Meetings

Allergies: Ecological Approach

The first annual meeting of the Society for Clinical Ecology was held in Chicago on 24 April 1966. The meeting was scheduled just prior to the annual meeting of the American College of Allergists because of the increasing interest of allergists in the broader scope given to their practices by the ecological approach. Interest in the field of clinical ecology has been expanding since Theron G. Randolph began calling attention to a broader spectrum of responses in patients seen during his treatments of allergy. Most significant observations have concerned the frequency with which patients showed mental aberrations, such as mental depression, schizophrenic-like reactions and other behavioral disturbances, in addition to more classical allergic symptoms such as asthma, hives, and headache. Observations of particular interest concern the tendency of such reactions to be caused by a variety of chemical exposures such as pesticide residues, volatile, and dissolved emanations from plastic material, airborne residues from gas kitchen and heating units, and fumes from auto exhausts and industrial operations.

Presentations covered various aspects of clinical ecology such as environmental engineering, objective measurements of clinical reactions, eosinophilic cellular changes caused by food allergy, and the experimental reproduction of clinical syndromes in the animal laboratory.

After confirming Randolph's observations in her own practice, Eloise W. Kailin (Washington, D.C.) secured the cooperation of Clifton Brooks (president of the organization) to establish by the double blind method that systemic reactions in susceptible individuals occurred to liquid foods stored in soft plastic containers. With the help of Lois Platt, Kailin found that women afflicted with the chemical reaction syndrome showed a diminished number of sex chromatin cells in buccal and vaginal smears. The sex chromatin count increased toward that of normal women as symptoms were brought under control by proper management of diet and environment.

Alicia Hastings, using the electromyograph, collaborated with Kailin. She showed that patients complaining of fatigue as a symptom of the chemical reaction syndrome developed electromyographic evidence of cerebral suppression of muscle when a solution of DDT, diluted from 10 to 1000 parts per million, was held under the nose and inhaled for 5 to 8 minutes.

Investigating these phenomena further in the laboratory, Alsoph H. Corwin (Johns Hopkins University) reported results of his experiments on allergies induced by food and inhalants in guinea pigs. Corwin pointed out that von Pirquet originally defined allergy as an altered reactivity without implying that it was necessarily immunological. In line with von Pirquet's definition, possibilities such as enzyme deficiencies or inherited or acquired metabolic defects (which modern methods may reveal to be associated with altered reactivity) can be blanketed together under the term allergy. For experimental purposes, it is required that the altered reactivity should be consistently reproducible and should be susceptible to measurement. Accordingly, Corwin chose guinea pigs as the animal and the pulse rate as the physiological indicator. His experiments presented a series of technical challenges. Allowances had to be made for the individual reactivity of guinea pigs. All animals would develop some kind of spontaneous, allergic reaction which would remain consistent for that animal, but in each case the particular food or inhalant causing the allergy was not predictible. Instruments had to be developed which would allow recording of the heart rate without disturbing the animal. Also, in order to study inhalant allergies, flowmeters were devised to measure dosage of impurities introduced into the air. By trial and error, conditions were found which would consistently produce the lowest control pulse rate. Then various foods and inhalants were found to act as accelerators or decelerators on the pulse rate. The dosimeter was also applied to the study of reactions to inhalants in human beings and revealed that 20 percent of the student population reacted to ethyl acetate, a substance to which people are exposed regularly in vinegar and alcoholic beverages.

The concepts presented at this meeting offered a hopeful outlook to clinicians in caring for "problem" patients often labeled "psychosomatic." Such patients have not been adequately studied in respect to their individual reaction to foods and inhalants of their environment. Information gained from clinical observations on these patients is needed by architects, environmental engineers, and dietitians to plan dwellings, factories, and a regimen of living which will reduce exposures to substances most often found responsible for reactions. With adequate study of these patients, one can observe not only the reversibility of symptoms, but various stages of adaptation. If the reaction is not brought under control, the breakdown of adaptation could produce acute or chronic illness.

