Title: Careers in Atomic Energy

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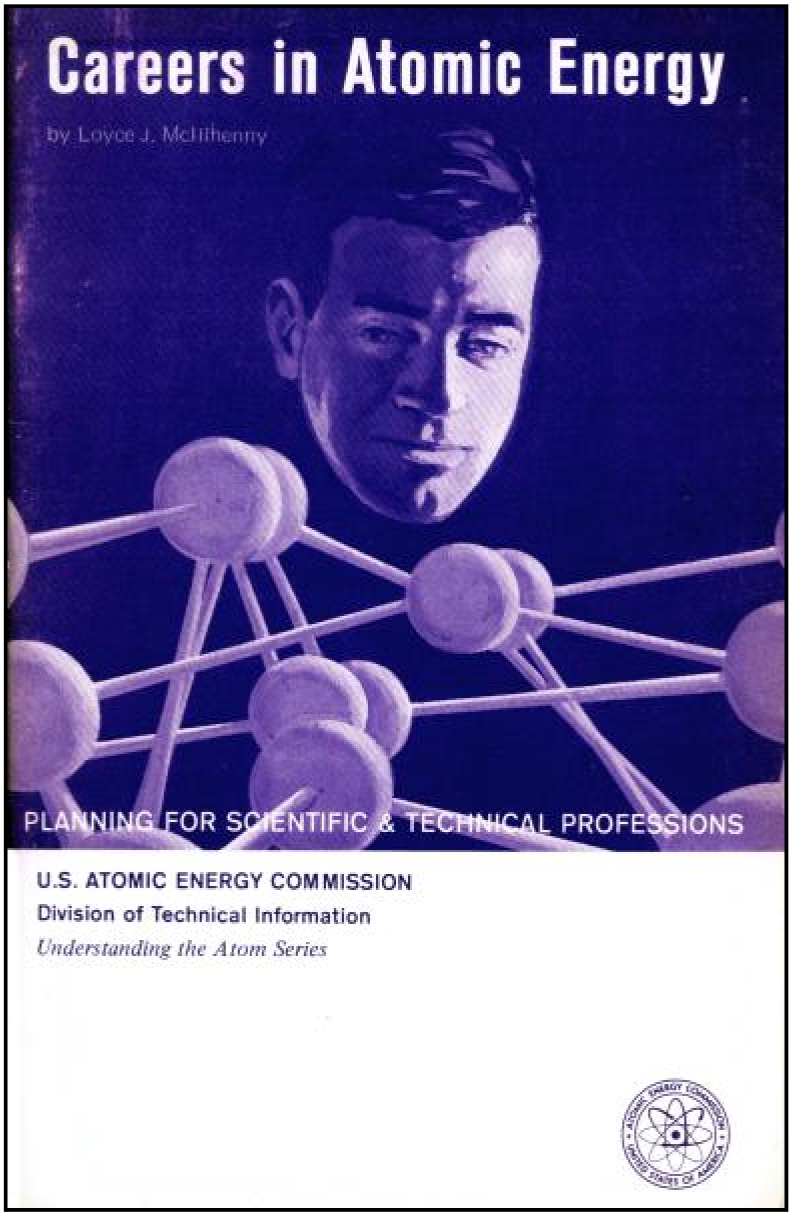
Release Date: May 1, 2013 [EBook #42626]

Language: English

Character set encoding: UTF-8

Produced by Juliet Sutherland, Matthew Wheaton and the
Online Distributed Proofreading Team at http://www.pgdp.net



Careers in Automic Energy
by Loyce J. McIlhenny
PLANNING FOR SCIENTIFIC TECHNICAL PROFESSIONS
U.S. ATOMIC ENERGY COMMISSION
Division of Technical Information
Understanding the Atom Series

The Understanding the Atom Series

Nuclear energy is playing a vital role in the life of every man, woman, and child in the United States today. In the years ahead it will affect increasingly all the peoples of the earth. It is essential that all Americans gain an understanding of this vital force if they are to discharge thoughtfully their responsibilities as citizens and if they are to realize fully the myriad benefits that nuclear energy offers them.

The United States Atomic Energy Commission provides this booklet to help you achieve such understanding.

Edward J. Brunenkant

Edward J. Brunenkant, Director
Division of Technical Information

Careers in Atomic Energy

by Loyce J. McIlhenny

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United States Atomic Energy Commission
Division of Technical Information

Library of Congress Catalog Card Number: 64-60275
1962; 1964(Rev.)

ABOUT THE AUTHOR

After receiving a degree in English at the University of Houston, Mrs. McIlhenny worked for nine years in editorial capacities at the Oak Ridge Institute of Nuclear Studies, where she prepared this booklet. She is now a housewife in Falls Church, Virginia.

Careers in Atomic Energy

LOYCE J. McILHENNY

TODAY virtually every aspect of science is concerned in some way with the atom.

