rather than a random arrangement of parts, and in the future, perhaps, forms of life may evolve which cause a decrease of entropy on a large scale. Are we then to have some parts of the universe in which the arrow of time points in the opposite direction from that in neighboring parts?

Such speculations may seem fantastic. It is, however, I believe, of the utmost importance for the chemists and the physicists to evolve fundamentally sound conceptions of such things as time and entropy.

The profound changes in physical thought, particularly those represented by the quantum theory, are rapidly bringing about a revolution in physical chemistry. The third law of thermodynamics involving chemical constants has changed radically our methods of studying chemical equilibria. The application of the quantum theory to band spectra promises to be of the utmost importance in chemistry. By enabling us to determine the moments of inertia of chemical molecules, the actual distances between the nuclei of the atoms in molecules can be found. Apparently our most accurate determinations of the heats of dissociation of elementary gases can be obtained from the band spectra through a knowledge of the energy levels of the various possible states of the molecules. In recent numbers of the *Journal* of the American Chemical Society, particularly in the paper of Giauque and Johnston, we see the beginnings of what promises to be the most accurate and fertile source of knowledge of chemical equilibria. From a detailed knowledge of the spectrum, for example of oxygen, and without recourse to any other experimental determinations, the specific heat at all temperatures can be calculated, and the entropy of oxygen at all temperatures is thus found. This, together with the heats of reactions which may be found by a similar method, makes possible the calculation of the degree of dissociation of oxygen and will ultimately make possible the calculation of all chemical equilibria.

The remarkable work of Dennison, Bonhoeffer and Eucken in predicting and isolating parahydrogen should prove to the chemist how many of his chemical discoveries will be obtained in the future by the application of these new theories of physics.

Gurney and Condon have recently derived from the wave mechanics an explanation of the fundamental laws of radioactivity. Similar methods will probably before long enable us to understand the processes involved in chemical reactions far better than they ever have before.

Physics and chemistry are being inevitably drawn closer together. It seems that there has never been a time when we can predict with such certainty rapid progress in fundamental chemistry, for the new theories of physics have as yet scarcely begun to be applied in the field of chemistry. The physicist, on the other hand, has much to learn from an increased knowledge of chemical phenomena which should provide him with a richness of experimental data far greater than any he has yet had an opportunity to use.

Unfortunately, although theoretical physics and chemistry are thus supplementing each other in many respects, are being merged into a new science, there are remarkably few men as yet that have received adequate training in both sciences. Before long, I hope, sharp distinctions between physics and chemistry will no longer exist, but at present there seems to be a very practical distinction.

In order to find approximately how many chemists are also active as physicists, and *vice versa*, I have selected at random 100 pages of the fourth edition of "American Men of Science" (1927), which contains the names of 13,500 American scientists. Of these, approximately 2,700 are classed as chemists and 760 as physicists. Of the chemists 87 per cent. are members of the American Chemical Society, while only 2.5 per cent. belong also to the American Physical Society. Seventy-seven per cent. of the physicists are members of the American Physical Society, while 4.3 per cent. are also members of the American Chemical Society. Thus only about 3 per cent. of the physicists and chemists of the United States whose names are given in the "American Men of Science" belong to both of the national societies. This leaves far too small a number of men who are capable or are properly prepared to carry on the important work of bringing these two sciences closer together.

To pave the way for the coming revolutionary changes in chemistry we must be prepared to modify our methods of thinking, probably along lines now so prevalent in physics. But, above all, we must urge young chemists in the universities and after graduation to become thoroughly well trained in mathematics and in modern physics.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE MICHAEL P. RICH BEQUEST FOR THE ADVANCEMENT OF SCIENCE

THE general endowment of the American Association for the Advancement of Science has been increased by a bequest of $10,000 through the will of the late Dr. Michael P. Rich, of New York City, who died on April 12, 1929. Dr. Rich had been a member of the association since 1891, enrolled in

Section N (Medical Sciences). In his last will and testament he wrote, "I give and bequeath to the American Association for the Advancement of Science, a Massachusetts corporation, the sum of ten thousand dollars, to be added to and become a part of its endowment fund."

