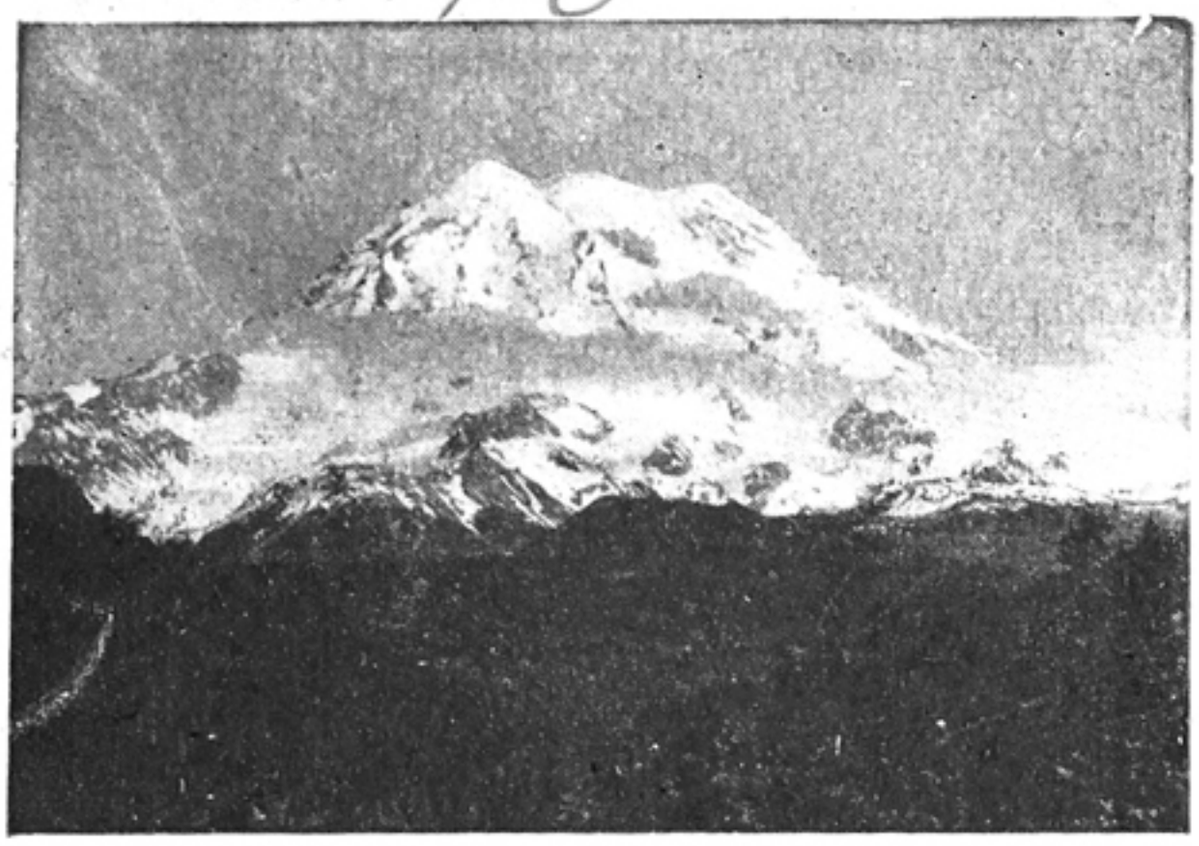
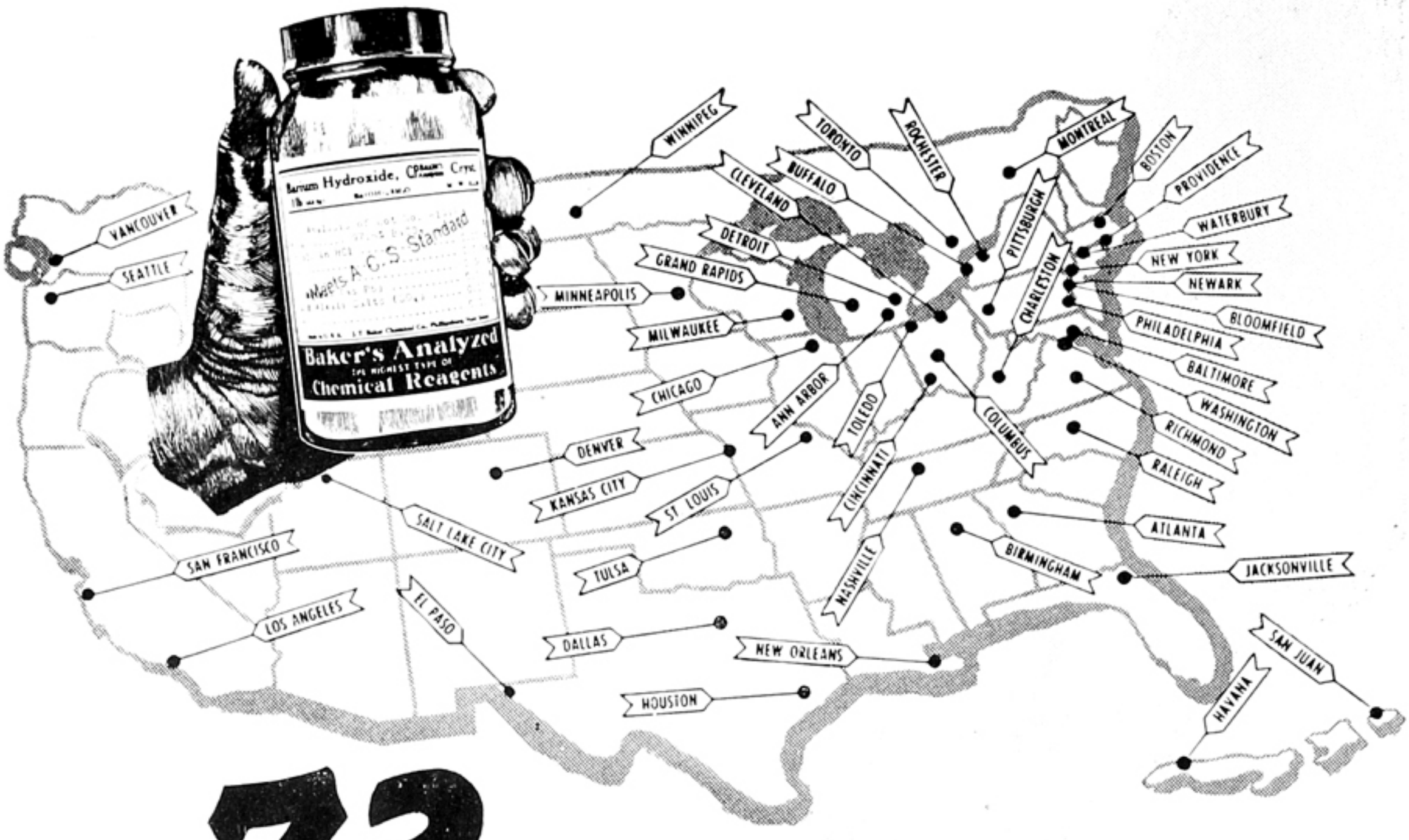


