The PUGET SOUND CHEMIST

Bulletin of the PUGET SOUND SECTION of the AMERICAN CHEMICAL SOCIETY

TABLE OF CONTENTS

INDEX OF ADVERTISERS

NOVEMBER, 1951

The PUGET SOUND CHEMIST

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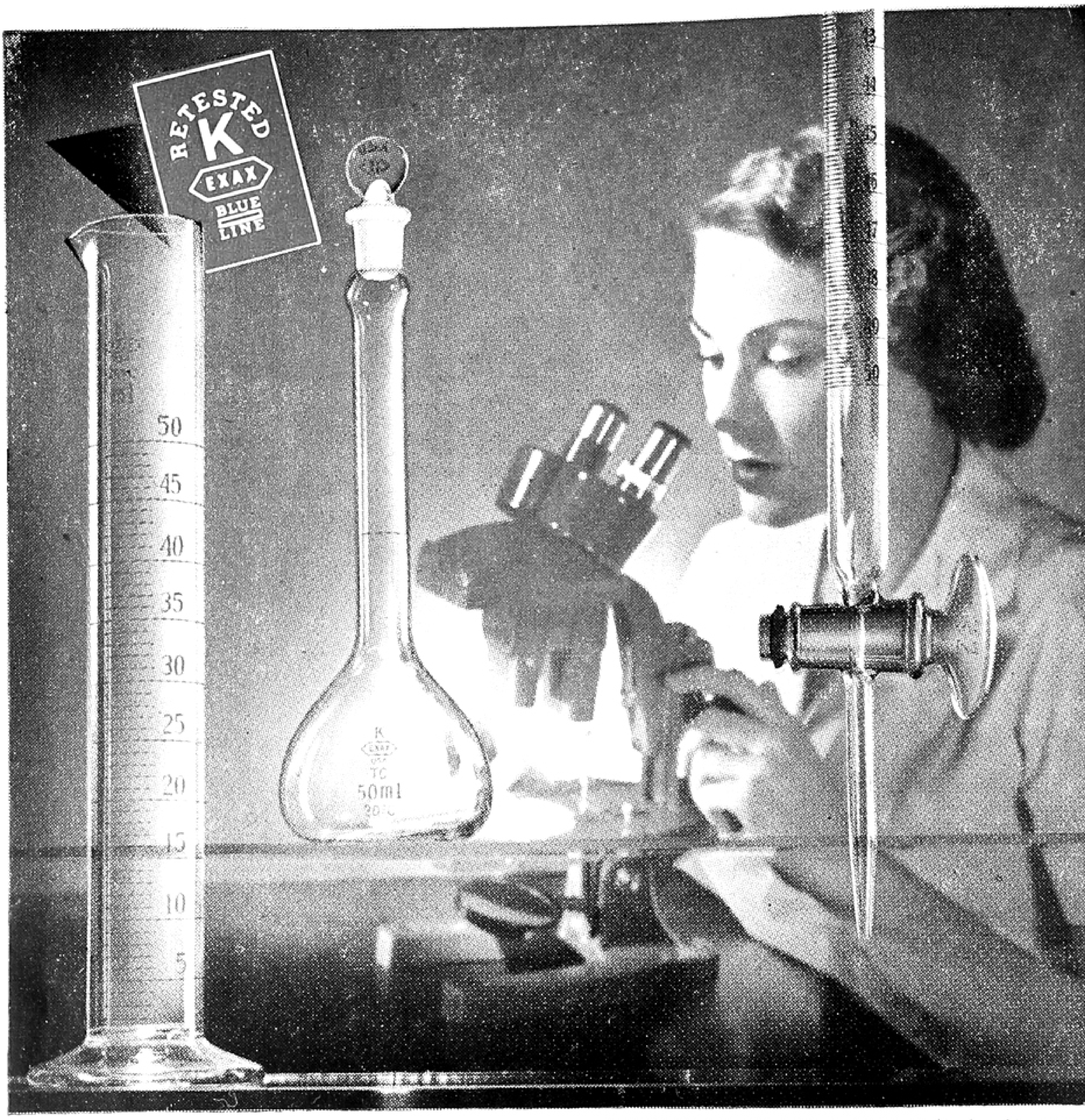
4



KIMBLE EXAX RETESTED Cylinder No. 20030, Flask No. 28015; Burette No. 17030

Tools of Science in the Arsenals of Democracy

Back of the men and machines that pour out the sinews of war stand the research laboratories. There, scientists check the quality of products before they are released to those who use them in defense of democracy. There, too, scientists probe to improve present weapons and supplies and develop new ones.

