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PROEFSCHRIFT

TER VERKRIJGING VAN DEN GRAAD VAN DOCTOR IN DE WIS- EN NATUURKUNDE AAN DE RIJKSUNIVERSITEIT TE UTRECHT, OP GEZAG VAN DEN RECTOR-MAGNIFICUS PROF. DR. J. BOEKE, HOOGLEERAAR IN DE FACULTEIT DER GENEESKUNDE, VOLGENS BESLUIT VAN DEN SENAAT DER UNIVERSITEIT TEGEN DE BEDENKINGEN VAN DE FACULTEIT DER WIS- EN NATUURKUNDE, TE VERDEDIGEN OP MAANDAG 4 APRIL 1938, DES NAMIDDAGS TE 4 UUR

DOOR

JAAP VROMAN
GEBOREN TE GOUDA

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אסיר תודה אני למורי היקיר והנכבד הפרופסור ד״ר ל. פיקרד על סעדו. בלי עזרתו לא היתה לי היכולת לחבר ספר זה. אני מודה לצבי צוקרמן ולאריה נידרמן ששמרו אותי כאשר חקרתי בחוץ, ולכל אלה בא״י, שהנעימו לי את העבודה. לכל ידידי האלה אני מגיש בזה את רגש תודתי מעמקי לבבי. עמל המחבר היה עמלם.

AAN MIJN OUDERS
AAN MIJN VERLOOFDE

SITUATION AND TOPOGRAPHY OF THE REGION.

The region investigated is a coastal strip along the Mediterranean and extending from Ijzim (about 20 km. south of Haifa) in the North, down to the properties of Karkur in the South. Its length is about 17 km.; its width varies from 8 to 10 km. The northern part as far as Binyamina consists of a low coastal strip, about 3 km. in width and a hilly country, strongly intersected by many wadis, in the interior. The boundary between the coastal plain and the hills runs almost parallel with the coast. Near Binyamina the hills suddenly come to an end, so that the coastal plain bends sharply inward: here we find the lowland of Binyamina, Pardess Hanna and Karkur. The hilly region mentioned before is the south-western part of Carmel. It is a table-land and consists, as we shall see, entirely of Cretaceous and Eocene. The volcanic tuffs of the Cenomanian cause — by their relative softness — stronger erosion (widening of the valley) than the surrounding rocks. The topography of the Senonian-Eocene is as a rule much softer than that of the harder Cenomanian-Turonian.

In summer the main-roads are well passable as a rule. In the wet season, on the contrary, the main-roads of the coastal plain cannot be used by heavy traffic. During that season the bus Zichron Jaacov — Haifa does not pass by El Fureidis, but by Bath Shelomo. This state of things is going to be changed, now that the newly ballasted road Tel Aviv — Haifa is finished. The numberless footpaths are passable for asses and horses in every season.

HISTORY OF THE GEOLOGICAL INVESTIGATION OF THE HILLS.

Already BELLARDI found *Nummulites* in the region we intend to discuss (6). The Eocene, in this way ascertained, has been indicated however, in the wrong place by LARTET (37), according to AVNIMELECH, DONCIEUX and PICARD (4). In 1910 BLANCKENHORN mentions (12, p. 420) the upper cretaceous basalts and tuffs of Ijzim and Zemmarin (Zichron Jaacov). His map of 1912 shows these eruptiva in different places. In this work he indicates the rocks of the Eocene-basin of Bilad el Ruha as Senonian. JOH. BOEHM (1900) collected Cenomanian-Turonian fossils from the environs of Ijzim (22). In 1915 E. FUCHS described samples of the cretaceous basalts and tuffs (29, p. 571). Moreover in 1927 (66a) NATHAN SHALEM writes a few things about the outward appearance of these effusiva in the field. In the same year BLANCKENHORN describes innumerable cretaceous fossils from the environs of Zichron Jaacov and from another place of Mount Carmel (16). He calls the silicified fossils near El Fureidis (western slope El Mitaman'a) Turonian, which, in my opinion, should be Cenomanian, as we shall see. In 1931 (17) he still held the same view about the age of these fossils. It appears from BLAKE'S description of Carmel (9) that he too must have visited the region we are going to discuss. PICARD has given only a few remarks in his numerous publications (see 48 and 50, p. 58, first paragraph).

AVNIMELECH rediscovered the Eocene of Bath Shelomo in 1936. It is to be regretted that he presumes a fault, running right across the whole region of southern Carmel, on quite insufficient grounds (3, p. 133, faille c). In the next chapter it will be shown that one has to be cautious in believing that *Actaeonella salomonis* Fraas is a good index-fossil for Turonian (3, p. 26).

So we see that work of various kinds has already been done in the southern part of Carmel, and my list is probably not even complete.

What had so far been wanting was a geological map with sections and the stratigraphical connection of the formations found. This work was only possible for me thanks to the fine and very precise topographic maps 1 : 20.000 of the Survey Office in Tel Aviv. The topography of my geological map has been adopted from this map. The fieldwork was done during a number of months of the year 1936.

STRATIGRAPHY OF THE HILLY COUNTRY.

A. Cenomanian.

Many complaints have been made of the difficult separation between Cenomanian and Turonian in Palestine. Moreover BLAKE regrets the fact that it has not been possible for him to give a stratigraphy for the whole Carmel. This is caused by the circumstance that even in so small a region as that which we discuss here the stratigraphy differs totally from place to place, a consequence of the quick changes of the facies. Nevertheless, BLAKE has tried to draw up a general diagram which I shall cite briefly (9, p. 58—59):

(a) Meleke i.e. white crystalline marble-like limestone consisting largely of fragments of *Radiolites*. Near the base is usually a quartz bed or lenses with *Nerinea c.f. olisiponensis* Sharpe .... There is little doubt that the meleke passes gradually upwards into the Turonian .... 150 to 300 feet.

(b) Dolomite or hard yellow granular limestone. The dolomite is the typical rock of Wadi Mughara and the south section of the south end of Carmel north of Binyamina .... 150-300 feet.

(c) Chalky limestone passing into chalky limestone with flints or soft dolomite .... 250 feet.

Deeper layers, not occurring in our region, do not matter here. I point out that in our region (b) and (c) merge into each other and form one complex (see the map).

It will be easy to describe some sections in our region; from South to North.

