mineral crystals of the shell. The composition of proteins of closely related species occasionally show some remarkable differences but, in general, prove to be quite similar. Representatives of very old families were found to exhibit relatively small differences. Proteins having the same function can thus remain essentially unchanged for long periods of time; in this sense, evolution is not inevitable (Abelson). The general problem of relating a time scale to rates of change in some proteins was discussed by several participants (Abelson, Margoliash and Smith, and Mayr).

W. D. McElroy, H. H. Seliger, and M. De Luca explored the catalytic properties of firefly luciferases and concluded that subtle differences in protein structure can, without change in the catalytic center, lead to different colors of light and thus have selective significance. They found that conformational changes are important not only for catalysis, but also for the resonance energy levels of the excited states. A wide range of spectral variations was observed when the emission spectra of 20 species of firefly were measured in vivo. The possibility of isozymes was indicated by the presence of two different luciferases in a single organism, the "automobile bug." In flight, this firefly emits a bright yellow light; when resting, the unconventional insect shows green "parking lights."

The role of specific selective pressures in the evolution of specific proteins was stressed by S. E. Luria. *E. coli* and *Shigella dysenteriae* have immunologically very different β-galactosidases, although the corresponding genes are homologous by genetic test. Unlike *E. coli, Sh. dysenteriae* lacks galactoside permease and, consequently, shows impaired galactoside utilization. It therefore seemed significant that the *Sh. dysenteriae* enzyme was rather ineffective. On the other hand, this organism's *i* gene (whose regulatory action tends to prevent formation of such ineffective enzyme) functions as well as the ***i*** gene of the *E. coli* strain tested.

In the evolution of proteins, even amino acid residues without known functional significance must have high selective value, and there must be strong selection pressures constantly, in view of the remarkable uniformity of the amino acid sequence for a particular protein in individuals of a given species (Mayr). Protein regions of unknown functional significance may, for example, be concerned with the attachment of the protein to appropriate structures (P. Siekevitz).

Evolution of Pathways: Conservation of Function

The evolutionary fate of a biosynthetic pathway can be regarded as reflecting the fate of the participating enzymes. Clearly, through the eons, extensive changes tend to accumulate in the enzymes, the translation and transcription machinery, and the genes themselves. In contrast, the catalytic function of enzymes—and hence the pathways in which they act—often seems to persist with impressive tenacity. What is conserved in this context, therefore, is function, not structure.

In organismal evolution, the appearance of some key compounds and, presumably, of the means for producing them must have been decisive events in diversification. K. Bloch concluded that among such key compounds are certain lipids (which function as components of cytoplasmic and intracellular membranes). Thus, sterols occur in all eucaryotic cells, but not in the procaryotes examined. Polyunsaturated fatty acids are found in eucaryotes and in the photosynthetic apparatus of blue-green algae, but otherwise are absent from procaryotes. Evidence justifying a distinction betwen animal- and plant-type polyunsaturated fatty acids was also presented; organisms such as chrysomonads showed dual traits in this respect. Steps for the introduction of double bonds into fatty acids and into intermediates of sterol synthesis require molecular oxygen as a direct electron acceptor. Bloch suggested that the advent of molecular oxygen in the atmosphere during evolution not only facilitated the development of a vastly superior system for energy metabolism, but also provided a unique reagent for biosynthetic innovations of pivotal evolutionary importance. Accordingly, the occurrence of special lipids and of the facilities for their production are very well correlated with phylogenetic considerations.

A tracer study on the distribution of two different lysine pathways over a range of organisms was described by H. J. Vogel. One of the paths (via α, ε-diaminopimelic acid), which may be the more ancient, was found in bacteria, blue-green and green algae, nonvascular and vascular higher plants, and certain lower fungi distinguishable by type of spore flagellation. Other lower fungi, as well as higher fungi and euglenids, exhibited the second lysine path (via α-aminoadipic acid). The consistency in the distribution of the two paths indicates a high phylogenetic significance for the character, lysine synthesis. A common ancestor of organisms having the α-aminoadipic acid path was postulated. The inferred ancestor was viewed as an organism, not producing lysine, in a line that had veered from the main stream of evolution of the plant kingdom in the direction of animality.