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Shock Metamorphism of Natural Materials

As recently as 60 years ago, it was generally considered unlikely that the impact of meteorites on the surface of the earth could produce any large or lasting effects. Proponents of the theory that the 4000-foot-diameter crater east of Flagstaff, Arizona, had resulted from such an impact were often regarded with the inattention and amused tolerance currently given to flying saucer fanatics. In the relatively

brief period since then, and particularly during the last 15 years, it has generally become accepted that hypervelocity impact of meteorites has occurred on the surface of the earth during geologic time, forming structures that range from shallow pits less than a hundred feet across to huge disturbed circular structures tens of miles in diameter.

The general acceptance of meteorite impact as a rare but spectacular geological agent is one obvious effect of the recent blending of several seemingly unrelated lines of scientific study into a new, exciting field of study dealing with the various effects of transient high-pressure shock waves passing through terrestrial materials. This broad area touches on the diverse fields of geology, geophysics, geochemistry, mineralogy, petrology, solid state physics, nuclear engineering, astronomy, astrophysics, and meteoritics. However, the recent rapid development of the field results from the combination of two areas of research. Geological studies of terrestrial impact structures have identified and described shock-produced effects in the target rocks. More recently, a variety of shock-wave and cratering experiments with both conventional and nuclear explosives has provided, under reasonably controlled conditions, considerable basic data for interpretation of the larger terrestrial structures.

Since 1945, experimental studies have contributed, often indirectly and unintentionally, to the study of impact structures. Cratering experiments have produced close structural analogues of terrestrial impact craters and have provided much quantitative information about the mechanism of crater formation. Smaller shock-wave experiments have provided basic data on the behavior of natural materials under transient pressures and have succeeded in duplicating many of the petrographic effects observed in naturally shocked rocks.

The expansion of the space program has given new and continuing impetus to studies in these areas. The data from the Ranger and Mariner IV pictures demonstrate that two of the three closely observed planetary surfaces are heavily cratered, raising the possibility that meteorite impact may be a more effective geomorphic agent on other planets than on the earth. Further, in view of the continuing controversy as to the impact or volcanic origin of lunar craters, the plans for imminent surface study on the moon and return of lunar samples have stimulated a search for definitive criteria for the effects of impact-generated shock waves on rocks.

Against this background, a Conference on Shock Metamorphism of Natural Materials was held at the National Aeronautics and Space Administration's Goddard Space Flight Center in Greenbelt, Maryland, on 14–16 April 1966. The conference had several purposes: (i) to bring together investigators in various related fields for presentation of their work and for informal discussions; (ii) to present a group of papers that would summarize the status of investigations of shock metamorphism; and (iii) to attempt to describe criteria uniquely diagnostic of shock effects for use in studying terrestrial craters and returned lunar samples.

Approximately 85 persons attended. Papers were grouped into six categories—theoretical high-pressure studies; artificial cratering experiments; natural and artificial shock metamorphism; and two sessions dealing with the microscopic deformation effects observed in shocked rocks.

The newness of the field is reflected in the uncertainty of definitions for the phenomena observed; many of the descriptive terms have been introduced from geological terminology. It soon became evident that some of these terms are being strained in their application to phenomena which lie outside the realm of geological experience. A working definition of shock metamorphism, suggested by Bevan French, might be "the totality of observed effects in natural rocks resulting from the passage of transient high-pressure shock waves." However, the papers in the section on shock metamorphism, particularly the reviews by Wolf von Engelhardt and E. C. T. Chao, indicate that the phenomena are entirely different from normal terrestrial metamorphism.

Conventional terrestrial metamorphism generally involves temperatures of a few hundred degrees, pressures generally less than 10 kilobars, and times of millions of years; under such conditions, mineralogical and chemical equilibrium is generally established within a large volume of rock. Shock metamorphism, by contrast, results from transient conditions with durations of milliseconds, peak temperatures of several thousand degrees, and peak pressures up to several megabars. Under these conditions, chemical kinetic effects play a large role and disequilibrium effects are common. Certain of these high-temperature disequilibrium effects, described in impactite glasses by A. El Goresy, provide a useful set of impact criteria, since many of the reactions involved (for example, the decomposition of zircon to baddeleyite) require temperatures well above those observed in normal geological processes.