The PUGET SOUND CHEMIST

Bulletin of the PUGET SOUND SECTION of the AMERICAN CHEMICAL SOCIETY

IN THIS ISSUE

APRIL, 1951



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The PUGET SOUND CHEMIST

Published by the Puget Sound Section of the American Chemical Society

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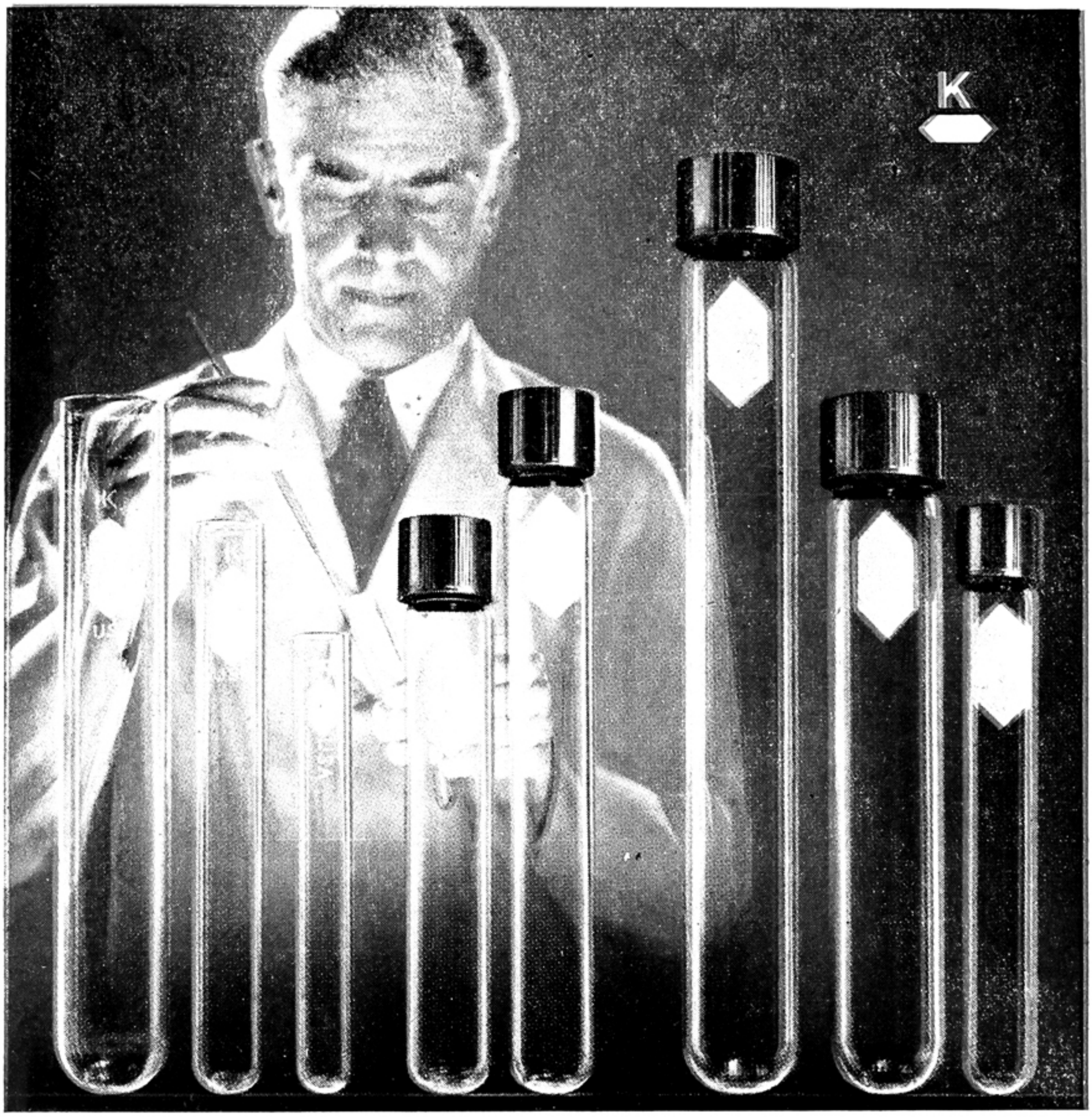

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MAY MEETING

Puget Sound Section

American Chemical Society

Will Be Held in April to Accommodate the Tour Speaker

Time

Friday, April 27, 8:00 p.m.

Place

Seattle, 131 Bagley Hall, University of Washington

Speaker

Dr. D. H. Templeton, University of California
Department of Chemistry

Subject

CHARACTERIZATION OF NEW RADIOACTIVE ISOTOPES

Refreshments and Social Hour After Meeting

MAY MEETING

Attention Southern Members of the Puget Sound Section

A SPECIAL MEETING of the Puget Sound Section will be held in conjunction with the Electrochemical Society in

Tacoma, May 16, 17 or 18

CANCELLED

This is being done to make it possible for members outside Seattle to have meetings. Speaker will probably be from *The Aluminum Industry*.

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APRIL SPEAKER

BIOGRAPHY

D. H. TEMPLETON

David H. Templeton, Jr., was born in Houston, Texas, in 1920. He majored in chemistry at Louisiana Polytechnic Institute in Ruston, where he graduated **summa cum laude** in 1941. He then entered the University of Texas to do graduate work in physical chemistry. He received the M.A. degree in 1943. In 1944 he interrupted his studies to join the Plutonium Project at the Metallurgical Laboratory at the University of Chicago. In 1946 he went to the University of California at Berkeley as a member of a nuclear chemistry group then being organized in the Radiation Laboratory by Professor G. T. Seaborg. At the same time he resumed his studies there. After receiving his Ph.D. at California in 1947, he became an instructor in the Department of Chemistry. In 1949 he was promoted to assistant professor. In 1948 he married Lieselotte Kamm, who now also has a Ph.D. in physical chemistry. They have one daughter.

The nuclear researches of Dr. Templeton have been concerned with the identification of new radioactive isotopes produced by transmutations induced by the Berkeley cyclotrons, and with the nature of these transmutation reactions. He has studied extensively polonium, bismuth, and lead radioactivities and has also published work on new isotopes of thallium, barium, cesium, and rubidium. With Professor I. Perlman and others he discovered the fission of bismuth, lead, and other lighter elements induced by high-energy particles, the alpha activity of light polonium and bismuth isotopes, and the secondary reactions responsible for the abnormal charge increase observed in certain cyclotron reactions.

Since 1947 Templeton also has been using X-ray diffraction methods to study the structures of inorganic crystals. He is interested especially in the crystal chemistry of the rare earth and actinide elements and of metallic borides, oxides, and silicides.

Templeton is a member of the American Chemical Society, the American Physical Society, the American Crystallographic Association, Phi Lambda, Sigma Xi, and the Sierra Club. His chief hobby is skiing.

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MARCH SPEAKER'S SUMMARY

SUBMERGED COMBUSTION

By K. A. Kobe

Submerged combustion may be defined as a combustion of fuel under such conditions that the combustion chamber is surrounded by the medium to be heated and from which the hot products of combustion escape and go up through the liquid so that most of the heat is transferred directly from the hot gas to the liquid . . .

In 1931 experimental work was started by the speaker at the University of Washington where it was used for the concentration of sulfite waste liquor which was then a pollution problem in the Pacific Northwest. The object was to concentrate the waste liquor to such a concentration of organic solids that it would support its own combustion. No difficulty was encountered in the concentration of this substance which has so many properties that make it difficult for the usual tube evaporator. These difficulties that were overcome are (1) the tendency of the solution to form a hard scale on the heat transfer service, (2) the great viscosity of the waste liquor as the concentration rises, (3) the tendency of the liquor to foam during the early stages of the concentration. It was realized that many other types of chemical substances had undesirable properties such as these and could be handled advantageously by submerged combustion evaporation. Following the work on sulfite waste liquor the evaporation of sodium sulfate has an inverted solubility curve; that is, the solubility decreases with increasing temperature, so that in a tube evaporator the sodium sulfate forms hard scale on the heat transfer surface. Submerged combustion was a

satisfactory solution to this problem, and this work became the basis for the work and plant installation of the Ozark Chemical Company at Monahans, Texas, where sodium sulfate decahydrate is melted and water evaporated by submerged combustion using natural gas.

