Meetings

Polar Geology

A symposium on geology held at the annual meeting of AAAS in Cleveland (27 Dec.), dealt with two main areas—the Arctic and Antarctic.

Several researchers from Ohio State University reported on recent studies in the Tasersiaq area of southwestern Greenland. S. B. Treves (Nebraska and Ohio State) stated that the Precambrian igneous-metamorphic complex underlying the eastern area includes two periods of intrusion and metamorphism. This is confirmed by a radioactivity analysis of zircons and biotite from a red gneiss in which the age of the the zircons is about 3000 million years, and that of the biotite is about 1900 million years. K. R. Everett (Ohio State) found, on a gneissic terrain, Artic brown soils and weakly developed Podsol on valley terraces, and Artic brown soils on ground moraine and colluvial slopes. Much of the upland area has little or no soil development. In summer, reversal of water circulation occurs in soils, especially on slopes, and results in an efflorescence of $CaCO_3$ and sodium and magnesium salts on the surface. D. D. Koob (Ohio State), studying plankton in freshwater lakes in the same area, reported that photosynthetic activity may occur under ice when the lakes are frozen and adult zooplankton populations may survive the winter. He also noted that seepage lakes supported smaller, but much more diversified, phytoplankton communities than those supported by glacier-fed lakes.

The structure of the Arctic Ocean Basin was discussed by N. A. Ostenso (Wisconsin). Results of a continuing program of magnetic and gravity surveys led to the interpretation that the basin is composed of four deeps, which are apparently oceanic in structure and are separated by the Alpha and Lomonosov Ridges (of continental structure) and a trans-Arctic Ocean continuation of the mid-Atlantic Ridge. The Central Siberian or Angara Shield does not connect with the Canadian Shield, as indicated by Soviet investigators.

J. A. Dorr (Michigan), on a somewhat different topic, reported that although there is abundant fossil evidence for intercontinental faunal migration and additional evidence for a Bering Land Bridge, after three summers of field search he failed to produce fossil evidence to support the proposition that Alaska was part of a migration route inhabited at various times in the Tertiary by vertebrate faunas moving between Eurasia and North America.

Several discussions dealt with current U.S. Antarctic activities in bedrock geology. In the Robert Scott Glacier area of the Queen Maud Range, V. H. Minshew (with C. H. Summerson, both of Ohio State) described a detailed later Paleozoic succession of alternating sandstone, shale, and coal, characterized by a *Glossopteris* flora. He suggested a correlation of his major units with those in the Ohio Range and Queen Alexandra Range, equating his nonglacial basal conglomerate with the tillites present in the other two areas. J. J. Anderson (Texas), presenting the results of Minnesota's studies (C. Craddock *et al.*) in the Ellsworth Mountains, noted that there were 12,000 meters of folded sedimentary rocks which have been moderately metamorphosed, and are composed mostly of clastics but have a thick carbonate unit near the base. Fossils indicate most of this section is Paleozoic in age. In the Antarctic Peninsula and southern Chile, Cretaceous sediments were desposited by along-slope and down-slope currents (K. M. Scott, M. Halpern, and R. H. Dott, Jr., Wisconsin) while these areas and the intervening areas were part of an islandarc system. Dating indicates that major orogenesis and plutonic activity in both areas lasted from earliest Cretaceous to early Tertiary.

The structure of the Transantarctic Mountains was discussed by E. S. Robinson (Wisconsin) on the basis of results of seismic, gravimetric, and magnetic surveys. He postulated a major fault extends along the west coast of the Ross Sea and along the fault significant horizontal displacement has occurred. No such fault is indicated on the East Antarctic side of the mountains where crustal thickness is 10 kilometers thicker than the section in the Ross Sea area. This theory leads to a modification of the "Great Antarctic Horst" concept.

J. M. Schopf (U.S. Geological Survey and Ohio State) reported that terrigenous deposits with plant fossils are represented along the Transantarctic Mountains for about 2400 kilometers. Leaves of *Glossopteris* are most common and, in the absence of Carboniferous or Triassic associates, suggest a Permian age. Plant microfossils also indicate a distinctly gymnospermous Permian flora. M. E. Pryor (Ohio State) observed that about 30 free-living and 28 ectoparasitic species of arthropods have been found in Antarctica, but that the source of the present free-living fauna is unknown. It is not proved that dispersal by wind occurs other than within the continent. The present free-living arthropod fauna may represent both relics from an ancient temperate fauna and post-Pleistocene immigrants from other continents or subantarctic islands.

Two related reports were concerned with studies in southern Victoria Land in Antarctica. R. L. Nichols (Tufts), discussing interglacial features in Wright Valley, said that the excessive salinity below the 60-meter depth in Lake Vanda resulted from the evaporation of a larger body of water with a lower salt content during Loop-Trilogy interglacial time. E. E. Angino (Texas A&M) studied the geologic implications and the chemistry of three saline lakes (one of which was Lake Vanda) in Victoria Land. Significant chemical differences exist among the lakes. The lake waters are clearly stratified into distinct layers; this suggests either more than one period of concentration or possibly different origins for the waters of the layers. The chemical zonation may have been initiated by past climatic variations; available evidence favors both a thermal and marine origin for at least some of the waters.