Physicians use radiation to treat disease. Mechanical engineers design components for nuclear reactors. Electrical engineers convert the energy of the atom into electricity. Botanists use radioactivity to learn more about plants, and zoologists use it to study animals. Chemists investigate compounds with radioisotopes. Physicists and mathematicians work out the intricate interrelations among the tiny particles of the atom. Agronomists use radioactive materials to improve fertilizers and crops, and nutritionists use them to improve animal diets.

A student—YOU—can find your career in atomic energy in any branch of science you choose because “atomics” is not a field unto itself divorced from the rest of the scientific world.

The best preparation for a career in nuclear energy begins with elementary arithmetic. This preparation advances through general science, algebra, biology, chemistry, physics, geometry, and trigonometry. The aspiring scientist will be wise to lay the groundwork for his future long before he reaches college by studying as much mathematics and science as he can handle. Although many a now-successful chemist entered college without knowing how to balance an equation, keen competition today demands that college freshmen have a solid foundation in mathematics and science.

Even in an age of specialization, the interrelation of the sciences has made it necessary for a scientist to have at least a speaking acquaintance with areas outside his own field. A chemist, for example, may find himself involved in biology; the research interests of a biologist may lead him into physics.

Moreover, English-speaking peoples have no monopoly on scientific accomplishment. Proficiency in German and French, at least a reading knowledge, has long been considered desirable and is often required of the serious scientist. In the light of modern developments, a reading knowledge of Russian might well be added to the list, and, as other countries and cultures expand their technologies, familiarity with still other languages may become necessary. (Indeed, a number of scientists who completed doctoral degrees years ago have recently begun to study Russian. This is not surprising since the education of a true scientist never stops with an academic degree, a job appointment, or a significant discovery.)

The most brilliant physicist on earth is of doubtful worth if he can’t communicate his ideas to other people. Thus even more important than a knowledge of foreign languages is a knowledge of one’s own. Almost too late has come the realization that many college graduates in the United States, although proficient in their particular fields, cannot write a correct English sentence. Accurate scientists cannot afford inaccurate communication. Proficient scientists know their own language.

The Scientific Mind

A widespread popular belief exists that the “scientific mind” is a trait that some people inherit and others don’t, like red hair or brown eyes. This is both true and false. Essentially, an innate “scientific mind” does not exist. In the natural course of growing up, however, some people acquire or develop certain characteristics that are most commonly found in successful scientists. These characteristics include curiosity, caution, thoroughness, patience, perseverance, and logical reasoning power. These are general traits, and all can be developed to some degree.

Scientists Are People

With increased national attention focused on scientific activities, some people have developed strange notions about the man who wears a lab coat. Scientists have a high degree of objectivity in the laboratory, but they usually are not different from the rest of society in matters of religion, marriage, parenthood, or politics. Often they don’t adhere to a strict eight-hour day, but neither does a salesman. They may seem unusually dedicated to their profession, but so does a master chef. They rarely are geniuses; sometimes they have superior intelligence; but frequently they have ordinary intelligence. Most are reasonably well balanced, some are eccentric, and a few are downright peculiar. But these same characteristics can describe lawyers, businessmen, and secretaries.

The Time to Begin

If you are seriously planning a career in science and if you are devoting your time to the study of science, mathematics, English, and foreign languages, you are laying the foundation in school right now for your future. You—whether you are a he or a she—can begin now without waiting until the sixth, or ninth, or twelfth grade introduces you to further courses.

Girls have no reason to feel that any branch of science, including nuclear technology and engineering, is strictly a "man's job."

Beginning now, you can supplement your studies by exploring science through books. You can go to your school library and to your public library for reading material. Teachers and librarians can help you select material.

The doors of knowledge can open, however, only as rapidly as you can read. The sheer bulk of scientific literature in print today is staggering. Any student who is a slow reader should seek immediate help from his teachers. Slow reading does not prove a slow mind, nor does slow reading improve comprehension. Both these ideas are false, and, if you mistakenly cling to either one, you cheat yourself. As a matter of fact, probably not one person in a million reads as rapidly as he can, and it would behoove even the exceptionally rapid reader to work at improving this basic skill, which is essential to all accomplishment.

Further, if you want to do serious scientific study, ask your teachers to outline science projects that you can undertake after school or during free periods. Many projects that are both educational and fun can be undertaken without costly equipment or a complete laboratory.

Other means of improving scientific understanding and competence outside the classroom include science clubs, state junior academies of science, and participation in science fairs. If these activities do not exist in your area, perhaps you can whip up enough interest among students, teachers, and parents to start them. If not, you can channel your science projects through such organizations as boys' clubs or Scouts.

The student who is avidly studying science in school and in extra-curricular activities sometimes sets his sights on a summer laboratory job. Although this is certainly worthwhile, often it cannot be realized. Many opportunities exist, however, for valuable summer study and training in the approximately 200 special programs for science students at colleges and universities. These programs are sponsored by the National Science Foundation to provide outstanding high-school students with unusual laboratory and study experiences.

College: Is It a Necessity?

