—the use of whole sample versus leaching techniques, correction for allogenic thorium and protactinium, and the need for determinations of isotope fractionation in dating the samples—were clarified. Among the problems that still remain unsolved are the varying results obtained in similar samples and sample preparation by different methods and measurement. It was generally agreed that it may be possible to clarify controversial issues by the preparation and inter-laboratory distribution of samples, such as red clay marine carbonates and marine limestones. These samples will be distributed among laboratories which are active or interested in dating marine sediments. Results of these investigations should be presented at a later date, possibly at a conference to be convened as a follow-up of this meeting.

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Gas Chromatography

Advances in gas chromatography were the subject of an international symposium held in Houston, Texas, 23–26 March 1964. The foreign countries represented were Canada, West Germany, Holland, Israel, Italy, South Africa, Switzerland, the United Kingdom, and Russia.

For several years it has been predicted that gas chromatography will become an analytical routine of established technique and instrumentation. The discussions indicated that this stage has still not arrived. The most noticeable current trend is the resurgence of gas-adsorption chromatography after a period of eclipse by gas-liquid chromatography. A. V. Kiselev (University of Moscow) reported studies of the adsorption of vapors on silica gels of differing porosity and water content. He found that the heats of adsorption of alkenes or ethers, or other polar adsorbates, varied with pore size and water content of the silica in a way that differs from the variation for alkanes or nonpolar adsorbates. This finding illustrates the role of specific physicochemical interactions between the surface and different chemical groupings in the adsorbate. It is the existence of such specific interactions between solutes and variously chosen stationary liquids that has given gas-liquid chromatography its recent dominance. It appears that adsorbents might also be manufactured to provide similar specificity.

Capillary columns have recently been used for gas-adsorption chromatography. H. Bruderreck (Scholven-Chemie, Germany) described capillary columns coated with graphitized carbon black, which could be used to separate hydrocarbons from C_1 to C_8 in groups according to carbon number. Many of the effects of surface nonhomogeneity—for example, peak tailing—can be removed by impregnating the graphite with a small proportion of nonvolatile liquid. G. P. Cartoni (University of Rome) described how glass capillary tubes can be used as adsorbent columns if they are first etched with sodium hydroxide solution; this etching produces a large hydroxylated surface area.

L. B. Rogers (Purdue University) reported on the use of adsorbents that had been prepared by careful elimination of water or other volatile ligands from various inorganic salts and complexes—for example, $Cu(Py)_2(NO_3)_2$. The resulting adsorbents all have a very small capacity but provide specific separations of mixtures not otherwise easily separated—for example, 2- and 3-alkanones of the same carbon number. Rogers emphasized that the recent development of gas-adsorption chromatography has been possible only because of the previous development of detectors (such as the flame ionization detector) sensitive enough to handle the minute concentrations of vapor required to keep within the linear region of the adsorption isotherms of low-capacity adsorbents. Also, it is becoming apparent that the curvature of adsorption isotherms on most of the adsorbents used in gas chromatography is due far more to heterogeneity of the surface than to incipient saturations, as described by the Langmuir isotherm.

Discussions on the development of detectors dealt with ways of making them easier to calibrate, or responsive only to selected groups of compounds, so that they could be used for limited qualitative identification. Bruderreck classified detectors into those sensitive to concentration (such as the catharometer) and those sensitive to the rate of flow of the mass of vapor through them (such as the flame ionization detector). At fast flow rates, detectors of the second class are more sensitive, but at very slow flow rates of carrier gas it may be that a concentration-sensitive detector of what is normally regarded as low sensitivity (for example, the catharometer) is more responsive than an ionization detector sensitive to mass flow.

J. E. Lovelock (University of Houston) described the construction of an ionization cross-section detector with a volume of only 10 microliters. A. Karmen (Johns Hopkins University School of Medicine) reported on a device by which the flame ionization detector could be made sensitive to halogen compounds. Metal gauze covered with sodium hydroxide is placed in the flame; halogens cause increased volatilization of the metal, and the ions of the metal are detected in a second flame above the first. The principles of the device were demonstrated by an impressive set of colored slides of apparatuses in which bunsen burners were used as the flames. Also discussed was a detector which depends on changes in the velocity of ultrasound, and one in which the vapors to be detected exchange with nonvolatile radioactive material in the column, after which the radioactivity of the exchanged material is detected in the effluent stream.

