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## RIVER COURSES IN THE JURA MOUNTAINS.

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It is well known to readers of *Science* that Prof. W. M. Davis, in his admirable analysis of the origin of the Valleys of Pennsylvania (National Geogr. Mag., Vol. I., No. 3, 1889), started from the assumption of a purely consequent, original course for the rivers which have excavated most of the Appalachian Valleys. As an illustration of such a kind of drainage system existing at the present time the Jura Mountains were given, following a statement published by Col. de la Noë and myself in our joint work, "Les Formes du Terrain" (Paris, 1888).

More recently, however, Prof. Davis has been led to change this view, according to the results reached by Mr. Aug. F. Foerste, in his valuable account of "The Drainage of the Bernese Jura" (Proc. Boston Soc. Nat. Hist., Vol. XXV., p. 392–420, 1892).

While admitting that Mr. Foerste has clearly shown that the River Birse could not have taken its present path if it had been a purely original consequent stream, I cannot agree with him when he endeavors to show that recourse must, *of necessity*, be had to the postulate of an antecedent origin; for it seems highly improbable that such a small river, whose upper drainage area is of so little extent, could have victoriously reinted the uplift of such great anticlinals as the Graitery, the Raimeux, the Roche and the Choindez folds are. The failure of other explanations to meet the facts, which is given by Mr. Foerste, together with the systematic arrangement of several series of *cluses* in straight lines, as the main support of the theory of an antecedent origin (loc. cit., p. 411), does not seem to constitute a valid argument: are we absolutely certain not to have overlooked some possibility, which could turn out, when followed out in detail, to involve the true explanation?

But, apart from these considerations, if such is really the origin of the *Cirques* followed by the Birse, we should expect to find in the Jura Mountains many other examples of the same absence of relation between river-courses and constructional form. In order to test in a definite manner the validity of Mr. Foerste's conclusions, and to see whether his theory may be of general application in the Jura or not, my friend, Col. de la Noë, has lately drawn, at my request, a large map of the whole country between Bâle, on the Rhine, and Belley, near the Rhone, a map upon which all the heights have been referred to a common datum plane (in a stratigraphical sense), viz.: the limit between the uppermost Jurassic beds and the base of the Cretaceous (Neocomien); as a basis for the work, use was made of the sheets of the new map of France, drawn in contours with 20 metres vertical interval on the scale of 1:200,000, geological boundaries being adjusted on the same from the detailed maps of the French and Swiss Surveys. The altitude reached at any point by the horizon selected, above the present surface, if denuded, or underground, if covered by more recent deposits, could be computed with a fair degree of approximation, thanks to the numerous measurements of sections published during the last decade for various parts of the Jura; contours were then constructed, every 100 metres apart, without any regard to the present topography, and a photographic proof of the map, reduced one-half, colored in the manner of an ordinary hypsometric map.[1]

The result is very striking: nearly everywhere a strict accordance is shown to exist between the actual courses of rivers and the distribution of the lowest parts of the constructional surface; the larger streams, those which might be expected to exhibit the most irregular courses if the assumption of an antecedent origin was correct, are precisely those which follow the most closely synclinal depressions, making use here and there of *cols* where anticlinal arches are locally lowered in a transverse direction. Such is the case for the river Ain, the longest among the tributaries which the Rhone receives from the Jura, and for the Doubs, the longest stream in the whole region. A beautiful illustration of a series of *cluses* arranged in a straight line, and demonstrably correlated with the lowering of several adjacent anticlines from both sides, is given by the river Bienne, between the town of St. Claude and its junction with the Ain. Many other cases might be pointed out to the same effect, viz.: that the Jura drainage, as a whole, is typically consequent upon the deformations, and that, accordingly, Professor Davis was quite right in postulating as the initial stage, in the development of Pennsylvania rivers, essentially original courses during Permian time.

As to the special case of the Birse, no doubt that apparent exception remains to be explained; that backward erosion may have been concerned in the production of the Bernese *Cirques*, Mr. Foerste himself seems to concede, in alluding to the Crémine cirque; and I believe nobody can have seen the Soulce depression, on the outside of the Choindez fold, or the great ravine south of Châtillon, a little more to the east, without being struck by the analogy of both features with an unperfected *cluse*—and their purely regressive origin is beyond question.

