

GEOLOGY AND GEOGRAPHY

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ABSTRACTS

Modeling Predictive Indices for Indiana Corn Production: 1960-1969.

NEIL V. WEBER, Indiana University at South Bend.—The purpose of this study was to quantitatively analyze the relationship (linear and quadratic) between fifteen independent variables (physical and socio-economic) and corn production in Indiana during the decade of the 1960's.

Preliminary analysis utilizing stepwise regression supported earlier research purporting that climate variables alone (i.e., monthly growing degree days and monthly precipitation during the growing season of Indiana dent corn) explain very little of the variance in corn yield during the period in question.

Subsequent analysis adding additional variables to the regression equation (i.e., two mechanization terms, two socio-economic terms, and a slope variability term) significantly improved the predictive ability of the model.

Although the complex model described in this study is a marked improvement over the simpler climatic model, the regular pattern of residuals suggests a need for additional testing and refinement. Some of the questions to be investigated are as follows: Might some of the variables be governed by subtler areal specific terms? Will the model hold across larger time intervals? Can the slope variability term be improved and/or replaced?

Climatic Change in Southern Indiana 1898-1975. CHARLES STANBERRY, Indiana University, Bloomington, Indiana 47401.—Regression analysis is used to examine the monthly and annual temperature and precipitation data of six stations in southern Indiana for evidence of trends. Temperatures are found to increase in the period 1898-1939 and to decrease from 1940 onward. The temperature increase is greatest in the months December-February. Temperature decrease is greatest in January and February. A quadratic equation is fit to confirm the date of the onset of the downward trend. The analysis applied to precipitation data yields no clear cut trends. Some evidence is advanced to indicate a change in precipitation trends concomitant with the change in temperature trends.

Spectral analysis of the data yields few significant periodicities or quasi-periodicities in the data. The analysis does indicate the presence of persistence in the temperature data.

Cross spectral analysis shows that precipitation and temperature do not vary together periodically over any wavelengths.

Migration of a Meander of White River Near Worthington, Indiana. ROBERT D. HALL and SHANNON L. HALL, Indiana University-Purdue University, Indianapolis, Indiana 46247.—An analysis of aerial photographs, topographic maps, and plane table surveys from 1937 through 1968 shows that a former meander of White River south of Worthington, Indiana, extended and expanded at erosion rates as high as 30 ft/yr (9 m/yr) prior to cutoff in 1968.

Maximum rates of erosion lie along radii from the meander center that are approximately normal to former flow lines of maximum velocity. A downstream shift in the location of maximum erosive power along the meander's outer bend resulted in a rapid southwesterly migration of the meander until 1966. Rates of erosion and meander migration decreased substantially from 1966 to 1968 suggesting that some of the discharge had assumed a flow path through the cutoff chute. Cutoff seems to have occurred as the meander radius to the point of impingement of the line of maximum velocity moved close to a parallelism with the trend of the chute. The former meander is now an oxbow lake.

Horton's Laws Related to the Quantitative Fluvial Geomorphology of Three Parke County Watersheds. ROBERT TEMPLETON and JOHN E. OLIVER, Department of Geography and Geology, Indiana State University, Terre Haute, Indiana 47809.—Data derived from three small Parke County watersheds are analyzed using various methods of quantitative geomorphology. The derived results are examined in relation to Horton's Laws of stream numbers, stream lengths and stream area. In each case the quantitative relationships closely correspond to the theoretical models. Although the hypsometric curves derived from observed data indicate that a graded profile has not yet been attained, the drainage density of the three areas shows that the derived patterns fit well within the hypothesized range.

Hydrology and Water Quality of the Crooked Creek Watershed, Indianapolis, Indiana. PATRICIA A. BOAZ and ROBERT D. HALL, Indiana University-Purdue University, Indianapolis, Indiana 46247.—A study of the hydrologic and chemical parameters of the Crooked Creek Watershed, located in the northwestern Indianapolis, Indiana, reveals the effects of rapid urbanization on this fifth-order basin. The physical characteristics of the watershed favor rapid runoff and high sediment yield in response to precipitation, particularly from the upper part of the watershed where most of the drainage net is concentrated and most of the urban development is taking place.