Many intelligent and successful people never attended college, but few of them are in the scientific ranks. If you want a career in science, you must first select a college or university. Many factors, of course, determine this choice.

The first question you have to ask yourself is a rather grim one: which schools will admit me? With the rapid increase in student population, the shortage of teachers, and the physical facilities of universities strained to bursting, it is no longer possible for colleges to admit everybody who wants to enter. Again, as always, this is where hard work in elementary and in high school pays off: good grades in “solid” subjects are master keys to university gates. Entrance exams required by many schools are stiff, but a background of twelve years of conscientious study usually prepares you to deal with them.

A college education is a costly business anywhere these days, but expenses can vary greatly from school to school. Once again the matter of precollege achievement crops up: open to undergraduate students with top records are scholarships and special educational loans and other programs designed to offset or defray college expenses.

After you consider entrance requirements and cost, you should weigh the location of the school, course offerings in your field of interest, faculty, and facilities. You should also evaluate the size and type of the institution in terms of your own personality. Parents, teachers, and local scientists can be excellent counselors in helping you make the decision.

Inevitably some intelligent students who lack motivation fail to achieve top grades in high school. Science careers are open even to these students if they choose their colleges carefully. Sometimes small, less well-known colleges will admit them because the competition for entrance is not as great as it is in “name” colleges. Small schools should not be dismissed as “second rate.” They are usually staffed by fine teachers, and, even with limited laboratory facilities, such colleges still offer excellent training.

Scholarships and Other Financial Assistance

A number of fellowships, scholarships, grants, and awards are available to assist the aspiring scientist in his education.

This financial assistance is offered by colleges; local, state, and federal government agencies; industry; private foundations; and individuals.

Literally thousands of other educational assistance programs exist. A list of some publications that contain information on currently available assistance is printed in the back as a guide. Some of the publications are in most libraries; others must be ordered from the publisher. Since financial assistance programs are undergoing constant change and revision, no directory can be complete, but these books will give you an indication of the range of the programs.

College: How Many Years?

Although it is common for a student to change his primary interest from one science to another during his college training, he should have in mind from the beginning the sort of broad career he wants and the amount of time that preparation will take.

For example, a bachelor’s degree in one of the physical or geological sciences such as physics, chemistry, biology, geology, archaeology, agriculture, metallurgy, or mathematics usually requires four years. Some engineering programs require five. A medical student, on the other hand, sometimes takes only three years of college and then goes directly into medical school without a bachelor’s degree but with six to eight years of training still ahead of him.

Physical and Biological Sciences

Most scientific endeavor today is undertaken by teams composed of individuals with doctor’s, master’s, and bachelor’s degrees in the sciences. These teams have supporting technical and administrative personnel to help them function efficiently.

In the physical and biological fields, scientists with doctor’s degrees have probably spent three to six years in college after they received their bachelor’s degrees. They are likely to head the team and to have the responsibility for planning and directing research and development projects.

Individuals with master’s degrees have spent about two years in graduate school. They have some research training and undertake scientific projects under direction, although they may also have some responsibility for planning and supervising.

The bachelor’s degree is not a research degree, and team members without graduate training are not likely to direct research. They probably spend their time conducting fairly routine research duties under the guidance of more highly trained supervisors.

The above outline is a general description of the typical situation; work conditions may vary greatly depending on the individual and his organization.

Engineering

Traditionally engineering has been somewhat different. Many engineers held responsible jobs after receiving only a bachelor’s degree. Some did earn a master’s degree, but few studied for a doctorate.

In the last ten years, however, this trend has changed with many more engineers receiving master’s and doctor’s degrees. Advanced study is especially important for a career in the nuclear field because the undergraduate years are filled mainly with basic engineering, and most nuclear courses must be taken at the graduate level. Moreover, the engineering sciences, as all other fields, are becoming increasingly complex. Thus graduate study through at least a master’s degree is advisable for the engineer.

The prospective engineering student should realize that a bachelor's degree will take from four to five years to complete, a master's degree will require an additional one to two years, and a doctor's degree will involve still another two to four years.

Medicine

A career in medicine is still a different story.

After three to four years in college premedical study, four years in medical school, at least one year of internship, and possibly a year's medical residency, a doctor can become a general practitioner. If he wishes to specialize, his internship may last for two years, and his residency period from three to four years. It is this latter, longer path that leads to a career in nuclear medicine and radiology, as well as to more familiar specialization, such as surgery, pathology, obstetrics, or pediatrics.

Veterinary Science

Also important in the field of nuclear medicine is the veterinary scientist.

A veterinarian spends from two to four years in undergraduate study and four years in veterinary school before receiving a Doctor of Veterinary Medicine degree that permits him to practice animal medicine. Then, if he wishes to enter nuclear veterinary medicine, veterinary pathology, or some other specialty, he undergoes additional training that is comparable to that of the physician who specializes.

Scientific Writing

Valuable in all areas of science and engineering is the technical writer.

