

PERMIAN MEGASPORES FROM HAZRU (DİYARBAKIR)

Kâzım YAŞIMAN and Yaşar ERGÖNÜL

Mineral Research and Exploration Institute of Turkey

INTRODUCTION

In his publications (34, 35) Dr. N. TOLUN, who has done geological Studies in the Diyarbakır Province, Hazru County, in 1951 and 1952, has worked on the detailed stratigraphy of the region and has also described the Carboniferous sandstones.

In the same region, in 1958, the field Studies were carried out by R. H. WAGNER (37), the phytopaleontologist of the Mineral Research and Exploration Institute. He recognized the existence of Permian in the above-mentioned region through his plant fossils that he had collected and determined. The Algae, which are the characteristic of Permian, were determined by Mrs. U. BİLGÜTAY (6) from a limestone sample collected some 50 meters above the continental layers. The material studied was brought by R.H. WAGNER (WAG. nos. 2, 5) and the drawings of the spores were prepared by o. KARADENİZ. We wish to express here our appreciation of their help. In our material of study we have discovered nine new species of Megaspores that are individually described below.

DESCRIPTION OF THE MEGASPORES

1 — *Zonalesporites (Triletes) hazruensis* n. sp.

Pl. I, Figs. 1-4; holotype Fig. 1

Diagnosis- — Spores generally rounded, sometimes roundly triangular in outline, flattened in proximal-distal or in lateral direction. Diameter of the whole spore (including cingulum) 990-1720 microns (the mean being 1320 microns, 45 specimens measured). Diameter of the spore body 680-1480 microns (the mean being 1058 microns). Periphery of the spore has a cingulum 145-170 microns wide; in some cases the cingulum was broken and not visible, but readily detached from the spore body. Triradiate ridges straight, coarse, as long as the radius of the spore; 50-80 microns wide, 60-120 microns high; in numerous specimens near the apex of the spore the highest and widest. Splits sometimes open. Equatorial ridges visible with difficulty. Contact faces have swells 40 microns wide and 10-15 microns high. Distal area irregularly covered with hair-like-appendages of the perispore. Exospore brown, smooth, 40-60 microns thick.

Remarks- — By the cover of the distal area this species slightly resembles *Triletes brasserti*, which has been identified by Dijkstra, in 1957, from the Lower Carboniferous of the Moscov Basin; however, there are important differences in the shape of the triradiate ridges, which are wider and higher in the direction of the apex of the spore and larger in spore size than this specimen.

2 — *Tuberculatisporites (Triletes) spinosaetosus* n. sp.

Pl. II, Figs. 5-8; holotype Fig. 5

Diagnosis. — The equatorial outline nearly rounded; mostly flattened in dorso-ventral and occasionally in lateral direction. Diameter 400-800 microns (the mean being 650 microns, 65 specimens measured). Triradiate ridges narrow and straight, $\frac{3}{4}$ of the radius of the spore in length, 40-45 microns in width, 30-40 microns, in height. Triradiate ridges generally not distinguishable in each specimen. The border of the contact faces and arcuate ridges not evident in equatorially flattened spores, but scarcely distinct in eccentrically flattened specimens. The entire spore coat densely covered with semi-translucent spines, 25-35 microns long at the base, about 15-20 microns in width. These spines are generally blunt-ended or sharp-pointed; a few of them ramified on the tips into two branches. Spore coat brown, 25-35 microns thick.

Remarks. — Although this new spore closely resembles *Setosisporites globosus*, it does not belong to the order of Lagenotriletes and can be distinguished from it by its larger size.

3 — *Tuberculatisporites (Triletes) tuberospinosus* n. sp.

Pl. III, Figs. 9-13; holotype Fig. 10

Diagnosis. — Spore rounded in outline, flattened in proximal-distal and in lateral direction. Diameter 280-600 microns (the mean being 480 microns, 50 specimens measured). Triradiate ridges generally straight or a little wavy; nearly $\frac{1}{2}$ of the radius of the spore in length, 30-50 microns in height and 20-25 microns in width. Arcuate ridges clearly distinguishable, 15-20 microns in width and height. The entire spore coat (including the contact area) densely covered with sharp-ended papillae, 10-15 microns in height and width. Spore coat brown, 20-30 microns thick.

4 — *Tuberculatisporites (Triletes) crestiformis* n. sp.

Pl. III, Fig. 14

Diagnosis. — Spore rounded in equatorial contour, compressed in proximal-distal direction. Diameter 260 microns (1 specimen was found). Triradiate ridges steep and wavy, extending nearly as far as the radius of the spore, 125 microns long, 10-15 microns wide and 30-35 microns high. Arcuate ridges clearly distinguishable, 10 microns wide, 20-25 microns high. Proximal and distal area — contact faces excepted — densely covered with warts. Spore coat brown to reddish, slightly shining and about 6-10 microns in thickness.

5 — *Laevigatisporites (Triletes) levis* n. sp.

Pl. III, Figs. 15-19; holotype Fig. 19

Diagnosis. — Spore circular in outline, generally the apex of the spore more or less elevated than the periphery; flattened in proximal-distal as well as in lateral direction. Diameter 245-600 microns (the mean being 510 microns, 60 specimens measured). Triradiate ridges straight or nearly so, about $\frac{2}{3}$ of the radius of the spore in length, 30-60 microns wide, 40-60 microns high, and there

where they meet the arcuate ridges a small prominence is visible. Contact faces distinguishable. Arcuate ridges 25-35 microns wide and about the same in height. Spore wall black, matte, smooth, without any ornamentation. Coat rather thick, about 35-40 microns.