1. Climbing the escarpment near Jazīrat el Qusseib, we first meet with unstratified gray grainy dolomite with some nodular flints at its base. Higher up these dolomites become stratified. Here they sometimes contain *Eoradiolites syriacus* Conr. The dolomite is the same as mentioned by BLAKE (9) sub (b). The nodular flints remind one of (c). On the table-land, a little to the

North, we find white porous semi-crystalline unstratified reef-like limestone. Near Kh. Umm el 'Alaq it contains *Pecten karmeliticus* Blanck.; in the southern part of the region, north of Kh. Esh Shuna, we find those limestones as well. Here they contain *Nerinea requieniana* d'Orb. and rests of *Rudists*. On this porous white limestone forming the lower layers of (a) of BLAKE, there lies again well-stratified dolomite. It can clearly be seen how the white limestone of Kh. Esh Shuna gradually passes into the dolomite both in the strike as well as perpendicular to it.

2. From Kh. Kabara towards the East we first pass the lower dolomites again. On the ridge joining on the eastern side we again meet with white crystalline limestone containing many casts, possibly of *Eoradiolites syriacus* Conr. In underlying dolomites eastward there occur many samples of *Pecten shawi* Perv. I found that in the South the white limestone again gradually passes into dolomite. In the wadi of Ard Abu Hamid there is a lens of stratified slabby limestones with nodular flints and rests of *Gryphaea*, which pitches away under the dolomites mentioned before. Mounting to the main-road in the direction of Bir Jabir we first meet again with the dolomite, afterwards we enter a large flat region of white porous limestone with rests of large *Nerinea's* and *Rudists*. In the quarry of Bir Jabir we find rests of *Chondrodonta munsoni* (Hill) besides fragments of *Echinoidea*. This white porous limestone passes eastward into well stratified dolomite lying on it. (See section O-P).

3. If we mount along the main-road from the station of Zichron Jaacov we first meet with thick-bedded dolomite, here far less steep than that in the southern part. Near the stoneworks of the firm of Paster there is intercalated in the dolomite a marly bed with many *Pecten shawi* Perv., *Hemiaster ?saulcyanus* d'Orb. and H. *?saulcyanus var. batnensis* Coq., *Cardium pauli* Coq., *Protocardium hillanum* (Sow.), *Arca ?dilettrei* Coq. and some rests of *Bryozoa*.

Near Zichron Jaacov we find much chalky material appearing in the mountain-side, but also dolomite. Near the cemetery we note yellow limestone with numerous, but unfortunately indeterminable *Lamellibranchiata* (e.g. *Pectinides* and *Ostreides*). South of the churchyard yellow chalks with *Rudists* appear, which towards the South are connected with the white porous chalk we discussed before. Towards the East the tectonic becomes somewhat more complicated (See section M-N). In Ard el Bustan we find an anticlinal dome containing in its core flinty limestone and surrounded by a belt of stratified dolomite, such as is found eastward of Kh. Umm el 'Alaq.

4. If we pass via Ard en Naffakha to the East, we first find limestone with many nodular flints in the mountain-side (see section K-L); halfway up the slope we see dolomites with numerous *Orbitolina's* somewhat to the South, and *Pecten shawi* Perv. to the North. This dolomite is the same as the lower dolomite of section 3. In the vineyard on the table-land we find porous white chalk: real white "nari"-chalk, lying on this dolomite. In the whole of this small region north-west of Zichron Jaacov, it occurs with yellow fossiliferous limestone. In somewhat less weathered white porous limestone there appear a few badly preserved *Nerinea's*. Here the yellow limestone contains — e.g. W. of Khallat et Tina — *Eoradiolites syriacus* Conr., *Trigonia* sp., *Alectryonia carinata* (Lam.), *Pecten shawi* Perv.; E. of Ard en Naffakha it contains *Exogyra columba* (Lam.) (small specimens). Somewhat more eastward we find fragments of *Chondrodonta* and *Ostreides*. This yellow limestone with the white porous limestone is again the "Meleke" of Blake. In the yellow limestone basalt and tuff are intercalated; we shall refer to them later on.

5. We shall now have a look at the wall of El Mitaman'a-Khallat et Tina-Jabal ez Zakhuri. On the western side we perceive something peculiar: near the wadi N. E. of $\frac{\text{VI}}{661}$ we see that th dolomite has totally wedged out; here the yellow fossiliferous limestone (Blake, a) lies immediately on the flinty limestones (Blake, c). These cavernous silicified limestones are of great hardness and form peculiar wild twists and twirls, which are still harder and have been left out by erosion. All fossils are silicified. The rock is well stratified but thick-bedded. The flinty limestone on the top of El Mitaman'a contains much *Gryphaea vesiculosa* Sow. Descending westward we find in the mountainside many samples of *Nerinea subgigantea* Blanck., *Nerinea requieniana* d'Orb. and *Actaeonella salomonis* Fraas, finally in deeper strata *Eoradiolites*

syriacus Conr. Together with the first mentioned form I also found one cast of *Cerithium* aff. *elias* Boehm.

Passing from El Mitaman'a to Khallat et Tina we first meet with dolomite of considerable thickness on the same level as the flinty limestones. On the dolomite there lies the yellow limestone with the Cenomanian fossils mentioned before. Towards the East this yellow limestone gradually thins out and near Jabal ez Zakhuri the Turonian lies immediately on the thick-bedded dolomite.

6. From El Fureidis turning to the East, we first see, at the foot of the slope, flinty limestone with many *Gryphaea vesiculosa* Sow.; then some yellow limestone and then again dolomite with *Exogyra columba* (Lam.). More to the East this dolomite contains *Orbitolina*, a few rests of *Pecten* and *Plicatula reynesi* Coq. They are followed by beautiful crystalline pure white hard carstic limestone, poorly fossiliferous, and of great extension. It is the lower part of BLAKE's (a). East of the wadi, which lies to the south of Edh Dhahrat, it immediately pitches below the upper strata of (a), consisting of yellow limestone with a thick bed, filled with *Eoradiolites syriacus* Conr. In this limestone, which forms the underlying stratum of the basalts and tuffs, there occurs moreover *Inoceramus* ? *lynchi* ? Conr.