Several years ago the typical technical writer or editor had a background of journalism or English grammar and some undergraduate study of one or more of the sciences. Editorial ability still depends largely on ability to handle the English language, but more and more frequently today the successful technical writer or editor has a bachelor's degree in one of the sciences. Sometimes he has a master's degree, and occasionally he holds a doctor's degree.

Supporting Fields

No scientific organization can function if it is manned only by scientists. Supporting and assisting personnel are essential to the scientific team, and training is widely available for the nonscientist who wants to work in a scientific installation.

Atomic energy, like fire, is not dangerous when it is under the control of people who know how to use it. Special instruments and protective clothing are used by trained technicians who are responsible for radiation control.

A nurse is a professional medical assistant. She can be certified as a registered nurse in three years, or she can earn both an RN and a bachelor’s degree in four to five years. Especially if she enters the field of nuclear medicine or if she is associated with a physician or organization engaged in the clinical use of radiation and radioisotopes, she will need a background in physics in addition to her study of chemistry and the life sciences.

Many colleges and universities offer two-year programs that lead to a certificate qualifying a student as a laboratory aide. The laboratory aide, or assistant, performs assigned duties under close supervision. He does not conduct actual research, but he supplies the scientist with an extra pair of hands.

Scientific organizations also need administrators, librarians, translators, personnel directors, glassblowers, instrument repairmen, accountants, and a host of other skilled individuals to keep the team running smoothly. Such positions may be filled by persons with very limited scientific backgrounds. But the advantage—for employment and for advancement—is on the side of the secretary, or purchasing agent, or bookkeeper who has made an effort to become familiar with basic scientific principles and terminology. Nonscientists with scientific background are sufficiently rare to make them unusually valuable assets to scientific organizations.

Work of the Atomic Scientist

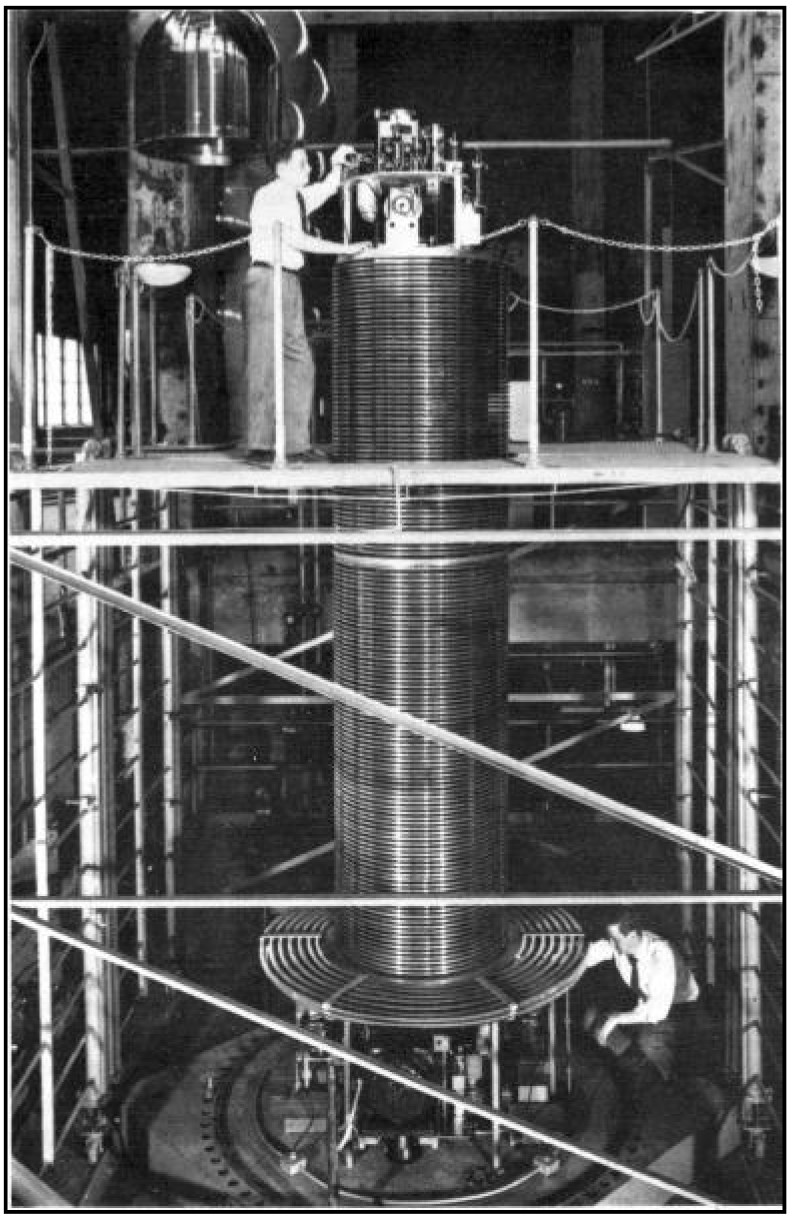
After he completes his formal education, the scientist sets about to investigate the world, for that's what science is all about. The methods he uses to carry out his investigations depend on his particular field. It is impossible to outline what an individual scientist does because he may do any of a thousand things in any of a thousand ways. He may be concerned with nuclear energy almost totally, or he may be concerned with it only slightly.