Remarks. — This new species slightly resembles *Loevigatisporites (Triletes) patulus* (DIJKSTRA, 1957) n. comb., but differs from it by its smaller size, shorter triradiate ridges and by shape of the spore and trilete mark.

6 — *Laevigatisporites (Triletes) tricallosus* n. sp.

Pl. III, Figs. 20, 21; holotype Fig. 21

Diagnosis. — Subtriangular in equatorial outline with distinct angles; usually one of the sides longer than the other two. Flattened proximal-distal direction. Diameter 240-280 microns (3 specimens measured). Triradiate ridges reaching up to the angles, on the apex 15-20 microns wide and of the same height, but towards the angles they become higher and thicker, about 40 microns. Arcuate ridges scarcely distinct. Contact faces grown like a callus. Spore coat, black smooth, about 15-25 microns thick.

Remarks. — This spore resembles *Triletes endosporitiferus* PREM SINGH (in both of the spores triradiate ridges are longer than the contact areas), however it can be distinguished by its smaller size and the presence of tricallus.

7 — *Laevigatisporites (Triletes) junior* n. sp.

Pl. III, Fig. 22

Diagnosis. — Spore flattened in proximal-distal direction; subtriangular in outline, usually one of the sides shorter and more rounded than the other two. Diameter 300 microns (1 specimen). Triradiate ridges nearly as long as the radius of the spore; at the apex of the spore 10-15 microns wide and high, to the periphery of the spore higher and wider up to 25-30 microns. Arcuate ridges not clearly distinguishable. The central parts of the contact faces and triradiate ridges are dark-brown to black, to the periphery of the spore light-brown. Spore coat brown, smooth, 10-20 microns thick, without any sculpture.

Remarks. — This new species most resembles *Laevigatisporites tricallosus* but differs from it by smooth contact faces (without callus) and by two-colored spore body.

8 — *Bentzispurites (Triletes) tenuilettes* n. sp.

Pl. III, Figs. 23-29; holotype Fig. 25

Diagnosis. — The shape of the spores round, sometimes subtriangular, flattened in proximal-distal or lateral direction. Diameter 240-320 microns (the mean being 280 microns, 40 specimens measured). Triradiate ridges very thin (like a thread), straight, about 3/4 of the radius of the spore in length, 4-7 microns as high as wide. Arcuate ridges flattened into a thin cingulum, 8-15 microns in width and same in height. Contact faces smooth, clearly distinguishable. Distal area orna-

mented with very small obscure reticulae, in some specimens this ornamentation not visible. Exospore brown, rather thin, about 5-12 microns in thickness.

Remarks. — This species shows some resemblance to *Bentziaporites bentzii*, but it differs from it by its smooth contact faces, very thin trilete and by distal sculpture.

9 — *Sporites spiculatus* n. sp.

Pl. IV, Figs. 30, 31; holotype Fig. 31

Diagnosis. — Spore rounded or subtriangular in outline; diameter of the spore 520 microns (2 specimens measured). The entire coat of the spore is densely covered with ocher-colored, semi-translucent spicules which vary from 40 to 85 microns in length and about 5-10 microns in width. The terminals of the spicules are sharp-ended or broken off, and they are nearly of the same thickness at the base and at the tips; intervals of some microns. The exospore is ocher-colored, semi-translucent and thin.

Calamospora SCHOPF, WILSON and BENTALL

10 — *Calamospora* spec., Type 2 ZERNDT

Pl. IV, Figs. 32-35

- 1931 Type 2; ZERNDT— Bull. de l'Acad. Pol. des Sci. et des Lett., Sér. A, p. 170, Pl. 3, Fig. 1, 2.
- 1933 Calamariaceen Sporen; HARTUNG — Dissertation, Berlin, und Arb. Inst. Palaeobot. u. Petrog. d. Brennsceine, III, pp. 97-105, Pl. 8-11.
- 1934 Spores de Calamariaccès, Type 2; ZERNDT — Bull. de l'Acad. Pol. des Sci. et des Lett., Trav. Géol. I, p. 15, Pl. 6; Fig. 3; Pl. 32, Fig. 8.
- 1937 Spores de Calamariacees, Type 2; ZERNDT — Bull. de l'Acad. Pol. des Sci. et des Lett., Trav. Géol. III, p. 5.
- 1938 Grössere Sporen von Calamariaceen, Type 2; ZERNDT — Bull. G.R. du II Congr. pour l'Avanc. d'Etudes de Strat. Carb. Heerlen, 1935, p. 24.
- 1938 Spores of Calamités; SCHOPF — Report of Invest. No. 1 of the Geol. Surv. of Illinois, p. 51.