During World War II submerged combustion burners produced by the Ozark Chemical Company were used extensively for the concentration of magnesium chloride solutions to be used for the production of metallic magnesium. This solution represents one that is extremely corrosive and difficult to handle in tube evaporators. Submerged combustion did the job in an extremely efficient manner, because the installations in Texas had available cheap natural gas.

Meanwhile, a different type of burner was developed for a purpose quite different from that of other workers. The Submerged Combustion Company of America developed a burner in which gas and air could be supplied to the burner under pressure and mixing take place in the combustion chamber. This eliminated the danger of a flashback from the burner causing an explosion. This burner was developed initially for the purpose of heating sulfuric acid pickling solutions in the steel industry. Previous practice had been to heat these tanks by blowing live steam into them, thus diluting the sulfuric acid. Submerged combustion, however, not only heated the solution but also evaporated water so that the solution could be maintained at its initial concentration. The scouring action due to the agitation and presence of large numbers of bubbles causes a more rapid pickling action at lower acid concentrations so that the production from a pickling tank can be improved by the use of submerged combustion. Although used extensively by the steel industry, this type of burner has progressed to many other industries and is used at the present time for the concentration of calcium chloride and solutions of other salts.

An interesting application is at the tin smelter in Texas City where a twenty-acre pond of waste acid had been stored for years. This solution is now being recovered by concentration using submerged combustion followed by a thermal decomposition of the hydrate ferric chlorides to produce hydrochloric acid which is recycled in the tin recovery process and a ferric oxide cinder.

Just to illustrate that natural gas and air are not the only combustible substances that may be used, the Hooker Electrochemical Company patented the reaction of hydrogen with chlorine to produce hydrogen chloride in a submerged combustion burner. The hydrogen chloride produced bubbled up through the aqueous solution and rapidly dissolved in the solution. To remove the large heat of solution the hydrochloric acid was circulated through a heat exchanger to reduce the temperature to the value desired in the absorption apparatus. This compact apparatus eliminates the large amount of heat transfer equipment usually used in the production of hydrochloric acid.

New applications of submerged combustion are being suggested continuously by chemists and engineers who find a possible answer to their difficult heating and evaporating problems in the merits of submerged combustion. Where scale formation, viscosity, foaming, corrosion, or suspended solids cause difficulty in the usual type of evaporators, then submerged combustion may be the answer to your heating or concentrating problems. Your speaker is interested in extending the field of usefulness of submerged combustion and is interested in discussing with you possible applications of this interesting and efficient method of heating and evaporating solutions.

●

BOY WELL PAID

A well-known attorney was always lecturing his office boy, whether he needed it or not. One day he chanced to hear the following conversation between the boy and the one employed next door:

"How much does your chief pay you?" asked the latter.

"I get $5,000 a year, $15 a week in cash and the rest in legal advice."

MINUTES OF 294th REGULAR MEETING

of the

PUGET SOUND SECTION

of the

AMERICAN CHEMICAL SOCIETY

New Yorker Cafe March 16, 1951
Tacoma, Washington

Preceding this joint A.I.Ch.E. - A.C.S. meeting were tours of the following industrial plants of Tacoma:

Sulphuric Acid Plant—American Smelting and Refining Company
St. Regis Pulp & Paper Company
Hooker Electrochemical Company.

After the social hour and dinner, the meeting was called to order by Dr. Frank West, chairman of the A.I.Ch.E.

Dr. Rex Robinson introduced the speaker of the evening, Dr. Kenneth A. Kobe, of the University of Texas.

Dr. Kobe's excellent historical summary and explanation of "Submerged Combustion" was thoroughly enjoyed.

The meeting adjourned at 9:30 p.m.

JIM C. DRURY, Secretary
Puget Sound Section
American Chemical Society

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OLYMPIA NEWS

Dr. Francis E. Horan, Jacob P. Rettenmayer Associate Professor of Chemistry at St. Martin's College, is one of the members of a team responsible for two research contributions published in a recent issue of BLOOD, Journal of Hematology. They describe the technique and results of studies on the electrical conductivity of blood in relationship to the cell count and various pathological conditions. It is a report on part of the research carried on by Dr. Horan while on the staff of Cornell University Medical School before coming to St. Martin's.

A special type of conductivity cell was designed for the purpose, and the investigators were able to derive an empirical equation relating red cell count to the measured conductivity.

At St. Martin's, Dr. Horan is currently combining his teaching duties with an investigation of the effect of ultrasonic vibrations on starch. This work was made possible by a Frederick G. Cottrell grant by the Research Corporation last summer.

* * *

Mr. Lowery W. Cody, the man who mixes the paint that puts the yellow line down the middle of the road, spoke to the Chemical Chapter of St. Martin's College on Monday, March 12. Relying chiefly on his long experience in paint chemistry at the State Highways Materials Testing Laboratory in Olympia, Mr. Cody spoke on the subject of commercial paints and pigments as extensively as time permitted. His interesting coverage of the field was illustrated with relevant literature, samples of basic paint ingredients, and work-sheets showing the design of original paint formulas. His audience was convinced of the many complicating factors involved in the formulation of a paint suitable for the roads, guard-rails, or bridges of the State highway system. Mr. Cody pointed out that Washington State has taken the lead in producing tailor-made paints, suitable for the special conditions found in our area. A paint that is practical and durable for Texas roads would be impractical in the wet climate of western Washington. The State Highways Laboratory developed a yellow paint that could be laid down even in the rain if need be. The rapid advances in resin chemistry makes possible continual improvements in paints and the consequent rapid turnover in the formulas used on our highways. A considerable portion of his time, said Mr. Cody, is spent in keeping informed on these new developments in basic ingredients for paints.

—Bede Ernsdorff

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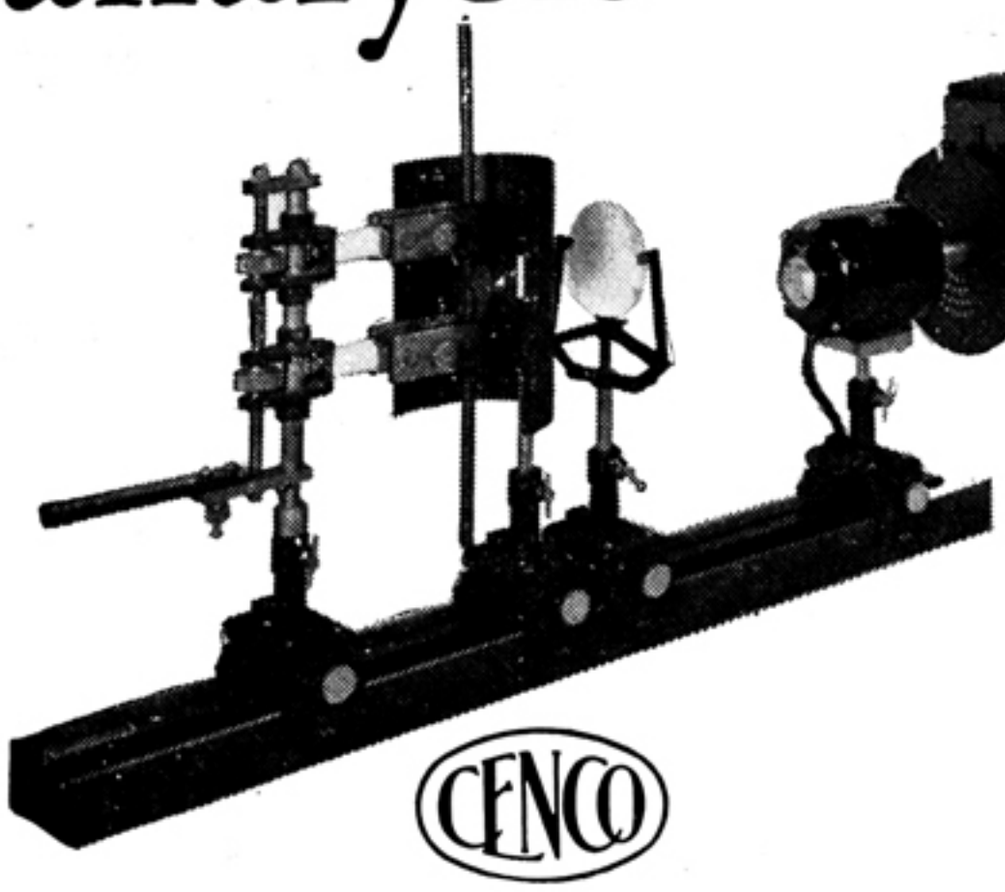
SEATTLE NEWS