The meticulous work of thousands of scientists in these essential laboratories would dwindle, then die, without their tools—scientific instruments. Kimble is humbly proud that the scientific instruments it produces have, in peace and war, been worthy tools in the hands of scientists everywhere.

In the turbulent times ahead, we shall do everything in our power, and ask the aid of everyone in control, to keep our nation's scientists supplied with the precision instruments we make to be weapons, as well as tools, in their hands.

KIMBLE GLASS TOLEDO 1, OHIO
Division of Owens-Illinois Glass Company

NOVEMBER MEETING

American Chemical Society

PUGET SOUND SECTION

Jointly with

Pacific N. W. Section of Electrochemical Society

TIME

MONDAY, NOV. 26TH, 1951, 8:00 P. M.

PLACE

Seattle, 131 Bagley Hall, University of Washington

SPEAKER

DR. K. S. SPIEGLER

SUBJECT

Electrochemistry of Ion-Exchange Resins

300th (DECEMBER) MEETING

Puget Sound Section

AMERICAN CHEMICAL SOCIETY

JOINTLY WITH

INSTITUTE OF FOOD TECHNOLOGY

SPEAKER: Dr. Neno D. Voth

SUBJECT: CHEMISTRY AND PROBLEMS OF FOOD AND DRUG ADMINISTRATION

MOVIE: "FRAUD FIGHTERS"

PLACE: —— SEE PAGE 8

TIME: TUESDAY, DECEMBER 4TH, 8:00 P. M.

N. B.—The above is the only and final notice of December Meetings

NOVEMBER SPEAKER

K. S. SPIEGLER

BIOGRAPHY

K. S. Spiegler was born in Vienna, Austria, in 1920 and completed his high school education there. He entered the Hebrew University in Jerusalem in 1938 and, after graduate work in inorganic chemistry, received the M.S. degree in 1942 and the Ph. D. in 1944.

Upon completion of his doctorate training, Spiegler was employed by the Anglo-Iranian Oil Company in Abadan, Iran, as a Development Chemist in the Water Section where he encountered ion-exchange problems for the first time.

From 1946 to the end of 1947 Spiegler worked on joint research of the Department of Physical Chemistry at the Hebrew University and the Palestine Potash Company on the evaporation of salt brine at the Dead Sea. From 1948 to 1950 he worked at the Weizmann Institute, Rehovot, Israel, on ion-exchange problems. He was in charge of the pilot plant for the demineralization of brackish waters, and was one the his country's delegates to the United Nations Conference on the Conservation of Resources at Lake Success, August 1949. In 1950 he won a fellowship at M.I.T. and has been working there since with Professor Charles D. Coryell on the electrochemistry of ion-exchange resins.

Spiegler is a member of the American Chemical Society, the Israel Chemical Society, two committees of the Israel Research Council, and Sigma Xi.

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Electrochemistry Of Ion-Exchange Resins

by K. S. Spiegler

Ion-exchange resins have found many applications for chromatographic separations and for purification of solutions. On the other hand, electrochemical properties of these resins have been studied only in the recent past. To interpret ion-exchange equilibria and separation in columns of ion-exchange materials the resin phase is often treated as a concentrated solution phase immiscible with the solution with which it exchanges ions.

This model is also suitable for the interpretation of the electrochemical properties of ion-exchange resins. They conduct the electric current which is carried through them only by the mobile exchangeable ions, while the resinous matrix remains stationary. Electrolysis of resins and electrode reactions have been investigated. By a suitable choice of electrodes, resin columns can be regenerated without the use of solutions. Moving boundaries in the resin phase, which were studied by the radiotracer technique, follow the laws of electromigration in solutions.

Electrophoretic separations by electrolysis of the resin have been carried out. The aspects of these separations are different from those in solutions or gels, as the adsorption affinity of the ions to be separated in addition to the frictional re-

(Continued on Page 8)

Electro Chemistry of Ion-Exchange Resins

(Continued on Page 6)

sistance to the migration of ions plays an important part and as only one charge type of ions carries the current. The solid nature of the resins eliminates thermal convection.

Recently, sturdy membranes consisting almost entirely of ion-exchange materials have been prepared. They have a considerably lower electrical resistance than synthetic membranes prepared previously, e. g., collodion, and owing to their properties of selective adsorption, they act as molecular sieves. Donnan diffusion, dependence of electrical conductance on frequency and membrane potentials are similar to those found in natural membranes and thus these synthetic polyelectrolyte materials may serve as models for biological systems.