Endosporites WILSON and COE

11 — *Endosporites* (?) *radiatus* (IBR.), Type 49 ZERNDT

Pl. IV, Fig. 36

- 1932 *Sporonites radiatus* IBR — p. 449, Pl. 16, Fig. 25.
- 1933 *Zonales-sporites radiatus* (IBR.), IBR. — p. 28, Pl. 3, Fig. 25.
- 1934 *Triletes karczewskii* ZERNDT — p. 27; Pl. 31, Fig. 3.
- 1944 *Endosporites* (2) *karczewskii* ZERNDT — S., W. et B., p. 45.
- 1944 *Triletes radiatus* (IBR.), —S., W. et B., p. 24.
- 1946 *Microsporites karczewskii* (ZERNDT) DIJKSTRA — p. 46, Pl. 4, Fig. 40.
- 1950 *Triletes radiatus* IBR, HORST, —Figs. 13, 14.
- 1951 *Spencerisporites karczewskii* (ZERNDT) CHALONER — p. 862, Figs. 1, 2, 6, 7.

12 — *Lagenosporhes nudus* (NOWAK und ZERNDT) POT. und. KR.

Pl. IV, Figs. 37-39

1936 *Lagenicula nuda*, Type 43, NOWAK und ZERNDT — p. 60, Pl. 1, Fig. 6.

1938 *Triletes* (?) *nudus* (NOWAK und ZERNDT) SCHÖPF — p. 30, PL 5, Fig. 7.

1946 *Triletes nudus* (NOWAK und ZERNDT) DIJKSTRA — p. 48, besonders, Figs. 72, 74, 75.

13 — cf. *Cystosporites* spec.

Pl. IV, Figs. 40-42

The shape of the spore oval, 1000 microns in length, 440 microns in width, spore coat bright black, every ornamentation lacking, only one longitudinal plication. Exospore about 20-25 microns thick.

14 — cf. *Calamospora* spec.

Pl. IV, Fig. 43; Pl. V, Figs. 44-46

Specimens round, 360 microns in diameter; specimens elliptical and oval, 640-840 microns in length, 480-520 microns in width. Triradiate ridges at the middle of the spore body thin and short, not always distyguishable. Spore coat

PLATE I

Figs. 1-4 — *Zonalesporites* (*Triletes*) *hazruensis* n. sp. x 50

PLATE II

Figs. 5-7 — *Tuberculatisporites* (*Triletes*) *spinosaetosus* n. sp. X 50

Fig. 8 — Portion of surface of spore body showing details of the spines. X 500

PLATE III

Figs. 9-13 — *Tuberculatisporites* (*Triletes*) *tttberospinosus* n. sp. X 50

Fig. 14 — *Tuberculatisporites* (*Triletes*) *crestiformis* n. sp. X 50

Figs. 15,19 — *Laevigatisporites* (*Triletes*) *levis* n. sp. X 50

Figs. 20,21 — *Laevigatisporites* (*Triletes*) *tricallosus* n. sp. X 50

Fig. 22 — *Laevigatisporites* (*Triletes*) *junior* n. sp. X 50

Figs. 23-29 — *Bentzisorites* (*Triletes*) *tenuiletes* n. sp. X 50

PLATE IV

Figs. 30,31 — *Sporites spiculatus* n. sp. X 50

Figs. 32-35 — *Calamospora* spec., Type 2 ZERNDT X 50

Fig. 36 — *Endosporites* (?) *radiatus* (İBRAHİM), Type 49 ZERNDT X 50

Figs. 37-39 — *Lagenosporites nudus* (NOWAK und ZERNDT) POT. und. KR. X 50

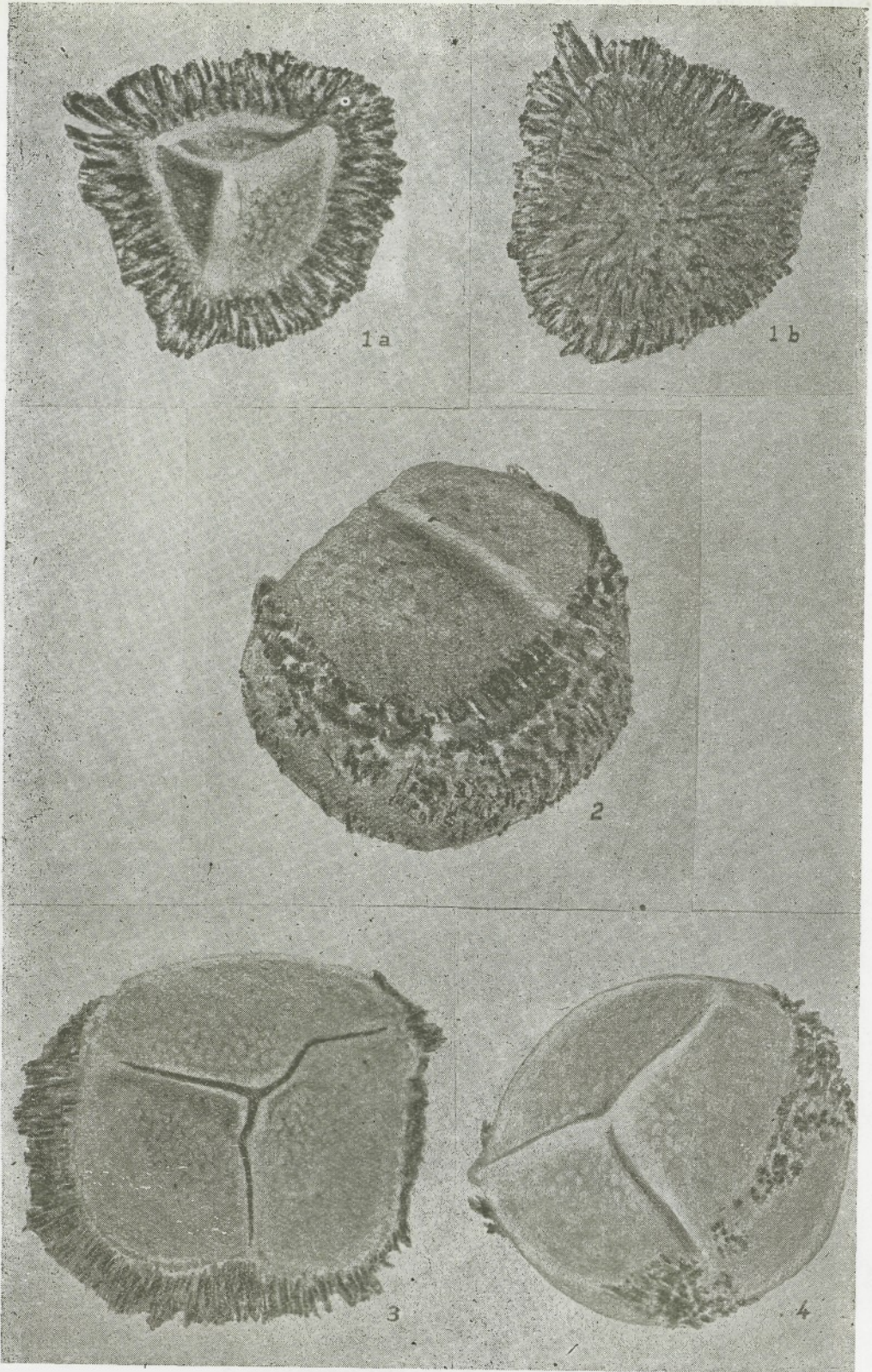
Figs. 40-42 — cf. *Cystosporites* spec. x 50