It is possible, however, to sketch examples of some of the activities undertaken by various members of the scientific community.

Most people are familiar with the broad academic breakdown of the sciences into physics, chemistry, biology, geology, engineering, and mathematics. It is therefore convenient to examine the activities of scientific personnel in each of these areas, as well as medicine, with emphasis on the nuclear energy aspects of each.

Physics

The physicist is dedicated to investigating the laws that govern the universe. He explores gravity, motion, mass, energy, and the myriad interrelated ways that the world is constructed to gain an understanding of his physical surroundings.



The very tiny world of the atom is invaded by very large tools such as particle accelerators, sometimes called "atom smashers."

A nuclear physicist concentrates his investigations on the atom. The subject of his research is, of course, incredibly tiny, and therefore invisible to him, but he studies the atom by finding out how it behaves when certain things are done to it.

To accomplish this, the nuclear physicist centers his day-to-day activities around equipment such as particle accelerators and nuclear reactors, which he uses to shoot nuclear particles into materials. What happens in these and many other processes provides him with information on the nature and behavior of atomic energy.

Within the framework of his interest, the practicing nuclear physicist may conduct basic or theoretical research to add to the body of scientific knowledge. He may design equipment to carry out new types of research. He may apply the principles of his science to improving the standard of living, as he did by developing the nuclear-power plants. He may work to improve nuclear weapons, to aid space travel, or to devise nuclear medical instrumentation for use by physicians. He has a place in one of the countless efforts that involve nuclear reactions and radioactivity.

Chemistry

The chemist studies the composition of substances.

For centuries man has known that various combinations and recombinations of substances produce other materials with different properties, and it is the chemist who combines and recombines.

A nuclear chemist, or radiochemist, specializes just as his name implies. He studies the effects of radiation on chemical substances, notes how chemical reactions are altered by the introduction of radioactivity, and analyzes the nature of nuclear energy materials and products.

When an experiment or a scientific application requires a purified compound, the chemist goes to work. When a substance is to be altered so that it takes on a different form, the chemist takes over. He develops better fuels for automobiles and space craft, better fibers for shirts and parachutes, better plastics for kitchens and submarines.

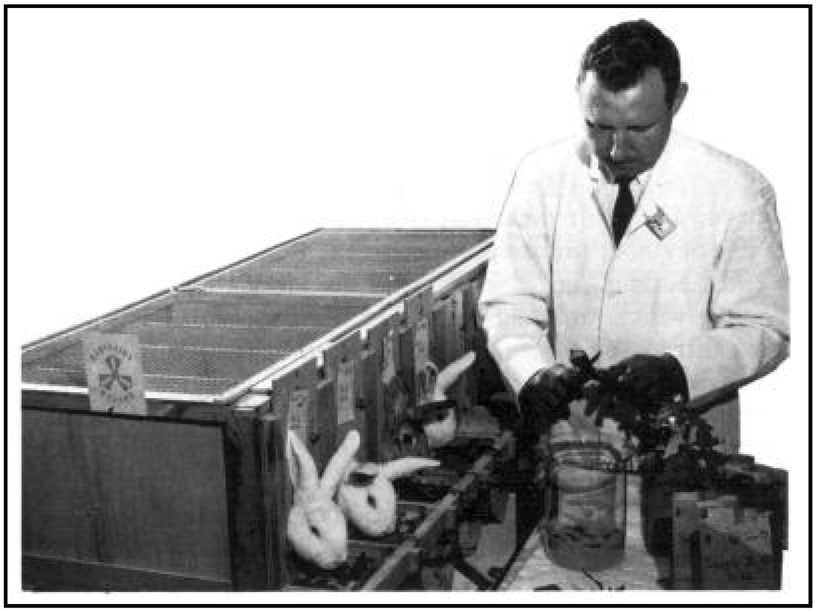
Biology

Biology deals with the structure and behavior of plants and animals: the botanist studies plants, the zoologist studies animals, and they both can use radioactivity widely in their research.

Radiation changes the pattern of plant behavior, and many botanists are vitally interested in the effect of various types of radiation on seeds and plant growth. Radiation can produce mutations, or basic changes, in growing things; thus, by selective breeding of desirable changes, it is possible to improve crops. Progress here is slow. Many millions of possibilities exist in the relations among the variety of plants, type and intensity of radiation, random chance, and other growing conditions, but already several new plant breeds have emerged, and other crops are bound to follow.

In addition to altering plants directly by radiation, the botanist can improve plants indirectly by using radiation: he can add radioactivity to fertilizer and evaluate the efficiency of its uptake by the plant to determine the most effective fertilizer for a particular soil or crop. The many, and sometimes seemingly strange, effects of radioactivity on plants and growing conditions provide a wide and fascinating field for the botanist.

