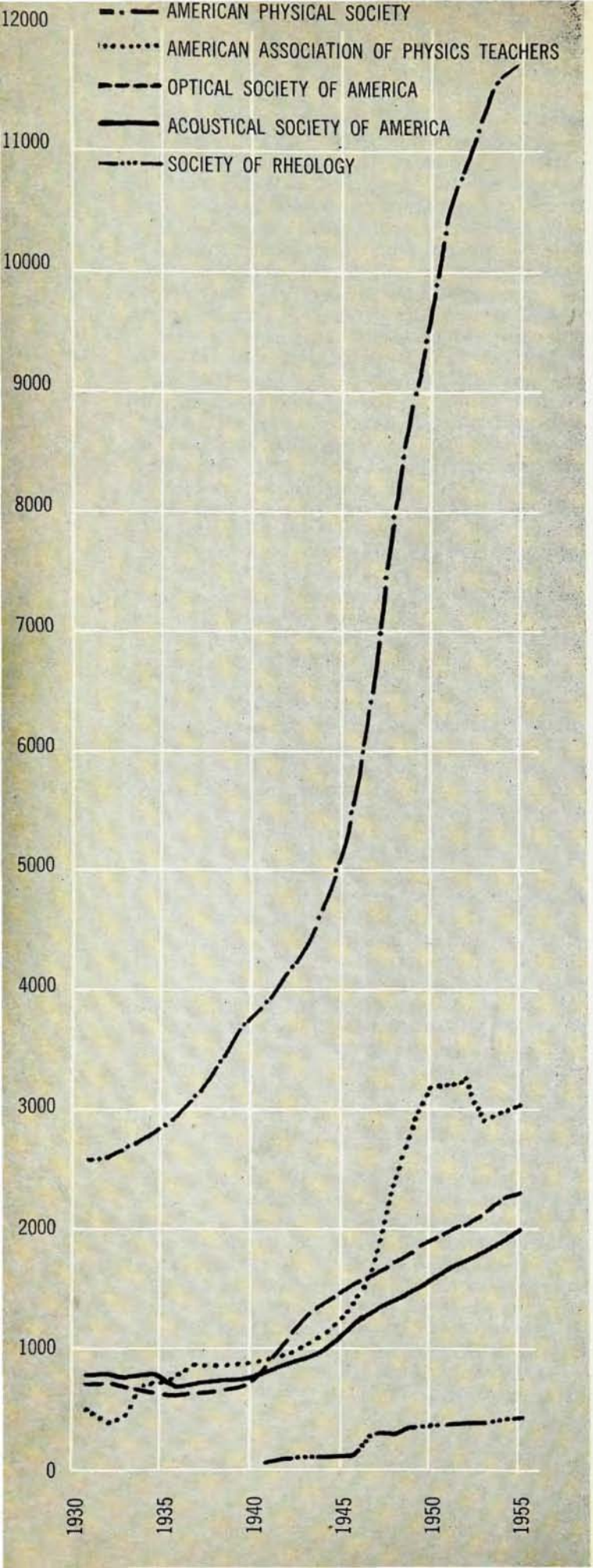


# American

*By* ***Marsh W. White***

THE current quarter century, which began in 1931, the year of the founding of the American Institute of Physics, has witnessed the most remarkable growth and development of the status of physics as a profession that this country has experienced. History has given weight to the thesis that the progress of science is directly proportional to the support given to scientists by the professional societies in the field. A study of the physics research journals will show how their growth and influence have closely paralleled the organization and increase of membership of the various professional physics societies.

The 25th anniversary celebration of the founding of the American Institute of Physics is clearly a logical time to review the growth of membership in the various organizations constituting the Member Societies of the Institute. Furthermore, it is wise to look at the data which reveal the rate of production of new physicists during the last quarter century. Also of considerable interest are data, now available for the first time in accurate form, that indicate some of the characteristics of physicists as human beings. Finally it seems wise to look as carefully as possible into the future and to try to predict the probability of a continuing and perhaps increasing demand for the services which physicists are peculiarly fitted to perform in this scientific era.