The possibility of using textural criteria in rocks to establish grades of different shock-metamorphic intensity was indicated by Wolf von Engelhardt and E. C. T. Chao in their studies of material from the Ries Crater in Germany, and by M. R. Dence in his description of the Canadian impact structures. Their studies indicate that planar deformation structures appear in quartz and feldspar at the "low" grades. At successively higher grades, quartz and feldspar are converted in situ into isotropic "glasses"; mafic minerals, such as hornblende and pyroxene, lose birefringence and apparently decompose by reactions involving oxidation. At the highest grades, the rock shows partial to complete melting, forming a glass in which definite flow structure is developed. Chao pointed out, however, that the development of such textures may be strongly conditioned by the rock structure, mineral composition, porosity, water content, and other factors, so that their use as exact pressure and temperature criteria may be hazardous.

The large number of recent studies was emphasized by the papers dealing with terrestrial impact structures. William Cassidy described briefly a new meteorite crater in Chile, formed in granite and about 1500 feet in diameter. Current studies by the Dominion Observatory of Canada, presented by M. R. Dence, have identified two new probable impact structures (Pilot Lake and Nicholson Lake) from geological studies. These results bring to about a dozen the number of probable impact structures identified on the Canadian Shield since the program was begun by C. S. Beals and his coworkers. Their program also indicates the usefulness and importance of geological and petrographic studies of such structures and also serves to underscore the importance of diamond core drilling in such studies. Almost

all of the material which showed diagnostic shock criteria had to be obtained by drilling; surface studies would not have provided sufficient evidence for identification of the structures. The importance of drilling was also emphasized in a brief note by M. A. Carrigy and Nicholas M. Short on the Steen River structure, Alberta, a subsurface anomaly for which the impact origin was proposed on the basis of deformational structures observed in small samples of drill core.

Field mapping of young, well-preserved impact structures supplies basic geological and petrographic data on structures whose impact origin is generally accepted. Reports dealt with the Campo del Cielo group (William Cassidy) and with the Henbury Craters in Australia (Daniel J. Milton). Milton's detailed structural study of the Henbury group noted certain structural features which may serve to distinguish impact craters from their volcanic counterparts. In particular, he cited outward radial movement of material along shallow inward-dipping faults as one feature which may be characteristic of impact craters.

The enigmatic problem of the "cryptovolcanic structures" and the shatter cones which they contain was discussed in three papers—a general review by Robert S. Dietz, and detailed mapping studies of the Flynn Creek (by David Robby) and Wells Creek (by Richard Stearns) structures in Tennessee. True shatter cones, Dietz reported, have been found from 17 circular structures for which an impact origin has been suggested, including the large Sudbury and Vredefort structures. Shatter cones have not as yet been observed from known volcanic or metamorphic structures. The two detailed mapping studies provided no definite evidence for an impact origin of either structure, nor was an impact origin disproved. The occurrence of a central uplift in each structure is difficult to reconcile with a simple impact origin, but similar uplifts have been observed in several of the Canadian structures.

It is still uncertain whether shatter cones are unique indicators of impact-produced shock waves. It is not yet proven that they require shock waves for their formation, or, if so, what pressures they represent. Some theoretical and experimental studies could make a solid contribution to the origin of these much-debated structures.

Artificial cratering studies have complemented investigations of terrestrial impact structures in two ways—the craters themselves provide structural analogues and the associated theoretical calculations of cratering mechanics are applicable to impact events as well as to nuclear explosions. Eugene Shoemaker, describing his geological mapping of the Teapot Ess and Jangle U nuclear craters, pointed out numerous structural similarities to impact craters. He also emphasized that there are structural differences which may prevent exact comparison of cratering mechanics in the two cases. Donald Gault, in his experiments with a high-velocity projectile gun, has been able to duplicate many impact structures on a small scale, forming faults and folds which resemble those observed in smaller natural impact craters. More importantly, his experiments have allowed him to investigate the effects of variations in velocity, impact angle, and target strength on the form of the resulting crater.