Dr. Curtis F. Gerald discussed **"The Application of Statistics"** before a group of chemists and engineers at Shelton High School on March 13.

Mr. Art Walton of Simpson Logging Company and Mr. Otto Goldschmid of Rayonier, Inc., arranged the meeting. At this writing Dr. Gerald plans to give

spectrographic analysis



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additional lectures on March 27 and April 10.

●

SPOKANE NEWS

Dr. G. H. Kissin, formerly Research Professor at Georgia Institute of Technology, is now associated with the Kaiser Aluminum and Chemical Company in Spokane, Washington. **Dr. F. J. Bowen,** formerly instructor of chemistry at the University of Florida also has joined the staff of the Division of Metallurgical Research of Kaiser Aluminum. Both Dr. Kissin and Dr. Bowen are active members of the American Chemical Society.

●

GROWTH OF THE PUGET SOUND SECTION

(In which we modestly extend hearty congratulations to ourselves.)

According to the report of the Executive Secretary of our National Society (CEN 29, 774-89, Feb. 26, 1951), our section in 1950 had by far the largest percentage increase in membership of any section having more than 500 members. Indeed, including even the largest sections, such as New York with 5512 members, we had the third largest numerical increase (74). These important facts were not clearly brought out by Secretary Emery in his 1950 report.

To what can we attribute our outstanding record, remembering that the Society as a whole gained only 2.1 per cent and that the seven largest sections, with aggregate membership of more than 20,000, suffered a decrease of 0.8 per cent? Unlike several of the sections, we have no large government-sponsored chemical plants. And why is it, though many of our members must travel a hundred miles or more to attend our meetings, the attendance is greater than that of many sections several times our size?

Can it be that our success is partly due to the fact that more and more of our members are being drawn into society activities? Can it be that each of us considers himself a member of the membership committee? Can it be that our local section, under the able leadership of its officers has truly endeavored to serve the needs of the members?

We urge the other local sections to analyze the reasons for the success of the Puget Sound Section, and to act accordingly.—(GLP).

●

WESTERN ALUMNI

PHILIP HAUGE ABELSON

Dr. Philip H. Abelson, Chairman of the Biophysics Section of the Dept. of Terrestrial Magnetism, Carnegie Institution of Washington, D.C., was born in Tacoma 37 years ago and received a B.S. in chemistry degree from Washington State College. Leaving the field of chemistry, he obtained a Ph.D. degree in physics from the University of California in 1939.

Concerning Abelson's work at California, the Smythe report reads as follows (page 101):

"The first evidence of the actual existence of these new elements (ruling out the original erroneous interpretation of the splitting of uranium as evidence for their existence) was obtained by E. Macmillan and P. H. Abelson who isolated 93-238 (neptunium) from uranium bombarded with deuterons in the Berkeley cyclotron. The sample was too small for isolation of the daughter product 94-238 (plutonium). Later enough (plutonium) was prepared to permit Seaborg, Kennedy and Wahl to begin the study of its chemical properties in the winter of 1940-1."

In the period 1941-5, Dr. Abelson was associated with the Naval Research Laboratory in Washington, D.C., and during 1944-5, was Civilian in Charge, Naval Research Laboratory Branch, Navy Yard, Philadelphia.

Even in 1932, Dr. Abelson appreciated the military possibilities inherent in control of radioactivity. No longer active in military research, he has been a member of the board of the National Cancer Institute since 1946, and during the past few years has published extensively in the fields of biochemistry and biophysics. —(GLP).

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THE SCIENTISTS

(Continued from March Issue)

The Internal Crisis

In the tremendous developments of the nineteenth century, however, some muddy crosscurrents appeared that are still plaguing scientists today. The ever reaching ramifications of science forced men into ever finer specializations. This tended to develop, particularly among the scientific rank and file, a narrow type of man, one who might, for instance, know all there was to know about surface prenomena of metals but little else, not even in associated branches of the sciences. At the same time science, still in a fairly crude mechanistic stage of development, was caught up in the optimism of the age — which included the shining utopia of socialism. It was the age, of course, that looked forward to almost endless, automatic progress everywhere.

Not much is left of the theory of automatic progress. And most of the crude mechanistic thinking of the nineteenth century has disappeared in the infinite subtleties of the Einsteinian universe and quantum theory. Indeed, the splitting of the atom, which represented the furthest reach of the new physics into the mysteries of matter, also annihilated the last of the nineteenth-century notions of an inevitable millennium. Man's world once again became the precarious place it had always been, in imminent danger of falling to pieces unless men struggle to use their knowledge to the right ends, a struggle facing all materialistic men, not simply scientists. This, the deepest of science's internal crises, has caused a wide reexamination of the sources and ultimate purpose of science. Dr. J. Robert Oppenheimer, who headed the bomb-building laboratory, has expressed the new mood as well as any. "In some sort of crude sense," says he, "which no vulgarity, no humor, no overstatement can quite extinguish, the physicists have known sin; and this **is** a knowledge which they cannot lose."

The External Crisis

At the same time that the scientists are afflicted with this self-examination and self-doubt, which is nothing less than the self-doubt of the society in which they live, they are faced with the necessity of strengthening the base of science, depleted and exhausted in its European sources by war and its aftermath. This not merely for the sake of science itself, but for the reason that science has become the major shield and bulwark of Western society. The task of promoting basic research presents special problems in the U. S., whose universities, unlike the European, have been more and more heavily keyed to the mass dissemination rather than the creative extension of knowledge.

Nothing has struck deeper at U. S. scientific morale, however, than l'affaire Condon — branding Dr. E. U. Condon, chief of the U. S. Bureau of Standards, by imputation, with no chance to defend himself, as the weakest link in atomic security. No other incident of recent times has called forth more explosive statements from all ranks of science, for in the close fraternity of physicists Dr. Condon is one of the most eminent and respected of men.

One reason for the extraordinary heat generated by the Condon affair that it is representative of other affairs, involving men of lesser prominence, which have not come out into the open. Though U. S. physicists in 1940 clamped a voluntary censorship on themselves before the U. S. even knew it had a secret in the atom, though the whole atomic-bomb project was one of the best-kept secrets of the war, scientists have been more pushed about by U. S. security regulations than any other group in our society. And not merely scientists in

government, but in industry and the universities, wherever government contracts of security nature are involved.

