometry, analysis, topology, tensor calculus and differential geometry, the monograph should prove of considerable interest to specialists in these various fields.

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ELECTRICITY AND MAGNETISM

A Textbook in Electricity and Magnetism. By H. C. KELLY. vi + 356 pages. New York: John Wiley and Sons, Inc. 1941. $3.75.

THIS elementary text attempts to give the reader an acquaintance with a great deal of modern physics as well as to cover the conventional topics suggested by its title. The twenty-eight chapters are short and emphasize the historical and descriptive aspects of the subject. The diagrams are numerous and well drawn, and a number of simple problems are placed at the end of each chapter. In the third chapter the author goes to some pains to find the potential due to a point mass without the use of the calculus, but does not hesitate to introduce integration by the time Chapter 7 is reached, and to discuss the partial differential equations of the electromagnetic field and the wave equation in Chapter 28. In discussing induced electromotive forces the author makes the common mistake of attributing the e.m.f. to "*relative* motion between a wire and a magnetic field."

The book should prove very useful in a survey course intended to cover modern developments in physics as well as the elements of electromagnetism. To cite a few of the modern topics presented, we find mention of superconductivity, the Barkhausen effect, the Stern-Gerlach experiment, the cyclotron and the electron microscope, and discussions of space-charge, the photo-electric effect, the Bohr theory and the mass spectrograph.

L. P.

HYDROBIOLOGY

A Symposium on Hydrobiology. By JAMES G. NEEDHAM and 51 other contributors. ix + 405 pages. Madison: University of Wisconsin Press. 1941. Price $3.50.

THIS book contains the 32 formal papers presented at a symposium on hydrobiology held at the University of Wisconsin on September 4–6, 1940, and the abstracts of 16 volunteer papers given at one of the

sessions. The various contributions cover a wide variety of hydrobiological subjects relating to inland waters, including not only the biological aspects but also the geological, physical, chemical and sanitary phases of this field of science.

The limnological papers deal with the sediments of natural and artificial lakes, the penetration of solar radiation into natural water, dissolved oxygen and lake types, aquatic bacteria in relation to the cycle of organic matter in lakes, trematode parasites of fresh-water snails, the rôle of aquatic fungi in hydrobiology, the limnological rôle of the higher plants, the photosynthesis of algae, the relation of hydrological conditions to speciation in fishes, the age and growth of fresh-water fishes, the fish production of inland lakes and streams, pond fish farming and the effect of pollution on fish life.

The sanitary contributions relate to swimming pool sanitation, water-borne diseases, the chemical treatment of lakes, the food economy of certain mosquito larvae, the relation of hydrobiology to malaria control, the significance of plankton in relation to the sanitary condition of streams, schistosome dermatitis and its control, the microbiology of sewage and sewage treatment and the biochemical relations in the activated sludge process of sewage treatment.

Most of the contributions carry illustrations and include generous bibliographies.

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REPORTS

THE OUTLOOK FOR EDUCATION[1]

A RISING public anxiety respecting the economic difficulties of the after-war period is shared by all our institutions, public and private. Colleges and universities are expected to find their income greatly decreased. Will fewer and fewer students be enrolled as the private incomes of parents shrink in a post-war period of deflation? Will some institutions have to be closed? Will federal support be required for continuation and is it desirable to receive or solicit it? Will the individual members of our faculties come to be as meanly supported as those of continental Europe in the two decades following 1918? Will courses of study tend to become narrowly "practical"?

I believe there are American-style answers to be made to these timorous questions. The post-war period may witness surprisingly great industrial and commercial expansion to satisfy enormous reconstruction and delayed consumption requirements. It is too early to prophesy doom and it is a grave disservice to assume it. In any event we have a sound pioneer tradition in education whose hall-mark is democratic *experiment*. Whatever we may have borrowed from Europe in ideas, materials and techniques, we can trace definite lines of experimentation directed down the years toward our own conditions. The first of these conditions is that education must be adapted to a democratic way of life. Our educational system did not become inclusive by accident. It did not expand by accident. It was an indispensable part of the avowed design of America in the colonial period and still more emphatically at the beginning of our national life. The bulwark of democracy was to be an educated electorate. We are absolutely committed to that course. An illiterate people will not and can not be united. Our union, to be either effective or free, must rest on understanding, and as "no one can know it all or miss it wholly," discussion and compromise are indispensable. Education to know America, to know its history, its social life, its industrial expansion, its artistic and literary creations, its scientific achievements, its power to work together on so vast a scale and at so high a level of efficiency—all this, and all our defects and colossal shortcomings as well—make an educational program that the American public, in our opinion, will sustain. The after-war period will require, as earlier periods of crisis have required, that our cultural institutions keep asking and attempting to answer the question, "How do we want to live in America?" This is the question and the experiment that unites us. There are two deadly dangers in education, the unquestioning acceptance of routine in teaching, and complacency with respect to existing standards and objectives of research. The spirit that maketh alive is compounded in part of free inquiry and controlled experiment; in part also of a high dissatisfaction with the limits of yesterday's horizon.

After this war is ended, whether or not we participate, America will not be like any other country in the world. It will still have more mechanical and electrical power per person by several hundred per cent., it will have its commitments to democracy and inter-group habits of cooperation, there will still be private property and private incomes, there will be a characteristically American outlook in which enterprise, hope and hard work will be blended.

More advanced experimentation will probably mark our educational policies in the post-war years. How can we deepen the study, within the university, of great human problems whose solution is the surest guarantee of the future unity and freedom of Amer-

[1] From the annual report of Dr. Isaiah Bowman, president of the Johns Hopkins University.