

physiochemical principles of vibratory compaction. The remainder consists of two articles by American authors and one by British authors.

Although each of the individual contributions is good, the book suffers in that the articles are disjointed, the subject matter is not comprehensively covered in certain areas, and there is some unnecessary duplication in figures and data among the various articles. It would have been preferable if a comprehensive new book had been written on this subject, rather than a simple compilation of some of the better articles existing in the literature.

The Russian article presents interesting data and concepts previously unavailable in English language articles. The work covered is very broad, ranging from vibratory compaction of metal and ceramic powders to vibratory compaction of sandy soils and concrete mixtures. This study is unquestionably the most comprehensive existing publication on vibratory compaction principles.

The second article, by R. K. McGeary, is a reprint from a 1961 *Journal of the American Ceramic Society* on the mechanical packing of idealized spherical particles. When first published, McGeary's work was viewed as an excellent basic study of carefully characterized spherical particles which were ideal in behavior. With the advent of spherical nuclear fuel particles, McGeary's work now assumes significant commercial importance.

The contribution by P. E. Evans and R. S. Millman discusses vibratory compaction of typical irregular particles. This article demonstrates the difference in packing behavior of typical non-ideal particles as contrasted to McGeary's idealized spherical particle work.

The final study by J. J. Hauth summarizes the extensive work performed by Pacific Northwest Laboratory on vibratory compaction of ceramic nuclear fuels. This article is especially useful to those working in the nuclear field.

The excellent bibliography greatly enhances the book's value. All important publications to date on vibratory compaction are referenced.

In summary, the book is probably the most comprehensive existing document devoted entirely to vibratory compaction and hence is of

considerable value to those interested in that subject.

Harry M. Ferrari is Manager of the Fuel Analysis Section in the Nuclear Fuel Division of Westinghouse Electric. He has held various management positions at Westinghouse, all related to nuclear fuel technology. In 1960-1961 he served as Technical Advisor to Fiat in Turin, Italy on Euratom contracts. He received a BS from Wayne State University and an MS and PhD in Metallurgical Engineering from the University of Michigan.

BOLSHEVIK BUBBLES

Title Bubble Chambers

Authors Yu. A. Aleksandrov, G. S. Vornov, V. M. Gorbunov, N. B. Delone, and Yu. I. Nechayev

Translation Scripta Technica; William R. Frisken, Translation Ed.

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Pages xii + 371

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Reviewer R. I. Louttit

Bubble chambers have been used effectively for about ten years in experiments in high-energy physics. Their high spatial resolution and reasonably high density interaction medium have made them ideal for the study of many characteristics of the "fundamental" particles of matter and their interactions with each other. A bubble chamber is a device which presents a transparent, superheated, liquid target (often liquid hydrogen) to a beam of high-energy protons or other particles from an accelerator, and in which the paths of charged particles are made visible by the growth of bubbles on the heat spikes left in their wake. A magnetic field is normally provided to permit momentum determination from the curvature of the tracks. These are recorded on film, and the

"events" are deciphered later through measurements on curvatures, angles, density of bubbles along tracks, etc.

The fundamentals involved in accomplishing all this, including the theory underlying the formation, growth, and recondensation of bubbles in superheated liquids, are treated in great detail in this book. Its tone is that of a pedagogical text, written at roughly the level of a graduate engineering course.

There is a good introduction, which would make worthwhile reading for all engineers and technical specialists charged with responsibility for operation of bubble chambers. It will also provide the novice with a reasonable picture of what a bubble chamber is required to do. One very thorough chapter is devoted to the problem of illuminating and photographing vapor bubbles in liquids. Serious photographers will, however, note a glaring error in the result given for the relationship between intensity of image and field angle θ . This is stated as a $\cos^7\theta$ dependence, but, fortunately for wide-angle photography, it is actually only $\cos^4\theta$.

As long as the book sticks to the theoretical aspects of its subject, it does a commendable job, but in its illustrations of the technology, it shows its true age. Most chambers referred to as first-line experimental devices were actually retired years ago in favor of larger, more accurate second-generation chambers. These latter chambers, some of which have now been in operation for five years, are mentioned as though they were in preliminary design. As a result, the book fails to report on several recent important technological improvements. These include the use of neon-hydrogen mixtures in hydrogen chambers to produce a target medium of continuously variable density (1965); the use of "superinsulation" in cryogenic chambers to reduce radiation heat loads to near-negligible levels (1963); and the use of Scotchlite as a retrodirector of illuminating light (1963), which made feasible the design of very large chambers ($>10\text{ m}^3$). The book contains no reference later than 1963.