Theoretical calculation of crater formation, using basic data on materials and combined with computer programs, was discussed in detail by J. T. Cherry and J. S. Kahn. Among the applications of such techniques to impact structures is the possibility of predicting the pressure-temperature-time distribution within the crater and of estimating where ejecta may be found. While such numerical methods have been long applied to cratering studies, they hold particular interest for geologists who, in studying and identifying impact craters, must locate clearly shocked material and make deductions about its history.

Microscopically detected changes in shocked rocks may provide the most powerful and general method of recognition of shocked materials. These features include planar deformation lamellae in quartz and feldspar, partial fusion of refractory minerals, and a variety of effects reflecting lattice damage produced within individual crystals by shock waves. These criteria can be detected in extremely small specimens, and may prove extremely important in identifying impact structures from drill core samples or (in the near future) from small samples of returned lunar material.

Nicholas M. Short told how textures similar to those in naturally shocked rocks can be duplicated by nuclear events and by small chemical explosions. Such experiments are at present crude and qualitative, but they do provide a similarity in microscopic textures with naturally shocked rocks which has not as yet been observed in materials from other geological environments.

The unique planar structures produced in shocked quartz were investigated. The lamellae are crystallographically controlled; as many as five to seven distinct sets of parallel planar features may occur in the same quartz grain, producing an appearance totally unlike that of ordinary naturally and artificially deformed quartz. Neville Carter suggested that deformation features parallel to the $(10\bar{1}3)$ rhombohedral direction in quartz are common in shocked quartz from known impact structures, but rare in metamorphically deformed quartz; this feature may constitute a unique criterion of shock origin. Wolf von Engelhardt reported that the $(10\bar{1}3)$ planes are common in quartz from the Ries Crater and from the Canadian craters; he reported that basal deformation lamellae (0001) were even more frequently observed. The significance of such structures was enhanced by a thorough review by John Christie, describing, by comparison, the types of deformation observed in quartz deformed under non-shock conditions. Charles Sclar reported that the deformational structures appeared present in shocked quartz down to dimensions accessible by the electron microscope.

Although these unique deformation lamellae may constitute the surest and most obvious criterion for identifying shocked rocks, there is much debate as to their character and origin. Short suggested that the planes are actually open fractures, while Christie argued that the fractures are closed. Von Engelhardt presented microscopic observations which suggested that the fractures are actually filled with a glass-like material.

Less well understood are a variety of observed effects representing progressive destruction of the crystal lattice by shock waves. Small-scale shattering and distortion of the lattice can be detected by x-ray crystallographic methods. Frank Dachille presented some preliminary data which suggest that shock deformation of quartz and carbonate minerals can be recognized and distinguished from normal geological deformation. Michael Lipschutz applied similar methods in recognizing

shock effects in the minerals of iron meteorites.

An extreme case of lattice deformation is the observed in situ conversion of quartz and feldspar into isotropic materials which preserve the original shape of the grain. Such material, formed from plagioclase feldspar (maskelynite), was recognized by Tschermak in 1872 in the Shergotty meteorite; similar material has since been observed in shocked terrestrial rocks. The exact character of such material is uncertain. It possesses considerable order, since T. E. Bunch reported that the material could be converted to single grains of feldspar by heating. It seems accepted that such material has resulted from shock deformation, but the mechanisms are uncertain. Terminology is also a problem here. It may be best to reserve the term "glass" for material that has actually developed flow structure, using some other term for glass-like material produced by shock below the melting point. Von Engelhardt's proposed use of the term "diaplectic" to describe mineral grains whose crystal structure has been destroyed by shock met with considerable argument and discussion.