Thus ion-exchange resins are solids in the physical sense, but electrolytic solutions the electrochemical sense—a combination of properties promising new applications.

Yours Is a Hazardous Profession

If you would stop and survey many of the physical dangers closely connected with your work, you might wonder at your courage or your ignorance for choosing a profession which constantly exposes you to mayhem and dismemberment. It has been dangerous for a long time and there has been little improvement with the years. Each step forward in knowledge has been accompanied by some new dangers. Let me cite some historical cases and point out the many constant dangers we live with during our eight hours of bread winning.

Fischer in the course of his epoch making research contracted phenol hydrazine poisoning and suffered for more than a decade—twelve years to be exact. What some people won't do for fame!

Ehrlich experimented with some arsenous compound for the extermination of the TB bug. You guessed it! He got TB.

Numerous cases, both historical and recent, too trivial to mention—Ph D candidates committing suicide after 7 years of research without result. Losing one's wife is also common in such cases. These we may classify as preprofessional hazards.

Let's look around where you work. Do you have high vac or high pressure gadgets capable of making a mess out of you? Any possible radiation? Poisonous gas leaks — Hg for example? Explosive gaseous mixtures going off at the lighting of your next cigarette—inadvertently, of course, but it could be too late. Shock sensitive material? I can go on to name more, but these will suffice to give you some shivers. Of course you are a careful operator and none of these hazards could possibly occur near you. But what about this new kid the boss just hired to work with you? He's careful too, but a little green and may not know what he is doing. Read about the big explosion in that oil refinery in Texas? The cause is still unknown. No one close enough to it lived to tell the story.

Sweating and having goose pimples at this stage of the game won't help you much. It's too late for you to change and besides the work is too damn interesting even though you are underpaid for the hazards you have to face everyday. One suggestion may ease your mind a little—sign up for more life insurance before the insurance companies have a chance to read this issue of P.S.C. Your boss should be persuaded with the help of this article if necessary, to share part of the cost of the new policy. Good luck! You will need it.

H. C.

Have you heard about the two bald-headed professors who put their heads together and made an ass of themselves?

Everyone likes to see a broad smile, especially if she smiles at him.

Notification of dinner and meeting place will come by card.—

Schoellkopf Medal Address
PRESSURE — THE UNKNOWN

Corneille O. Strother, Medalist

Presented before the Western New York Section, American Chemical Society,
May 22, 1951
Reprinted from The Double Bond

The purpose of my remarks tonight is to call to your attention a rather neglected field, namely the study of chemical phenomena at high pressures. Perhaps it would be well to digress a moment to specify the pressure range I shall hereafter mean by the term "high pressures." I shall mean, in general, pressures in excess of 25,000 pounds per square inch and extending to the neighborhood of 150,000 pounds per square inch. To give you some idea of the magnitude of these pressures, I should mention that the pressures generated in the firing of guns or cannons are between 50,000 and 100,000 pounds per square inch. The pressure at the deepest part of the ocean, about six miles down, is only about 15,000 pounds per square inch.

In the physical sciences, we are interested in knowing what external conditions can be changed to alter the internal energy of the system under investigation. Of the external conditions that we can control, temperature and pressure seem to be the most significant for chemical reactions. Changing the temperature brings about more complex changes than changing the pressure; for a change in temperature not only alters the volume of the system but also the thermal energy. As the temperature goes up, there is an increase in the energy associated with the translational, rotational, and vibrational motion among the molecules with an attendant expansion. Whereas an increase in pressure brings about only a contraction without any change in kinetic energy. It is assumed in the foregoing that only one variable is being changed at a time. So we might say, roughly speaking, that an increase in pressure is partially equivalent to lowering of the temperature.

The supposition that to some degree increasng the pressure is equivalent to lowering the temperature is illustrated by the fact that the melting points of most solids are raised by increasing the pressure. Mercury can be frozen by raising the pressure to 180,000 pounds per square inch at room temperature or by lowering the temperature to about 50 degrees C. at room pressure. However, it is readily seen that it is much more difficult experimentally to freeze mercury by the application of pressure than to obtain the same result by lowering the temperature.

Since we look at matter today as composed of particles, atoms or molecules, the compression by the application of pressure has served to bring the particles closer together in opposition to their inherent repulsive forces. This compressing together of the particles may permit attractive forces to become operative that were too short-ranged to be effective when the particles were farther apart. A physical or chemical change then results. A crude analogy might make this point clearer. Droplets of mercury running about on a flat surface may bounce off one another. However, if the droplets are forced together, at first they may be distorted and then the small droplets merge to form larger droplets.