In trying to contemplate, as a whole, the variety of findings reported at this symposium, one gains a palpable impression of the molecular raw material of evolution. A range of evolutionary constancy and variability in the nature and workings of nucleic acids and proteins is now becoming discernible. In other contexts, structure is often associated with sameness, and function with change. At this meeting, we have seen many fascinating examples of macromolecular variation and of metabolic constancy. In the domain of evolution, have Parmenides and Heraclitus reversed their roles?

The National Science Foundation furnished financial support for this symposium. The proceedings will be published in book form.

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Military Problems in Cold Regions

Examples of failure to prepare adequately for military operations in cold regions can be found in history from the time of Hannibal to the Korean conflict. Cold, darkness, wind, snow, ice, muskeg, glaciers, vast unpopulated areas, insects, ice fog, and whiteouts are well-known examples of factors which characterize the harsh and hostile arctic environment. It is depressingly true that many of the major military problems faced by our troops in Korea more than 10 years ago are still with us today. A periodic reminder of this fact, an assessment of the current status of research that is nibbling at the edges of military operational problems, is not only enlightening but serves as a stimulus for a more concerted effort toward their resolution.

Such a stimulus was provided by a symposium reviewing research on military problems in cold regions presented at the 15th Alaska Science Conference at Fairbanks on 1–4 September 1964. Approximately 400 scientists from Alaska and other states attended.

The purpose of the symposium was to focus attention on problems which affect military operations in cold regions, to outline the major research efforts being expended to solve these problems, and to point out some promising avenues of approach to future research. E. F. Clark (Army Research and Development Directorate, Washington) opened the symposium with a paper on the philosophy for military research and development in Alaska. He particularly stressed the point that as a nation we have not developed as positive an attitude toward the Arctic as we have toward the Antarctic.

Troy L. Péwé (University of Alaska) summarized the climatic and terrain features of Alaska which are particularly pertinent to military operations. Unpublished data included maps showing the extent of past and present glaciation in Alaska, the distribution of ice wedges and permafrost types, and the degree days of freezing. Lt. Col. Richmond (Combat Developments Agency, U.S. Army, Alaska) followed with a summary of major army operational problems in cold regions, a summary based primarily on observation of maneuvers and field operations of the army in Alaska. He particularly stressed problems associated with cross-country movements of vehicles and personnel, failure of materials in extreme cold weather, control of ice fog, the effect of permafrost and frozen ground on construction and explosives potential, and the omnipresent problem of soldier load in the Arctic.

Murray M. Jacobson (U.S. Army Materials Research Agency, Watertown, Mass.) reviewed problems associated with rubber, plastics, and lubricants in cold regions. In cold environments, most engineering metals actually become stronger, but they lose ductility and become dangerously brittle. Thus the major problem at low temperatures is brittle fracture. The presence of notch defects, particularly in the case of high-strength alloys, plays a predominant role in contributing to sudden brittle fracture.

Military construction problems in Alaska were summarized by Col. Byron Kirkpatrick (deputy district engineer, Anchorage). He stressed the need for better insulation and vapor barriers in exterior wall construction and the elimination of through-metal connections and metal windows which transmit cold to interior surfaces, thus inducing condensation and frosting. He emphasized the need for (i) lighter, stronger, cheaper, and more efficient construction materials; (ii) improved or new materials, particularly bitumen, concrete, and paint which can, hopefully, perform the desired function and which can be placed, worked, and cured under all conditions of weather; (iii) better construction equipment; and (iv) improved construction techniques to provide a better project in a shorter period of time.

Lloyd K. Clark (Clark and Groff Engineers, Salem, Oregon) discussed arctic and subarctic sanitation under field conditions. He cited the discomforts and dangers inherent in current disposal practices. Recommended research studies included inquiry into the feasibility of containing human waste in individual containers; development of chemical oxidants and disinfectants which, in small quantities, would effectively disintegrate or destroy waste bacteria; and adaptation of supply containers to use for waste disposal. He concluded that sanitation under field conditions in the Arctic is practically the same now as it was when man first came to the region.