A last word about the crystalline pebbles in the Tertiaries of the Bernese Jura: Mr. Foerste, following J. B. Greppin, believes that they came from the Schwartzwald, to the north of the district. But that conclusion is far from certain. Dr. Rollier, who has carefully surveyed the district on the scale of 1:25,000,

[1] The method here described does not seem to have been, as yet, appreciated to its full value. Originated, I believe, in America, with Professor Lesley's efforts, and splendidly applied to the study of the anthracite fields of Pennsylvania by his lamented assistant, the late Charles A. Ashburner, it has been but little resorted to, outside of very limited districts and for purely scientific purposes. So far as I am aware, the only similar attempts yet made to construct in contour-lines stereograms of displacements, for a broad geographical area, are Mr. Dollfus's "Carte hypsometrique de la Surface de la Craie dans le Bassin de Paris," on the scale of 1:1,000,000, published in Bulletin No. 14 of the French Geological Survey (Paris, 1890), and the two maps illustrating the shape of the Trenton limestone in Ohio and Indiana, published by Professor Orton and Mr. Phinney in the Eighth and Eleventh Annual Reports of the United States Geological Survey, respectively. I myself constructed, several years ago, a contour map, still unpublished, showing the deformations of the Dakota sandstone in western Colorado (from Hayden's atlas of that state), and where the same agreement between structure and hydrography as is here advocated for the Jura was plainly exhibited. The construction of such maps would be specially fitting in those countries where detailed geological surveys are conducted upon topographical maps in contours as a basis, such as are in most parts of Germany.

when conducting five years ago the Swiss Geological Society on the ground, expressed the opinion, then endorsed by Professor Gutzwiller and Professor Baltzer, that the pebbles, at least in part, came, on the contrary, from the south and were of Alpine origin;[2] and it may be well to recall that such was also Studer's opinion.[3] It would make the case very different, in so far as several of the paleo-geographical conclusions of Mr. Foerste are concerned.

## INDIANA ACADEMY OF SCIENCE.

THE ninth annual meeting of the Indiana Academy of Science was held in the capitol at Indianapolis, Dec. 27 and 28, 1893, under the presidency of Dr. J. C. Arthur, of Purdue University. The morning of Wednesday was devoted to a discussion of the proposed biological survey of Indiana. The directors having the survey in charge first presented reports of their respective divisions. Dr. L. M. Underwood, Division of Botany; Dr. C. H. Eigenmann, Division of Zoölogy; Prof. V. F. Marsters, Division of Palæontology. For some time there has been under discussion a plan for several states to coöperate in the work of such a survey; This matter was taken up, and Dr. J. M. Coulter, of Lake Forest, Ill., spoke for that state. Prof. R. E. Call represented Kentucky. Several of the workers on the Indiana Survey spoke on various phases of the work. "Phænerogams," discussed by Prof. Stanley Coulter; "Fishes," Dr. C. H. Eigenmann; "Plans for Successful Work," Dr. J. M. Coulter; "What Can the High Schools Do to Help the Survey?" Prof. W. S. Blatchley. "Can the Common Schools Aid?" Prof. W. W. Norman; "Mollusks," Prof. R. E. Call; "Palæontology," Prof. V. F. Marsters; "Ornithology," A. W. Butler. The discussion occupied the full half-day.

In the afternoon the Academy met in two sections, one devoted to botany and zoölogy, the other to chemistry, physics and mathematics. In the former the following papers were presented: "An Alphabetical and Synonymical Catalogue of the Acrididæ of the United States," W. S. Blatchley; "On the Hibernation of Turtles," A. W. Butler; "Some Notes on a Variety of *Solanum Dulcamara*," R. Wes. McBride; "Indiana Fishes," C. H. Eigenmann; "Review of Botanical Work in Indiana with Bibliography," L. M. Underwood; "Notes on an Imbedding Material," John S. Wright; "Recent Notes on Indiana Birds," A. W. Butler; "The Distribution of Indiana Birds," A. W. Butler; "On the Occurrence of the Rarest of the Warblers (Dendroica Kirtlandi) in Indiana," A. B. Ulrey; "Histology of the Pontederiaceæ," E. W. Olive; "Growth in Length and Thickness of the Petiole of *Richardia*," Katherine E. Golden; "The Geographical and Hypsometrical Distribution of North American Viviparidæ," R. Ellsworth Call; "Recent Notes on Cacti," J. M. Coulter; "The Field Columbian Museum," J. M. Coulter.