The final part is devoted to methods for obtaining useful data from the pictures, and to various types of possible experiments. It

contains one section, which may be of special interest to the readers of this journal, on the use of a bubble chamber as a high-efficiency spectrometer for low-energy neutrons, giving very good energy resolution.

The translation is generally good in that the language is fairly relaxed and normal, but the book contains a large number of errors, most of which seem clerical in nature. Where they result in misspelled names, they are of little importance, but where they yield incorrect functional relationships, they become irritating.

R. I. Louttit is a Physicist in the Bubble Chamber Group at Brookhaven National Laboratory. Aside from research in high-energy physics, his principal work has been in the design and operation of hydrogen bubble chambers. He received his PhD from Washington University in St. Louis in 1958 and has since been at Brookhaven except for 1963 and 1964, when he was at the Center for Nuclear Research at Saclay, France, to oversee the construction of a hydrogen bubble chamber for the Deutsches Elektronen Synchrotron in Hamburg, Germany.

ELEMENTARY, MY DEAR WATSON

Title Proceedings of the First International Conference on Forensic Activation Analysis

Editor Vincent P. Guinn

Publisher Gulf General Atomic, 1967

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Price \$7.00

Reviewer Mary T. Kinsley

These proceedings cover 24 papers presented at the First International Conference on Forensic Activation Analysis, held in September 1966 at General Atomic Laboratories in San Diego, California. The conference was attended by law enforcement people and most of the nuclear scientists active in the field of forensic activation analysis. Papers were presented by both

groups. Nine countries were represented at the Conference: Australia, Brazil, Canada, England, France, India, Japan, Scotland, and the United States. The conferees were introduced to the neutron activation method, to the past and current trends in forensic activation analysis, and to the legal aspects involved in the acceptance of data obtained by a rather new scientific method.

The conference was divided into three sessions. Conferees were introduced to "Forensic Activation Analysis" in the first session. Scientific papers in this session described the method, related pioneer work in the field, and explained the composition of activation analysis laboratories of various complexities. Legalistic papers in this session related the Internal Revenue Service utilization of the method and the difficulties encountered in the introduction of a new scientific method in court. "Forensic Activation Analysis of Various Evidence Materials" was dealt with in the second session. The papers described the application of activation analysis to prove the authenticity of old paintings, regenerate old documents, compare paint samples, analyze commercial glasses, detect gunshot residues, and characterize ammunition. The third session was devoted to the "Neutron Activation Analysis of Hair." Hair is widely studied in forensic science because it is a very common piece of evidence in criminal cases.

The application of activation analysis to forensic problems is not well developed technically. Only a small number of people with limited support are working in this field; therefore, the results are limited and much more study is needed. The forensic scientist should evaluate this technique with other technologies such as gas chromatography, emission spectroscopy, atomic absorption spectrometry, and mass spectrometry. Neutron activation analysis probably has greater potential because of its sensitivity, specificity, and the nondestructive nature of the analysis when matrix effects can be compensated for or eliminated. Many interesting applications in the book illustrate the present development of neutron activation analysis in forensic science and the value of acquiring compositional data while keeping the evidence intact. However, more intensive studies for all types of

criminal evidence are needed before the method can be accepted. It would be hazardous to rush such evidence into court before the method is fully developed. Libraries of reference data, accurate correlation and interpretation of data, and standard reference materials are needed. The increased potential described by some conferees could then be realized. For example, they suggest sample coding—the intentional addition of stable, easily activated isotopes to manufactured products that will help identify and trace the origin of samples used as criminal evidence.

Increasing interest by law enforcement people makes the book's appearance particularly timely. These proceedings should introduce the method and help them understand its limitations as well as its great potential. Activation methods are not readily recognized and accepted, even by the scientific community, since they are not generally well known and are usually handled by a specialist. Rather elaborate and expensive facilities are necessary; therefore, the method must be "sold" by dispersing information. Scientific acceptance is imperative before the method can be accepted in the courts. Legal authorities usually follow a traditional conservative approach. More cooperation and understanding are needed between scientists and legalists so that this method can be utilized to solve forensic problems.

The compilation in one book of all neutron activation work relating to forensic science is the chief value of this volume. Several pictures of attendees in conference and touring the laboratory and views of the site in general contribute very little to the book. Activation analysts will find no new work presented in these proceedings but may be interested in the problems encountered in the introduction of new scientific methods in court and in the judgment of the scientific merits of these methods by lay persons whose backgrounds are not generally associated with science. Law enforcement people are introduced to a new method that has the potential of replacing several old nonspecific forensic methods and of expanding the capabilities of forensic science.

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