7. To the North, the section becomes more and more simple. The dolomite rapidly thins out and the whole region between El Fureidis and Kh. Manara shows from top to bottom the following rocks:

- I. yellow fossiliferous limestone with intercalated basalts and tuffs;
- II. white crystalline limestone;
- III. thin bed of yellow limestone and yellow marl (not marked with special signature on the map);
- IV. flinty limestone.

IV. *Ostrea vesiculosa* Sow. is the fossil of most frequent occurrence. It appears in many thin strata. Besides we find near Suwamir indeterminable *Nerinea's*. In the wadi opposite Er Rubbeida a *Discoidea*(?).

South of Kh. Manara we note moreover *Nerinea requieniana* d'Orb., and *Actaeonella* sp. in fairly large quantities. In chalky parts of Mount El 'Arnin (W. of 'Ein Ghazal) we also find numerous *Orbitolina's*.

III. Yellow limestone and yellow marl occur especially near Umm et Tos, south of 'Ein Ghazal, etc. In those places the yellow marls are most frequent. As to their appearance they remind one somewhat of the volcanic tuffs in level I. In the yellow limestone of the same level between 'Ein Ghazal and El Lihif we find *Pecten shawi* Sow. and *Pholadomya vignesi* Lartet. Moreover south of 'Ein Ghazal we meet with *Exogyra columba* (Lam.).

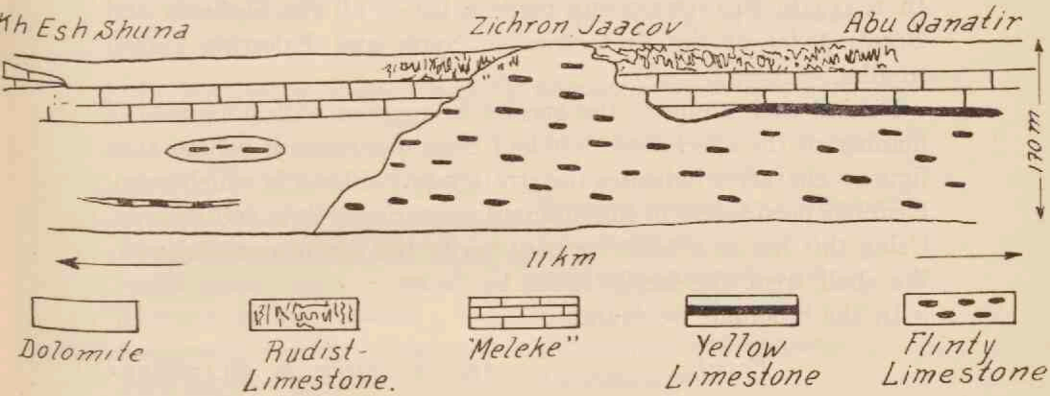


Fig. 1. Schematic cross-section through the Cenomanian rocks from S. to N.

II. The white crystalline limestone that, in its turn, lies on III contains, it is true, many rests of fossils e.g. of *Pectinides*, but they are indeterminable. It is strongly carstic and has, on its fracture, a purple weathering incrustation. It covers a large surface.

I. The upper strata mainly consist of yellow limestone, again with many *Eoradiolites syriacus* Conr. Near Abu Qanatir we note moreover *Exogyra columba* (Lam.), *Caprinula ?cedrorum* (Blanck). *Arca trigeri* Coq., *Nerita* aff. *mundae* (Sharpe) and a single *Orbitolina*. Southward we also find *Alectryonia carinata* (Lam.) and *Actaeonella's* (*Actaeonella salomonis* Fr.?) As mentioned before, this limestone contains intercalated basalts. To the East of Abu Qanatir it is bounded by dolomite into which it gradually merges. Somewhat to the South this dolomite contains small *Gastropoda*, and covers the basalt. *Caprinula ?cedrorum* (Blanck.) has also been found on Er Riba'at, on the same level.

Fig. 1 is a diagrammatic section of the entire Cenomanian between Kh. esh Shuna in the South and Abu Qanatir in the North, in which the different facial transitions, which I take to exist here, have been indicated.

Discussion of the age of the rocks.

It is necessary to investigate, whether the rocks I have so far regarded as Cenomanian in this chapter, really belong to it. Therefore we shall review all the fossils I collected from these formations. In 1934 (18) BLANCKENHORN made a list of all the *Mollusks* and *Brachiopodes* of the Cretaceous in Syria and Palestine known to him.

Behind each name of the species he marked with a figure the number of the specimens that had been determined; behind that figure a character indicates the stratigraphical level in which every form has been found in the different countries of Asia and Europe. Using this list as a basis we may verify the age of our *Mollusca*. We shall treat the fossils facies by facies.

In the dolomite we found:

Fossil.	*Age, according to* BLANCKENHORN.
Eoradiolites syriacus Conr.	Lower Cenomanian-Turonian
Pecten (*Vola*) *shawi* Perv.	Vraconian-Cenomanian
Cardium pauli Coq.	Cenomanian-lower Senonian
Protocardium hillanum (Sow.)	Aptian-Senonian
Arca delettrei Coq.	Cenomanian
Exogyra columba (Lam.)	Cenomanian-Turonian
Plicatula reynesi Coq.	Cenomanian-Lower Senonian

In the white limestone we found:

Fossil.	*Age, according to* BLANCKENHORN.
Pecten ?karmeliticus Blanck.	Cenomanian
Nerinea requieniana d'Orb.	Cenomanian-Turonian
Eoradiolites syriacus Conr.(?)	Lower Cenomanian-Turonian
Chondrodonta munsoni (Hill)	Cenomanian-Turonian
Caprinula ?cedrorum (Blanck.)	Cenomanian

In the flinty limestone we found:

Fossil.	*Age, according to* BLANCKENHORN.
Gryphaea vesiculosa Sow.	Cenomanian-Turonian
Nerinea requieniana d'Orb.	Cenomanian-Turonian
Nerinea subgigantea Blanck.	Cenomanian-Turonian
Actaeonella salomonis Fraas	Cenomanian-Turonian
Eoradiolites syriacus Conr.	Lower Cenomanian-Turonian
Cerithium aff. *elias* Boehm	Lower Cenomanian (as regards the typical specimens)

In the yellow Rudists-bearing limestone we found:

Fossil.	*Age, according to* BLANCKENHORN.
Eoradiolites syriacus Conr.	Lower Cenomanian-Turonian
Alectryonia carinata (Lam.)	Cenomanian
Pecten shawi Perv.	Vraconian-Cenomanian
Exogyra columba (Lam.)	Cenomanian-Turonian
Inoceramus ? lynchi ? Conr.	Vraconian-Cenomanian
Arca trigeri Coq.	Cenomanian
Caprinula ?cedrorum (Blanck.)	Cenomanian

In the thin yellow limestone-bed mentioned in Section 6 sub III we found:

Fossil.	*Age, according to* BLANCKENHORN.
Pecten shawi Perv.	Vraconian-Cenomanian
Pholadomya vignesi Lartet	Vraconian-Senionian
Exogyra columba (Lam.)	Cenomanian-Turonian

Among the fossils not belonging to the *mollusks* only two *Echinoidea* were determinable as regards their species. According to BLANCKENHORN *Hemiaster saulcyanus var. batnensis* Coq. serves as an excellent index-fossil for Cenomanian (15, p. 103) on the southern coast of the Mediterranean. As we have already seen, somewhat doubtful forms come from a marly bed in the dolomite.

Nerita aff. *mundae* Sharpe, which I collected in yellow limestone of Abu Qanatir, was not yet found in Palestine; this form has been found in Portugal in formations which are upper Cenomanian or lower Turonian.

Looking through the list of our fossils it becomes evident, that the age of the rocks in which they have been found can only be Cenomanian or Turonian. If we leave out of account those fossils the species of which we could not determine with certainty, and a few forms which have been found on Carmel only, and therefore cannot be regarded as conclusive, a few forms are left which tell for Cenomanian and against Turonian. They are: *Pecten shawi, Alectryonia carinata, Arca trigeri* and perhaps *Hemiaster saulcyanus var., batnensis*. One of them is only known from Palestine. Its conclusive evidence must therefore not be overrated. *Pecten shawi, Alectryonia carinata* and *Hemiaster saulcyanus var. batnensis*, however, are "true" index-fossils for Cenomanian, partly for the whole vicinity of the Mediterranian, partly even for regions of still larger extension.

In view of the above-mentioned facts, we need not doubt of the Cenomanian age of the rocks that I regarded as such. So far we have only considered the fossils I found myself. This becomes somewhat different, if we also consider the fossils found by BLANCKENHORN in the same region.

In 1931 (17) BLANCKENHORN mentioned (p. 10) that he found the following fossils near "furedis" (El Fureidis) not far from Zichron Jaacov and south of "usufja" in Carmel: *Nerinea requieniana* and *subgigantea, Actaeonella salomonis, Itieria zemmarinensis, Hippurites resectus* and *Radiolites peroni*. His first findingplace is concerned with the flinty limestones of El Mitaman'a. I repeatedly visited this spot, yet I did not succeed in finding the last three forms mentioned by BLANCKENHORN. The list in (18), already referred to, mentions that *Itieria zemmarinensis* Blanck. only occurs in Turonian. As this species has been found only in some places north west of Ijzim except near El Mitaman'a it cannot be looked upon as a good index-fossil for Turonian. As to the second form, we meet with far greater difficulties. *Hippurites* is a genus which has not yet been found in the Cenomanian. BLANCKENHORN mentions once more the form *Hippurites resectus* Defr. in 1934 (18, p. 232); he relates, that in the collection he determined, *Hip-*

purites resectus occurs; its findingplace, however, had not been exactly established. He writes moreover that *Hippurites grossouvrei* Douv. has been found near Zichron Jaacov in silicified state.

It is obvious that in 1934 BLANCKENHORN changed the name of the specimen of *Hippurites resectus* he mentioned in 1931, and that earlier he was led astray by a picture of DOUVILLÉ (27, Pl. V, fig. 7), of which BLANCKENHORN writes (18, p. 232) that it resembles more the section through *Hippurites grossouvrei* Douv., than that through *Hippurites resectus*.

However this may be, BLACKENHORN does not clearly indicate why he has the name of *Hippurites* changed, or why he thinks that he made a mistake in 1931. It is quite impossible that in 1934 he would not have described the same *Hippurites* he mentioned in 1931, for his treatise (18) is a complete catalogue of all cretaceous *Mollusks* from Palestine and Syria. His picture of *Hippurites grossouvrei* in (18) reproduces a *Hippurites* beyond all doubt.

Let us now take the third form, *Radiolites peroni* (Choffat) Douvillé, found near El Mitaman'a by BLANCKENHORN, but not by me. This form is only known from the upper Cenomanian of Portugal, France, Albania, Persia, the Karakorum, Tripolis and Tunesia. We now have the remarkable situation, that the fossils we found ourselves bear witness for being Cenomanian. Among the forms found by BLANCKENHORN, but not by me, there is one that also speaks in favour of Cenomanian, whereas *Hippurites*, according to our present knowledge, cannot be older than Turonian. Seeing that the large majority of the facts speak for Cenomanian, I think I have a right to adhere to the Cenomanian age of the complex described. The *Hippurites grossouvrei* either comes from another finding-place, or we have to deal with a find—as yet very improbable — of a *Hippurites* in the Cenomanian.

In conclusion I wish to state, that it is desirable to look for *Hippurites* in the Cenomanian-Turonian of Palestine; they will prove to be of better use in order to enable us to separate Cenomanian from Turonian than many other fossils.

B. Turonian.

Compared with the Cenomanian the Turonian is very monotonous. In the whole of the region, we can devide it into two zones.

1. The deeper zone, the so-called "Mizzi Helu" is a well-stratified dense limestone of milky colour (see BLAKE 9, p. 106). It may be seen on the map, how this zone runs through the whole region. One may even trace it through the whole of Cisjordania. Everywhere north of Shefeya it can contain *Nerinea requieniana* d'Orb. and *Actaeonella salomonis* Fraas in higher zones; besides some large *Rudists* (*Durania ?*) and *corals*.

Among the *Foraminifera* we find especially many *Miliolidae*; besides fewer *Textularidae* and *Discorbinae*, and hardly any *Globigerinidae*. In one place N. of Umm el Jarab we find *Alveolina* sp. in a layer of "Mizzi Helu" moreover containing *Nerinea nötlingi ?* Boehm. In the South near the source of the Nahr ez Zarqa we find, besides indeterminable *Rudists* with radial wallstructure, many small *Foraminifera* resembling *Calpionella's*. Hardly any flint occurs in all this "Mizzi Helu". From the fossils mentioned thus far *Nerinea requieniana* and *Actaeonella salomonis* may — according to BLANCKENHORN — occur in Cenomanian as well as in Turonian. *Nerinea nötlingi* Boehm has as yet been found only in the Cenomanian of Carmel and has therefore no evidential value. So, for the Turonian age of the "Mizzi Helu" in our region we have no better argument than that they contain fossils which may occur in Cenomanian as well as in Turonian, but that we did not meet with fossils, which might exclusively point to Cenomanian; moreover that they rest on rocks we regard as Cenomanian.