Late in 1947 the Federation of Atomic Scientists, the group that effectively fought for civilian control of atomic energy, made a survey of 140 representative research laboratories on loyalty clearance procedures. One big laboratory in the electrical industry, though less than half its work was in the security area, ran all its research employees through the loyalty mill to save itself trouble. All told, the federation investigated some fifty cases of dismissed scientists, and all were based on guilt by association, often tenuous or hearsay. None was allowed to hear the full charges against him, confront his accusers, appeal from the final decision, or employ other due processes of law — since little, if any, of the evidence would be admitted in any court. All cases were anonymous by the dismissed scientists' requests, because publicity made it harder to find reemployment. In self-protection, the federation has made a close investigation of F.B.I. methods and its peculiar line of questioning in order to supply its members and their friends with a guide on how to answer F.B.I. agents.

This is not the climate in which science flourishes. Scientists are again quitting atomic-research projects in droves. Oak Ridge alone in the past has lost two-thirds of its scientific personnel — some 60 per cent of its physicists and 70 per cent of its chemists. The majority of scientists recognize the need for some security procedure, but one in which an accused man has the common right of defending himself. Without that right, whole regions of science are becoming hazardous areas of occupation, in which a man can lose his livelihood, suffer grave financial loss and mental anguish, and acquire a lifetime stigma upon the flimsiest possible evidence and without appeal to law.

Most top physicists have shifted to cosmic-ray research not only because it is the new frontier of physics but because it is so far totally unpractical and outside military secrecy. One West Coast physicist refused an industrial job at handsome pay when he found it would include work under military contract. A top university chemist refused for a year to accept Navy research money being pressed on him until he got a contract which stated that its main purpose was to promote fellowship in pure research. And there are now two recorded cases in which American scientists, revolted by the turn of affairs here, have left the U. S. and taken up residence abroad, one under British rule, an ironic twist in world history. What can happen to science when it is militarized and harassed was discovered after we punched through the hollow shell of German might. German science had gone sterile in ten short years.

For a Strong and Free Science

Scientists, to be truly scientists, must have freedom, stature in society, and decent pay. And decent pay is not the least of the requirements. In France, between 1900 and World War II, scientists' salaries were pared to the level of a high-school teacher's wage by inflation and an indifferent government, and French science literally withered on the vine. In a heavily monetary society like our own it will be disastrous not to recognize that scientists must be scaled into the economy at a level more commensurate with their attainments and importance to society. The country cannot depend wholly on those few queer individuals who are willing to forego most of the advertised fruits of our economy to pursue pure science and teaching. All educational levels are desperately in need of adjustment. And the universities must be strengthened and restored as the citadels of freedom and fundamental research by civilian governmental funds, administered by scientists for scientists, and by other means. An interesting proposal is that

personal gifts to universities for scientific research be deductible in toto from income-tax payments in order to diversify the source of funds and provide less dependence on government.

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FOR AN EFFECTIVE AMERICAN CHEMICAL SOCIETY

The 1950 report of our National Secretary (CEN 29, 773, Feb. 26, 1951) should give every one of us cause for serious contemplation. The membership of the seven largest sections decreased by 0.8 per cent; many chemists subscribed to fewer journals, a large proportion of the new members were students and "industrial interns"; and we lost many persons in the age group 30 to 50, who evidently find that the ACS does not serve their needs. On the credit side, however, we have about one million dollars in surplus funds and a **Chemical and Engineering News** that publishes more than 4000 pages per year.

As underlined by John B. Saxton, (CEN 29, 738, Feb. 26, 1951), business organizations are not operated for the purpose of honoring the cultural and mental attainments of their employees. They are operated solely for the maximum financial gain of the investors and no one else. To serve the needs of the profession the American Chemical Society must represent the interests of those who make their living by practice of their profession; those whose work is research, production control, consulting, and teaching rather than those who are primarily administrators, employers, salesmen and research directors. Occasionally those of the latter group do make excellent officers, but only to the extent that they serve the interests of chemists who live by the sale of their technical services.

We urge all experienced chemists to remain with their Society. Let us cooperate to the fullest extent with our national organization in its efforts to bring all chemists into the Society. If you know one of the several hundred chemists of this area who is not a member, urge him to join now—(GLP).

AN EXCITING ERA IN NUCLEAR PHYSICS

Presented at The Washington Academy of Science, March 15, 1951

By PHILIP H. ABELSON

(It is perhaps unfortunate that chemists are so little aware of the contributions of Dr. Philip Abelson. The address reprinted below was given by Dr. Abelson when he was presented with a 1950 Award For Scientific Achievement by the Washington Academy of Science.—Ed.)

On being notified that the Washington Academy of Science had seen fit to honor me with this cherished award, my first reaction was naturally one of pride. This was soon replaced by a feeling of humility as I realized the extent to which friends and colleagues had contributed to the scientific research which led to the award. It seemed appropriate, therefore, to spend these brief moments in recalling some of the events of the past sixteen years.

In 1935, when I was accepted as a graduate student in the University of California Radiation Laboratory, nuclear physics was on the threshold of a great era. Ernest Lawrence's cyclotron was producing 4 million volt deuterons at a current of 3 microamperes. About a score of artificial radioactive isotopes had been produced. Uranium fission was yet to be discovered. Eventually, the cyclotron was to lead to the creation of more than a thousand new radioactive substances and the building of billion volt machines. As a novice in the laboratory, my principal duty was part-time operation of the cyclotron. For research effort, I joined the other men who were busily identifying radioactive isotopes, new species of which were being created almost daily.

Late one evening early in 1936, E. O. Lawrence came into the laboratory. He was obviously troubled about something. He paced back and forth, clenching his jaws from time to time. At length, he approached me, saying:

"Abelson, I hear you know something about chemistry. I have just been reading Fermi's description of the Rome experiments on neutron irradiation of uranium. He produced a new isotope of uranium which emits an electron and therefore must be decaying into element 93. He reports three or four transuranic elements formed by a series of B-disintegra-

tions. There is something incomplete about this picture and I wish you would look into it."

About the same time, a graduate student gave a seminar in the chemistry department, reporting on the Rome experiments and some new work of Hahn and Meitner, who had extended the earlier experiments. The German workers postulated transuranic elements with atomic numbers up to 97. As the seminar progressed. G. N. Lewis, was then chairman of the department, chewed agitatedly on a big cigar. When the talk was over, he cross-examined the student at length and was obviously unhappy about the picture of transuranic elements that had been presented. He was loath to accept their existence on the basis of the evidence which had been presented. Other scientists at the time were not comfortable about the picture, but none that I knew were as acutely disturbed as Lawrence and Lewis.

During the next two years, I worked industriously on the problem and found four or five new radioactive decay periods. Thus, the situation seemed more confused than ever. In retrospect, the key to the difficulty was that the irradiation of uranium by neutrons formed a large number of radioactivities, none of which was present in quantities greater than 10 to the minus 14th grams. Unless the proper inert carrier is added to a solution, such small quantities of materials will often not behave in a manner similar to microscopic amounts. The problem of adsorption on the walls of a glass container is often difficult with these small quantities. As a result, if one made any kind of precipitation from a solution containing irradiated uranium, the precipitate would be radioactive. Indeed, on one occasion, just for fun, I put a piece of old sock in the solution and, upon filtering and washing, found that the residue was radioactive. I announced to some of my colleagues that I had discovered the new element, "old sockium." The results of this experiment made me feel that I did not have the key to the problem. Hence, I turned to studies of the identification or characteristic X-rays emitted by artificially radioactive substances. This work proved more successful, and I was able to get the first X-ray line from element 43, now known as technetium.

