PROGRESS OF BIOSTRATIGRAPHY IN THE USSR

V. K. VASSILENKO

Petroleum Institute, Leningrad, USSR

ABSTRACT.—Reference is made to recent advances in biostratigraphical work in the USSR. The value of such work in correlation, e.g. juxtaposition of stratigraphic sequence of marine and continental deposits of the same age, etc., is discussed.

To this day the palaeontological method in stratigraphy continues to be the only method on the basis of which time-rock units are separated and the sections of far removed regions correlated with each other. The latter circumstance opens up possibilities of comparing the section under study with a certain standard, i.e., of determining the geological age of the deposits.

A great deal of research work in connection with the preparation of the State geological maps as well as work of practical nature has served as an occasion in our country for an extensive development of biostratigraphy and palaeontological investigation connected therewith. Field research in stratigraphy is being supplemented by work of a great number of palaeontologists, whose number already exceeds 1,000. As a rule, all geological institutes, regional geological administrations and many manufacturing trusts have their animal microfossil, plant macrofossil and spore and pollen laboratories. Of these particular mention must be made of the Paleozoological Institute of the Academy of Sciences and of the Universities for the study of the remains of vertebrates. Nonetheless we still experience a great shortage of stratigraphists cum palaeontologists to satisfy all the practical requirements.

To start with we shall examine the approach of the Soviet geologists in the sphere of the stratigraphy of the marine deposits and then pass on to that of the continental ones.

Our geologists believe that we attain a precise, almost synchronic correlation between the sections, by following the palaeontological method for the marine deposits. The phenomenon of the transition of the complexes of the leading fauna from one horizon to another in different regions is very rare, if it exists at all. This assertion follows from our practical work and is confirmed by the observations of the rate of migration of the contemporary marine organisms. It may be that the time of migration of the marine animals is so meagre as compared with the span of the geological history that it may be regarded geologically as insignificant. Due to this circumstance, it is necessary to take the only course of the evolutionary process for the entire palaeozoogeographical sphere. Certain deviations in the conditions of existence lead to the development only of the representative forms. The partial deviations to be observed in the compositions of fauna mainly depend on the local facial conditions. The Cenomanian complex may serve as an example of such a rapid migration of homogeneous fauna.

It is necessary to emphasize these prerequisites especially because in the programme report of the USA Delegation to the last Mexican Geological Congress, great doubts were expressed about the main possibilities of synchronic correlations of sec-

lary rays 1 to 11 (low) and (d) presence of resinous tracheids. The present specimen is thus a new species of *Dadoxylon* and is referred to *D. Shuklai* sp. nov.

Besides being a new species, this form also shows an interesting combination of some *Mesembrioxylon* characters i.e. field pits bordered with a vertical pore, uniseriate round pits, sometimes biseriate sub-opposite on the one hand, and the characteristic *Dadoxylon* features on the other.

Diagnosis.—Growth rings well marked, transition from autumn wood to spring wood well defined ; resin canals or resin-filled parenchyma absent. Bordered pits present only on the radial wall of the tracheids. Radial pits uni to biseriate, contiguous, uniseriate round or biseriate sub-opposite. Pits in the field 1-4, bordered or simple with a narrow vertical pore. Rims of Sanio absent. Pits 12 μ to 15 μ. Medullary rays uniseriate (mostly) to biseriate, 2 to 10 cells high with a maximum height of 28 cells.

ACKNOWLEDGMENTS

My sincere thanks are due to Prof. V. B. Shukla for his constant and inspiring guidance in the progress of this work.

REFERENCES

BHARDWAJ, D. C., 1953, Jurassic woods from the Rajmahal Hills, Bihar *Palaeobotanist*, II, pp. 59-69, Lucknow.

CHITALEY, S. D., 1949, *Dadoxylon Chandaensis* sp. nov. from the district of Chanda, C. P., *Jour. Ind. Bot. Soc.*, 28, (3) : 172-180.

——, 1949, On a new species of *Dadoxylon, D. eocenum* sp. nov. from the district of Chhindwara, C. P., India, *Jour. Ind. Bot. Soc.*, 28 (4) : 227-234.

FRENTZEN, K., 1931, Die palaeogeographische Bedeutung des Auftretens von Zuwachszonen bei Hölzern der Sammelgattung *Dadoxylon, Central bl. f. Min., etc., Abtt.* N., No. 11, 617-24.

GOTHAN, W., and SZE, H. C., 1933, Uber Fossile Hölzer aus China, *Mem. Nat. Res. Inst. Geol.*, No. 13. Nanking, 87-103.

GOTHAN, W., 1905, Zur Anatomie lebender und fossiler Gymnospermer-Hölzer. *Abhande. d. kgl. preuss. geol. Landesanstalt.* 44 (N. F.) : 1-108.