As most people know, radiation also affects animal tissue. The zoologist wants to know how and why this is true and how varying conditions alter animal reactions to radiation. The research of the animal physiologist is basic to later medical applications of radiation to human beings. The veterinary scientist has the grave responsibility of testing radioisotopes, radiation drugs, chemicals, surgical procedures, and various combinations of these in animals to determine which can be used to diagnose or cure disease in man. He passes his findings on to the physician for further research only after he has made every possible test and evaluation. Sometimes he works with chemists, nutritionists, bacteriologists, and other scientists. What happens to animals could happen to human beings, and that is why physiologists watch carefully the animals that eat radioactive foods and study the offspring of animals that have been exposed to radioactivity.



Animal studies using radioactive materials give important information concerning physiology, both animal and human.

Geology

A main interest of the geologist is the history of the earth and its ever-changing life, especially as revealed in fossil formations and deposits under the soil.

The geologist has a vital place in the field of atomic energy since he helps provide the raw materials for nuclear processes. The atomic age has made radioactive materials essential to life, and the geologist must locate valuable deposits, determine their extent, analyze their purity, and plan their extraction.

Engineering

The engineer is the how-to-do-it man. This technical man of action comes in many varieties—mechanical, electrical, metallurgical, ceramic, industrial, civil, instrument, and chemical, to name a few.

In the field of nuclear energy, the mechanical engineer shoulders the responsibility for designing, supervising construction, and guiding the functions of the giant accelerators, nuclear reactors, atomic-propulsion plants, space-ship engines, and other mechanical equipment that must be constantly devised, improved, constructed, and redesigned.

The electrical engineer devises the intricate circuits that keep the vast equipment working smoothly, works out complex controls for instrumentations, eliminates malfunctions, and formulates electrical processes for new installations and devices.

Metallurgical and ceramic engineers test and evaluate the strength, durability, and other characteristics of materials to be used in the fabrication of equipment, and they produce new materials for specific jobs. For instance, a metallurgical engineer might produce a space-ship shell that meets the requirements of (1) minimum weight, (2) maximum shielding from radiation, and (3) high strength. He may analyze various materials for use in atomic reactors, nuclear submarines, or medical treatment rooms where radioactivity is used. The ceramic engineer tackles similar problems, working with ceramic products rather than metals.

The industrial engineer is concerned with the efficient use of machines, materials, and men in production.

The civil engineer takes the plans of the atomic plant and designs buildings and facilities for particular processes.

The instrument engineer examines a job to be done and then designs the instrumentation to do it. He must understand what happens when his instrumentation is integrated into an entire system of production and control. For instance, the engineer who develops an instrument to be used in a gaseous-diffusion plant for the separation of uranium isotopes must understand the entire process of uranium separation.

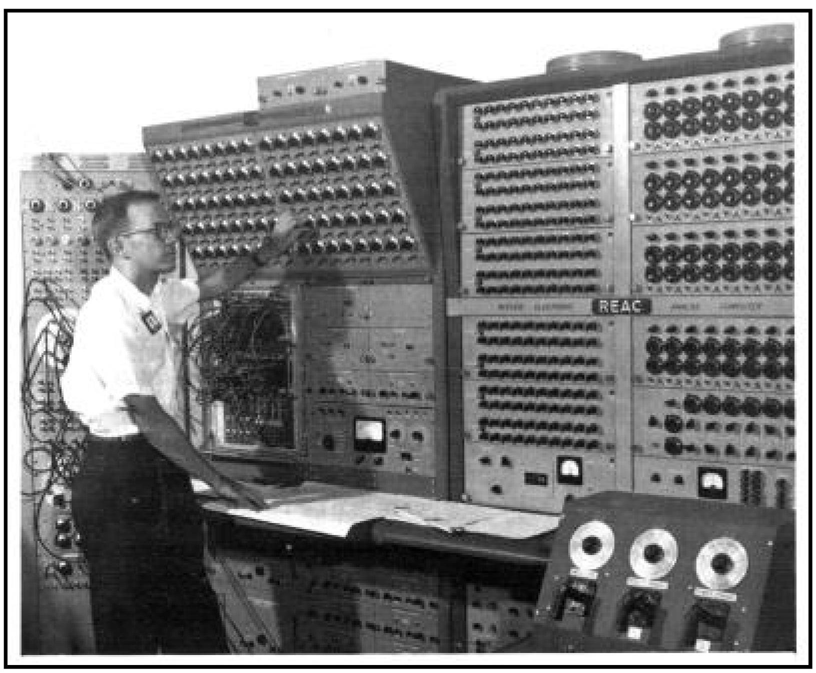
The chemical engineer works closely with the chemist. If the latter develops a new plastic, the engineer decides whether to put it into large-scale production and, if so, how.