If we go through the list of BLANCKENHORN (18), we see that only very few fossils in Cisjordania may be regarded as good index-fossils for Turonian. The *Hippurites* alone can be of assistance to us. So it is of the greatest importance for the determination of the age of the "Mizzi Helu" that Avnimelech has found *Hippurites* in the subjacent bed of a "Mizzi Helu" (3, p. 34). Through the whole of the literature "Mizzi Helu" is called Turonian (see AVNIMELECH 3, p. 26, BLANCKENHORN 11, p. 79 and 17, p. 16, BLAKE 7, p. 16 and 9, p. 51 etc.).

2. The higher zone consists of a bed of white to pale yellow crystalline limestone, porous, with numerous rests of indeterminable fossils. It contains *Hippurites*(??) and *Ostreides*. Sometimes it forms escarpments.

Both zones are generally well discernible. The "Mizzi Helu", however, may sometimes be somewhat crystalline, and sometimes the crystalline limestone contains lenses of "Mizzi Helu". Both complexes together have a thickness from 60 to 140 m.

C. Senonian-Eocene.

On the crystalline limestone of the upper-Turonian there lies everywhere white chalk in the very facies of the Senonian in other regions of Palestine. Contrary to other places it is poor in fossils. I only found determinable material on the erosion-rest on which the village of Shefeya has been built. Here, besides *shark-teeth*, the rock contains indeterminable *Lamellibrachiata* and *Ammonites*; moreover: *Leda perdita* Conr., *Dentalium cretaceum* Conr., *Dentalium octocostatum* Fraas and *Cerithium* sp. Picard. Finally fragments of a *Baculites* have been found on the way to Bureika east of Ard el Bustan. Sometimes the rock contains some bitumen and very rarely flint. It is totally unstratified. Hills composed of this material are quite covered with a hard "Nari"-incrustation, which has a preserving effect on the soft masses of chalk beneath. The rock being so unstratified nothing can be said about tectonics and thickness. West of Kh. Tata a band of very well stratified flintbeds — gradually widening northeastwards — is intercalated into this unsympathetic complex. They alternate with chalk-beds containing nodular flints; I take these flinty limestones to be Eocene, thus agreeing with AVNIMELECH (4). They contain many *Globigerinae* and fragments of *Radiolaria* (see also AVNIMELECH 3, p. 77). I did not find *Nummulites* in my region.

The boundary between Senonian and Eocene has nowhere been ascertained in Carmel, the fossils collected in the Danian-Eocene being very scanty. The small *Nummulites* occasionally found by PICARD and AVNIMELECH in the flinty strata never occur in continuous levels, but form small lenses, not easily to be found, and often widely distributed. But neither the flinty strata themselves go on continuously: from Shannaq el Jihash southward, the flinty zone is found to thin out gradually and in the South of Bir Tata the flint is totally lacking. If we consider the western and the northern border of the flinty complex, it appears to lie normally on the non-stratified chalk. The southern and eastern border, however, are not easily definable; the rock grows continually poorer in flint and gradually passes into unstratified chalk, which therefore must be Tertiary. At the same time the vegetation, which on the flinty complex is always very poor, gets somewhat more flourishing.

D. Transition Eocene-Oligocene.

It is necessary to say something about the drill-log between Abu Habil and Tell Abu Hamad. Its depth is 410 m. At a depth of 25 m. already *Nummulites* and *Amphisteginae* have been found in grey chalky rock. PICARD calls them Giveat-Ada limestones. They are from 150 m. to 250 m. thick and are covered by a few meters of silicified limestone. According to AVNIMELECH they are Oligocene (3), according to BLAKE, Miocene(?) (9) and according to PICARD "Lower-Tertiary". Below these strata flinty limestones follow, which we have learned to know as Eocene. I have handled material and some *Foraminifera* from the drill-log of Abu Habil, but AVNIMELECH will treat the subject himself.

THE UPPER CENOMANIAN BASALTS AND TUFFS.

Basalts and tuffs have been found between Ard el Bustan and Abu Q̰anatir in a narrow zone. Near Bir Jabir on the main-road some basalt-waste may be seen.

Tuffs occur especially in the surroundings of Zichron Jaacov, and west of Shefeya. They are variegated: red, pale green, yellow and brown. The tuffs have been macroscopically well described (29, 66); therefore I will not enter into a further macroscopical description.

The effusiva are dense or vesicular. The dense basalt is black; macroscopically only the Olivine is identifiable. It is generally found in loose boulders (e.g. in the tuff of Shefeya and Zichron Jaacov) and only rarely in continuous beds. The vesicular basalt weathers much more easily than the dense; it is friable and often has brown weathering-incrustations.

1. Age. The map already shows that the basalts and the tuffs of Shefeya are covered by Turonian limestones. It can more clearly be seen in the field. On the northern and western side of Shefeya the basalts pitch below Turonian limestones. Between "Mizzi Helu" and tuff there sometimes lies a thin stratum of yellow limestone with or without *Rudists*. This proves that the basalts and the tuffs are Preturonian. (Near Salmaniyat and further between Shefeya and El Fureidis we meet with enclosed fragments of basalts in the chalky white "nari-"limestone, which elsewhere covers the tuffs and basalt, but which is here only found as boulders. We shall see hereafter that these two finds supply no argument for the Preturonian age of the basalts, the "nari" being a very young formation. I discovered a microscopical fragment of basalt in a slide of yellow, Cenomanian Rudist-limestone. This rock comes from Abu Qanatir; it proves the Cenomanian age of the basalt.

The basalt and tuffs are younger than the lower strata of the yellow Rudist-limestone; for everywhere west of Shefeya we see how these lower strata pitch away under the tuffs. At the contact with the tuffs these strata often show recrystallized Calcite (weak contact-metamorphism).

