# Comments and Communications

## On Structural Variation in Conifer Wood

We have noticed with great interest the comment of R. D. Preston (*Science,* 112, 312 [1950]) about our note on x-ray investigation of the change in orientation of cellulose in sound and infected tracheids of chir (*Science,* 111, 151 [1950]). Regarding his contention that we have not referred to his work in our note, we have to say that as his brilliant work is not directly related to our discussions we avoided referring to it in our short preliminary note; we shall refer to it in detail in our complete paper. The extreme variability of structure in conifer wood, as pointed out by him, was also mentioned in our note and therefore received our very special attention. Contiguous chips from a region in the block of the sample which looked quite homogeneous have been used in the experiment, one chip being taken for an x-ray photograph of the sound wood, and another to obtain the photograph of the infected sample. As we obtained the same result on repeating the experiment a number of times, the results cannot be spurious. We are, however, attempting to take x-ray photographs of the same sample before and after infection, but as the samples for x-ray photographs are quite thin it is difficult to avoid complete disintegration of the sample on infection.

Dr. Preston's suggestion that the observed results are due to the removal of a disordered fraction of cellulose as a result of selective enzymatic action on disordered cellulose only appears to be too premature. Attempts are being made to bring out the mechanism that produces this interesting result.

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## The Earth's Origin

Harold C. Urey (*Science,* 110, 445 [1949]) has suggested that the core of the earth was composed of "moon-like material" surrounded subsequently by a uniform mixture of stone and iron. Later this core rose to form the Pacific Basin. The composition of Earth, Venus, and Mars can be explained by chemical reactions occurring at temperatures of 1,500–1,600° A. In a personal communication Dr. Urey wrote that he believes the earth is becoming 1,000 degrees hotter per billion years, and that the solar system condensed from cold gas and dust. Some of the difficulties inherent in this hypothesis are:

*a*) When the original core of the earth was gathering its mantle of stone and iron, the moon, revolving around the earth, should also have acquired a similar mantle.

*b*) The terrestrial rarity of neon requires that the earth condensed from dust and gas, in which the concentration of this cosmically abundant element was vanishingly small, for neon could not have escaped capture unless the temperature had been from 5,000 to 8,000° A.

*c*) If, as Urey suggests, condensation occurred at temperatures of 1,500–1,600° A, the anhydrous atmosphere would necessitate the assumption that Mars condensed in an anhydrous region of space, for water could not have been thermally dissipated from Mars at the temperatures postulated by Urey.

*d*) The formation of the Pacific Basin as postulated by Urey requires that the original core, which he assumes to have been of "moon-like material," should rise to the surface as a whole in order to form "the Pacific Basin with its floor of basaltic rock." Even if the earth had an original core of rock, it could scarcely have bobbed up in one piece, for the tensile strength of rock, especially if hot, seems inadequate to permit the leading hemisphere to pull the following hemisphere downward past the center of the earth. Instead, the buoyancy of the core would have pulled it apart into many fragments, thus forming, not one Pacific Basin, but many basins with "basaltic floors" scattered over the face of the globe.

*e*) The expansion of the earth in becoming 1,000 degrees hotter would be expected to cause tension failure all over the earth, but nearly all the failures are due to compression.

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## Undergraduate Chemical Research

To the average freshman on registration day, research and chemistry are synonymous, but in too many schools the chemistry major graduates without ever having experienced anything but regimented laboratory exercises, repeating classic experiments that he can find described in dozens of textbooks. Of course, such exercises are vital preliminaries to research, but they are not very stimulating to the chemistry majors we would like to encourage to go on to graduate school.

Some schools have tried to remedy the situation by assigning senior research problems, but commonly we lose our best students to mathematics or physics in their sophomore and junior years. Besides, a senior problem is often merely busy work, because its selection is limited by what is assumed to be undergraduate research ability and by what is available in the way of faculty supervision, laboratory space, credit hours, equipment, and chemicals. As a consequence, the average senior problem is not of sufficient importance to merit a paper and probably will not be published, even anonymously, in the proper tables of such data.

Yet each one of us has repeatedly searched the literature in vain for some simple constant that he knows one of his good juniors could determine if he only had the time. It is even probable that the particular constant wanted has been determined many times over because it was necessary to some larger research problem, but it has not been published or collected for the proper table of data.