Mathematics

The mathematician deals with numbers and their relations to one another. Progressing from the 2-plus-2 stage into higher mathematics, this science is essential to all the others—from the simple task of counting test tubes in a cabinet to an incredibly complex mathematical idea.

The mathematician speaks the language of all sciences using his special tool. Without him modern technology would not exist because mathematics interprets and explains all other sciences.

However, when mathematics becomes too complex, the mathematician puts aside his pencil and paper and turns to an electronic computer. Since computers can carry out mathematical calculations from 100 to 1,000,000 times as fast as a human being, they are necessary today and will be essential tomorrow.



The much-publicized electronic computers are vital in modern science, but they can’t add two and two without trained personnel to operate them.

A computer, however, doesn’t replace the mathematician any more than an adding machine replaces an accountant. The mathematician must help to design the computer, understand what material to store in its memory banks, know how to feed problems into it, and be able to read the results that come out.

Medicine

The medical profession is dedicated to repairing and healing the human body. Although many mysteries still surround medicine, doctors are trying to solve these mysteries of the body through research.

A medical scientist may decide to specialize exclusively in the use of radioactive materials. If so, he is called a radiologist and is an expert in the use of radiation beams, injection of radioisotopes, and implantation of radioactivity into the body, as well as in the use of the more familiar radium and X-ray devices.

The practicing physician also, after receiving special training and licensing, may use radiation and radioisotopes as another tool in his little black bag. For instance, a suspected thyroid disorder can be diagnosed by following the behavior of a small, harmless dose of radioactive iodine in the patient. A tumor may be brought under control with the use of a strong beam of radiation directed at the diseased tissue.

Behind the physician stand teams of medical research scientists testing the effects of radiation on tissues and cultures and serums in the laboratory. They strive to increase knowledge of the medical benefits of atomic energy.

Nurses in nuclear medicine understand how to handle radioactivity. Pharmacists who enter the field prepare radioactive pharmaceuticals for clinical uses.

Related Fields

It is convenient to discuss scientific activity in the general categories of physics, chemistry, biology, geology, engineering, mathematics, and medicine, but strict lines are not actually drawn around these areas.

There are in the United States today about 2000 individuals who are engaged in a profession that did not even exist twenty years ago: these are the health physicists, who are neither medical men nor physicists. They have backgrounds in physics, true, and they combine this training with training in physiology, botany, chemistry, mathematics, and instrumentation.

It is the duty of the health physicist to evaluate and control any potential hazard in the use of nuclear energy. The health physicist understands the effects of radiation on human tissues and plants. He keeps a constant check on radiation levels in installations where radioactivity is used; he foresees emergencies that might arise; he eliminates unsafe practices; and he assures that personnel working in nuclear energy fields are free from related hazards. The health physicist is a key figure in making the nuclear energy industry one of the safest in the world.

Another profession that spans the sciences is that of the technical writer or editor. In a laboratory he translates the notebooks of the scientist into reports. In an editorial office he edits manuscripts for publication. On a newspaper staff he translates scientific findings into articles for the public.

It is difficult, undesirable, and usually impossible, for a scientist to confine himself to his own field because all sciences affect one another. A chemist may use the tools of the physicist and become a physical chemist; a physicist may go in the other direction and become a chemical physicist. It is not uncommon for a chemical engineer to find himself doing the work of an instrument engineer, or the mechanical engineer to find himself doing the work of an electrical engineer, or both of them doing the work of a nuclear engineer.

The physicist, the chemist, the physician, and the engineer who once thought that outer space was the exclusive domain of the astronomer now find themselves solving reentry problems for missiles, stirring up rocket fuels, testing the effect of weightlessness on the body, and examining diagrams for space craft. Perhaps the botanist who today is totally concerned with the flora of earth will tomorrow find himself fingering a bit of fungus from Mars.

Location of the Atomic Scientist

In the rapidly changing world, each year finds the scientist increasingly important. He is needed to maintain and improve fast-changing technology, to combat disease, to develop natural and man-made resources, to improve food sources and production, and, in general, to work for the betterment of mankind.

The graduate scientist and the engineer will find jobs waiting and will be able to choose, to some extent, the sort of work they wish to do and where they wish to do it.

It is impossible to list all types of organizations open to science graduates, but it is relatively simple to divide them into general groups.

The United States Government

Scientists are needed in federal agencies such as the National Science Foundation, the National Bureau of Standards, the Atomic Energy Commission, the National Aeronautics and Space Administration, the Public Health Service, the National Institutes of Health, and the Departments of the Army, the Navy, and the Air Force. Positions in these and other federal organizations are open in program administration, basic research, development, and applied research. Numerous positions exist at AEC laboratories that operate under contract—Ames, Argonne, Berkeley, Bettis, Brookhaven, Hanford, Knolls, Livermore, Los Alamos, Oak Ridge, Sandia, and Savannah River, as well as at the Health and Safety Laboratory in New York City.