Fig. 43 — cf. *Calamospora* spec. x 50

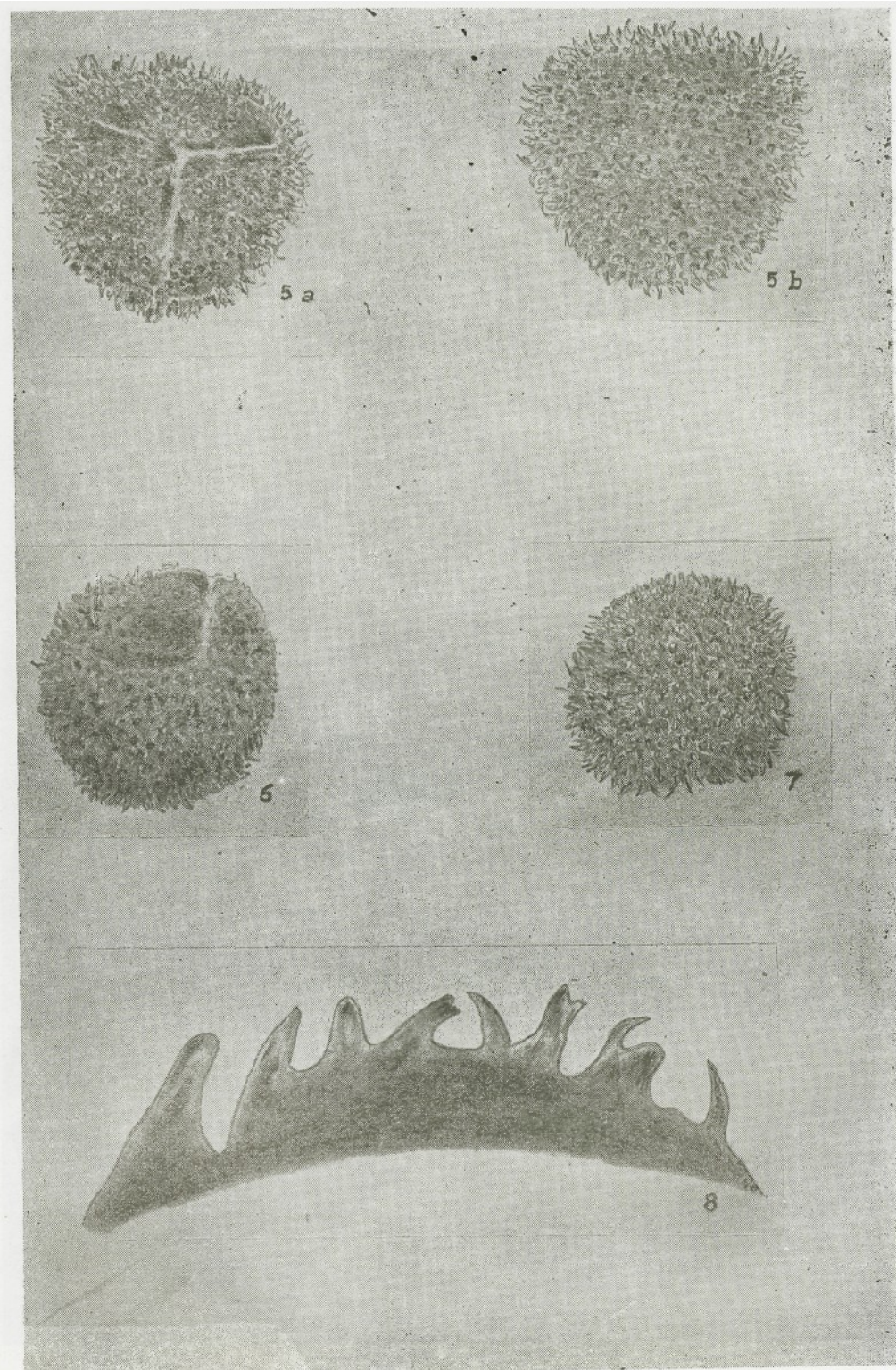
PLATE V

Figs. 44-46 — cf. *Calamospora* spec. X 50

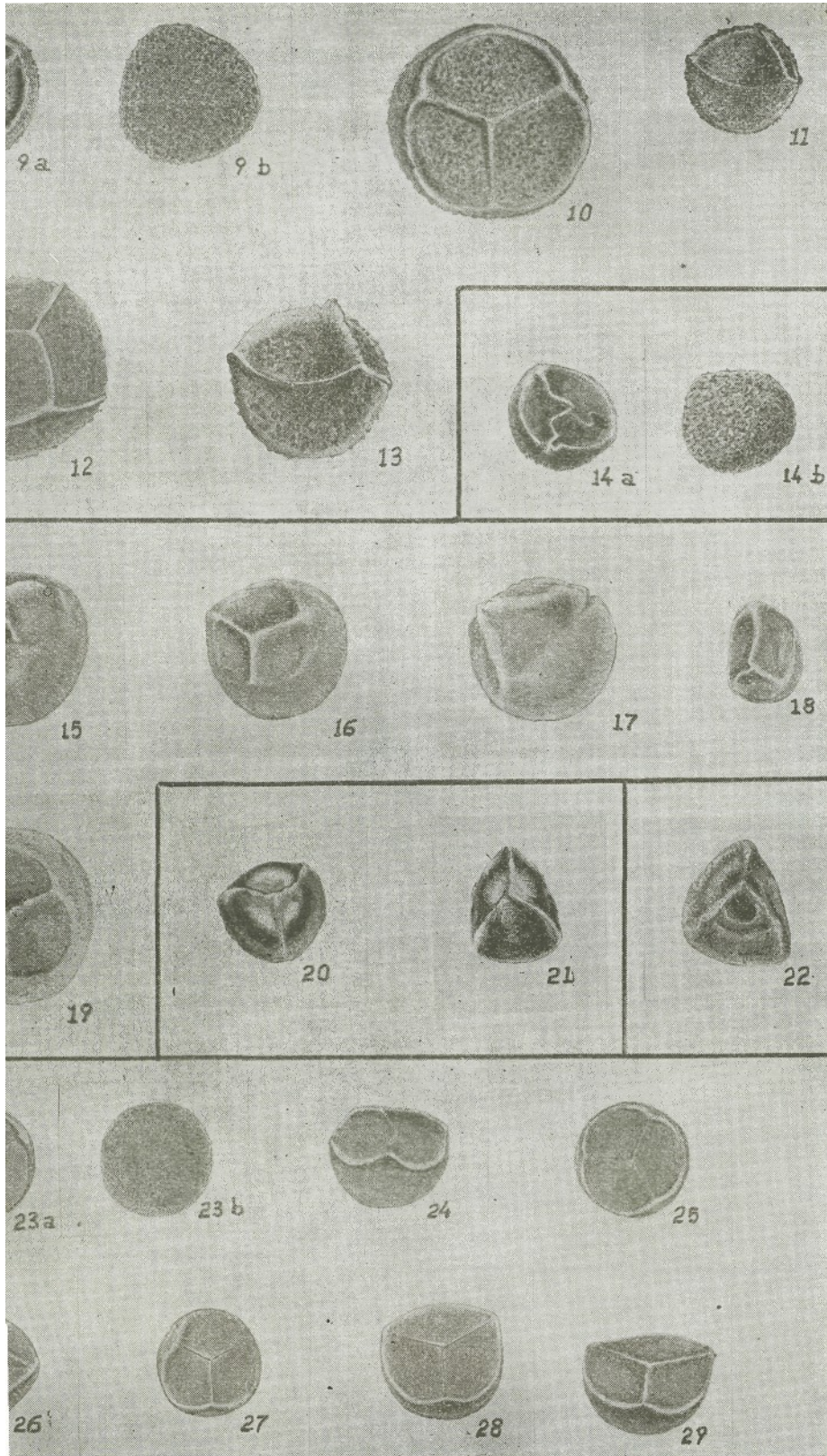