Some of us have tried to encourage our seniors by assigning a problem to a team of students in the hope that, in the short time allotted, enough work will be done and enough checks made to publish the results. But almost invariably the whole project fails because one student fails to complete his share.

Many solutions to the problem of stimulating undergraduate research had been suggested and tried, including the idea of cooperative research, when a national cooperative research program was proposed by W. P. Cortelyou and the author of this paper in an article in the December 1936 *Journal of Chemical Education*.

Ultimately, the National Cooperative Undergraduate Chemical Research Program was organized at the St. Louis meeting of the American Chemical Society on September 6, 1948, to stimulate undergraduate chemical research and to supply data to fill existing gaps in the chemical literature. The major premise of the program is that usable chemical data can be obtained from check results made by two or more undergraduate students assigned to a specific determination, independent of, and unknown to, each other.

As the program is only a little more than two years old, our organization is still in the experimental stage. Our new catalogue has been mailed to about 100 schools. It lists 8 research projects that have been set up for cooperative research:

1. Sensitivity of inorganic qualitative analysis reagent solutions, directed by W. P. Cortelyou, of Roosevelt College.
2. Solubilities of inorganic fluoride salts in organic solvents, directed by John H. Walkup, of Centre College.
3. Solubilities of inorganic chloride salts in organic solvents, directed by Kirby E. Jackson, of the University of Alabama.
4. Solubilities of the inorganic sulfamates in water at various temperatures, directed by Sister Agnes Ann, of Immaculate Heart College.
5. Preparation and characterization of acyl derivatives of acenaphthene, directed by Edith J. H. Chu, of Immaculate Heart College.
6. Preparation and characterization of alkyl esters of benzenesulfonic acid, directed by Bertin L. Emling, of St. Vincent College.
7. Determination of indices of refraction of two-liquid solutions at different concentrations of each liquid, directed by R. I. Rush, of Centre College.
8. Determination of vapor pressure relations of organic compounds, directed by Elton M. Baker, of Fresno State College.

Each project is in a field of research where the techniques are within the abilities of undergraduates and in which the results will be of more than academic interest. Each project director expects to collect enough data to publish one or more papers, and adequately checked data will be sent to N. A. Lange to be published in the proper tables of the *Handbook of Chemistry*. The program is financed by contributions of $10 a year from each school sponsoring one or more projects.

Each project is subdivided into research units. A research unit is of such a nature that a student can obtain acceptable results and write a complete research report in 50 laboratory hours, the equivalent of one semester hour of college credit. For instance, a research unit of Sister Agnes Ann's project on the solubilities of inorganic sulfamates is the determination of the solubilities of calcium, barium, and strontium sulfamates in water at 20°, 30°, and 40° C.

The project director assigns each research unit to two or more students in different schools and furnishes adequate laboratory procedures. The research of each cooperating student is directed by his own teacher in his own laboratory. When the student has completed a research unit his teacher, the local director, sends his report to the project director. When a report is accepted the project director recommends that the successful student be awarded a Certificate of Acceptance by Handbook Publishers, Inc. (publishers of the *Handbook of Chemistry*).

Certificates have been awarded to 12 students cooperating on Dr. Cortelyou's project on the sensitivity of qualitative analysis reagents and to 2 students cooperating on Rev. Bertin Emling's project on the alkyl esters of benzenesulfonic acid. Both men expect to publish papers soon. Of course, each paper will list the names, teachers, and schools of the students furnishing the data used.

The program has thus already started "to stimulate undergraduate research and to supply data to fill existing gaps in the chemical literature." In addition, several logical by-products can be expected. Under this program a teacher in even a very small school may direct a research project and have enough student participants to obtain publishable results. If the program develops normally, any university might recognize a Certificate of Acceptance as a qualification for a graduate fellowship or assistantship. It has even been suggested that universities might sponsor projects in the program in much the same way that the major league baseball teams sponsor bush league teams to train potential Joe DiMaggios. Indeed, the program might be beneficial to a university's own undergraduate chemistry majors, who are often neglected because the best of the faculty, laboratory space, and equipment are reserved for graduate research.

Industry might profit by, and collaborate in, this work. When, as in the May 1950 *Journal of Chemical Education*, a list of cooperative research projects is published, individuals or companies having pertinent data in their files could submit it to the project directors to be checked by independent workers. This would help eliminate much needless repetition and result in the publication of a tremendous mass of hitherto unavailable data.

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