HALLE, T. G., 1911, On the geological structure and history of the Falkland Islands, *Bull. Geol. Inst. Univ.*, Upsala, 11.

HOLDEN, R., 1916, On the anatomy of two Palaeozoic stems from India, *Ann. Bot.*, 31, 315-26.

RAMANUJAM, C. G. K., 1953, On two new species of *Mesembrioxylon* from the vicinity of Pondicherry, South India, *Palaeobotanist*, II, pp. 101-106. Lucknow.

RAO, H. S., 1936, On a sphaerosiderite, containing a new species of *Dadoxylon* from the Lower Gondwana Coal Measures of India, *Rec. Geol. Surv. Ind.*, 69, 174-83.

SAHNI, B., 1920, Petrified plant remains from the Queensland Mesozoic and Tertiary formations. *Queensland Geol. Surv. Publ.* 267 : 7-38.

——, 1931, Revision of Indian Fossil Plants, Part II, Coniferales, (b. Petrifactions), *Pal. Ind., N. S.* 11, 67-97.

——, 1933, *Dadoxylon Zalesskyi*, a new species of Cordaitean trees from the Lower Gondwanas of India. *Rec. Geol. Surv. Ind.*, 66, Pt. IV, 421.

SAHNI, B., and SINGH, T. C. N., 1926, On some specimens of *Dadoxylon Arberi* (Sew.) from Queensland and New South Wales, *Jour. Ind. Bot. Soc.*, 5, No. 3, 103—12.

SEWARD, A. C., 1919, Fossil Plants, 4, Cambridge.

SEWARD, A. C., and WALTON, J., 1923, On some Fossil Plants from the Falkland Islands, *Quart. Jour. Geol. Soc.*, 79, 313-33.

SHUKLA, V. B., 1938, On a new species of *Dadoxylon, D. Deccani* sp. nov. from the Deccan Intertrappean Series, *Journ. Ind. Bot. Soc.*, 18, Nos. 5 and 6, 355-67.

——, 1944, *Dadoxylon resinosum* sp. nov. from the Chhindwara district of the Central Provinces, *Jour. Ind. Bot. Soc.*, 23, No. 3, pp. 83-90.

SZE, H. C., 1934, On the occurrence of an interesting fossil wood from Urumchi (Tihua) in Sinkiang, *Bull, Geol. Soc., China*, 13, No. 4.

VARMA, C. P., 1954, On two new species of *Mesembrioxylon* from the Cretaceous Rocks of the Trichinopoly District. Madras. *Palaeobotanist*, 3, pp. 97-102. Lucknow.

WALTON, J., 1925, On some South African fossil woods, *Ann. S. Afr. Mus.*, 22.

WARREN, E., 1912, On some specimens of Fossil woods in the *Natal Museum, Ibid.*, 2, Pt. 3.

EXPLANATION OF PLATE 20

FIG. 7—Part of a tangential section showing distribution and height of medullary rays × 35.

8—Radial longitudinal section showing bordered pits × 250.

9 & 10—Radial section showing cross field pitting with bordered pits having vertical slit (× 300, × 600 respectively).

11 & 12—Radial section showing cross field pitting with simple pits. (× 160, × 400 respectively.)

tions. This point of view was subjected to strong criticism and rejected in the USSR.

It is possible to avoid accidental errors in the correlation of the sections by palaeontological method by not availing oneself of individual species of index forms, but by using the whole complex of species. It is even worthwhile to indicate a number of species accompanying it, along with the zonal forms.

It is possible considerably to raise the accuracy of biostratigraphical division of the sections when it is based on the evolutionary monogenetic, sequences of the species. A typical example of this group of fossils in the Cretaceous deposits in the USSR is the species of *Belemnitella*. While studying the evolutionary changes of the species one may distinguish not only the index complexes, but also mark palaeontological borders of the subsections.

The division of the sections on the basis of the palaeontological data is effected according to the usual scale : system ± series stage ± substage ± zone—subzone. The division of the sections into zones and subzones can be maintained only within the limits of a single basin or a single palaeozoogeographical sphere. When the sections of different spheres are correlated the question arises as to what stratigraphical sub-division does the student confine himself.

In the course of the long discussion, that took place in the USSR last year two points of view were put forward. Certain stratigraphists were of the opinion that such a correlation is possible only upto the series ; while others, more optimistically inclined admit the possibility of a remote correlation even for the stages.

It must be said that this question is far from being a theoretical one. In the course of our practical work we have to deal with the attempts to extend local stage scale for individual regions, when making geological survey maps. The elevation of the Tertiary formations of central Asia to the rank of the stages by the Academician O.S. Vialow can be cited as one of the instances of such cases.