An outstanding example of the effect of high pressures upon chemical reactivity is the formation of the plastic, polyethylene, from ethylene. Ethylene is a gas with a critical temperature of 9 degrees C. Under rather mild conditions of temperature and pressure it can be polmerized readily to liquids resembling gasoline or oils. However, in order to produce a solid polyethylene, it is necessary to impose a considerable external pressure of the order of several thousand pounds per square inch. The supposition

(Continued on Page 20)

Minutes of the 298th REGULAR MEETING

of the

PUGET SOUND SECTION

of the

AMERICAN CHEMICAL SOCIETY

Bagley Hall, University of Washington

October 25, 1951

The meeting was called to order at 8 p. m. by Dr. E. C. Lingafelter, Chairman.

Mr. Collis Bryan, Chairman of the Nominating Committee, reported the committee's selection of nominees for officers of the Section. There being no further nominations from the floor, and as a quorum of the membership was present the Secretary was instructed to cast a unanimous ballot in favor of said nominees.

Therefore, the officers of the Puget Sound Section for the year 1952 are as follows:

Chairman—Mr. Charles V. Smith
Chairman-Elect—Dr. Paul C. Cross
Secretary—Mr. Jim C. Drury
Treasurer—Mr. Robert G. Paquette
Councilor—Mr. Albert H. Hooker
Alternate Councilor—Dr. Hyp Dauben, Jr.

The speaker of the evening, Dr. Harry J. Emeleus of Cambridge University, England, was introduced by Dr. George Cady.

Dr. Emeleus spoke on "Some Recent Developments in Fluorine Chemistry." His lecture on the methods of making fluorine compounds, their physical and chemical properties, and their possible commercial use was extremely interesting and thoroughly enjoyed by the audience.

The meeting adjourned at 9:30 p. m., followed by a social hour.

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A half breed is a man with a cold in one nostril.

Kissing a girl because she lets you is like scratching a place that doesn't itch.

STRIKE TWO

This is our second issue of the Puget Sound Chemist. Although this event is not likely to alter the destiny of the universe, nor the copy become a prized collection item, we entertain a father's pride that Volume 12 No. 8 of the Puget Sound Chemist has been born. The child always looks beautiful to the parent, however ugly he may be to other eyes.

No very radical departure from previous policy of rearing the child is anticipated. The Puget Sound Chemist is published for the members of the ACS in this neighborhood. It will publish any material sent in providing only that space is available, that the material sent is of interest to chemists and chemical engineers and that it shall not conflict with the laws of the land.

It is our thought to print from time to time material of interest to ACS members about the chemistry and chemical engineering departments of the smaller colleges and universities in the area. Mr. George Szego has been good enough to provide the first copy on the Chemical Engineering Department of Seattle University, printed elsewhere in this issue. We hope that staff members of other institutions will take the hint and forward suitable material concerning their departments.

We thought we might also add two other regular or irregular features. First, we would like summary write-ups of the chemical industries in the Pacific Northwest, supplied by the industries themselves and, second, a page for correspondence would make the Puget Sound Chemist more truly the organ of the members. This latter feature will depend on whether or not members supply correspondence on live topics.

One last word—we will be happy at any time to receive suggestions and criticisms for improvement of the Puget Sound Chemist. One word after the last—don't make suggestions which involve a lot of work unless you are prepared to help with the work.

E. T. R.

The Chemical Engineering Curriculum at Seattle University

G. C. SZEGO

The School of Engineering at Seattle University was established in 1941, about 40 years after the founding of the college. In 1948, the writer became the school's first instructor in Chemical Engineering. While "chemical engineering" had been offered for about 3 years, only a sketchy program of upper-level courses was outlined, and a unique opportunity was available for the layout of a curriculum which represented a completely fresh start without the drawback of having to work in the framework of an established course seqquence.

The courses other than chemical engineering are substantially what is considered standard in the way of fundamental science, mathematics, engineering and chemistry at most universities. The chemical engineering work is somewhat different. Our first premise is that most of our men are taking this work as their terminal study, so that we do not point particularly toward their taking graduate work, a view-point not shared by some schools. Nevertheless, we have had a number of very successful alumni in the graduate schools of several outstanding universities. Our second feeling is that there is only one kind of design: economic design, and our entire curriculum is carried out with constant emphasis on this point.