Thoughtful physicists are profoundly grateful for that very small but inspired group of men who first organized the American Physical Society in 1899. For

*Fig. 1. Membership in the professional physics societies during the current quarter century.*

# Physicists in the current quarter century

two decades they and their colleagues were numbered only in the hundreds. A period of modest but substantial growth followed World War I. The spectacular achievements of physics and physicists in World War II resulted in a relatively enormous increase in interest in physics as a profession. A rapidly accelerated growth in the membership of the American Physical Society naturally resulted, as shown in Fig. 1.

The Optical Society of America was founded in 1916 by an alert group of charter members who sensed the need for an organization definitely directed toward the promotion of interest in the field of optics. The membership grew rapidly (with the exception of a few years prior to World War II) and in recent years the roll of the OSA has greatly increased, as is shown in Fig. 1.

Some forty people interested in acoustics perfected plans in 1928 which led to the formation of the Acoustical Society of America. A charter membership of about 450 was obtained by 1929. However, the total number of members did not change greatly from this figure until the rapid advance of this science in and following World War II.

The American Association of Physics Teachers was organized only shortly before the founding of the American Institute of Physics. After a slow start this membership rose gradually until during the recent post-

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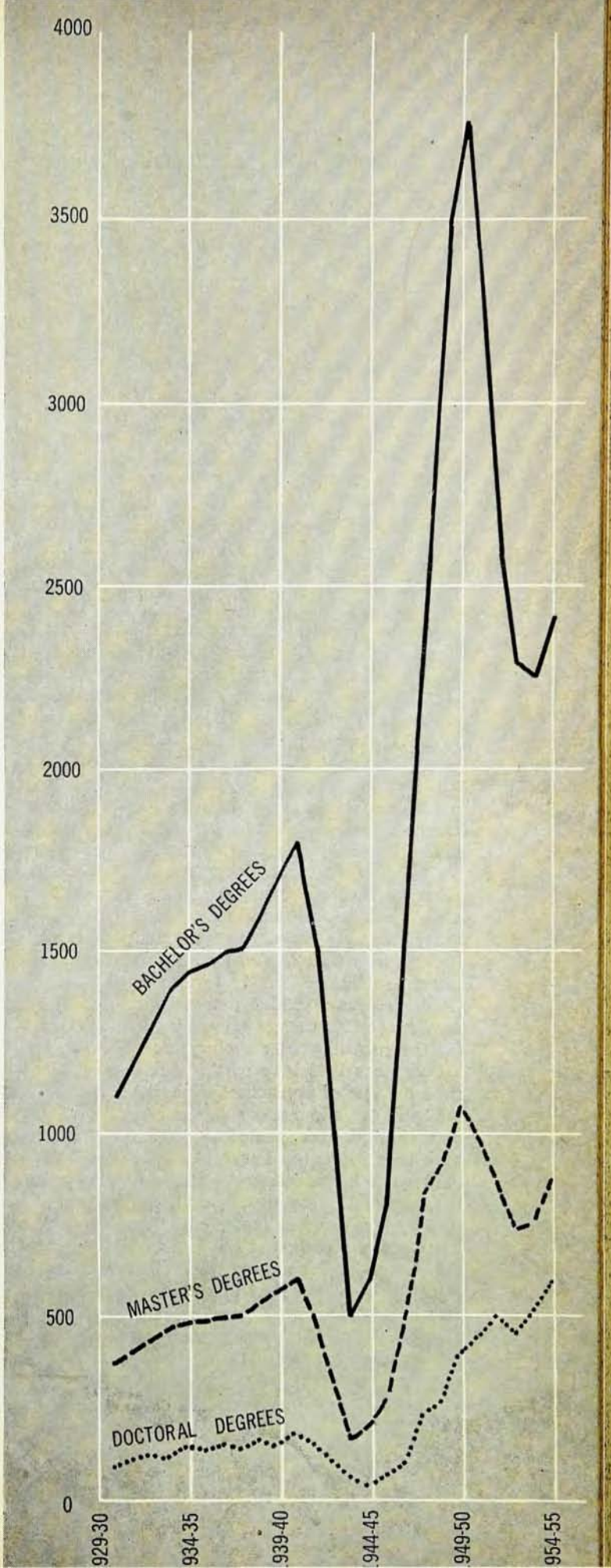