The above-mentioned facts sufficiently prove the upper-Cenomanian age of the basalts and tuffs.

2. The microscopical examination of the eruptiva.

A. Dense Basalt.

1. Findingplace: 900 m. W. of Shefeya. At first sight the slide gives the impression that the rock is a common olivine-basalt. As phenocrysts there occur: a) Titaniferous Augite, in scanty crystals. They are of zonal construction; the rims especially are of a violet colour; they contain a zone of inclusions. b) Common Augite, more faintly coloured. This too is rare. The maximum size of the crystals is somewhat more than 0,5 mm. c) Olivine, often in groups; size up to 0,5 mm. It is by far the most frequent phenocryst. It is serpentinized superficially and along fissures; the Serpentine has a green colour owing to Chlorites etc. Some Olivines have been altered into Iddingsite.

The groundmass consists of numerous laths of Labradorite (maximum size 1/6 × 1/60 mm.), groups of small Augite-crystals, much less Olivine, which has partly been altered into green Serpentine, but mainly into Iddingsite. Moreover, the groundmass contains Magnetite, often agglomerated into small groups. Between all these minerals there is a mesostasis, which is nearly colourless. It is veined with delicate little cracks, and its quantity is rather important. The refraction-index of this mesostasis is but little more than that of canadabalsam. The bi-refringence is a little less than that of the Plagioclase. There are no distinct crystal-contours; with crossed nicols we therefore perceive irregular grey and dark spots. We shall see afterwards that this mesostasis is probably Nepheline. Secondary minerals are — besides Serpentine and Iddingsite mentioned before — Chlorite and finely crystallized Calcite in irregular spots.

The rock is a Nepheline-bearing olivinebasalt.

2. Findingplace: between Shefeya and Es Salmaniyat. The slide again has the aspect of an olivinebasalt. The phenocrysts are formed by many Olivines and groups of rather large Augites. The Augites are nearly colourless and have some little irregularly distributed inclusions. As in the former slide the Olivines are partly serpentinized; the Serpentine is olivegreen to darkgreen.

Among the minerals of the groundmass, many Plagioclase-laths achieve such a considerable size (up to 1 mm.) that they may surpass the phenocrysts in length. Little Augite-crystals frequently lie within them, along their rims, and elsewhere too Augite-inclusions occur within the Plagioclase. Besides these large Plagioclases there also occur smaller Plagioclases. In the groundmass we moreover find much Augite and Magnetite distributed in tiny particles, accumulating especially near the Augite-crystals and also forming inclusions within them. One cannot say with any degree of certainty if scanty Olivine also occurs in the groundmass. Everywhere in the groundmass we find spots of a mesostasis with nearly the same properties as in the former slide. The refraction-index is either a little larger or a little smaller than that of the balsam (1,550—1,538). The bi-refringence is very low. Very likely we again have to deal with Nepheline. Different kinds of secondary minerals occur. The Serpentine has been coloured by Chlorites; spots of

Chlorite also occur in the groundmass. The Magnetite sometimes has a clear red rim of Limonite. Finally there occur in the slide numerous vesicles filled with Zeolites. Some fillings are isotropic; their refraction-index is much smaller than that of canadabalsam (Analcite?); other vesicles are filled with minerals of low bi-refringence; their refraction-index also is very low. The fillings of those vesicles frequently have a parquet-structure. They are biaxial positive.

A second slide has been used for some reactions. The slide, not provided with a coverglass, was for some time covered with a solution of gentian-violet in water. After filtrating no minerals appeared to have taken-in the colouring matter. The colouring matter only remained in some fissures. From this it may be concluded that no gelatinous minerals are to be found in the slide; therefore the isotropic fillings cannot be Opal. Afterwards (HOLMES, 33b, p. 276) the slide was treated with hydrochloric acid and then, after filtrating and rinsing, again with gentian-violet. After cleaning it could be seen that in rather numerous places parts of the mesostasis had become intensely violet. I found that one vesicle filled with isotropic minerals had also taken-in the colouring matter. Olivines were but little coloured, Chlorite somewhat more. So, all these minerals had been more or less gelatinized by the hydrochloric acid.

This rock is again a Nepheline-bearing olivinebasalt.

3. Findingplace: about 500 m. SW. of Abu Qanatir. Again the slide has the appearance of fairly normal olivinebasalt. The phenocrysts consist mainly of serpentinized Olivine, but alteration into Talc sometimes occurs as well; Augite as a phenocryst in rounded agglomerations is rare. Here and there it contains inclusions (? Magnetite) and is pale violet (? titaniferous Augite).

The groundmass mainly consists of rather large Plagioclases (see former preparation) and Augite; it is, moreover, rich in Magnetite; the Magnetite accumulates especially near the Augite. It is often developed as skeletons of crystals. It may be that some red grains indicate the place where Olivine-crystals in the groundmass have been altered into Iddingsite. It is not entirely impossible that little spots of a colourless mesostasis are present in the groundmass; but it could not be proved with certainty. Secondary minerals in the groundmass are Chlorite and Calcite.

The rock is an olivinebasalt.

4. Findingplace: Bir Jabir. Rather fine-grained basalt. Phenocrysts are almost exclusivly serpentinized Olivines. The Serpentine has been coloured light green by Chlorites. Iddingsite sometimes occurs. Alteration into Talc is rather common. Augite-phenocrysts hardly evei occur. The groundmass, consisting largely of Plagioclase (Labradorite), Augite-aggregations and some Magnetite, contains much of the colourless mesostasis (see former descriptions). Some spots of the mesostasis are pale yellow. In the groundmass there occur moreover spots of brownishgreen and grassgreen Chlorites.

A second preparation from the same locality was treated according to the method described on page 17, whereby — after the treatment with hydrochlorie acid and gentian-violet — the mesostasis became intensely purple. The other minerals remained nearly unaffected. Only the chloritic minerals were partly decolorized, partly coloured yellow. Before the treatment with hydrochloric acid, the refraction-index of the mesostasis had been measured. It appeared that it frequently did not much differ from that of canadabalsam, but in several spots it was much smaller, viz. about 1,48 (Zeolites!).

The rock is a Nepheline-bearing olivinebasalt.

5. Findingplace: origin of the wadi running from N. to S., to the N. of wadi Es Salmaniyat. Rather coarse-grained basalt. Phenocrysts are groups of Olivines, serpentinized along fissures. The colour of the Serpentine is brown to brownish green. Moreover many phenocrysts of titaniferous Augite with irregular inclusions occur in the preparation.