The writer's own opinion is that a considerable portion of the work in what is referred to as "Chemical Technology" or "Industrial Chemistry" is largely wasted. He feels that a certain amount of this work in lecture, motion picture and plant trip form has a beneficial orienting influence. However, many schools offer as much as 4 quarters of this work plus an extensive laboratory program. Since about 1920, professional training in chemical engineering has been organized on a unit operations and unit processes basis, the theory being that since any chemical (in the broadest sense) industrial undertaking can be synthesized by the suitable combination of several of these "units,' the chemical engineer thus can be trained to be equally useful in such widely dissimilar industries as petroleum refining and whiskey production. It was this very fundamental concept that developed chemical engineering from an empirical art in each field to the creative and living science to which it has unquestionably attained. Why then should the chemical engineering student study in excessive detail the steps involved in the causticizing process except as a random illustration of fundamental principles and to familiarize him with some of the terms and equipment used in industry? Industry plans to orient the newly-employed engineer in the particular process in which his services will find application.

Our curriculum consists of the following work: 1 quarter of Chemical Technology in which are studied a few selected industries, illustrated by films and plant trips; 1 quarter of Ch. E. Calculations, at the conclusion of which the student turns in as his term report a complete energy and material balance over an entire chemical plant; 1 quarter of Applied Ch. E. Calculations covering empirical equations, nomography, dimensional analysis, graphical and numerical calculus; 1 quarter of Physical Metallurgy with laboratory; 1 quarter of Fuels and Lubricants with laboratory; 2 quarters of Ch. E. Thermodynamics covering First and Second Laws, real gas thermodynamics, flow-processes, fugacity, partial molal quantities, activities and chemical equilibrium; 2 quarters of Unit Operations with laboratory; 2 quarters of Ch. E. Economics and Design, in which the student selects a process, first draws up a complete economic survey to determine whether it would be economically feasible to construct this plant in Seattle, and then in the second quarter makes a complete plant design, designing all equipment by economic balances, thus getting the opportunity to compare his previous estimates with

(Continued on Page 16)

the actual figures. During these courses, the lectures also cover corporation finance and patents; 1 quarter of Advanced Ch. E. calculations, covering multicomponent distillation and absorption, kinetics and catalysis; 1 quarter of Seminar, in which the methods of using the chemical literature are presented and each student gives several talks covering articles in the technical literature; and finally the Bachelor's thesis, in which independent work in constructing or modifying equipment or working out some suitable problem culminates in a properly-written thesis. All of the reports and term projects are accepted only if in the prescribed form and in good, clear English, and accompanied by a letter of transmittal.

The work and problems in each course are especially designed so that the student integrates his training from other courses. In the senior year the problems are often given with incomplete or too much and inconsistent data, to foster in the student a dependence upon his own critical faculties and an engineering maturity.

Anyone looking in an appropriate book can specify the area for the heat exchanger in a given heat transfer problem with simplified data. However, we feel that this is not design in any sense of the word. Our students are taught that only one of the many possibilities will do the job at the least cost, including indirect expenses such as depreciation and maintenance. They also learn that each piece of equipment has an effect on the design of other parts of a process or plant, and that the inclusion of these effects in the design of all equipment is the only possible procedure.

Recently the writer was told by an executive of a well-known chemical corporation that the most difficult thing for him to do is to get the chemical engineers in his charge to appreciate these economic truths.

We feel that the courses which are most often displaced from, and to the detriment of, chemical engineering curricula by excessive time on "Chemical Technology" are undergraduate Chemical Engineering Thermodynamics and Plant Design.

The engineer's training only begins during his university days, but at the same time we can emphasize that which we feel will be the most important to the most of the students. Also we can attempt to imbue him with a point of view which will serve him well in his career.

●

Central Scientific Company of California has broken ground in the central manufacturing district of Los Angeles for a new 50,000 square foot plant and warehouse. The new structure will replace an 18,000 square foot warehouse in the city and is scheduled for completion by next February. The company makes scientific instruments and laboratory supplies.

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KIMBLE GLASS

M. R. Kopf, Jr.

In response to requests from users, Squibb type separatory funels with delivery stems of larger inside diameter are being produced by Kimble Glass, Division of Owens-Illinois Glass Company.

The larger diameter of the stem permits the column of liquid in the stem to break and drain out after the stopcock is shut off, thus facilitating recovery of the liquid in the stem. It is not necessary to empty the funnel and then open the stopcock to obtain this volume.