Figs. 47-50 — Seeds (?) X 50



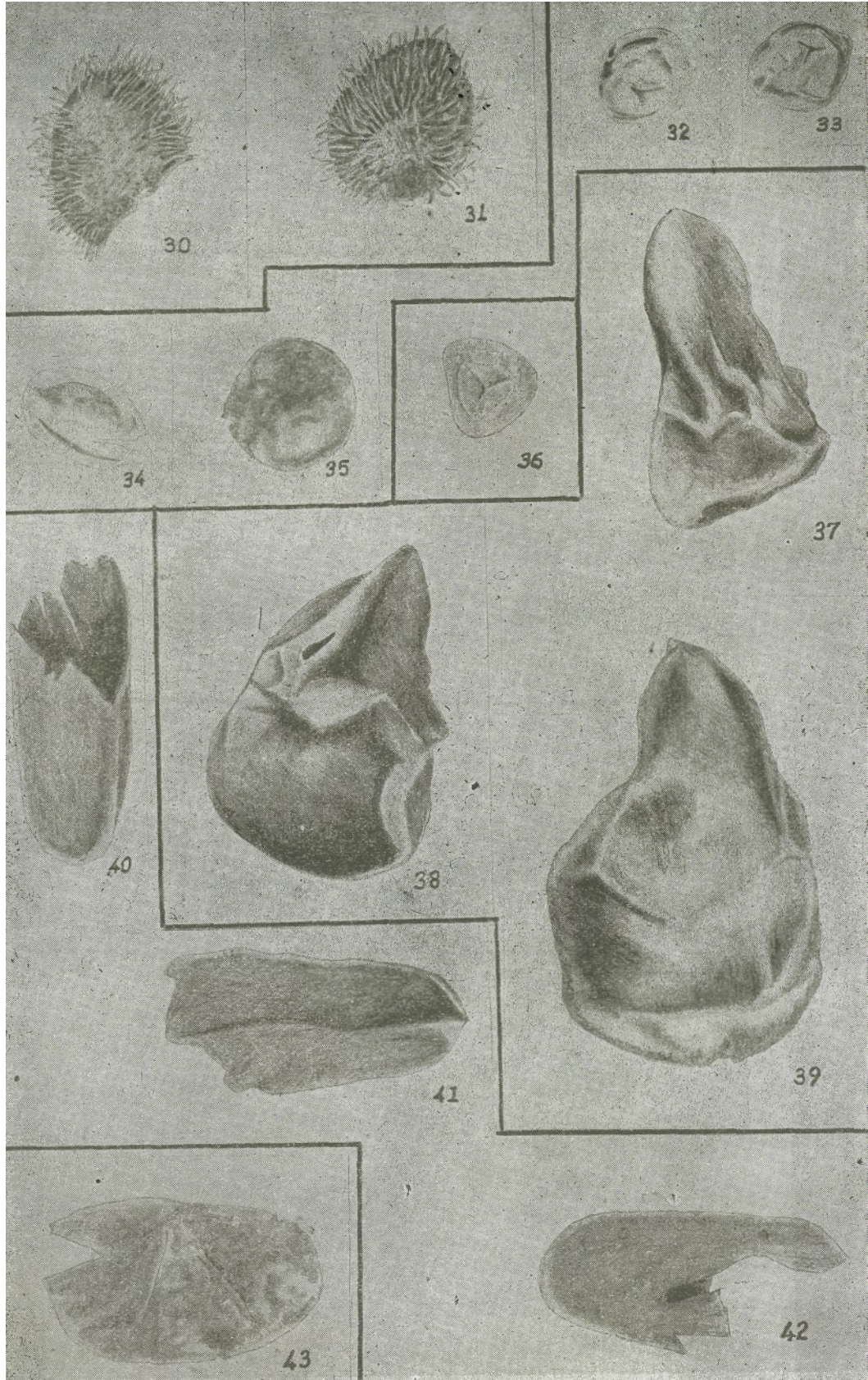
Drawing by O. KARADENİZ



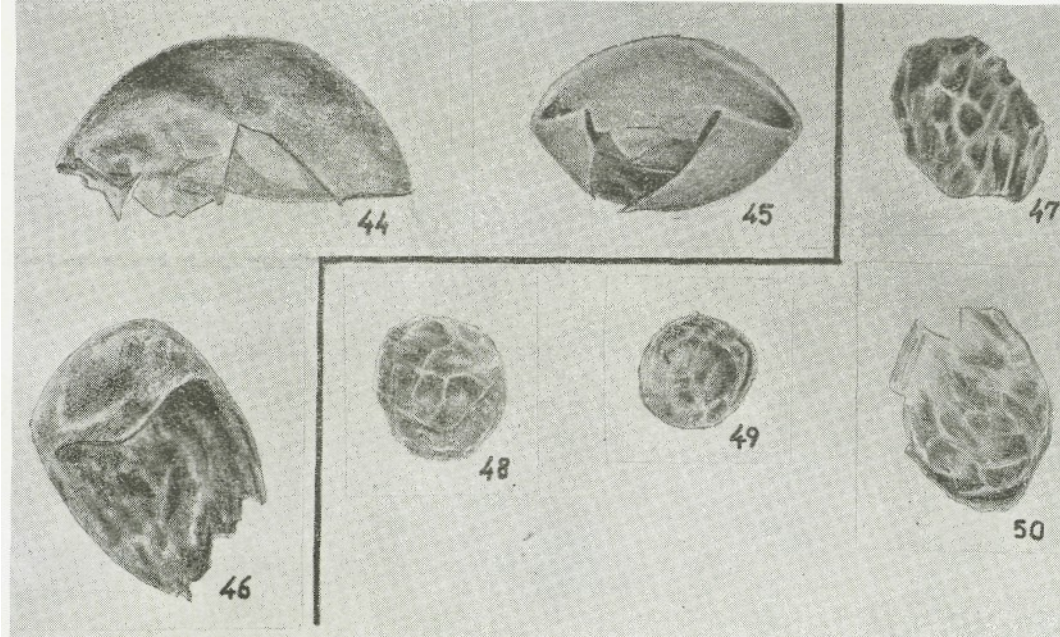
Drawing by O. KARADENİZ



Drawing by O. KARADENİZ



Drawing by O. KARADENİZ



Drawing by O. KARADENİZ

brown to red, bright, semi-translucent, plicate or wrinkled. Certainly these specimens belong to *Calamospora*.