Contrary to former preparations, the groundmass contains less Magnetite, which occurs in skeletons. The Plagioclases are large and may surpass the phenocrysts in length. Many little Augite-grains and Augite-needles of the groundmass project into the Plagioclase or form inclusions within them. Spots of a yellow mesostasis occur in several places in the groundmass. It is very much cracked. Its refraction-index is distinctly lower than that of the Plagioclase. It is not entirely isotropic. The contours of the differently orientated fields are — nevertheless — not distinct. Sometimes groups of radially orientated needles occur in this mesostasis. Secondary minerals are Serpentine and Chlorite. The Chlorite occurs in the groundmass as irregular spots and spherolites.

A slide from the same locality has been treated with hydrochloric acid and gentian-violet. The yellow mesostasis became dark violet. A third slide clearly shows how the yellow mesostasis appears as well in vesicles, the core of which sometimes contains chloritical material. In this preparation the anisotropy of the mesostasis is a little more distinct than in the former one; at the same time, it may be observed that the refraction-index is much lower than that of balsam. Larger spots are biaxial and positive (Zeolites). Olivinebasalt.

6. Findingplace: W. of the pumpingstation, south of Shefeya. Rather fine-grained basalt. Phenocrysts are strongly serpentinized Olivines, agglomerated into little groups, often surrounded by a vague zone of grassgreen chloritic minerals; sometimes with a narrow rim of Iddingsite. Moreover colourless and very rare Augite occurs. The groundmass consists of small laths of Plagioclases, aggregations of Augite and small grains of regularly distributed Magnetite. Neither is the colourless mesostasis of feeble bi-refringence lacking. Moreover, some vesicles are filled with a colourless, dull mineral, which is quite isotropic. It also occurs here and there in the groundmass. Its refraction-index is lower than that of the much more transparent mesostasis and of course lower than that of canadabalsam too. Only little Chlorite is to be found in the groundmass. Finally we see how the few Olivine-grains in the groundmass have been partly altered into Iddingsite.

7. Findingplace: 650 m. W. of Shefeya. Fine-grained basalt. Most of the phenocrysts are partly serpentinized Olivine-crystals; alteration into Talc also took place. They have a tendency towards agglomerating in groups. Pale violet Augite as phenocryst is scarce. The groundmass mainly consists of small Plagioclases, agglomerations of prismatic Augite, and finely distributed crystals of Magnetite, which are inclined to agglomeration. Moreover, a transparent, weakly anisotropic mesostasis may clearly be seen, notwithstanding the fineness of the groundmass. Everywhere its refraction-index is lower than that of the Plagioclase. Chlorites appear here and there in the groundmass, partly forming spherolites.

Another slide from the same findingplace displays a coarser groundmass, in which the colourless feebly anisotropic mesostasis is much more distinct. Its refraction index is but little higher than that of canadabalsam. Augite-phenocrysts do not occur in this slide. The Magnetite is more inclined to agglutination. Sometimes the Magnetite has a reddish rim. The Chlorite (and the Serpentine along the Olivine-phenocrysts) may be sea-green, but mostly olive-green. Besides the Chlorite-spots mentioned we also find secondary Calcite in the groundmass.

Nepheline-bearing olivinebasalt.

8. Findingplace: N. border of Zichron Jaacov. Olivinebasalt. Phenocrysts are numerous Olivines, mostly agglomerating, changed into Serpentine and Talc along fissures and borders. Moreover there occurs a small group of Augite-phenocrysts, almost colourless and pale violet.

The groundmass consists of rather large Plagioclase-laths, Augite-aggregations and Magnetite, which is finely distributed and here and there agglutinates into bigger masses. Irregular spots of colourless mesostasis appear as well, distinguishable from the non-idiomorphic Plagioclase by a lower refraction-index (somewhat more than that of canadabalsam) and the absence of twinning. Secondary minerals in the groundmass are Chlorites, appearing as spots and as spherolites, filling vesicles.

Here and there we find some secondary Calcite, too.

9. Findingplace: between Abu Qanatir and El 'Arnin (SE. of 'Ein Ghazal). Olivinebasalt. The Olivine-phenocrysts show alterations into Serpentine, flaming-red Iddingsite and into Talc. Augite as phenocryst does not occur.

The groundmass is very fresh and consists of rather large Plagioclase-laths between which aggregations of Augite in very large quantities and only few irregularly bordered groups of Magnetite. Moreover the Magnetite frequently forms skeletons. It is not certain whether a few Olivines are present in the groundmass. I was not able to demonstrate the existence of a colourless mesostasis. Brown and green chloritical minerals also occur in the groundmass. Another slide from the same locality shows that a zeolitic mesostasis most positively occurs. It has a very low refraction-index and the bi-refringence can only be stated with a gypsum-slide.

This mesostasis again is yellow-coloured; it also occurs in vesicles, sometimes containing chloritical material in their core. A third preparation from the same locality contains beautiful Iddingsite, which has developed along the borders of some Olivine-phenocrysts.

A fourth preparation was treated with hydrochloric acid and gentian-violet. The small quantity of mesostasis became stained. It proved to be quite xenomorphic between the crystals of the groundmass. The Olivines too took in some of the colouring-matter. The Chlorites became golden-yellow.

10. Findingplace: bottom of the wadi W. of Zuweiq. Olivine-basalt with a large quantity of Zeolites. The Olivine-phenocrysts are strongly serpentinized. Moreover phenocrysts of beautiful titaniferous Augite are found.

The groundmass consists of Plagioclase of moderate size, Augite-aggregations (grains and short little columns) and Magnetite. The yellowish mesostasis of feeble bi-refringence is of very frequent appearance. Its refraction-index is distinctly lower than that of canadabalsam. Chlorite also appears in the groundmass; it is green or brownishgreen.

In another slide from the same locality, which unfortunately was broken, there occurred a big ($\frac{1}{2}$ mm.) nearly octagonal crystal. It was colourless and of a low refraction-index; it consisted of lamellae, which were weakly bi-refringent, and developed in two systems, perpendicular to one another. In some angular points this crystal was altered into the yellowish mesostasis. A spectral-analysis of this crystal showed strongly developed K- and Na-lines. It probably was Leucite.