*Fig. 2. Degrees awarded to physics majors during the current quarter century.*

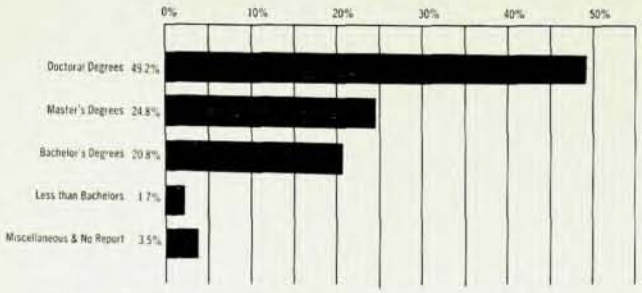



*Fig. 3. Educational training of physicists.*

war period the curve of growth took a decided increase in slope.

The Society of Rheology has never been large, but the growth in numbers in recent years has been steady and substantial.

What is the total number of physicists in this country? This is a question which one cannot answer with any great accuracy. The answer depends, of course, upon the definition of a physicist. There is no general agreement concerning this definition. If one attempts to classify as physicists those persons who by education, training, and experience are qualified to do serious work in physics the total number may be roughly estimated to be about 20 000. There are probably more than 6000 living PhD's in physics. The American Institute of Physics has recently mailed out about 17 500 questionnaires to members and nonmembers of the Institute who were known to be physicists or deeply interested in physics. Nearly 15 000 of these questionnaires were returned. Excluding the nonphysicists in the group, and eliminating the students and retired physicists, a register of 10 000 bona fide physicists is now actually on file in the Institute register. Data concerning these registrants are given later in this paper.

Accurate data concerning the production of physics PhD's have been compiled for a number of years. The pioneer studies of M. H. Trytten [1] and Knapp and Goodrich [2] have yielded data with reference to the numbers of PhD degrees granted in physics. These data for the current quarter century are shown in Fig. 2.

Only since 1946 have reliable data been obtained to show the rate of production of physicists-in-training at the bachelor's and master's degree levels. Studies of the number of degrees granted in physics at these levels have been supported since 1946 by Sigma Pi Sigma, the physics honor society for students. Two years ago the task of the compilation of these data was taken over by the American Institute of Physics and is being continued as a portion of the Register of Physicists by the Institute. Reports on these investigations have regularly been published in the *American Journal of Physics* and *Physics Today*. The curves showing the numbers of bachelor's and master's degrees awarded in physics are given in Fig. 2.

[1] M. H. Trytten, The Scientific Monthly, 50, 37–47 (Jan. 1945).
[2] Robert H. Knapp and H. B. Goodrich, *Origins of American Scientists*, Univ. of Chicago Press (1952).