One day in the fall of 1938, I asked Luis Alvarez what he thought I ought to be working on. He told me that I should resume studies on the neutron irradiation of uranium. I soon found that there was a radioactivity which emitted characteristic X-rays. Their wave length was such that they could be L-radiation emitted from a transuranic element or K-radiation from an element of medium weight. I had built a bent crystal X-ray spectograph for use in identifying the X-ray line. The films were actually being exposed when we first heard of the announcement that Hahn and Meitner had discovered uranium fission. Realizing that the radiation was probably K-radiation from an element in the middle of the periodic table, a few hours sufficed to prove that a three-day tellurium activity in decaying to iodine produced characteristic iodine K-radiation. There followed a period of intense work in which most of the former mysteries became clear and obvious, and a number of the fission products were identiifed.

In August, 1939, M. A. Tuve and R. B. Roberts appeared in Berkeley to examine designs for the construction of a 60-inch cyclotron at the Department of Terrestrial Magnetism here in Washington. They also sought to recruit two men to aid in the construction and subsequent use of the insrument. I was chosen as one of these two. The circumstances of the journey here were, perhaps, prophetic. When I boarded the train, the world was at peace. When I left the train, much of Poland had been overrun. It was in an atmosphere of mounting tension that we carried on that winter. One day in March, 1940, I came across a report by Emilio Segre. He had studied further the products of neutron irradiation of uranium. Ed MacMillan had developed an interesting technique for studying fission products. He prepared films of uranium oxide of about 1/10,000th of an inch thickness. The fission products formed by irradiating the foil with neutrons

possessed energies and ranges sufficient to allow them to escape from the uranium film and be collected on a neighboring foil. He had found that some two-day half-life activity remained in the uranium. Segre had examined this activity and from its chemical reactions concluded that it was one of the rare earths. If one looks at a periodic table, neptunium (element 93) lies in the same column as rhenium. Rhenium behaves not at all similarly to rare earths. It is easily reduced to the metal; its oxide is volatile; it forms sulfides which are insoluble in acid solutions. Reasoning from the periodic table, Segre concluded that the two-day half-life activity could not be a transuranic element because its properties were not related to rhenium.

It occurred to me that another interpretation of the experimental facts was possible, that the two-day half-life was actually a transuranic element, that reasoning by analogy from the periodic table need not be correct.

In 1940, the neutron sources available at the Department of Terrestrial Magnetism were rather weak. Many of the nuclear studies involved use of linear amplifiers whose background would be enormously increased if they were to become contaminated with uranium. Hence, it was not advisable to perform chemical separations with uranium at the Department of Terrestrial Magnetism. Tuve arranged with Sterling Hendricks for some laboratory space at the old Fixed Nitrogen Laboratory, and Larry Hafstad joined with me in irradiating some uranium with neutrons from the big electrostatic generator. Owing to the low intensities of neutrons available, it was not possible immediately to get clear-cut evidences that the two-day half-life was element 93.

Early in May, I decided to take a vacation in Berkeley. On arriving, I found that Ed MacMillan also considered it likely that the two-day half-life was a transuranic element. Accordingly, we joined forces and in a week demonstrated conclusively the fact that the two-day half-life material had chemical properties different from any of the known elements and that it was produced by the B-decay of uranium 239. We found that the two-day half-life neptunium decayed into a relatively stable element 94.

On returning to Washington, I found that events had moved swiftly. France had fallen, and no one could predict how long Britain might last. The S-1 uranium committee had been formed, with L. J. Briggs as chairman. This committee outlined and initiated the research which later provided the sound technical background for the large scale industrial developments of the Manhattan district. Among the committee's members were M. A. Tuve, Ross Gunn and J. W. Beams. There were grave fears that the Germans might be working on an atomic bomb. Since it was already known that U-235 was the active isotope in uranium fission, it would be necessary to separate large quantities of this substance. The isotope separation looked fantastically difficult. In those days a few thousand dollars was an enormous research budget. On the other hand, there was the possibility that some easy method might be found. If this country were not alert, we might find ourselves completely at the doubtful mercy of Hitler.

The most successful isotope separation scheme for heavier elements at that time was gaseous thermal diffusion method which had been developed by the German workers, Clusius and Dickel. One day, Ross Gunn visited the Department of Terrestrial Magnetism. He had with him a book entitled, "Progress Reports in Physics," the annual British publication. It contained an article on isotope separation by Urey, in which the author reviewed all the known methods. Gunn suggested that I look into the methods to see if I could find any that looked promising for application to uranium. I was very much interested in some studies that the German workers, Kersching and Wertz, had made, using salt solutions in a liquid thermal diffusion column. They found that an interesting isotope separation was obtained when aqueous solutions of zinc salts were employed. Some simple columns were built and tested at the Department of Terrestrial Magnetism. It was found that good separations

of potassium isotopes could be obtained. In order to facilitate studies with uranium, Tuve arranged with Lyman J. Briggs, then director of the Bureau of Standards, for a laboratory on the third floor of the Northwest Building. I made some runs with uranium solutions and found all manner of difficulties. The uranium salt hydrolyzed badly and deposited in a black precipitate all over the metallic surfaces of the apparatus. There was a very large concentration of the salt with respect to water so that the top of the column where U-235 was supposed to be was practically distilled water while the bottom contained most of the solute. It was clear that the separation method could be applied to uranium only if a stable liquid compound of uranium could be found. The leading candidate was uranium hexafluoride. This material had never been produced in more than gram quantities and then only by reaction of fluorine gas with uranium metal, both of which substances were, at that time, themselves laboratory curiosities. Gunn had encouraged the chemistry department at the Naval Research Laboratory to work on production of the compound, and a group working under R. R. Miller had succeeded in making nearly a hundred grams, with production limited by the scarcity of uranium metal. Unfortunately, the apparatus which I proposed to use required more than a kilogram. It occurred to me that it might be possible to produce uranium hexafluoride by a process not involving the metal. Accordingly, I built a fluorine generator and installed it in the Chemistry Building at the Bureau of Standards in H. B. Knowles' laboratory.

A fairly simple method was found for making the hexafluoride, and with the help of Knowles, the material was soon being produced at a rate of nearly a kilogram a day. For more than a year until a commercial organization took over, the laboratory was the leading producer of this material. With the compound available, it was possible to conduct experiments on its physical chemical properties and to determine the conditions under which it was stable. These tests showed that the compound was a suitable substance for use in the column. By May, 1941, a small, but measurable, separation of the uranium isotopes had been achieved. Encouraged by this first successful separation of uranium isotopes, it was decided to extend the work and to carry it out at the Naval Research Laboratory under the general direction of Ross Gunn. With John L. Hoover as a principal colleague, the optimum conditions for column construction and operation were determined. The work led successively through a small pilot plant at the Naval Research Laboratory, a larger installation in the Philadelphia Navy Yard, to a full-scale plant at Oak Ridge. In its final form, the process had the advantage of extreme simplicity and low initial cost, since a column consisted merely of three concentric pipes. This simplicity was reflected in fast construction, once the plant was authorized. With the stimulus of Colonel M. C. Fox of the Manhattan District, the plant was virtually constructed in 75 days. The principal disadvantage was a rather large heat consumption, which made the process uneconomical for long-term operation.