Hydrologic data indicate that the amount of yearly runoff has increased at an average rate of 22% since 1969. The number and magnitude of peak discharges have also increased. Monthly chemical data for the summers of 1975 and 1976 support hydrologic indications of urbanization by showing marked increases in those constituents which result from increased population. Chemical studies have also located the

sources, nature, and extent of point pollution, and assessment of non-point pollution is currently underway in one subwatershed.

Images of Downtown. ROBERT B. JESSEN, Indiana University, South Bend, Indiana 46614.—As part of a study of citizen attitudes toward the downtown area of South Bend, Indiana, 1310 randomly selected respondents were asked to indicate by drawing on a map, the boundaries of what they identified as the downtown area. It was hypothesized that respondent's ability to draw the map as well as the size and boundaries of the downtown area should vary according to such factors as the respondent's age, sex, income, educational level, place of residence within the city, and uses of the downtown area. Over ninety percent of the sample were able to draw boundaries for the downtown area on the map provided. It was found that statistically significant, as well as practically significant, variations in size and boundaries of the downtown area were found for all of the aforementioned variables, except income. The greatest differences were found among persons of different educational levels and among persons who used the downtown for differing purposes.

Additionally, size and boundary variations were tested against attitudes toward the downtown. Significant differences were observed on attitudes toward security, traffic conditions and sewage provided by the downtown area, depending on the size and specific boundaries selected.

It was concluded that the term "downtown" as used in many studies is an ambiguous one. "Downtown" means different things to different persons in a spatial sense; and in turn, these spatial perceptions influence attitudes and behavior toward downtown.

A Descriptive Study of Indiana State University Faculty Settlement Patterns Over 55 Years. GROVER C. WORCESTER and BENJAMIN MOULTON, Department of Geography and Geology, Indiana State University, Terre Haute, Indiana 47809.—Between 1920 and 1975, an accelerated outward migration from Terre Haute by an expanding Indiana State University faculty was quite apparent from the interpretation of the data collected. The data consisted of addresses taken from telephone books for each of the sample years and illustrated on maps of Terre Haute. The figures were used to make percentage graphs with the two main categories being urban and rural population.

The maps showed three dominant clusters of settlement during the fifty-five-year period. Some fluctuation occurred within these clusters but their dominance remained.

The northeast quarter of Terre Haute was and still is apparently undesirable for settlement by professors.

Most significant was the increased outmigration of professors to the rural areas around Terre Haute as the years went by. The rate of outmigration is accelerated.

Except for the established areas, political Terre Haute is no longer an area generally chosen to live in by the faculty at Indiana State University.

An Approach to Automatic Well-Log Correlation. B. D. KWON, R. F. BLAKELY and A. J. RUDMAN, Indiana University, Bloomington, Indiana 47401.—Automatic (computer) correlation of well logs include how parameters of relative displacements and thickness of geologic strata affect correlation processes. These parameters are studied by operational properties of the discrete Fourier transform (DFT). It is shown that cross-correlation of power spectra can predict the thickening between two logs (stretch factor) and the cross-correlation of such stretched logs gives a relative displacement. Stretching is accomplished by interpolation.

Empirical results show that most geophysical logs are rich in low frequency components that are a source of difficulty in correlation. Hence, original data are first filtered by taking their first differences to attenuate low frequencies and smoothly enhance high frequencies. Correlation of model studies are highly effective; however, field data often need additional filtering to achieve improved results. Automatic windowing with high cut filters and statistical zonation techniques may properly select portions of the log for effective correlation.

Variability in Seven Devonian Species of *Polypora* M'Coy. JAMES F. STRATON, Eastern Illinois University, Charleston, Illinois 61920 and ALAN S. HOROWITZ, Indiana University, Bloomington, Indiana 47401.—Evaluation of 14 measurable characters indicates that seven (number of apertures in 5 mm, branch width, number of branches in 10 mm, dissepiment width, fenestrule length, fenestrule width, number of fenestrules in 10 mm) are useful for differentiating seven species of *Polypora* that occur in the Speed Member of the North Vernon Formation and the underlying Jeffersonville Limestone of southern Indiana. Meshwork formulae are presented for the following species and subspecies: *Polypora aculeata* (Hall), *P. adnata* (Hall), *P. celsipora minima* (Hall), *P. laevinodeata* (Hall), *P. quadrangularis* (Hall), *P. shumardii* Prout, and *P. transversa* (Hall). Five species are considered synonyms: *P. submutans* (Hall) and *P. blandida* Ulrich [= *P. aculeata* (Hall)], *P. laevistriata* (Hall) and *P. striatopora* (Hall) [= *P. quadrangularis* (Hall)], and *P. cultellata* (Hall) [= *P. shumardii* Prout]. *P. intermedia* Prout is considered unrecognizable. Univariate and multivariate analyses of measurements generally yield consistent results with respect to taxonomic assignments. The coefficients of variation for these polyporans are comparable to those found in other bryozoan studies.