Problems of the mobility of vehicles over snow and muskeg were summarized by Sterling J. Knight (Army Waterways Experiment Station, Vicksburg, Miss.). Most tracked vehicles, but very few wheeled vehicles can move on snow. The type, wetness, depth, and strength of snow were cited as being particularly significant factors in vehicle mobility. In general, only a few of the very low-ground-pressure, tracked vehicles can drive over muskeg. The type and strength of muskeg and the depth to a frozen layer appear to be most important parameters in this respect. Knight stressed the need for greatly increased emphasis on field studies, on remote sensing of terrain conditions, on quantitative terrain analysis, and on the fundamental relations between vehicles and the media on which they operate.

Melvin Marcher (U.S. Geological Survey) covered water supply problems in Alaska. He discussed distillation of sea water, the problems involved in utilizing surface water in Alaska, and the location of groundwater supplies in permafrost areas. He stressed the utilization of infiltration galleries in permafrost areas given a certain set of hydrologic conditions.

The problems associated with long-distance radio communications in the polar regions were discussed by Howard F. Bates (Geophysical Institute, University of Alaska). In general, it has been found that if long-distance communications are disrupted because of some abnormal disturbances, the best technique is to shift to a higher frequency rather than lower as is now the practice. Absorption effects decrease rapidly with frequency, and propagation over non-great-circle paths appears more prevalent at higher frequencies.

W. Keith Boyd (U.S. Army Cold Regions Research and Engineering Laboratory, Hanover, N.H.) reviewed C.R.R.E.L.'s basic and applied research activities in such diverse fields as ice mechanics, arctic pile foundations, and permafrost hydrology.

Reports on research into human factors affecting arctic military operations reviewed current research and identified areas which require attention in the future. W. H. Hall (Army Research Institute of Environmental Medicine, Natick, Mass.) discussed research aimed at improving the effectiveness of arctic military operations. The necessity for defining the environment in "biologically-determined engineering design parameters" was emphasized. Information of this kind is a prerequisite not only for quantification of the design of protective clothing but also for assessing the usefulness of military training and conditioning programs. R. F. Goldman (A.R.I.E.M.) noted that conventional clothing is unable to protect a soldier for 8 hours at −40°F in a 5-kilometer-per-hour wind unless supplemental heating of the hands and feet is provided. A 7-pound (3.18-kilogram) auxiliary heating system which provided the additional heat necessary to meet an 8-hour requirement was described. S. J. Kennedy (U.S. Army Natick Laboratories, Natick, Mass.) in a discussion on clothing and equipment advances reviewed the "thermolibrium" concept which envisions a single, total body clothing system to provide mechanical, respiratory, and thermal protection against multiple environmental stresses. He was followed by C. J. Eagan (U.S.A.F. Arctic Aeromedical Laboratory, Fort Wainwright, Alaska) who presented a modified wind-chill chart describing the wind-chill indices as equivalent temperatures under calm conditions. The chart has proved more useful and understandable than previously used environmental cooling power charts; it has been distributed in pocket-card form to all military personnel within U.S. Army Alaska. R. G. Possenti (Arctic Aeromedical Laboratory) concluded by reviewing his work on small group performance at remote military sites.

This symposium brought together many scientists and interested military observers from Alaska and from the other states. The variety of subjects discussed indicates the considerable scope of scientific talent required to resolve the problems of military operations in cold regions. Research specialities represented included biology, civil engineering, geography, geology, geophysics, hydrology, materials engineering, physiology, and psychology. Even with such a multidisciplinary representation it was recognized that only a fraction of the military problems and research needs for cold regions could be summarized. A welcome interest was shown in the symposium by military representatives stationed in Alaska. Such symposiums tend to strengthen the ties between the scientific and military communities and to narrow the gap between research effort and military needs.

This conference was held under the auspices of the Alaska Division, AAAS. The papers presented at this symposium are scheduled for publication as part of the *Proceedings of the 15th Alaska Science Conference* about 1 January 1965.