With the end of the War, came a logical period of reassessment. Many of the problems of nuclear physics had been solved. The challenges remaining involved the creation of costly high-energy machines, the engineering of nuclear reactors, and the creation of rather complicated equipment for the observation of cosmic rays. The field had become one in which it was necessary to spend large amounts of money and time in building equipment in order to make a few observations. On the other hand, nuclear physics had created a new challenge in biology. The availability of the new radioactive isotopes made it possible for men trained in physics and chemistry and willing to learn biology to make substantial contributions to the understanding of the dynamics of living processes. In my earlier work, I had seen that the combined application of physical and chemical methods to studies in nuclear physics had been a powerful ap-

proach. Might not such a combination applied to biological processes be likewise creative?

Accordingly, I was delighted when Tuve, the new director of the Department of Terrestrial Magnetism, suggested the desirability of a venture in biophysics. We jointly concluded that one of the major challenges of our epoch is the study of the dynamics of the living processes.

During the last four years, a small group at the Department of Terrestrial Magnetism has worked along these lines. During the period while we were acquiring the necessary knowledge in biology and biochemistry, the Carnegie Institution of Washington has supported us in every way. Our group is now making contributions, none of which have been spectacular. However, a solid groundwork has been laid, which may, one day, lead to a new, unusually productive era. Should this occur, it will again come as a result of mutual encouragement and stimulation among friends and colleagues.

●

U. S. ON WAY TO "SUPER STATE," SAYS UTAH SENATOR

NEW YORK.—The United States is on the way towards becoming an American counterpart of a "super-state." Though this may be necessary during the present emergency the citizens must start thinking even now on how they can transfer the government back to the people when the crisis is over. The American people must be alert lest Washington provide a trap for the nation instead of a tunnel through which daylight can be seen and through which the citizens can eventually emerge.

So spoke Wallace F. Bennett, newly elected senator from Utah, before the New York section of the Paint, Varnish & Lacquer Association here on Jan. 18.—(CEN 29, 375, Jan. 29, 1951.)

●

A despot doesn't fear eloquent writers preaching freedom—he fears a drunken poet who may crack a joke that will take hold.—E. B. White. Courtesy of Miniaturesque.

THANK YOU

The editorial staff acknowledge the assistance of Bede Ernsdorff, C. F. Gerald, R. W. Moulton, Edward Cowles, Eric Reaville, E. C. Lingafelter and C. V. Smith, who very materially aided in the preparation of this issue.

●

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HINTS FOR CHEMISTS

The chemistry student should notice that
chlorine
Is stuff altogether distinct from a chorine.

The chlorine, a gas, through a hole can
escape,
While the chorine possesses a definite
shape.

The chlorine is colored a yellowish green
While the pink of the chorine is easily
seen.

For its chemical properties study the
chlorine,
But for interesting physical aspects the
chorine.

★

AMERICAN FOLKWAYS

A handsome young man in Wyo.
Took his girl for a walk in the glo.
And, doubtless because
Of some natural laws,
Her hair, on return, needed co.

●

ARCHIMEDES' PRINCIPLE

There was a fat man of Nantasket,
Who put out to sea in a basket.
But they found him, 'tis stated,
Quite badly hydrated,
So they kept him on land, in a casket.

—Courtesy of DR. J. H. HILDEBRAND
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The Twelfth National Organic Chemistry Symposium, sponsored by the Division of Organic Chemistry of the American Chemical Society, is to be held in Denver, Colorado, on June 12, 13, 14 and 15, 1951. The Colorado Section of the A.C.S. will act as host.

●

CONSIDER HER WAYS AND RELAX

(Courtesy of "Miniaturesque")

If you wait long enough science will usually come up with a good excuse for any failing you may have. One of the more common forms of self-abasement comes from the murderous impulses aroused in the Early Ruffled Grouse by the Morning Warbler. "Get up, you slob, it's nearly seven o'clock!" shouts one brisk and revoltingly clear-eyed character, breathing deeply at the open window; while the other groaningly tears himself from the deep comfort of bed feeling as though he had left his outer skin sticking to the sheets. Not only does he feel that his soul won't catch up to his body for hours, but he is made to believe that late sleeping is a kind ot moral lapse.

Those who have developed guilt complexes from an inability to enjoy following the proverb about Early To Bed And Early To Rise, who would rather be sickly, poor and stupid rather than have to get up at quarter of seven, can take some comfort from the discovery that people fall into three types according to their temperature curves. If a person takes his temperature at regular intervals and charts it, he will find that it makes the same curve day after day, from subnormal through the "normal" 98.6 degrees and a little above, then back down again. Work is done best at the high point. The natural early riser reaches his peak around noon and declines from then on; he is most efficient in the morning, and by early evening is yawning and ready for bed. The second type, long reviled as a sluggard and infuriated with advice to admire ants, works well in the afternoon and is the life of the party at night. These are people who should be actors or on the night shift. A third (superman) type is bright in the morning, spends a long dull afternoon and revives again in the evening.

Maybe you can't change your job to suit your temperature curve, but you can arrange your work so that the heaviest part will come at your peak of efficiency; and you can explain to your loved ones as you snarl at them over breakfast that it's not you being impossible, it's your metabolism.

●

A representative of an insurance company called upon a recent widow to present her with the check for her husband's insurance. She was still bathed in tears but a look at the check—for fifty thousand dollars—stopped her seemingly inconsolable weeping. "You may not believe it," she sighed, "but I'd give twenty thousand of this to have him back."

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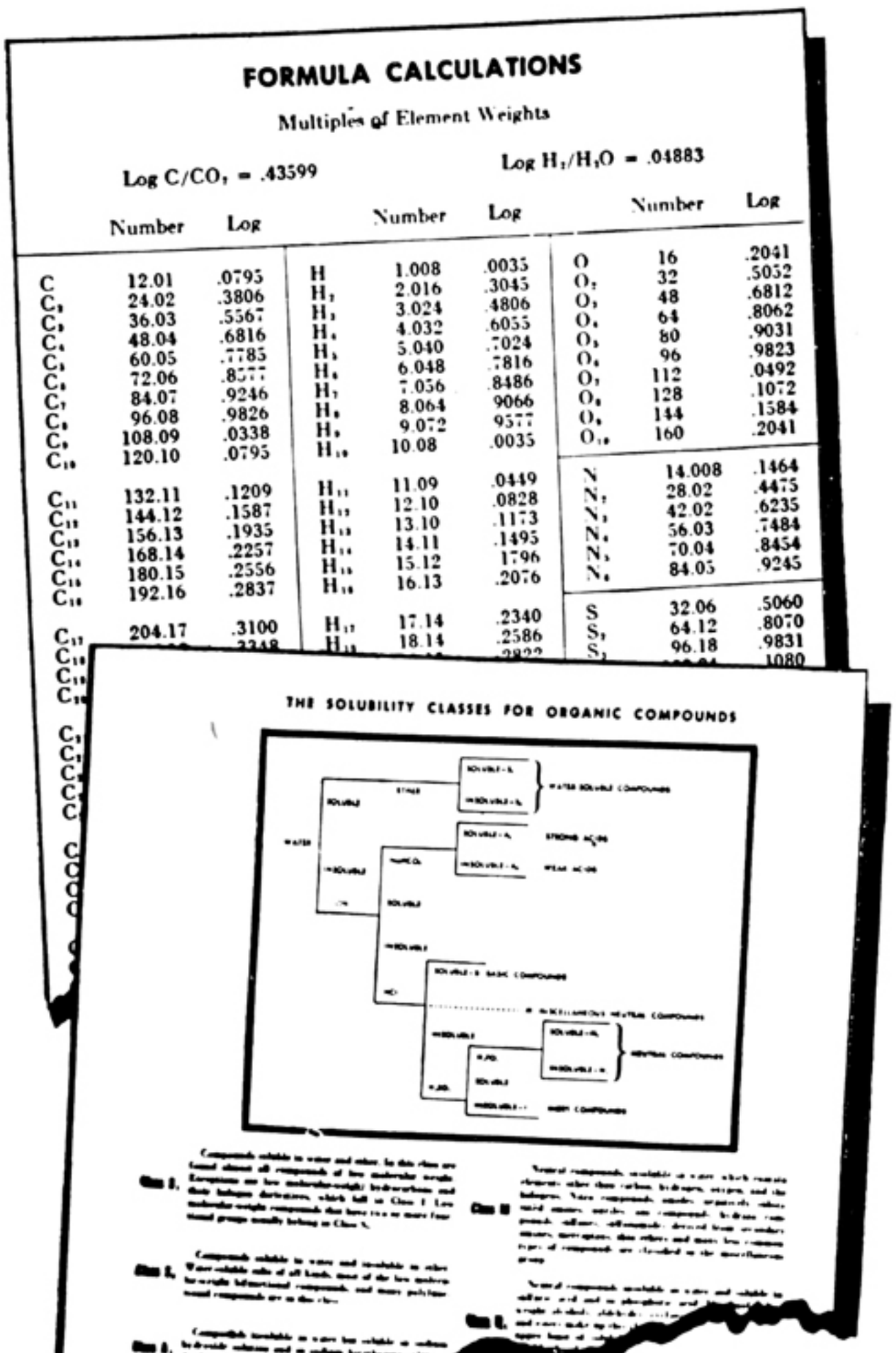