Quantitative separations are more easily and completely obtained.

In addition to this feature, Kimble Squibb type separatory funnels are made with larger neck openings and with more gradually sloping shoulders than are usually found on similar type funnels. Since all sizes hold a considerable amount of liquid over the nominal capacity, safer manipulations are permitted. Both these features permit easier cleaning. Stopcocks and stoppers are of standard taper.

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Last line of defense: "The folks will be home any mniute."

Remember . . .

DECEMBER MEETING – DECEMBER 4th

See Page 5

No Other Notice Will Be Given!

BOOK REVIEW

Chemistry . . . Key to Better Living. Edited and Produced by the Staffs of **Chemical and Engineering News** and **Industrial and Engineering Chemistry.** American Chemical Society, 1155 Sixteenth St., N. W., Washington 6, D. C. xxi 244 pages. 1951. $4.00.

This volume might well be used as a style manual or model for those engaged in preparing books or specializing in graphic art. But it is far more than that. It is primarily a history of chemistry in America during the past 75 years and of the interrelation of the American Chemical Society and the American chemical industry as they have developed and progressed side by side during that period. A series of papers on chemical progress during the 75 years since the founding of the ACS, reviews the development of chemical science and its industrial applications and discusses the part the ACS and its divisions played in the advancement of chemical knowledge and skill. This series was organized to subdivide chemistry roughly into the fields covered by the divisions of the ACS and the order of presentation follows approximately the chronological order in which the divisions were established. These histories are all written by outstanding leaders in the fields covered.

A special feature of the book is "The First 75 Years" by Anthony Standen. This story, copiously illustrated, and written in the inimitable style of the author of "Science Is A Sacred Cow," relates, as its title indicates, the significant developments of the first 75 years of the ACS and particularly the role the Society and its members played in the industrial chemical growth of the Nation. A picture-caption story graphically presents this same 75-year period. Then there are sections written by well-known authorities who give a glimpse at our science and civilization. They discuss contemporary problems as the scientist, philosopher, business executive, and teacher envision them.

In addition to the excellent make-up, arrangement, and typography, the volume is arrestingly bound in cobalt blue cloth, lettered in genuine gold leaf with the ACS emblem attractively displayed on the backbone and outside front cover. This book should be a "must" in the library of every chemist and chemical engineer who is proud of his profession and his professional society, their beginnings, development, and progress during 75 years, and their limitless opportunities. It should be a valuable reference in the libraries of industrial concerns, research laboratories, and educational institutions.

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TO BRAG OR NOT TO

Should a man "blow his own horn?" Should he shout of his deeds loud and strong or should he heed the advice of elders and allow his deeds to speak for themselves.

These are difficult questions for many men, especially the younger, who are struggling up the ladder of success. They know from experience that no one likes a boaster and yet there's always the nagging notion that if they don't speak up, the world will pass them by.

Too many times it seems as though the "horn blowers" fairly soar to the top rung of the ladder, sometimes on words alone with few deeds to aid the ascension. The more modest, shy and capable ache to cry out in protest and unmask the false climber. But to do that might label them as jealous. So they live uneasy with the injustice, struggling with their own consciences.

There is comfort to these modest ones in the fact that an arrow too arises swiftly into the sky but falls just as fast if it does not have some power supply of its own to maintain the attitude.

And so it is with men.

The phoneys and fakes can rise, rocket-like, to the top. But eventually there comes a time when they must make a decision—the right one; solve a

problem—the right way. It is then that idle words, unbacked by deeds, are put to test and found wanting.

In a sense, the overly shy and modest men also are at fault. Their crime is not one to others but to themselves.

The world parades past the meek, little mouse without a glance but it always notices the roaring lion.

Perhaps the answer to "horn blowing" can be resolved without loss of ethical conduct. It's a good idea to blow your own horn now and then but only if you have something worth blowing about, a melody worth playing, a tune worth being heard.

That is not playing the part of a boaster. It's an honest evaluation of yourself to others, proof that you have faith in you.

—Gould Battery News.

Announcement

At the recent meeting of the Directors of the Cenco Corporation, the parent stock-holding company, and the Central Scientific Company held at 1700 Irving Park Road Chicago, John T. Gossett, President of Central Scientific Company, was elected Chairman of the Board of Directors of both companies, succeeding to the responsibilities of the late Chairman, E. Perry Holder.

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Please patronize them.