Several papers indicated a renewal of interest in the factors that produce the dispersion of chromatographic peaks in packed columns. In this connection, the theoretical work published by J. C. Giddings (University of Utah) in the last few years has clearly been a stimulus. Giddings discussed the "C-term," a quantity whose magnitude is relevant in determining the resolution secured in chromatography at fast flow rates of the mobile phase, and thus relevant in studying how to perform analyses in the minimum time. It has been concluded that the part of the "C-term" which is attributable to slow lateral diffusion of vapor in the gas phase is of primary importance in determining the performance of preparative columns. It also appears that flow turbulence may well be relevant in gas chromatography at fast flows. Previously, it had been thought that the Reynolds number for flow in gas-chromatographic columns is so small that all flow is laminar, but it was pointed out that in packed beds of irregular particles, turbulence may occur at quite small Reynolds numbers. Evidence for turbulence in pipelines carrying natural gas at high pressure and high speed was presented by regarding these pipelines as giant capil-

lary columns and applying Golay's equation for the dispersion of a small zone of vapor introduced in an instant at one point in the pipe. Measurement of the dispersion some 30 kilometers away showed the plate height to be smaller by many powers of 10 than would be expected if turbulent flow did not occur. More evidence that columns performed better than would be expected at very fast flow rates came from J. C. Sternberg (Beckman Instruments) and others, but whether this high performance was due to turbulence or to any of many other features of a complicated subject was not really clear.

Gas chromatography is at present less used than many other analytical techniques for the cataloging of reliable numerical data for analytical use. Experience has shown that analysts are reluctant to determine partition coefficients of vapors in various stationary liquids, or to use such determinations, and even reliable tables of relative retention data are rather few in number. A few years ago E. Kovats (Technische Hochschule, Zurich) proposed compilation of a "Retention Index" in which a retention volume for a given vapor in a given solvent is expressed by logarithmic interpolation between the retention volumes of the successive *n*-alkanes which are eluted before and after the vapor of interest. At the meeting Kovats pointed out the advantages of his index, and there are many indications that it will gain wide acceptance as a satisfactory means of presenting data.

A new type of liquid-liquid and liquid-solid chromatography was described by E. Bayer (Tubingen, Germany). This technique, in which surface-activated capillaries are used at ambient temperatures, is suitable for nonvolatile compounds, such as amino acids, carbohydrates, and steroids. The analysis of 22 amino acids was effected in 90 minutes. The improvement of detectors for this system should cause a renaissance of liquid chromatography.

At this conference techniques of gas chromatography, rather than its applications, were emphasized. However, several cases were noted in which solutions to problems, which could be studied by no other method, were obtained by gas chromatography (for example, the analysis of small quantities of complicated mixtures of amines of biochemical origin and the analysis of polluted air). It is important for researchers involved solely with the technique to realize that study of the detailed characteristics of the flow of a gas through an absorptive tube is trivial unless it leads to some useful result.

This symposium, the second international one to be held on this subject, was sponsored by the University of Houston.

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AAAS: Southwestern and Rocky Mountain Division 40th Annual Meeting

The Southwestern and Rocky Mountain Division of the American Association for the Advancement of Science held its 40th annual meeting in Lubbock, Texas, 26–30 April 1964. Texas Technological College served as host institution and provided facilities for the meetings.

Specially featured addresses at general sessions of the meetings included "Antarctica, frontier of international science," by Laurence M. Gould (president, American Association for the Advancement of Science). The annual John Wesley Powell Memorial Lecture was given by Eugene Shoemaker (chief, Branch of Astrogeology, U.S. Geological Survey, and research associate in Astrogeology, California Institute of Technology). Shoemaker spoke on "The history of the moon." The address of the retiring president of the Division, Edwin R. Helwig (University of Colorado) was "Chromosomal polymorphism in various populations of *Trimerotropis suffusa* (Orthoptera)."

Special symposiums consisting of invited papers included a full-day series on "Indian and Spanish American Adjustments to Arid and Semi-arid Environments," under the sponsorship of the Division's Committee on Desert and Arid Zones Research, and a single session presentation on the "Improvement of Science Teaching," sponsored by the Division's committee for that purpose. Programs of the sections of the Division included 102 individual research papers. The sessions for these papers were well attended, and generated a great deal of interest. An innovation in the sessions of the section for the Social Sciences was a series of lecture and audience-participation demonstrations in which the computer is used as a teaching machine in various