Science at Work

TUCKED into a corner of the Administration Building is one of O. U.'s most valuable research instruments, an infrared spectrograph worth several thousand dollars. It is operated by the physics department as part of the work being done under the auspices of the Research Institute.

A spectrograph separates a beam of light into its component frequencies or colors. An *infrared* spectrograph is designed for light of lower frequencies than can be seen or photographed; that is, for light beyond the red of the rainbow. Since these "colors" or frequencies cannot be photographed, an infrared spectrograph is equipped with a complicated detecting and recording system that draws a graph of the intensity of the infrared light against its frequency. Such a graph is called a spectrum. The separation of the infrared light into its various frequencies is accomplished by refraction in a huge prism made from a single crystal of rock salt. This crystal is a larger version of the crystals of rock salt found in any kitchen salt shaker.

All molecules (which are the smallest units of a compound which retain identity in character with the substance) have vibration frequencies within the infrared range. When continuous infrared light is passed through a substance, the light having frequencies equal to the molecular vibration frequencies is partially absorbed. No two types of molecules have identical vibration frequencies. Therefore, no two chemical compounds have identical spectra. By comparing the spectrum of an unknown mixture with the spectra of pure compounds, the physicist can determine the nature of the mixture under investigation.

The absorption of light at any one of the characteristic vibration frequencies of a compound depends on the amount of the compound through which the light passes. So quantitative as well as qualitative analysis is possible.

O. U.'s infrared spectrograph was designed by Dr. Norman Wright, '29ms, of the Dow Chemical Company, Midland, Michigan, one of the pioneers in industrial infrared spectroscopy. Don C. Smith, '40ms, of the Naval Research Laboratory, Washington, D. C., constructed certain auxiliary parts and installed the instrument. Mr. Smith has been at the University since December supervising the construction of a much larger spectrograph which the University physics department is building for the Navy under the sponsorship of the Research Institute.

The University's infrared spectrograph is, at present, being used in various projects sponsored by industries engaged in war work. E. Brock Dale, '40phys, Phillips Petroleum Company fellow, is developing methods for analysis of materials used in synthetic rubber and high octane gasoline. Annette Herald, Ethyl Research Corporation fellow, is investigating infrared spectra of a series of very pure hydrocarbons prepared under auspices of the American Petroleum Institute. These spectra, now distributed only for restricted circulation, will be published after the war for general use in petroleum research. Russell Hudson, graduate assistant, is working on a project dealing with nitroparaffins which is supported by the Commercial Solvents Corporation.

The industrial work carried on by the Research Institute under the direction of Acting President G. L. Cross and Dr. J. Rud Nielsen, recently appointed research professor in physics, is in addition to pure research done by various faculty members. Dr. Dudley Williams, assistant professor of physics and author of many papers on infrared spectroscopy, is studying the molecular structure of rubber and of certain alcohols with the aid of the infrared spectrograph. He is being assisted by J. D. McDaniel.

One of the most efficient in the country is the Raman spectrograph buried in the basement of the Administration Building. This instrument is used principally for fundamental research. Believed to be the largest liquid-prism spectrograph in the world, it was designed by Dr. Nielsen. For measuring the intensities of the Raman bands, there is a recording microphotometer designed and built by Dr. F. W. Crawford, '39ms, '43ph.d, chief of the exploration section of the research department of the Phillips Petroleum Company.

Dr. Nielsen is the man most responsible for the spectroscopic research at the University. Specializing in the field of theoretical physics as applied to Raman spectra and molecular structure, he is internationally known for his work in spectroscopy.

Dr. Nielsen was born in 1894 in Copenhagen, Denmark, and received two degrees from the University of Copenhagen. He came to America in 1922 as a fellow of the American-Scandinavian Foundation. He received his Ph.D. degree in 1924 from the California Institute of Technology, Pasadena. Positions he held before coming to O. U. were instructor, University of Copenhagen, and professor of physics, Humboldt State College, Arcata, California. He held a Guggenheim Memorial Fellowship from 1931 to 1932 at the Institute of Theoretical Physics, Copenhagen.