FORMULA CALCULATIONS

Multiples of Element Weights

Log C/CO₂ = .43599 — Log H₂/H₂O = .04883

	Number	Log		Number	Log		Number	Log
C	12.01	.0795	H	1.008	.0035	O	16	.2041
C_2	24.02	.3806	H_2	2.016	.3045	O_2	32	.5052
C_3	36.03	.5567	H_3	3.024	.4806	O_3	48	.6812
C_4	48.04	.6816	H_4	4.032	.6055	O_4	64	.8062
C_5	60.05	.7785	H_5	5.040	.7024	O_5	80	.9031
C_6	72.06	.8577	H_6	6.048	.7816	O_6	96	.9823
C_7	84.07	.9246	H_7	7.056	.8486	O_7	112	.0492
C_8	96.08	.9826	H_8	8.064	.9066	O_8	128	.1072
C_9	108.09	.0338	H_9	9.072	.9577	O_9	144	.1584
C_{10}	120.10	.0795	H_{10}	10.08	.0035	O_{10}	160	.2041
C_{11}	132.11	.1209	H_{11}	11.09	.0449	N	14.008	.1464
C_{12}	144.12	.1587	H_{12}	12.10	.0828	N_2	28.02	.4475
C_{13}	156.13	.1935	H_{13}	13.10	.1173	N_3	42.02	.6235
C_{14}	168.14	.2257	H_{14}	14.11	.1495	N_4	56.03	.7484
C_{15}	180.15	.2556	H_{15}	15.12	.1796	N_5	70.04	.8454
C_{16}	192.16	.2837	H_{16}	16.13	.2076	N_6	84.05	.9245
C_{17}	204.17	.3100	H_{17}	17.14	.2340	S	32.06	.5060
C_{18}			H_{18}	18.14	.2586	S_2	64.12	.8070
C_{19}						S_3	96.18	.9831
C_{20}								.1080

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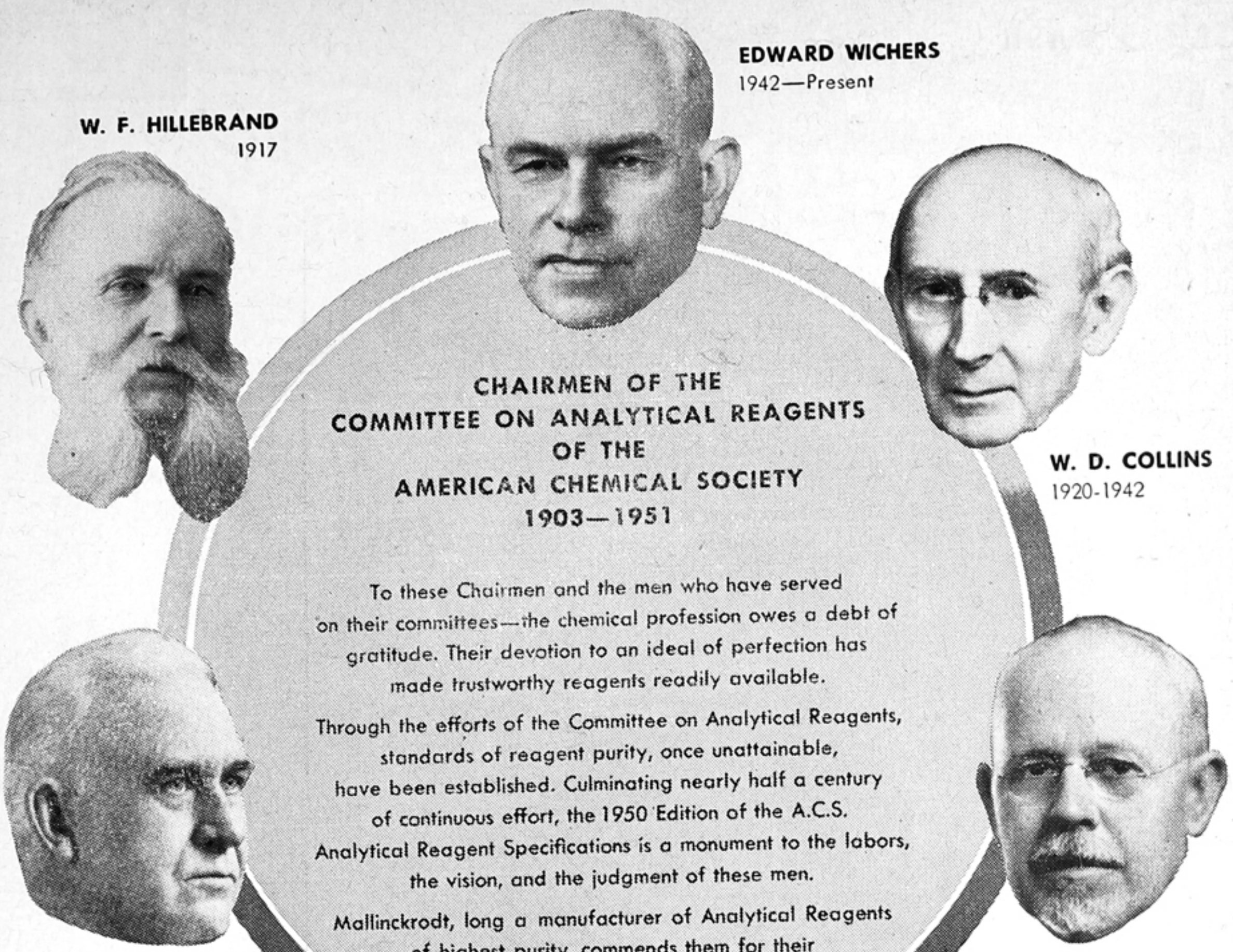

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