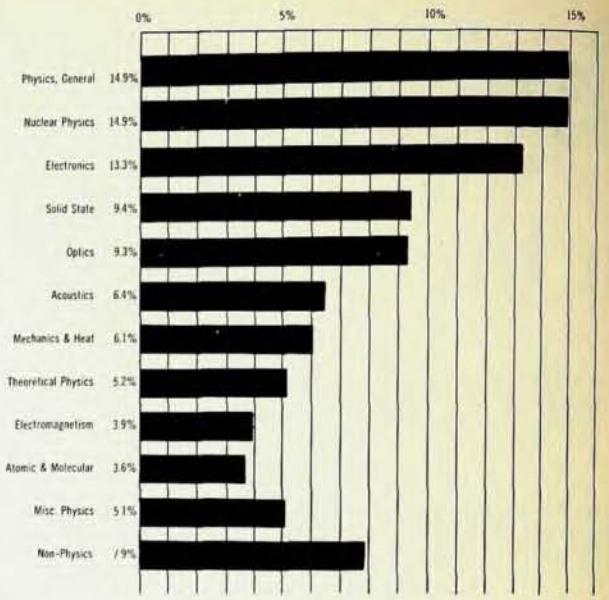



*Fig. 4. Occupational specialties of physicists.*

The great rise in the popularity of physics as a career following World War II is clearly shown in Fig. 2. A considerable portion of this large enrollment in the physics major was no doubt caused by the bulge of students who were in college under the provisions of the G.I. bill. The decline in numbers that followed this bulge has now been checked and it may be confidently assumed that the post-war higher birth rate will result in a steady increase in the student populations attending colleges and universities. It seems probable that enrollments in the physics major are now likely to continue to grow, with a resulting increase in the numbers of degrees awarded to physics majors at all levels. Some attempts to predict the supply of physicists during the next decade were published in the February 1954 issue of *Physics Today*.

At present some 542 colleges and universities are awarding bachelor's degrees to physics majors. The number of these institutions continues to grow slowly. Offering the master's degree in physics are 182 physics departments, while about 75 are prepared to give work at the doctorate level. Lists of these institutions are

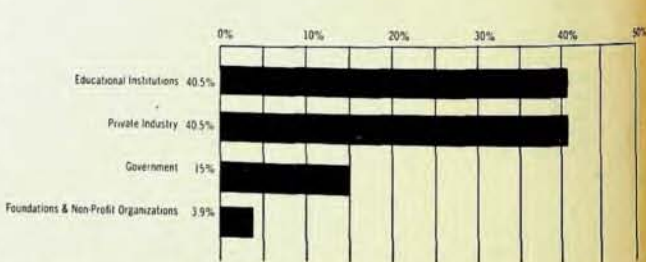



*Fig. 5. Employers of physicists (no report available on 0.1%).*

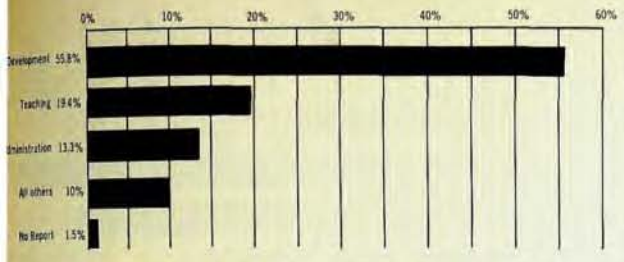



*Fig. 6. Functions performed by physicists.*

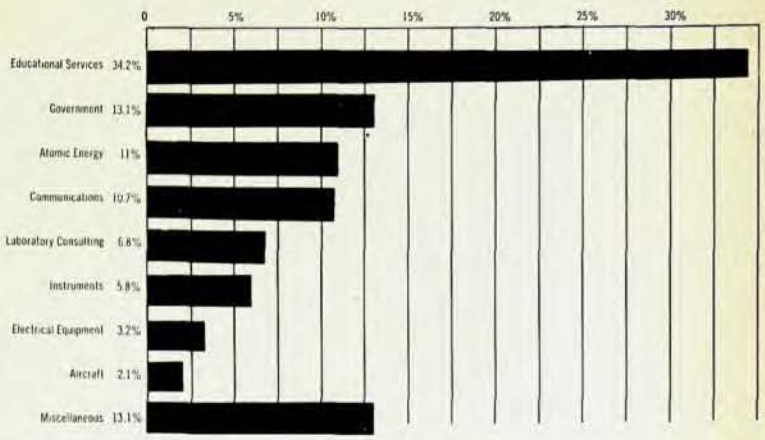



*Fig. 7. Work classifications of physicists.*

revised annually and are available from the American Institute of Physics.

Until very recently there have been very few data available concerning American physicists. Shortly after the end of World War II, the American Institute of Physics cooperated with the Department of the Army in a comprehensive study of the utilization of physicists during the war. This study included data that made it possible to analyze the educational and professional background of some 7000 physicists.[3]

An excellent analytical study of manpower resources in physics was conducted in 1950–1951 in cooperation with the American Institute of Physics by the National Scientific Register, then functioning as a part of the National Science Foundation and at that time operationally administered by the U. S. Office of Education. The findings of this study were published [4] as Number 3 of the Scientific Manpower Series of the Federal Security Agency. Data concerning 6600 physicists, mostly members of the American Institute of Physics, were obtained and analyzed. It was estimated that this survey covered about one-half of the professional physicists in this country.