Private Industry

Unlimited opportunities are found in private industry. Most industries have extensive research and development programs, as well as production activities. In addition to the industries that are engaged primarily in the design and fabrication of nuclear and electronic equipment, hundreds of industries use radioisotopes and radiation in tracing, testing, development, inspection, and quality control.

Opportunities are open to the scientist who wishes to work for himself. He may organize his own company to provide self-employment or he may serve as a private consultant.

Educational Organizations

With the growing demand for scientists comes an increasing need for science teachers—good science teachers—from the elementary through the university graduate-school level. The scientist who enters the teaching profession need not feel that he turns his back on a research career. Thousands of significant investigations and discoveries are made at colleges and universities where science faculty members combine teaching with research.

Although the basic salary scale for the science teacher is not normally as high as that of the industrial scientist, this situation is improving. Moreover, many college faculty members augment their salaries and keep in touch with new developments by acting as part-time consultants to industry and government. A scientific teaching career offers certain advantages: frequently the professor enjoys greater freedom than the industrial scientist in budgeting time and channeling interests, and teachers also experience the satisfaction of developing human minds.

Hospitals

Hospitals and medical research institutions must have highly competent scientific staffs. Besides physicians they need chemists, biochemists, biologists, bacteriologists, and often physicists and veterinarians.

State and Local Governments

Scientists hold important posts in state and local government ranging from the director of a state health department to the chemist in a police laboratory to the radiation safety advisor on a civil-defense commission. As the states assume more and more responsibility for licensing and regulating nuclear and other scientific development, the need for state-employed scientific staff members will grow.

Other Organizations

Scientists are needed also in private research foundations, pharmaceutical and drug houses, international organizations, museums, observatories, weather stations, and thousands of other installations.

Professional Satisfaction

Members of the scientific community are generally happy in their work. A scientist may experience temporary discontent with a particular job, or budget restriction, or management practice, or coworkers, but seldom does he regret being a scientist. He is much more likely to regret that he didn’t study even more science.

Moreover, scientific salaries generally range from above average to excellent, opportunities for advancement are good, and the profession usually enjoys high community respect.

Atomic energy is revolutionizing life today, and future scientific revolutions are beyond imagination. But an atom does not have a brain; it must be manipulated by people. The men and women who explore the world of the atom invariably find that they are exploring a world more exciting than the world in the dreams of Marco Polo or Columbus.

SELECTED READING LIST

FINANCIAL AID

American Foundations and Their Fields. By Wilmer Shields Rich. 7th edition, 1955, 744 pages. American Foundations Information Service, 527 Madison Avenue, New York 3, New York. $35.00.

Blue Book of Awards. Edited by Herbert Brook. 1956, 186 pages. Marquis—Who’s Who, 210 East Ohio Street, Chicago 11, Illinois. $8.00.

College Program in Nuclear Engineering. 1956, 106 pages, American Institute of Chemical Engineers, 25 West 45 Street, New York 36, New York.

Credit for College; Student Loan Funds in the United States. By W. W. Hill. 1959, 37 pages. The College Life Insurance Company of America, Indianapolis, Indiana.

Education Programs and Facilities in Nuclear Science and Engineering. 1960, 76 pages. Fellowship Office, Oak Ridge Institute of Nuclear Studies, Oak Ridge, Tennessee. Free.

Financial Aid for College Students: Undergraduate. By Theresa Birch Wilkins. 1957, 232 pages. United States Government Printing Office, Washington 25, D. C. $1.00.

How to Finance a College Education. 1960, 10 pages. Funds for Education Inc., 319 Lincoln Street, Manchester, New Hampshire.

How to Look for Scholarships. By J. L. Angel. 2nd edition. 1960, 26 pages. World Trade Academy Press, 50 East 42nd Street, New York 17, New York. $1.25.

Information on Science Scholarships and Student Loans. National Science Foundation. 1960, 9 pages. United States Government Printing Office, Washington 25, D. C. $0.15.

Lovejoy-Jones College Scholarship Guide. By Clarence E. Lovejoy and Theodore S. Jones. 1957, 123 pages. Simon and Schuster, Inc., 630 Fifth Avenue, New York 20, New York. $1.95 (paperback).

National Register of Scholarships and Fellowships. By Juvenal L. Angel. Volume I: Scholarships and Loans, 329 pages. Volume II: Fellowships and Grants, 232 pages. World Trade Academy Press, 50 East 42nd Street, New York 17, New York.

National Science Foundation Annual Report. Published annually. United States Government Printing Office, Washington 25, D. C. $1.00.

Need Financial Aid for College? 5 pages. Engineers Council for Professional Development, 29 West 59th Street, New York 18, New York. $0.03.

Need a Lift. 80 pages. American Legion, P. O. Box 1055, Indianapolis 6, Indiana. $0.15.

Scholarships and Fellowships Available at Institutions of Higher Education. By Theresa Birch Wilkins. 1951, 248 pages. United States Government Printing Office, Washington 25, D. C. $0.70.

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SCIENTIFIC AREAS

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