Remarks. — Probably these forms are identical with Type 2 ZERNDT, but are larger and thicker than the latter.

15 — Seeds (?)
Pl. V, Figs. 47-50

Diagnosis. — Round, 240-360 microns; oval 320-640 microns long and 235-440 microns wide. Probably flattened in proximal-distal direction. Coat brown to red, shining, rather thick, but semi-translucent and reticulate. Reticulae 40-80 microns in diameter.

Manuscript received October 1, 1959

B I B L I O G R A P H Y

- 1 — ARNOLD, C. A. (1950) : Megaspores from the Michigan Coal Basin. *Contr. Mus. Paleont. Univ. Mich.*, Vol. V, No. 5, pp. 59-111.
- 2 — ARTÜZ, S. (1957): Die Sporae dispersae der Türkischen Steinkohle von Zonguldak Gebiet (mit besonderer Beachtung der neuen Arten und Genera), Serie B, Tome XXII, Fase. 4, Istanbul.
- 3 — BENNIE, I. and KIDSTON, R. (1886) : On the occurrence of Spores in the Carboniferous Formation of Scotland. *Proc. Royal Phys. Soc. Edinb.* Vol. IX.
- 4 — BONET, M. C. and DIJKSTRA, S. J. (1956) : Megasporas Carboniferas de la Camocha. *Instituto de Investigaciones Geologicas «Lucas Mallada»*, Madrid.
- 5 — BHARDWAJ, C.D. (1957) : The Palynological investigations of the Saar Coals. *Paleontographica*, Abt. B, Vol. 101, Liefg. 5-6, pp. 73-125, Stuttgart.
- 6 — BİLGÜTAY, U. (1959): The Permian calcareous Algae from southeastern Anatolia, *M.T.A. Bull.*, No. 52, p. 49, Ankara.
- 7 — CHALONER, W.G. (1951) : On Spencerisporites, gen. nov., and *S. karczewskü* (ZERNDT), the isolated spores of *Spencerites insignis* Scott. *Ann. Mag. Nat. Hist.*, T. IV, Ser. 12, pp. 861-873, London.
- 8 —————(1952) : On *Lepidocarpon Waltoni*, sp.n. from the Lower Carboniferous of Scotland. *Ann. Mag. Nat. Hist.*, T. V, Ser. 12, pp. 572-582, 1 pl., London.
- 9 — (1953) : A new species of *Lepidostrobus* containing unusual Spores. *Geol. Mag.* pp. 90, 97-110, Pl. 2.
- 10 —————(1954) : Mississippian Megaspores from Michigan and adjacent States. *Contr. Mus. Paleont. Univ. Mich.*, Vol. XII, No. 3, pp. 23-35.
- 11 —————(1954) : Notes on the Spores of two British Carboniferous Lycopodes. *Ann. Mag. Nat. Hist.*, 1, 81-91, 10 Figs, London.
- 12 — DIJKSTRA, S. J. and VAN VIERSSSEN TRIP, P. H. (1946) : Eine monographische Bearbeitung der Carbonischen Megasporen etc. *Med. Geol. Sticht.*, Ser. C-III-1. pp. 1-101, Maastricht.
- 13 — DIJKSTRA, S. J. (1949) : Megaspores and some other fossils from the Aachenian (Senonian) in South Limburg, Netherlands. *Med. Geol. Sticht.*, Nw. Ser., Vol. III, pp. 19-33, Maastricht.