About two years ago the National Science Foundation made a grant to the American Institute of Physics for the purpose of supporting the Institute in the establishment and continuous maintenance of a comprehensive Register of Physicists. As of April 1, 1955, the Institute had mailed out to members and nonmembers a total of about 17 500 questionnaires. Nearly 15 000 were returned and IBM cards were punched and a study was made of slightly more than 13 000 who were regarded as physicists by the Institute staff. When some 1350 students, retired physicists, and about 1900 registrants who showed a first specialty in other than physics were removed from the list, a remainder of 10 000 professional physicists was finally obtained. It is believed that this list represents a large fraction of the bona fide professional physicists in the United States. About 2.5% are women; only 3.5% of the group are not United States citizens.

The educational background of the physicists in the current Register is shown in Fig. 3. The distribution of these classes is not greatly different from the corresponding groups in the 1951 survey. In both cases it is probable that the AIP population is heavily weighted with senior physicists with the PhD degree. Some estimates would indicate that less than a third of the country's professional physicists hold doctorate degrees.

The occupational specialties of these physicists, Fig. 4, show some significant changes from the corresponding data of previous surveys. In 1951 the leading speciality was electronics, with 18% of the population; the second highest was a tie between nuclear physics, with 15%, and another group of 15% who gave no specialty and were classed as "physics general". The current study shows a tie for first place between physics general (15%) and nuclear physics. Electronics is third, with 13%. Solid-state physics has increased from 6.5% to 9.4%. Optics has declined from 14.4% to 9.3%. Other specialties have not greatly changed.

The employers of physicists are indicated in Fig. 5. A decided change is seen here, in comparison with the 1951 data. Private industry now employes 40.5% of our professional physicists, as compared with 32.4% in 1951. Educational institutions now utilize 40.5% of the present population although 46.5% were so employed in 1951. Other classifications are not greatly changed.

Large changes have taken place in five years in the functions performed by physicists. The data of Fig. 6 show that 55.8% are now engaged in research and development activities, in comparison with 47% in 1951. Teaching has suffered a great loss from 37% in 1951 to 19.4% at present. Management and administration is attracting larger numbers of physicists, with 13.3% currently and only 8.3% in 1951.

The leading role played by educational institutions in the work classification of physicists is clearly shown in Fig. 7, with 34.2% of the current group performing educational services. It should be remembered that this group includes a minority of teachers of physics and a majority who are doing research and development, mostly under contract, in laboratories in or connected with educational institutions. Atomic energy now appears as a separate classification, not shown individually in previous studies. Communications and labora-

[3] Marsh W. White and William H. Crew: *Physicists In and Following World War II*, Am. J. Phys., 18, 487–495 (Nov. 1950).
[4] *Manpower Resources in Physics—1951.* Scientific Manpower Series No. 3, Federal Security Agency, U. S. Government Printing Office.