In the aforementioned conference, a majority of the geologists spoke of the distant correlation of the stages and it was decided as far as possible to avoid distinguishing new stages. But all the same, local stages had to be maintained for individual regions, as, for example, for the Cambrian and Silurian of the Siberian platform. For the present it was found impossible to apply the Western European scheme to this region.

In order to ensure stratigraphic division of the marine deposits we have intensively to develop palaeontological investigations. Among the invertebrates the following are particularly being studied in detail at present in the USSR : small Foraminifera, corals, Bryozoa, Brachiopoda, Lamellibranchia, Gastropoda, Goniatites, Ammonites, Echinoidea, and Insecta. The great importance of the spores and pollen was explained for the stratigraphy of the marine deposits. It has already become possible to find spores in the upper pre-Cambrian horizons. They are to be noticed in large quantities in Cambrian and higher horizons. Diatoms are very extensively utilized for the stratigraphy of marine deposits.

As a result of this work we have sufficiently worked out stratigraphical schemes of Cambrian, Silurian and Ordovician of the Baltic and Siberian platforms ; Devonian and Carboniferous of the Russian platform and of the Urals ; Jurassic and Cretaceous deposits of the Russian platform and of Caucasus ; Tertiary deposits of the Crimea, Caucasus and Central Asia. These detailed stratigraphic scales ensured the prospecting work, particularly deep drilling for the oil, and made it possible to draw a large number of palaeogeographical maps.

The palaeontological method of the study of stratigraphy of continental deposits has already since a long time obtained recognition in the USSR in the works of M. D. Zalessky on Donetz and Kuznetsk coal basins.

In recent years practical requirements have arisen for intensifying stratigraphical work in Siberia. The first results of their work were last year summed up in an All-Union Conference.

As is well known there is in Central Asia and Siberia almost a continuous section of continental deposits covering a stratum with a thickness of over 20,000m consisting

of middle Carboniferous to the present day. It has been all the time difficult to use the palaeontological method for their stratigraphy because of the scantiness of the finds of animal and plant fossils. Only with the application of spores and pollen analysis great possibilities were opened up in this sphere. Already it has become possible to obtain reliable stratigraphical schemes for vast regions. One such, for instance, has been constructed for Carboniferous and Permian deposits in Kuznetsk, Minusa and Tunguska basins. It may be said with confidence that it will be extended to Western and Eastern Siberia. Also an interesting scheme of stratigraphy for spores and pollen was drawn up for the Tertiary deposits of Kazakhstan and Western Siberia. There is no doubt that after a few years the entire section of the continental deposits of the Asiatic parts of the USSR will get its palaeontological foundation. After the stable spores and pollen complexes have been exposed on a wide area, it is possible to attach to them disconnected finds of molluscs, ostracods and vertebrates.

The plant remains of Carboniferous and Permian Karaganda, Kuznetsk and Tunguska basins, which were studied much earlier, now receive more reliable stratigraphic tie. Similarly, remains of characae and diatoms are drawn from the solution of the questions of stratigraphy.

The correlation of the sections of spores and pollen is based on the comparison of the percentage content the beds of the different groups of fossils. In ancient deposits usually these groups are artificial but in the younger ones they are distinguished as ecological ones. In such an analysis of the fossil material along with the stratigraphic tasks the palaeo-geographical one also is resolved for Mesozoic and Cenozoic. At the present time the change of vegetation has been already explained in general outline for Cretaceous and Tertiary period of Western Siberia.

If we now try to describe the future tendency of the development in the USSR of the palaeontological method in stratigraphy, we shall have obviously to state here the following :

First of all the divisibility of the stratigraphic sub-divisions will be increased and new zonal species and complexes of species explained.

The lists of already known index complexes of species will be extended. This will enable us to expand the area of application of individual schemes.

In proportion, as the palaeontological investigations continue the number of evolutionary ranks studied in detail will go on increasing, which will create a firmer basis of palaeontological methods.

Making the borders of palaeobiological spheres more precise for the seas and continents of the past epochs will serve as the basis for defining the limits of operation of the local stratigraphic scales.

The increasing number of the wells drilled every year inevitably will lead to a rapid development of all kinds of micropalaeontology and first of all the one which is connected with the study of foraminifera, ostracoda, spores and pollen. There is no doubt that megafossils also will be studied, but at present they play rather a secondary role, though, it is according to them that the age limits in standard sections are determined.

Of great interest will be the juxtaposition of the stratigraphic schemes of marine and continental deposits of the same age. In this the spores and pollen complexes which are found in one or the other deposits will undoubtedly play the main role.

Translated from the Russian by A. B. Khardikar.