Type III—Statistics of Extremes Analysis of Modified Mercalli Earthquake Intensities for the Eastern United States. PAUL J. HAFER and ROBERT F. BLAKELY, Indiana University, Bloomington, Indiana 47401.—The return periods of earthquakes in the Eastern United States were predicted using Type III statistics of extremes. Three sites were chosen for study. One, Anna, Ohio is a midwest location of moderate activity. The second, New Madrid, Missouri is a very active area. The third, Bloomington, Indiana is between the first two locations.

Type III statistics indicate that the most probable intensities for Anna, Bloomington, and New Madrid are, respectively, II⁺, III⁻, and III⁺. Application of the method also predicts return periods for intensity VI for the same sites of 40, 250, and 16 years, respectively.

Historically Authentic Masonry Materials in the Renovation of Christ Church Cathedral. JOHN B. PATTON, Indiana Geological Survey, Bloomington, Indiana 47401.—The original part of the "little church on the Circle" in Indianapolis, Christ Church Cathedral, was built between 1857 and 1859. Renovation now in progress has required identification and matching of masonry materials for authentic restoration and preventive maintenance.

Bearing walls consist mainly of Laurel Limestone (middle Silurian), which was formerly quarried extensively in various southeastern Indiana counties. Quoins, buttresses, and some trim are from a thinly laminated zone in the middle part of the Jeffersonville Limestone (middle Devonian), probably from northwestern Jennings County. Steps and most trim, including belt course, lintels, sills, and surrounds for door and window embrasures, are Salem Limestone (middle Mississippian) from the famed "Indiana Limestone" district in the Bedford-Bloomington region. Careful work has thus far avoided the necessity of replacing any stone.

The masonry joints are being routed by hand to a minimum depth of nearly an inch where the old mortar is sound and to firm mortar elsewhere. Interior voids and the deep parts of routed joints are filled. After this first-stage mortar has set, the mortar is brought forward to less than an inch from the face and again given time to harden, after which final pointing is done with mortar that closely approximates the original in appearance. The binding agent is two-thirds lime and one-third natural-cement mortar (the original was entirely lime). The aggregate for both the original mortar and the present pointing is more coarse than modern masonry sands. Joints are raked shallowly and brushed, retaining the outlines of the individual stones by shadow and light.

Classifications of Springs in South-Central Indiana. RICHARD L. POWELL, Consulting Geologist, Bloomington, Indiana 47401 and STEPHEN D. MAEGERLEIN, Analytical Chemist, Naval Weapons Support Center, Crane, Indiana 47522.—Spring waters issuing from carbonate bedrock of Mississippian Age in south-central Indiana may be classified according to their chemical characteristics. The springs may be ranked by size according to their discharge. The spring orifices may be classified according to their physical characteristics. The subterranean water systems may be defined accordingly.

Spring discharges range from seeps to hundreds of cubic feet per second. Seventeen springs in Indiana are estimated to exceed one cfs minimum flow.

Spring waters are generally cool and clear with an increasing carbonate content during low flow stages, and are warmer and turbid with a decreasing carbonate content during flood flow stages. Mineral springs with a high sulfate content are fed by deep ground water flow systems, but some shallow cavern flow systems have a higher than expectable sulfate content that indicates some transmissivity of deeper groundwater.

Numerous examples of several types of subterranean water systems are present: bedrock interstices systems; systems within bedrock joints and fractures; gravity flow systems within integrated, solution widened joints and solution channels; integrated, partly inundated, gravity flow and shallow artesian systems through cavernous channels; deep artesian systems, probably within cavernous openings; and combinations of the above.

Eight springs larger than one cfs are gravity flow cave springs. Six large springs are partly inundated or combined artesian and gravity flow cavern systems. The three largest springs are associated with deep artesian systems.