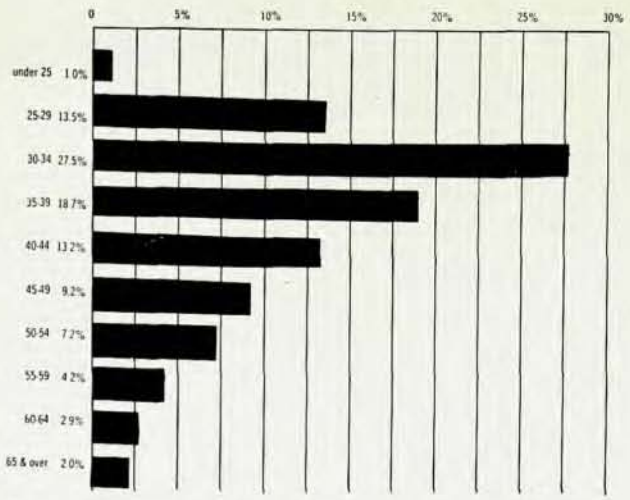



*Fig. 8. Ages of physicists (no report available on 0.6%).*

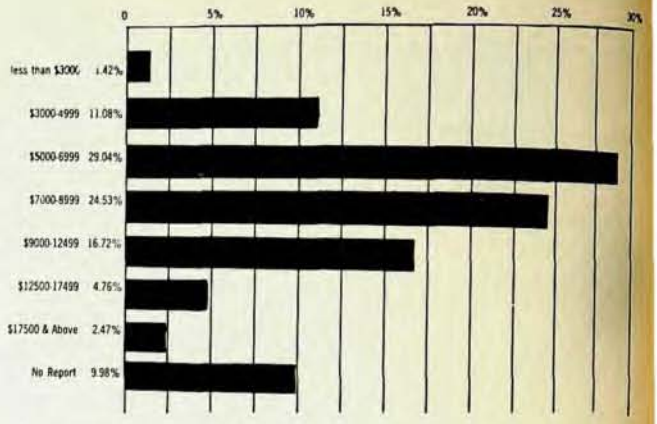



*Fig. 9. Salaries of physicists.*

tory consulting are much larger classes than was formerly the case.

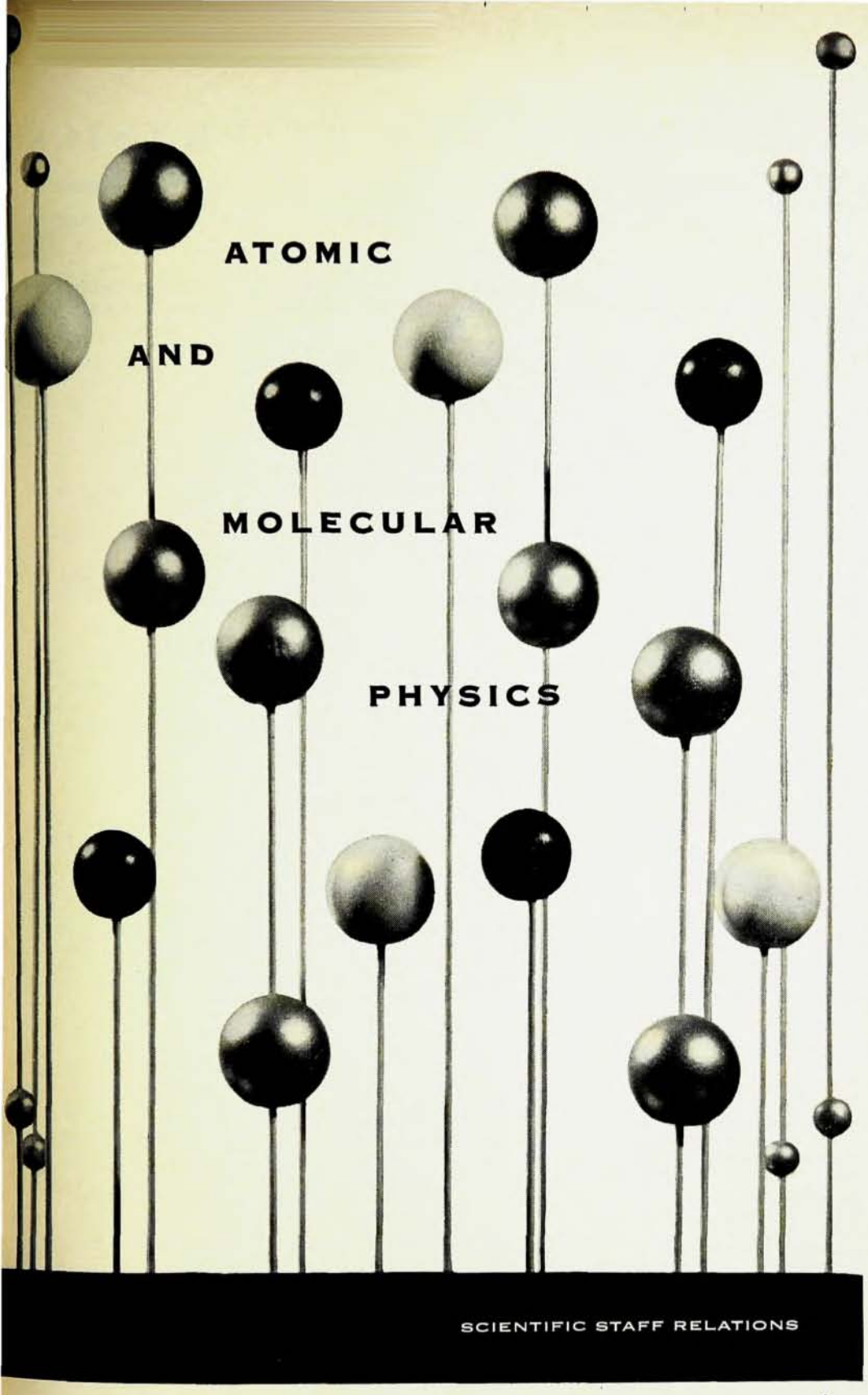
Contemporary physics seems to be essentially a young men's game. The data of Fig. 8 show that the median age of physicists is now about 35 years. Furthermore, most of these physicists are members of the societies in the American Institute of Physics and previous surveys have shown that society members tend to be older than nonmembers. Only 16% of current physicists are 50 or older. The 1951 study showed marked differences in the age distribution of physicists between the newer fields of physics and the classical fields. About 60% of the quantum theoretical physicists and nuclear physicists, and 46% of the specialists in electronics and atomic and molecular physics, were under 35 years of age. The 1951 data suggested that the great expansion of physics in recent years had been effected principally by the entrance of new graduates rather than by the transfer of personnel from other specialties.