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Magnetism: A Decade of Conferences

The Tenth Annual Conference on Magnetism and Magnetic Materials, held in Minneapolis 16–19 November, completes a decade of unprecedented activity in magnetism in the United States. This is shown by comparison with two conferences that preceded this series. A "Ferromagnetic Symposium and Conference" was held in 1931 in Schenectady; volume 39 of the *Physical Review* contained the full text of the two symposium papers, abstracts of the seven conference papers, and summaries of the discussion. The "Washington Conference on Magnetism" was held in 1952; the 67 papers, with discussion, were published in *Reviews of Modern Physics* in 1953. The program of the 1964 conference listed 22 invited and 149 contributed papers, as well as an evening symposium. This report will therefore deal not with individual papers but with the following topics: fields attained, materials studied, measurement techniques, and theory.

An impressive forward step during this period was the upward extension of available steady magnetic fields. In 1931, it was usual to produce a few hundred gauss with solenoids or a few thousands with electromagnets; in 1952, attainment of 35 kilogauss was reported; in 1964, fields to 80 or even 100 kilogauss "are now economically within the reach of most research budgets." This accomplishment is the result of development of new superconducting materials. Fields as high as 255 kilogauss are available at the M.I.T. National Magnet Laboratory. Research applications of these high fields are still few; but there has been great expansion of the range of materials studied and of the measurement methods applied to them.

The 1931 conference dealt with ferromagnetic metals (iron, nickel, and cobalt) and alloys. The 1952 conference devoted much attention to new high-resistivity ferromagnetic compounds (ferrites) and antiferromagnetic compounds. The basic principle in both is that the coupling between nearest-neighbor spins tends to orient them antiparallel (rather than parallel, as in iron), so that the spins form two sub-lattices with opposite spontaneous magnetizations. In antiferromagnets these sub-lattice magnetizations, in the absence of a field, cancel one another; in ferrites they cancel one another only incompletely because, though opposite in direction, they are not equal in magnitude. Since 1957, still another group of compounds has been investigated: those in which the sub-lattice magnetizations fail to cancel one another because, though equal in magnitude, they are not quite opposite in direction (hematite is an example). The theory that explained this "weak ferromagnetism" led also to predictions of other interesting properties, such as magnetoelectric interactions, in certain compounds. Like the ferrites, but more complicated (having more than two sub-lattices), are the ferromagnetic garnets first studied in 1956. All these materials—metals, alloys, ferrites, garnets, weak ferromagnets, antiferromagnets, and magnetoelectric materials—received attention at the 1964 conference. In addition to composition, size and geometry are important. In 1931, only material in bulk was studied; in 1952, there was great attention to fine particles; in 1964, the interest has shifted to thin films. This interest has been generated by the need for faster magnetic memory elements for computers; the microsecond switching time is the chief limitation of the ferrite cores now being produced in great quantity.

In 1931, measurement of magnetic properties usually consisted of fluxmeter observations of static hysteresis curves. By 1952, ferromagnetic resonance (resonance of the precession of spins about a d-c field in response to a transverse microwave field) had been discovered, had been used to get information about ratios of magnetic moment to angular momentum, and had been applied in the development of microwave devices such as "gyrators." Now, in 1964, the garnets have provided narrower resonance-line widths, and thin films have permitted observation of spatially nonuniform resonance modes; "microwave devices and magneto-optics" provided material for one session of the latest conference. A technique new in 1952, but the topic of an entire session in 1964, was direct study of ordered spin structures (as in an antiferromagnet) by neutron diffraction. A technique still new in 1964 is use of the Mössbauer effect to measure microscopic effective magnetic fields.

In 1931 spontaneous magnetization was explained with the Weiss molecular-field theory, reinterpreted on the basis of elementary ideas about exchange forces. In 1952 exchange itself was the topic of a symposium, and the statistical mechanics of the Ising model was the subject of a 37-page review. The 1964 papers show considerably more progress in the statistical mechanics of such localized-spin models than in the quantitative theory of exchange forces in metals. Several new theoretical techniques have been developed. They have been ap-