E-11. Earthquakes in Iowa: past, present, future. R. S. CARMICHAEL *Dept. of Geology, Univ. of Iowa, Iowa City IA 52242, and R. ANDERSON, Iowa Geological Survey, Iowa City IA

A current review is made of the relationship between historical seismicity (location of earthquake activity) and geologic structure of the basement rock, for Iowa and the central midcontinent. Such work is part of an evaluation of seismic risk for siting major facilities such as nuclear power plants and dams, in a project of the Iowa Geological Survey being funded by the Nuclear Regulatory Commission. In the past 130 years, Iowa has felt modest effects from 11 earthquakes with epicenters located in the State, from about 18 more near its borders, and has felt dozens more with epicenters as far away as Charleston S.C., Quebec City, and Oklahoma. Iowa and its environs are in a geologically stable region of ancient tectonic development. The good news is that it is thus unlikely to have major earthquakes; the "bad" news is that a moderate earthquake, as could be expected in the area of New Madrid Mo. or the Nemaha feature in Kansas and Oklahoma, will have a much greater "felt area" and widespread damage potential here in the central U.S. than a similar-sized earthquake in the western U.S. This is due to differences in crustal attenuation and, for Iowa, directivity of isoseismal lines due to basement trends.

E-12.New Evidence of Early Ordovician Tectonism in the Upper Mississippi Valley. G. A. LUDVIGSON*, and M. P. MCADAMS, Iowa Geological Survey, Iowa City, IA 52242.

Recent stratigraphic investigations in the Upper Mississippi Valley have reinstated Ulrich's controversial "Canadian-Ozarkian" unconformity at the base of the Shakopee Fm. in the Prairie du Chien Group (Early Ord.). The cause of local angular truncation of strata beneath the unconformity, however, has never been satisfactorily explained. The hypothesis of tectonic origin was tested by making strike and dip measurements from folds truncated by the Shakopee Fm., and by measuring fracture orientations from strata above and below the unconformity. The strike azimuths measured from folds beneath the unconformity align along an E-W trend ($\bar{x}$=89°), and have a standard deviation (33°) that compares quite favorably with that from data reported from the Precambrian rocks of the Baraboo synclinorium in Wisconsin. The fracture populations from rocks above and below the unconformity were compared and found to be significantly different at the 95% confidence interval. A standardized residual technique was used to identify fracture orientations in the pre-Shakopee units which may have been present before Shakopee sedimentation. The fracture sets obtained are arrayed in extension, conjugate shear, and tension fracture orientations that would result from a stress field with σ_1 = N-S, σ_2 = vertical, and σ_3 = E-W. This stress field is consistent with the postulated E-W fold trend, strongly suggesting that the structures below the unconformity are tectonic in origin.

E-13. Hydrothermal Alteration at Mineral Creek Mines, Allamakee County, Iowa. P.L. Garvin, Dept. of Geology, Cornell College, Mount Vernon, IA 52314.

Investigations of hydrothermal alteration of carbonate rocks at the Mineral Creek Mines near Waukon, Iowa were conducted in the field and the laboratory. Sulfide ores, typical of upper Mississippi Valley-type lead-zinc deposits, were emplaced in solution collapse-related structures in the Ordovician Oneota Dolomite. Hydrothermal alteration accompanying primary mineralization produced dolomite and quartz (jasperoid). The quartz occurs in three morphological varieties: cryptocrystalline, microcrystalline, and fibrous. The first two varieties occur most often as replacements of oolites and related structures. Fibrous quartz is present as small irregular knots in hydrothermal dolomite. Both dolomitization and silicification are pervasive, with dolomite replacing quartz in most cases. Three lines of evidence support the belief that, contrary to earlier reports, most quartz is pre-hydrothermal: 1) common nodular form of the quartz, 2) pre-sulfide brecciation of quartz along with dolomite, 3) presence of preserved oolites in the quartz.

MATHEMATICS

A-1. Modeling and Control of Childhood Diseases. DAVID TUDOR, Dept. of Mathematics, Cornell College, Mt. Vernon, Ia. 52314.

Differential equations modeling the course of an epidemic were studied under the influence of an immunization program. Parameters were estimated and used to predict the efficacy of plans to eliminate certain childhood diseases by vaccination. Both ordinary differential equations and integral equations were used in the modeling process.

A-2. Symbolic Solution of Linear Systems of Differential Equations. ROBERT B. FEINBERG*, Dept. of Mathematics, and RONALD G. GROOMS, Computation Center, Ia. State Univ., Ames, IA 50011.