Dr. Nielsen is a fellow of the American Physical Society, the American Association for the Advancement of Science, the Oklahoma Academy of Science, and a member of the American Association of Physics Teachers and Sigma Xi, national scientific research society.

He has written papers which have appeared in many American and foreign journals, including the *Physical Review,* the *Journal of Chemical Physics* and the *Journal of the Optical Society*. He has written numerous essay book reviews, especially on the philosophy of physics.

Research projects of Dr. Nielsen and his associates now in progress include the following: infrared absorption spectra of pure hydrocarbons and other petroleum products, intensity measurements in Raman spectra, spectrographic analysis of oil field waters and spectroscopic methods of analyzing mixtures of certain organic compounds.

—ELIZABETH LEES.

Scientific Thinking

The methods of science, which are within the reach of all, might lead to surprising results if used by individuals in their thinking, Acting President George L. Cross said in a recent speech.

In the following paragraphs, Dr. Cross points out that technology, and not science, is to blame for political and social unrest in the world; that people who apply scientific reasoning to their own lives are less susceptible to propaganda and rumors, and that if the scientific method were developed on an individual basis and extended to larger social units, toleration would be the most hoped-for result.

People say glibly that the present confused situation is due to social and political unrest in the world and that wars are merely symptoms of this unrest. How did the unrest develop? I am sorry to say that many have a tendency to blame it onto the tremendous and far-reaching scientific developments which were initiated in the past century.

Anne Morrow Lindbergh wrote in the *Atlantic Monthly,* June, 1941, as follows, "The causes, it seems to me, go back to the actions of our own in the last century, to the impact of science on the delicately balanced life of man." A leading churchman of England, thinking in a similar vein, urged a moratorium on science in order that the social development of the world mght have a chance to regain pace. He thought that scientific progress had so far out-stripped social development that only by an arrest of the former could the catastrophe of war be avoided. Many prominent people have agreed with these points of view.

Is there any validity to this reasoning, and is science really to blame for the terrible international situation that we face today? This is a difficult queston, but I think that I can point out a few things.

During the earlier part of the nineteenth century, the curricula in our schools and colleges were built upon courses in literature and philosophy. It was thought that from these could be obtained the core of information, culture and wisdom necessary for anyone who hoped to acquire an education. The causes of this great misunderstanding and opposition to science are complex and multitudinous. And because they existed, science and the scientific method could not become a tool for the use of those who were developing the social and humanistic patterns of our national and international relationships.

Although it was opposed vigorously by many of our social leaders, science, or at least the fruits of science, was sought eagerly by the industrial and commercial phases of our civilization. This resulted in the development of technology. I think it will occur to you at once that with the philosophical and social leaders rejecting the concepts of science, and the industrial and commercial personnel embracing it, things were bound to get out of balance. The wonder is that they did not become even more out of balance before the reconciliation which occurred to some extent in the first quarter of the twentieth century.

There are many definitions of science, but none of them is particularly useful. Huxley once said that science is trained and organized common sense. Perhaps it is more than this. It is at least a method

of using evidence in arriving at facts and of using facts. However, there is nothing mysterious or especially difficult about science or the scientific method. The methods of science are within the reach of all, and of course the scientists think that they have developed the best possible methods for determining facts and evaluating the evidence from which facts are derived. Perhaps all of us tend to use the scientific method to some extent in that we use a certain amount of evidence in arriving at our facts. However, the scientist is much more careful than the average layman in evaluating his evidence and arriving at his facts. Here, I think, is an opportunity for the lay citizen to profit a bit from the method of the scientist.

It might be helpful to illustrate by an example how a scientist works. It is to be taken for granted that he is seeking the answer to a question. Let us assume that the question is, "Can a chicken catch typhoid fever?" The scientist might proceed as follows: Define question—Make observations—Tentative answer or theory—Additional observations—Experimentation under controlled conditions—Statement of facts.