- 14 — DIJKSTRA, S. J. (1949) : La signification stratigraphique des Spores. *Soc. Geol. de Belgique*, T. LXXII, fascicule special.
- 15 —————(1950) : Carboniferous Megaspores in Tertiary and Quaternary Deposits of SE England. *Ann. Mag. Nat. Hist. London*, Ser. 12, Vol. III, pp. 865-877.
- 16 —————(1951) : Wealden Megaspores and their stratigraphical value. *Med. Geol. Sticht.*, Nw. Ser., Vol. V, pp. 7-21, Maastricht.
- 17 —————(1952 a) : Megaspores of the Turkish Carboniferous and their stratigraphical value. *Int. Geol. Congr. Report XVIII th. Session*, part. X, proc. of Sect. J. pp. 11-17.
- 18 —————(1952 b) : New Carboniferous Megaspores from Turkey. *Ann. Mag. Nat. Hist. London*, Ser. 12, Vol. V, pp. 102-104.
- 19 —————(1952 c) : The stratigraphical value of Megaspores. 3. *Congr. Strat. Geol. Carb.*, Heerlen, pp. 163-168.
- 20 —————(1955) : The Megaspores of the Westphalian D and C. *Med. Geol. Sticht.* Nw. Ser. 8, pp. 5-11.
- 21 —————(1955 a) : La correlation des veines de charbon par les Megaspores. *Publ. Ass. Etud. Palfont.*, Brux., No. 21, Hors Ser., Vol. VIII, pp. 107-119.
- 22 —————(1955 b) : Megaspores Carboniferas Espanolas y su empleo en la correlacion estratigrafica (with English Summary). *Estudios Geol.*, No. 27. 28, Vol. XI, pp. 277-354, Madrid.
- 23 —————(1956) : Some Brazilian Megaspores, Lower Pennian in age, and their comparison with Lower Gondwana Spores from India. *Med. Geol. Sticht.*, Nw. Ser., Vol. IX, pp. 6, Maastricht.
- 24 —————(1956) : Lower Carboniferous Megaspores. *Med. Geol. Sticht.*, Nw. Ser., Vol. 10, pp. 5-18.
- 25 — DIJKSTRA, S. J. and PIERART, P. (1957) : Lower Carboniferous Megaspores from the Moscow Basin. *Med. Geol. Sticht.*, Nw. Ser., Vol. XI, pp. 5-19.
- 26 — İBRAHİM, A. C. (1933) : Sporenformen des Agirhorizontes des Ruhrreviers. *Dissertation Th.* Berlin, 1932, 46 p, 8 Pl. Konrad Tritsch, Würzburg.
- 27 — KALIBOVA, M. (1951) : Megaspores of the Radnice Coal Measure Zone of the Kladno-Rakovnik Coal Basin. *Geol. Surv. Czechoslovakia*, 18 (Pal.), 21-83, Pl. 5-8, Prague.
- 28 — POTONIE, R. and KREMP, G. (1955) : Die Spores dispersae des Ruhrkarbons. *Abdruck aus Palaeontographica*. Teil I und II Sonder. Bd. 98 und 99, Abt. B., Hannover.
- 29 — PIERART, P. (1955) : Les Megaspores contenues dans quelques couches de houille du Westf. B et C aux charbonnages Limburg Meuse. *Publ. Ass. Etud. Paleont.*, Brux., No. 21, Hors Ser., Vol. VIII, pp. 125-142.
- 30 — . —————(1956) : Quelques Megaspores contenues dans les charbons Stephanien des Bassins de Blanzky et de Decazeville. *Bull. Soc. Beige. Geol.*, t. LXIV, fasc. 3, pp. 587-599, 6 pl.
- 31 —————(1957) : Note preliminaire sur les Megaspores du Westphalien C supérieur en Campine Beige. *Paläont. Z.*, 31, 1/2, 46-52, Stuttgart.
- 32 — STACH, E. U. and ZERNDT, J. (1931) : Die Sporen in den Flamm-Gasflamm- und Gas-kohlen der Ruhrkarbons. *Glückauf* 67, pp. 1118-1124, Essen.
- 33 — SCHÖPF, J. M. (1938) : Spores from the Herrin (No. 6) Coal Bed in Illinois. *Rept. Investig. III. Geol. Surv.*, No. 50: 1-55.
- 34 — TOLUN, N. (1951) : Etüde geologique du Bassin Nord-Est de Diyarbakır. *M. T. A. Bull.* No. 41, p. 65, Ankara.
- 35 —————(1954) : Güney-Doğu Anadolu'nun stratigrafisi ve tektoniği. *M. T. A. Arch. Rap.* No. 2147, Ankara (in Turkish).
- 36 — WICHER, C. A. (1931) : Über Abortiverscheinungen bei fossilen Sporen und ihre phylogenetische Bedeutung. *Arb. Inst. Paläobot. Petrogr. Brennst.* 5, 87-96, Preuss. Geol. L.-A., Berlin.

- 37 — WAGNER, R. H. (1959) : Une flore Permienne d'affinités Cathaysiennes et Gondwaniennes en Anatolie sud-Orientale. *Extrait des C. Ä., des stances de l'Acad. des Sci.*, T. 248, pp. 1379-1381, Paris.
- 38 — YAŞIMAN, K. and ERGÖNÜL, Y. (1958) : Amasra (Tarlaağzı) E. K. İ. Galerisindeki Kömür Damarlarının Sporolojik etüdü ve Korelasyonu. *M. T. A. Mec.* No. 51, p. 42, Ankara (in Turkish).
- 39 — ZERNDT, J. (1930) : Petrograficzne badania wegla z Podladu «Izabella» W Trzebini. *Przeglądu Gorniczo-Putniczaga Dabrow Goru Humiezego*, 1-4, 5 Tafeln.
- 40 —————(1932) : Megasporen aus den Zwickauer und Lugau - Ölsnitzer Karbon. *Jahresber. Berg- und Hüttenwesen in Sachsen*, 9-16, 4 Tafeln, Freiberg.
- 41 —————(1934) : Les Megaspores du bassin houiller Polonais. I. *Bull, de l' Acad. Pol. des Sci. et des Lettres, Trav. Geol.*, 1-56, 32 PL, Krakau.
- 42 —————(1937) » Les Megaspores du Bassin Houiller Polonais. II. *Bull, de l'Acad. Pol. des Sci. et des Lettres*, 1-78, 241-278, Krakau.
- 43 —————(1938) : Die Eignung von Megasporen als Leitfossilien. II. *Carbon. Congr., Heerlen* 1935, *Compte Rendu* 3, 1711-1732, Maastricht.
- 44 —————(1939) : Sprawozdanie z badan Megaspore. *Przyczynki do Geologii Polski*, 1-4.
- 45 —————(1940) : Megasporen des Saarkarbons. *Paleontographica* 84, Abt. B, 133-150. Tafeln 9-13, Stuttgart.