The median annual income of physicists at present is about $7500 (Fig. 9). In 1951 it was $6100. Then the best-paid quarter received over $8000; today that group has salaries of more than $9000. Currently 17% of our physicists have salaries above $10 000. Only 12% receive less than $5000 per year. Again it must be noted that previous studies have shown that the higher paid members of the profession are those who are usually members of professional societies. Hence the physicists in this survey probably had higher salaries than all of the physicists in the country. Older physicists in the group surveyed tend to earn considerably more than their younger colleagues. Also those with the higher academic degrees have higher salaries than those with lesser education. The 1951 survey indicated a median differential of about $200 per year between bachelor's and master's degree holders and $1800 for the difference between master's and doctor's degree physicists. Of course the latter differential is partially due to age differences. It is a well-known fact that salaries in industrial positions are considerably above comparable levels in government laboratories and they in turn are higher than similar jobs in educational institutions. These conditions have previously been so well documented that this situation need not be further discussed here.

There has been comparatively little attention given to serious quantitative studies of the requirements of the country for physicists at various levels. At present the situation can be summarized by noting that the demand for physicists so greatly exceeds the supply that attempts to determine numerical deficiencies are almost hopeless. One has only to glance at the display advertisements in the newspapers and technical journals to see how desperate the situation is just now. There seems no reason to think that this condition will change greatly in the foreseeable future. The production of physicists-in-training can be roughly extrapolated for at least ten years and the numbers seem to be only a fraction of those which could be used by the rapidly growing needs of the country.

Reference might be made to the study of the employment outlook made in 1953 by the Bureau of Labor Statistics of the U. S. Department of Labor.[5] This study emphasized the large gap that now prevails and which will continue to exist between the supply and the demand for physicists. The National Science Foundation is currently completing a quantitative study of the requirements of the country for physicists and other technical personnel. Their preliminary findings amply confirm the conditions mentioned above. The only probable way in which these conditions might change would be a major depression or a governmental policy shift which would drastically reduce funds available for research and development. Neither of these fearful prospects seems very likely under present conditions. Hence the employment outlook for physicists seems rosy indeed. Members of the physics profession will have plenty of work to do during the next quarter century.

[5] *Employment Outlook for Physicists.* Bulletin No. 1144, U. S. Dept. of Labor, in cooperation with the Veterans Administration.

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