Let $\bar{x} = [x_1,\ldots,x_n]^T$, $x_i' = dx_i/dt$, and suppose A and b are respectively n x n and n x 1 matrices. Then the differential equation system $\bar{x}' = A\,\bar{x} + b\,u(t)$ may be solved as follows: 1. determine the minimal polynomial $H(t) = c_0 + c_1 t + \ldots + c_{k-1}t^{k-1} + t^k$ of A with respect to b; 2. solve the differential equation $H[D]\,x = u(t)$; 3. set $\bar{x} = z_1 x + z_2 x^{(1)} + \ldots + z_k x^{(k-1)}$, where $z_k = b$, and $z_{k-i-1} = A\,z_{k-i} + c_{k-i-1}z_k$, $0 \leq i \leq k-2$. The authors plan to implement the above method in a computer program for the symbolic solution of linear systems of differential equations.

A-3. Determining elementary topological properties through an explicit construction. Donal Marxen, Dept. of Mathematics, Loras College, Dubuque, IA 52001.

Relying more often than not on existential arguments rather than explicit constructions, investigators have had difficulty in determining topological properties of such objects as the free topological group or semigroup and the free product of topological groups. In this paper an explicit construction is provided for the free topological semigroup F(X) generated by the space X. It is then shown that such properties as metrizability, separability and local compactness are transmitted from X to F(X).

A generalization of Dixmier's center-valued trace theory. I. Kovacs, Dept. of Mathematics, Loras College, Dubuque, IA 52001

Let A be a von Neumann algebra and G a group of *-automorphisms of A. Denote A^G the von Neumann subalgebra of all elements of A which are invariant with respect to each element of G. If A possesses "sufficiently many" positive normal linear forms invariant with respect to each element of G, then it is possible to construct a mapping of A onto A^G which has properties analogous to those of the Dixmier's center-valued trace in finite-type von Neumann algebras. The presentation will be introductory.

A-4. A PHYCHOLOGIST'S CONTRIBUTIONS TO MATHEMATICS. Elizabeth A. Blobaum, Clarke College, Dubuque, IA 52001.

Louis Leon Thurstone's life and contributions to psychometrics. Includes detailed development of his original learning curve equation and a revised learning function in which he defined attainment as the probability that a given practice trial would be successful. In addition, his law of comparative judgments is derived and explained. With this method, Weber's and Fechner's laws of just noticeable differences in physical stimuli were extended to include areas such as the measurement of attitudes and values.

A-5. MATHEMATICS IN THE BIOLOGICAL SCIENCES.
Renata M. Korona, Clarke College, Dubuque, IA 52001.

Topics for mathematical applications to areas in general biology, physiology, and ecology are presented as follows: the thermal diffusion equation, the theory of blood flow measurement, a mathematical model of the nerve impulse, the genetic code and nucleic acid sequences, the field of chemotherapy, the population growth curve, predator-prey population, and the circulation of phosphorus in a simple pasture ecosystem. The advantage which biologists would gain from a knowledge of the various branches of mathematics has been largely overlooked. Opportunities and investigations involving mathematical research in the field of the biosciences are just beginning.

A-6. LINEAR ALGEBRA AND ITS TOOLS. Jeanne M. Haupert, Clarke College, Dubuque, IA 52001.

A detailed background for the field of linear algebra, especially the evolution of the tools used in the field: elimination, determinants, and matrices. The historical development of the tools of linear algebra is traced in relation to the use of these tools as means of solving simultaneous linear equations. The works of such mathematicians as Leibniz, Cayley, LaPlace, and Gauss are examined in relation to the development of an important area in mathematics, physics, engineering, and economics - the field of linear algebra.

Infinitesimal Analysis - Then and Now. K.D. Stroyan, Math. Sci. Div., Univ. of Iowa, Iowa City, Iowa 52242.

Abraham Robinson's modern theory of infinitesimals ("nonstandard analysis") gives us a new perspective from which to view the history of calculus. We can interpret old proofs of Euler, Cauchy or Gauss and see what changes are needed to make them rigorous in the current sense. We can make interesting comparisons with epsilon-delta modernizations of those same proofs. Frequently the two modernizations are inequivalent! (Both are modifications and incomparable to the originals in the strictest historical sense.) Occasionally this process has useful applications in the classroom. Some of the neoclassical proofs bring helpful geometric reasoning into basic facts of calculus. In those cases instructors have a choice of either saying the pictures are "only heuristic" or of introducing the infinitesimal numbers by some simple means. I will give Keisler's axioms for hyperreal numbers and discuss several of these new old proofs indicating why they are rigorous (or rigorizable).