PRESSURE — THE UNKNOWN

(Continued)

is that the pressure crowds together the ethylene molecules to such an extent that some type of activation of the molecules takes place with a resultant chemical reaction between them. In this case as compared with the mercury droplets, we can visualize the effect of pressure being the distortion of the electronic shells of the ethylene molecules, that is activation, followed by the coalescence of the molecules into polyethylene.

Such a crude picture seems to be borne out by two observations. First, in the pressure region where polyethylene is formed, very little, if any, liquids are formed which would indicate that subjecting the molecules to high pressures has produced a different mechanism for the polymerization. Second, the amount of pressure necessary to start a rapid polymerization of the ethylene is quite critical. Only a moderate change in pressure above a certain high value will change the polymerization reaction from one of insignificant velocity to quite a high one. Further increase in pressure will cause an increase in the velocity to some extent. However, a pressure is soon reached above which the reaction velocity is not changed much by a mounting pressure. It seems as though the high pressure had overcome some critical barrier to reaction; just as in the case of the mercury droplets, a minimum pressure was necessary to make them coalesce.

Let us pursue this picture of the effect of pressure a little further. The ethylene molecule is a very simple molecule with a high degree of symmetry. Therefore, one might expect to be able to pack these molecules quite close together with the reactive double bonds contiguous. However, in the case of derivatives of ethylene such as various vinyl compounds, the pendant groups upset the symmetry of the molecule and offer steric hindrance to close packing. So one might expect that a higher pressure would be necessary with these unsymmetrical molecules to bring about a rapid polymerization.

As a matter of fact, it has been found that for some vinyl compounds, higher pressures are necessary for rapid polymerization than with ethylene. This is especially interesting since the vinyl compounds can be polymerized slowly to high polymers at atmospheric pressure, something that cannot be done with ethylene. In a general way these observations give support to the view that high pressures have brought about an activation by the distortion of the molecule.

Actually this is undoubtedly not the whole story since polymerizations involves three steps, namely initiation of the chain, chain growth and termination of the chain. Pressure could have a decisive effect on any one of these. But there is no question that the crowding together of the molecules causes associations that do not exist at lower pressures.

At quite low pressure, of the order of 3,000 pounds per square inch, ethylene will form a very stable hydrate with water. This compound is quite stable and may completely block high-pressure lines despite considerable pressure gradients. Further, ethylene under 25,000 pounds per square inch will readily dissolve a number of organic solids or liquids. Such phenomena are observed for many gases under pressure. Nitrogen, for example, is usually considered a rather inert material. At a pressure of 100,000 pounds per squire inch or so, it can take up a fair amount of normal lubricating oil—a fact which is sometimes troublesome. Gases only exhibit this solvent power under sufficiently high pressures to have the molecules packed closely together.

In the investigation of the influence of high pressure on chemical reactions, it is important to know precisely the temperature, the pressure, and the time of residence of the molecules in the reaction zone. We have found that good

control of these conditions can only be obtained in experiments in which the reactants are passed through the reaction zone. In other words, a flow system is much superior to a static system. If the experiments are performed by merely charging a heavy-walled container with the reactants and bringing the system to pressure, very little precise information is learned. So it is strongly urged that flow systems be used by those investigating reactions under high pressure. In order to operate a flow system it is necessary to assemble an apparatus composed of pumps, piping, valves and pressure controls. The extra effort in doing so is well repaid by the speed and precision with which experiments can be done. We view the static type of experiment as a purely exploratory one to establish whether a reaction takes place at all.

To my knowledge, however, it has been always necessary to transfer the study of the reaction to a flow system to learn much of anything about the reaction.

The desire, nevertheless, to operate a flow system at high pressures brings up another problem. In addition to the fact that many materials may freeze under pressure and clog the lines, the viscosities of many liquids rise quite rapidly with pressure. This may not be of too much importance up to 50,000 pounds per square inch, but above that figure fewer and fewer materials can be pumped at a suitable rate because of either solidification or because of the extreme viscosities. We have developed a pump that will behave rather well somewhat above 100,000 pounds per squire inch, but because of the factors just mentioned there are very few materials outside of the permanent gases that remain sufficiently fluid to be pumped at such pressures.

High-pressure chemical reactions can be attractive commercially. Processes are now operated up to 50,000 pounds per square inch which is a considerable increase over the prewar figure of 15,000 pounds per square inch. But for a process

to be attractive for large scale operations, it must be an exceedingly rapid reaction to allow a high throughput. There are two reasons for this requirement. First it is feasible to build a high-pressure reactor of a few gallons capacity as contrasted with a 1,000-gal. autoclave. Second, for its size, high pressure equipment is expensive and, therefore, it is necessary to process a large amount of material through moderate size equipment to lessen the investment.