This is the way the scientist works in arriving at his facts and in making his decisions. However, it is not the method used in solving social and political problems. My point, I think, will be clear. We are out of balance not because of too much science, but because of too little science in certain areas of human affairs. We need to use more science in those processes pertaining to social and political development.

But I can hear you say that the scientific method, as I have outlined it, is too cumbersome and time consuming to be used in solving social and political problems. However, unemployment, poverty and war are even more cumbersome and costly, and there are many who think that these could be avoided to a very great extent if scientific methods were applied in the solution of our social and political problems. We can return to this point later. In the meantime, I should like to discuss technology just briefly.

Technology, often confused with science, is really the practical application of scientific knowledge. While science seeks only for the facts of nature, technology attempts by any device to obtain profit from scientific facts. It follows that technology may be completely unethical in its use of scientific facts, and, in such instances, may actually constitute a menace to social development. The use of science to produce instruments of war, insofar as aggression is concerned, is a case in point. Here, however, it is not science, but the misuse of science through technology that is the offender.

As Dr. Arthur N. Bragg has pointed out in his recent article entitled "Science, Practical and Impractical," when Anne Morrow Lindbergh blamed science for the present unbalanced condition of the world, she really should have blamed technology. Similarly, the English theologian who proposed a moratorium on science should have proposed a moratorium on technology, or at least a moratorium on non-ethical technology. Science itself is neither good nor bad, it simply is. Whether good or bad results are obtained from science and the scientific method depends entirely upon the people who use it. Specifically, it depends upon you and your kind.

I would not want to imply that all or even any large proportion of the technological pursuits are anti-social or in any way undesirable. Much good will come from technology, even from wartime technology. For instance, the technologist will continue to produce synthetic chemicals, such as the sulfa drugs, synthetic quinine and synthetic vitamins.

Science has demonstrated greater success in establishing general principles and using them to advantage than has any other field of human endeavor. Now, we must become involved in the enormously difficult task of developing fundamental principles, based upon scientific reasoning, under which the relationships of human beings may be brought into better order.

There are, of course, many matters associated with our everyday life that cannot be subjected to scientific analysis. Questions pertaining to the quality of art and literature are cases in point. Religion is another, and questions concerning mysticism and the supernatural. Positive scientific evidence cannot be obtained about any of these. This list, however, does not include social and political problems. Most of our troubles are due, I think, to the fact that we have not been careful to obtain our facts and use them properly. As a non-scientist put it, when speaking of the use of facts in solving our various problems, "we should find them, filter them, focus them and face them." In other words, with respect to each problem that may arise, we need to, first, get all the facts that have a bearing on the problem, secondly, study the problem in the light of these facts, third, choose the tentative solution which seems likely to work best, and four, make tests on a limited basis to determine if the prospective solution will work.

But granting that all of this is desirable, what can be done to bring about the desired changes? Obviously it would be unreasonable to expect that any one individual or a small group of individuals, could do much to affect the thoughts and attitudes of a state or nation.

Perhaps we can make a start by applying the elements of scientific reasoning to our own lives. This can be done, or at least begun, by our developing a much more critical attitude toward the evidence that we use in acquiring our facts. Most of the rumors that come to us daily would have to be discarded for lack of evidence, of course, and many choice bits of gossip would lose their validity, but out of it all might come much clearer thinking and a saner approach to the problems of the day.

I think that we would soon find ourselves much less inclined to jump at conclusions. All of this would result in a healthful reluctance to form judgments before all of the evidence has been examined carefully, and this in turn could lead to more charitable attitudes toward our associates, immediate and remote. Propaganda cannot be used successfully on an individual who has been taught to reason scientifically, and who demands to see all of the evidence before he accepts a statement as a fact. Toleration of individual differences, which is a prime requisite for the success of a social organization at any level, and without which no one can validly profess even the basic elements of education, would be the most hoped-for result.