As many know, the American Association has an endowment fund, now amounting to over $150,000, which is kept permanently invested by the treasurer of the association, who is now Mr. John L. Wirt, of the Carnegie Institution of Washington. It is administered under the laws of the Commonwealth of Massachusetts, from which the association received its incorporation in 1875. The income from this fund, at the present average annual rate of about 4.7 per cent., is available for appropriation by the association council, in accordance with constitutional provisions and those of the donors. The association has been the recipient of a number of larger gifts and bequests and of many smaller ones and the permanent endowment has been increased each year since it was inaugurated. To the endowment are added each year all sustaining membership fees (of $1,000) and all life-membership fees (of $100). Gifts have been received also for the current funds of the association.

The uses for which the council may appropriate the income from the endowment may be classified as (1) for scientific research, (2) for the general purposes of the advancement of science and (3) for special purposes. It is provided that the income from the fees paid by life members and sustaining members shall be available for general purposes until the decease of these members, after which it shall become available for furthering scientific research. For the association year 1927–28 (October 1, 1927, to September 30, 1928) the income from the fees of living life members and sustaining members was $1,341.85 and the income from the fees of deceased endowment members was $560.95. The total endowment income for 1927–28 was $6,493.48, available as follows:

For research	$4,327.69
For general purposes	1,956.46
For special purposes	209.33
	$6,493.48

Grants in aid of research, to individuals and to organizations, are regularly made from the first part of the income. From the second part of the income are paid the annual journal subscriptions for all living life members and sustaining members, who receive the official journal throughout life. The income from the Jane M. Smith Fund is used, according to the terms of that bequest, specifically for the establishment of emeritus life memberships, of which two or three have been created annually in recent years. The council elects these emeritus life members from among the annual members of longest standing. The treasurer's report on the endowment funds of the association appears annually in SCIENCE about February 1.

It is seen that the Michael P. Rich bequest constitutes a very definite addition to the association's endowment. It is a lasting memorial to the active interest taken by Dr. Rich in the general aims of the association. With the rapidly increasing membership, which now amounts to over 18,500, and with the recently greatly enhanced appreciation of the association by the intelligent public of the United States, such additions should be not infrequent in the future. The association welcomes gifts and bequests for the advancement of science and undertakes to administer such funds in accordance with the wishes of the donors.

BURTON E. LIVINGSTON,
Permanent Secretary

APPLICATIONS FOR GRANTS FOR 1930

THE council of the American Association for the Advancement of Science makes available each year a sum of about three thousand dollars from the income of the permanently invested endowment funds and this appropriation is allotted to individual members as grants in aid of research. Allotments are made by the Committee on Grants for Research, at the time of the annual meeting of the association, and all applicants are informed in January with regard to the outcome. Each year the list of grantees for the ensuing year appears in SCIENCE about February 1. Grants become available immediately, the funds being disbursed by the treasurer of the association in accordance with the desires of the grantees.

Applications for grants are made on special blanks, obtainable from the permanent secretary's office in Washington. For the year 1930 all applications must be received before December 1, 1929. Consideration is given to applications for any amount up to five hundred dollars; while a few grants of that amount have been allotted in recent years, most of the grants have been for smaller sums. Each application is to be supported by letters from two persons acquainted with the applicant and with the project for which the grant is requested.

The Committee on Grants for Research has the following membership. The number given in parenthesis after each name denotes the last calendar year of the member's term of office.

L. G. Hoxton, for physics (*chairman*); University of Virginia, Charlottesville, Virginia (1929).

Vernon Kellogg, for zoology; National Research Council, Washington, D. C. (1929).

W. Lash Miller, for chemistry; University of Toronto, Toronto, Canada (1930).