Up to the present time, only a relatively few people have studied the effect of pressure upon chemical reactions. Since the results of using high pressures are highly unpredictable, particularly with regard to the acceleration of reactions, more investigators with broad interests would doubtless disclose new observations of importance. At the present time, the great lack of empirical knowledge of chemical reactions at high

(Continued on Page 22)

Pressure—The Unknown (Cont.)

(Contined)

pressures has retarded the systematic exploitation of this field.

Besides contributing to our knowledge of chemical reactions, high pressure studies may also reveal information with regard to the structure of matter. The tremendous volume of work done by Professor Bridgman has been directed toward this goal and the examination of the influence of pressure on physical properties.

An example of this is the study of the behavior of water under pressure at different temperatures. Water is one of those few abnormal substances that expands on freezing. As a result, the application of pressure causes the freezing point to be lowered until at —22 degrees C. and 30,000 pounds per square inch the ice crystal gives up the struggle to maintain itself and collapses into a more compact crystal structure. Progressive increase in pressure raises the melting point of this form of ice so that it can exist at higher temperatures. Higher and higher pressures change the ice into other crystal types which are stable at higher temperatures. In fact an ice, termed "hot ice" by Professor Bridgman has been formed well above the boiling point of water by the tremendous pressure of 600,000 pounds per square inch. The change from one form of ice to another occurs at a definite temperature and pressure. This is reminiscent of what we said earlier regarding, first, the mercury droplets, and second, the polymerization of ethylene. Since the crystal structure collapses because the applied pressure overcomes the repulsive forces within the crystal, the use of high pressure serves as a means of studying these forces.

These brief remarks on the study of the effect of high pressures have shown that high pressure work should prove fruitful in two great divisions of chemistry, namely, (1) the study of the physical properties and structure of matter, and (2) the nature of chemical reactions.

A Hearty Welcome to The Following New Members

BROWN, Bruce W., 2721-31st Ave. So., Seattle 4, Wash.

BREKKE, John E., West Wash. Exp. Station, Puyallup, Wash.

ALLAIRE-WOODWARD, Inc., 591 National Ave., Chehalis, Wash.

BRIDGEFORTH, Robert M. (Jr.), 9055 E. Shorewood Drive, Apt. 674, Mercer Island, Wash.

BUCKHAM, James A., 1823 Ravenna Blvd., Seattle 5, Wash.

CARROLL, Cecil D., 3209 No. 26th St., Tacoma 7, Wash.

CUNNINGHAM, Leon W., Jr., 4092 Union Bay Circle, Seattle 5, Wash.

DANDLIKER, Walter B., Dept. of Biochemistry, School of Medicine, University of Washington, Seattle, Wash.

DEL GUZZI, John, 605 E. 11th St., Box 409, Port Angeles, Wash.

HALSEY, George D., Department of Chemistry, University of Washington, Seattle, Washington

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STRAWBERRY JAM JAM

After opening and diligently searching through a jar of strawberry jam, Mrs. Smith was surprised to find only one strawberry. Intending to be sarcastic, she wrapped the strawberry in a bit of wax paper and sent it with the following note to the makers:

Dear Sir

I found one strawberry in a jar of your strawberry jam. Inasmuch as I fear this is a mistake, I herewith return your strawberry.

Yours truly,

Mrs. Smith.

The reply she received went as follows:

Dear Mrs. Smith:

We are returning your strawberry. It is yours by right. It is now the policy of this company to insert one strawberry in every jar of our strawberry jam.

Yours truly

J. L. McIlvanie,
Fifth vice president
in charge of public
relations.

Il donna ses noms et qualitès: docteur David Matthieu, mèdecin en chef de l'hóspital Ambroise-Parè, officier de la LLègion d'honneur. En d'autres temps, un tel tèmoignage aurait suffisamment èclairè le commissaire. Mais alors, en France, les savants ètaient suspects.

—Anatole France.

Nothing more impairs authority than a too-frequent or indiscreet use of it. If thunder itself was to be continual, it would excite no more terror than the noise of a mill. —Anon.

She: "Now that I've told you my past, do you still want to marry me?"

He: "Yes, beloved."

She: "I suppose that you will expect me to live it down."

He: "No, I expect you to live up to it."

Why are there so many virgin forests? Only God can make a tree.