If this type of thinking, developed on an individual basis, could then be extended to the larger social units, the results might be surprising. At least this much is true, careful judgments based upon well scrutinized evidence, will not be made by groups until the members of the group have learned to use the technique on an individual basis; and therein lies the opportunity for each individual to make his own private contribution to more orderly group thought.

Hybrid Corn Up to Farmers

Most of the responsibility for the success of hybrid corn in Oklahoma will have to rest with state farmers, Dr. O. J. Eigsti, associate professor of plant sciences at the University of Oklahoma and developer of a "tailor-made" corn for Oklahoma, says.

Farmers must convince themselves that hybrids are different from open-pollinated corn and also which type is best for their soil, he adds.

Dr. Eigsti believes that hybrids will increase corn yield about 15 to 20 bushels per acre. And his tests in eastern Oklahoma seem to bear out this belief. Many farmers have reported substantial increases in their corn yield after finding a hybrid which is adapted to their particular soil and weather conditions.

Hybrid corn is specialized corn bred to make maximum yields under the soil and weather conditions existing at a given location. For this reason different strains have been discarded, others added—trying to find the right types for all parts of the test area.

Letters

In the Tall Timber

I am under a large tree near a foxhole, dodging observation by "enemy" planes.

Just received your note about annual membership and subscription to *Sooner Magazine*. Am sending a check to renew membership from date of expiration of last subscription.

Mud has been eye-high to a tall Indian and the weather miserable. However, will try to live through it and blame Hitler for my hereabouts.

Luck to all. Keep sending my *Sooner*. It is nice to read about people you know and have known.

Sincerely,
Foy L. George, '36ba, '40ed
Captain, Field Artillery
Tennessee Maneuvers

Finances Needed for O.U.

I've had a rating for some time but haven't gotten around to writing you about it. I got a technician fourth grade in August and have managed so far not to get busted but one never knows around here where one stands, does one? I am in a General Service Engineer regiment and am placed on the water purification crew.

I appreciated very much your list of all the Sooners in the service and enjoyed looking it over.

I surely hope Oklahoma politics wakes up to the fact that we have a good university in Oklahoma and we need one to continue, but realize that it takes money to run one. I for one am willing to pay more taxes if necessary to keep a good university.

Sincerely,
C. Harlan Dunn, '41eng
Sergeant, Engineers
Camp Claiborne, Louisiana

Boys Get Job Done

Received the address change card, and on returning it, decided to include this note.

For the present, we are out of the line, back in a rest area, for which I'm sure all officers and men are grateful.

Have been overseas since last February. Participated in the Sicilian invasion and have been belly deep in mud in sunny Italy for some time. To see the job these boys from Oklahoma, Texas, Arkansas, etc., have done under the most difficult handicaps, only impresses more thoroughly on one's mind that from our neck of the woods comes the fightin'est bunch of men Hitler will ever have to sweat out.

See some of the O.U. boys every once in a while. Capt. W. K. Garnett, '37law, is a battery commander in my outfit. "Tex" and I spin the yarns quite frequently of the good old days at school. . . .

Best regards,
Al Sims, '33bus
Major, Field Artillery
Italy

Shirk Wouldn't Quit

As to action over here, we saw no real action in Africa, as things folded up there just as we moved into combat. We made the Sicilian invasion and fought through that campaign and are now in Italy in action. We were not in the initial invasion of Italy.

As you probably know John Shirk is missing in action over here and you may be interested in the story as I got it from his outfit. He was a forward observer with the Artillery when an enemy counter-attack developed against the hill he was on. During the fight he was wounded in the hand and sent back to an aid station. He had his hand treated but refused to go to the rear, grabbed a rifle and went back up on the hill. The hill was overrun by the enemy and retaken the next day. There was no sign of Shirk or his body. Some doughboys who were captured at the same time and later escaped recalled seeing some officers taken prisoner who had been with Shirk. It is thought that he was taken prisoner

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