In the physico-chemical section were presented: "Estimation of Organic Matter in Water by the Potassium Permanganate Method," Thos. C. Van Nuys and Sherman Davis; "1. 4. Di-amino-cyclo-hexane," W. A. Noyes and H. H. Ballard; "Preliminary Note on Variations of Strength of Timber in Different Parts of the Cross Section of the Tree," Thomas Gray; "A Method of Determining Traces of Cyanogen in Organic Matter," Sherman Davis; "Integration of a Linear Vector Differential Equation," A. S. Hathaway; "An Autographic Method of Testing the Magnetic Qualities of Iron," Thomas Gray; "A Case of Stereo-isomerism in the Hydrazones of Benzoin," Alexander Smith; "Camphoric Acid," W. A. Noyes; "The Value of the Steam Pipe within the Smoke Box of a Locomotive, as a Means of Superheating," Wm. F. M. Goss; "An Experimental Study of the Action of the Counterbalance in Locomotive Drive-Wheels," Wm. F. M. Goss; "Methods of Starch Determination," W. E. Stone and D. B. Hoffman; "The Combustion Gases of the Locomotive," W. E. Stone.

Wednesday evening the Academy met in general session. The following officers were elected for the ensuing year: President, W. A. Noyes, Terre Haute; Vice President, A. W. Butler, Brookville; Secretary, C. A. Waldo, Greencastle; Assistant Secretary, W. W. Norman, Greencastle; Treasurer, W. P. Shannon, Greensburg. President Arthur then addressed the Academy on "The Special Senses of Plants."

Thursday morning the early part of the session was devoted to the reports of committees. A change was made in the constitution of the Academy providing for a body of fellows. The following papers were then presented: "Should the Study of Natural Science in the Lower Classes of the Public Schools be Encouraged?" W. W. Norman; "The Detection of Strychnine in an Exhumed Human Body," W. A. Noyes; "Absorption of Poisons by Animal Tissue After Death," P. S. Baker; "The Application of Graphical Methods to the Solution of Some Problems in Electrical Engineering," Harold B. Smith; "Induration of Certain Tertiary Rocks in Northeastern Arkansas," R. Ellsworth Call; "The Effect of Environment on the Mass of Local Species," C. H. Eigenmann.

At the afternoon session the following papers were offered: "The White Clays of Southern Indiana," A. W. Butler; "The Ash of Trees," Mason B. Thomas; "Poisonous Influence of *Cypripedium spectabile*," D. T. MacDougal; "Notes on the Biological Survey," Mason B. Thomas; "Notes on Sectioning Woody Tissues," John S. Wright; "The Stomates of Cycas," Mason B. Thomas; "Symbiosis in Isopyrum Biternatum," D. T. MacDougal; "Our Present Knowledge of the Distribution of Pteridophytes in Indiana," Lucien M. Underwood; "Concerning the Effect of Glycerine on Plants," John S. Wright; "The Adventitious Plants of Fayette County," Robert Hessler; "Bibliography of Indiana Ornithology," A. W. Butler; "Bibliography of the Batrachians and Reptiles of Indiana," O. P. Hay; "Bibliography of Indiana Mammals," A. W. Butler and B. W. Everman; "The Effect of Light on the Germinating Spores of Marine Algæ," Melvin A. Brannon; "Notes on Saprolegnia," George L. Roberts; "Contributions to the Life-History of Notothylas," D. M. Mottier; "Some South American *Characinidæ*, with Six New Species," A. B. Ulrey.

The Academy decided to hold its next meeting in May at Rochester, Indiana, where, in connection with the meeting, an exploration of some of the beautiful lakes in that vicinity can be undertaken.

—Diana Clifford Kimber will soon publish a text-book on "Anatomy and Physiology for Nurses," in connection with Louise Darche. Miss Kimber's experience as assistant superintendent in both the New York City and the Illinois Training School for Nurses has led her to feel the need of such a manual and to undertake the work. It is designed to fill a middle place between the text-book written for medical students and that for use of children in schools. The subject is presented in a scientific manner, but the technicalities which discourage the average student have been, so far as possible, avoided.

[2] See Eclogæ Geologicæ Helvetiæ, 1888, No. III., p. 281.
[3] See L. Rollier, Etude stratigraphique sur les terraine tertiaire du Jura Bernois (Archives des Sc. Phys. et. Nat., March, 1892).