M. B. Giovinetto (Wisconsin) reported that the mean mass flux at the periphery of the Antarctic Ice Sheet is $(0.85 \pm 0.46) \times 10^{14}$ grams per kilometer per year, and the mean ice thickness is 350 ± 175 meters, suggesting a mean rate of ice movement on the order of 285 ± 155 meters per year. Variations in Antarctic sea-ice distribution between 7° and 92°W longitude were discussed by J. A. Heap (Michigan), who said that evidence from 62 years of study at Laurie Island suggests a repeated shorter-term variation with about a 4-year period, and one longer-term (1923–32) variation with prolonged severe ice conditions. The superabundance of ice in the 4-year cycle may be due initially to a persistent cyclonic cell over the Weddell Sea; the prolonged period was linked with low air temperatures which prevailed less strongly north of the Antarctic Convergence. In the Ross Sea area of Antarctica, L. K. Lepley (Texas A&M) believes the submarine morphological features are directly related to the continental ice sheet. He attributes the great depth of the outer shelf to isostatic depression by the continental ice when the ice was more extensive, and the origin of Sulzberger Bay possibly to erosion by a locally accelerated "ice stream" during glacial maxima. He considers longitudinal and transverse submarine ridges as moraines. An interesting laboratory study (L. D. Taylor and J. Gliozzi, Ohio State), using a Coulter counter as a tool in stratigraphic studies of Antarctic firn, concerns a quantitative analysis of solid matter (1 to 3 microns in diameter) contained in firn cores. One result of this study indicates a possible 2-year cyclic variation in particulate distribution with depth.

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The Ionosphere and Radio Propagation in the Lower Frequencies

Recent results of investigations of the ionosphere, with particular emphasis on radio propagation in the lower frequencies, were presented at a session of the third western national meeting of the American Geophysical Union in Boulder, Colorado, 27 December 1963. The papers dealt with seven topics: "Schumann' resonances of the earth-ionosphere cavity; measurement of the phase velocity of very low frequency waves in the earth-ionosphere cavity considered as a waveguide; chemionization in the ionosphere; F-region theory; evidence that certain magnetic micropulsations may be excited by slow electrons trapped in the magnetosphere; statistics of occurrence of very low frequency emissions, including comparison of magnetically conjugate locations; and theory of the interaction of very low frequency waves with fast trapped electrons.

Simultaneous measurements made in the frequency range 0.2 to 5.0 cycle per second at several low-latitude stations were presented by Lee Tepley, (Lockheed Missiles and Space Co., Palo Alto, Calif.). A number of simultaneous records at magnetically conjugate stations, Kauai and Tongatapu, showed similar patterns of periodically enhanced pulsations with a period of about 2 minutes, but out of phase by 180 degrees. At Canton Island, near the magnetic equator in the same magnetic meridian, the pattern appeared to be a superposition of those at Kauai and Tongatapu. Such an alternation of enhancements in opposite hemispheres was predicted by the theory of Jacobs and Watanabe, who supposed that hydromagnetic waves would be generated by slow electrons trapped in the magnetosphere.

J. R. Wait (National Bureau of Standards, Boulder, Colo.) extended the theory of resonances of the earth-ionosphere cavity, initially published by W. O. Schumann in a series of papers beginning in 1952. The resonant frequencies are roughly related to the reciprocal of the time taken by an electromagnetic signal to go around the earth (1/7 second). The problem is treated generally in terms of a contour integral, and specific solutions were obtained which facilitate the interpretation of experimental data.

Charles Polk (University of Rhode Island, Kingston) reviewed the evidence for enhancement of noise generated by thunderstorms at the Schumann resonant frequencies. The data seemed to show reasonable correlation with thunderstorm activity, but less well-marked correlation with solar flare activity and sunspot numbers.

Speaking on phase velocity at very low frequencies and the height of the lower ionosphere, F. K. Steele (National Bureau of Standards, Boulder) gave an account of phase and amplitude measurements of 18-kc/sec waves transmitted simultaneously at Jim Creek, Washington, and at Balboa, Canal Zone. Measurements of relative phase of the two signals at Boulder (Colorado), College (Alaska), Maui (Hawaii), and Tucuman (Argentina), permitted the phase velocity to be calculated, and from this, by the theory of propagation in the earth-ionosphere waveguide, it was possible to deduce the effective height of the bottom of the ionosphere. The results, 70 km in daytime and 95 km at night, are in good agreement with other data.

R. D. Cadle (National Center for Atmospheric Research, Boulder) presented data and arguments to show that important amounts of ionization in the ionosphere are contributed directly by certain chemical reactions. Laboratory studies of chemionization reactions suggest rate constants comparable to those for neutral gas-phase reactions; this together with available information about the concentrations of reacting constituents suggest that the following reaction is likely to be important in the E and F regions:

$$N(^2P) + O(^3P) \rightarrow NO^+ + e.$$

In the D region, the chemionization reaction of sodium with atomic oxygen appears to be the important one:

$$Na + O + O \rightarrow Na^+ + O_2 + e.$$

The theory of the F-region is extremely difficult because effective recombination times tend to be comparable to the length of the day; diffusion is strong and is complicated by the earth's magnetic field; and transport of ionization by winds and electrodynamic forces tend to be important. T. Shimazaki (National Bureau of Standards, Boulder) reported some results of a systematic theoretical analysis of night-time variations of the F-region electron density over Puerto Rico. Two approaches were made. In one the temperature was assumed to remain constant, and vertical drift was invoked. The remarkable result is that the phase of the drift oscillation, required to make the theoretical time variation agree with observation, is almost exactly that of the current system for the geomagnetic quiet-day (S_q) current system. In the other approach, drift was assumed to be absent, and the night-time temperature decrease (about 15 percent) required for agreement of the theoretical electron density variation with the observed variation is quite reasonable. Further analysis is required to determine the proportion in which the two effects are present in nature.

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