Like most meetings dealing with new scientific areas, the conference provided some basic data and answers, while at the same time creating and discovering a new host of questions and problems. Many questions require further study. One objective of the conference was to promote work in these directions. The major problem is that detailed mechanism of shock wave interaction with crystals and with polycrystalline aggregates is so complex as to be still poorly understood. Further theoretical and experimental studies are needed. Specific problems include the significance of shatter cones as shock criteria, and the exact nature and origin of the quartz deformation lamellae which seem to provide such a good record of shock waves. Another problem of interest for the geologist is the comparative study of explosive volcanic rocks to study what deformational features develop under the supposed lower pressures which characterize such processes. Finally, little thought has been given to possible interactions between intense shock waves generated by large impacts and the earth's crust; such interactions might produce geophysical "rebound" effects and strongly modify the original shape of large craters.

The conference was jointly sponsored by the Goddard Space Flight Center, the Geophysical Laboratory of the Carnegie Institution of Washington, and the Branch of Astrogeology of the U.S. Geological Survey. A few copies of the conference program, containing the abstracts, are available for distribution.

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Diseases of Laboratory Animals

The diseases of laboratory animals was the topic of the fourth annual meeting of the Gesellschaft für Versuchstierkunde in Copenhagen 21–23 April 1966.

The significance of *Mycoplasma* strains, closely related to those that cause disease in laboratory rodents which are isolated from man, was discussed by E. A. Freundt (Aarhus University, Denmark). Although guinea pigs and rabbits are generally believed free of mycoplasmas, limited serologic evidence suggests that they occur in these animals.

B. E. Gustafsson (Karolinska Institute, Stockholm) warned against overlooking residual germ-free characteristics in cesarean-derived, so-called SPF (specific-pathogen-free) animals. The germ-free animal differs greatly, both anatomically and physiologically, from its less restrictively raised counterpart. The extremely large ceca found in certain germ-free species is an example of this difference. Another difference is a clotting defect, related to a vitamin K deficiency, observed in rats and mice. Both of these conditions are readily treated by the addition of specific microorganisms to the intestinal flora. All the differences between germ-free and conventionally raised animals and the microorganisms useful in treatment are not known. One purpose of the studies of Gustafsson and his associates, therefore, is to determine the composition of the "minimal flora" required for germ-free animals to be useful as a nucleus for an SPF colony.

J. S. F. Niven (National Institute for Medical Research, London) discussed the recent reports concerned with the activation of latent Tyzzer's disease in mice after thymectomy. Although Tyzzer's disease was considered unique to mice, recent well-documented reports also describe the disease in rabbits. What she believed to be Tyzzer's disease occurred in a colony of rhesus monkeys. The disease was characterized by diarrhea, loss of weight, extensive liver necrosis, and a high mortality rate. Typical "Tyzzer's-like" organisms were found within the liver cells of these primates.

F. Wensinck (Bakteriologisch-serologisches Laboratorium der Rijksuniversiteit, Gronigen, Holland) reviewed the advantages and disadvantages of the various techniques and substances used for sterilization and disinfection in laboratories housing animals. Discussing chemical disinfection, he remarked about the confusion caused by conflicting recommendations made by producers of disinfectants. He indicated surprise at the sustained interest in the phenol coefficient, an extremely poor method for evaluating disinfectants.

All the papers will be published in *Zeitschrift für Versuchstiekunde*. The *Zeitschrift*, comparable in many ways to the American journal, *Laboratory Animal Care*, is devoted exclusively to the publication of articles on medicine, science, and technology in connection with laboratory animals. Now in its ninth volume, it publishes articles in either German or English.

The commercial exhibits were both interesting and instructive. Most major European and many American producers of laboratory animals, animal equipment, and diets were represented.

The Gesellschaft is the European equivalent of the American organization specializing in laboratory animal science, the Animal Care Panel. It was founded in Germany, and its first two meetings were held in that country. The 1965 meeting was held in Zurich and, although it is international in scope and attendance, all papers and discussions at this meeting were in German. The meeting in Copenhagen was truly international in scope, attendance, and presentation. More than 200 laboratory animal specialists from 12 European countries and the United States participated. Of the 19 papers presented, 12 were given in English.

The next meeting of the Gesellschaft will be held at Prague, Czechoslovakia, 26–28 April 1967. Its theme is to be laboratory animal nutrition and metabolism.

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