A third slide was treated with hydrochloric acid and gentian-violet. Here, too, the mesostasis took a violet colour. After desiccation transparent isotropic small crystals were to be seen on cracks in the gelatinous silicic acid. They were probably of hydrochloric natron. Before the preparation was subjected to this treatment, the refraction index had been determined. It was about 1,49.

11. Findingplace: between Khallat et Tina and Zichron Jaacov. Olivinebasalt. It hardly contains any mesostasis.

12. Findingplace: N. of Es Salmaniyat and W. of El Murabba'a.

Olivinebasalt. In the slide no mesostasis could be seen; in a stained one, however, small quantities were found.

13. Findingplace: wadi El Hinu (below 'Ein Ghazal). A little vitrophyric olivinebasalt, which — also in other respects — somewhat differs from all those mentioned above. First of all, the Olivinephe-nocrysts have been less changed into Serpentine. Moreover, these Olivines show very clearly magmatic resorption, a phenomenon almost absent in the other, above-mentioned basalts. Moreover the amount of Augite-phenocrysts is considerable. The colour of the Augite-rims varies between grey and pale violet. They are very rich in numerous kinds of irregular inclusions, which are sometimes arranged zonally. These Augites equally show — but by no means everywhere — magmatic resorption. Sometimes small Augite-crystals form big groups. It may be observed that the quantity of big and small phenocrysts looks more numerous than in the rocks mentioned before.

The groundmass of this basalt is much darker than that of those mentioned before; in consequence it is more difficult to discriminate the different minerals. In a dark brown, probably isotropic, basis there lie, generally speaking, numerous regularly distributed grains of Magnetite. Besides, there are many extremely small columns of Augite in the groundmass. I did not succeed in discovering Feldspars. Moreover some small Zeolites occur in a fair amount of vesicles.

B. Vesicular Basalt.

1. Findingplace: bottom of the wadi W. of Zuweiq. Weathered amygdaloidal basalt. The Olivine-phenocrysts have been completely altered into carbonates with strings of Limonite. In the groundmass, the borders of the crystals of the rather large Plagioclases may still very clearly be seen. The refraction-index is less than that of balsam and they are rather distinctly twinned (Albite). The rest of the groundmass consists of a turbid, dark, grained substance, in which there are numerous untransparent dendrites: basaltic glass which is more or less altered. Here and there a distinct Magnetite cube can be seen. The amygdaloidal vesicles are filled with carbonates, probably Calcite.

2. Findingplace: W. of the pumping-station, S. of Shefeya. Very badly weathered basalt. The greater part of the Olivines has been altered into a brown opaque mineral (Limonite?), for the rest into Chlorite. The groundmass shows the contours of numerous Plagioclases, which however in general display no twins, often hardly any bi-refringence. Large fragments of the groundmass are impregnated with a fine grained mineral which is also found in veins and vesicles. Its refraction is somewhat less than that of balsam; the bi-refringence is not high (Chalcedone?). The Magnetite of the groundmass has still remained rather fresh. There are big Calcite-amygdules. The slide corresponds with the description of a preparation by E. Fuchs (29, p. 571, no. 3). His rock came from almost the same findingplace.

3. Findingplace: in the slope ½ km. S. of Es Salmaniyat. Strongly weathered, vesicular basalt.

The only rests of the Olivines are bi-refringent, red rims, probably of Iddingsite, occurring in what once was the marginal zone of the Olivine.

The Plagioclase of the groundmass is well developed and, though it is quite albitized, we still clearly perceive twinning; Magnetite crystals of the groundmass are of frequent occurrence; moreover thin dark dendrites can be found. The numerous vesicles and cavities are filled with coarse-grained to fine-grained Calcite.

4. Findingplace: bombs in the green tuff 600 m. SW. of Shefeya. From the Olivines there remain only pseudomorphoses of Limonite and Chlorite, perhaps with some Talc. Very rare fragments of fresh Augite are still present. The groundmass consists of numerous albitized Plagioclases, of finely distributed Magnetite which frequently forms crystal-skeletons, and moreover of Limonite and Chlorite. The number of amygdules is rather large, but they are very small, partly empty, partly filled with Chlorite and Calcite. If both minerals occur in one vesicle, then the Chlorite lies on the periphery and the Calcite in the centre.

5. Findingplace: 1½ km. N. of Shefeya. Very considerably weathered amygdaloidal basalt. Rare Limonite-carbonate pseudomorphoses after Olivine occur. The groundmass consists of numerous Albites between which there is a brown limonitic badly transparent mass, here and there with rests of small Magnetites. There

are numerous veins and amygdules of Calcite. Along the periphery of the latter there is nearly everywhere a narrow rim of constant breadth, consisting of a fibrous mineral with a low refraction-index and a low bi-refringence; the fibres being perpendicular to the wall of the vesicle. In the Calcite there sometimes occur small vermiform spherolites consisting of the same material.

6. Findingplace: NE. of the ruin between Shefeya and El Fureidis. Very badly weathered basalt. It has probably consisted exclusively of groundmass and gas vesicles. The former still shows little narrow Albite-laths with, between them, an opaque mass (probably altered glass). The vesicles are filled with Calcite. They occupy nearly half of the surface of the slide.

7. Findingplace: 900 m. NW. of Shefeya. Vesicular weathered basalt. It probably contains pseudomorphoses of Calcite-Limonite after Olivine-phenocrysts. The Plagioclase of the groundmass is entirely albitized. The groundmass moreover consists largely of limonitic material and fine Magnetite-grains. The vesicles are filled with Calcite, also with a little Chalcedone(?), sometimes occurring as spherolites or vermiform aggregates.

8. Findingplace: NW. of Zuweiq and SW. of Umm el Jarab. Vesicular basalt with entirely altered crystals of Olivine and with a groundmass consisting of Albite and Limonite. The vesicles are generally empty; Calcite-filling is rare.

9. Findingplace: bottom of the wadi W. of Zuweiq. Vesicular basalt with many pseudomorphoses of carbonate-Limonite after Olivine-phenocrysts. In the groundmass we see Albites and an entirely opaque mesostasis; moreover vesicles filled with Calcite and peripheral Limonite.

10. Findingplace: pass S. of Salmaniyat. Vesicular basalt, in contact with a subjacent limestone-bed. From the Olivine-phenocrysts there only remain cavities, sometimes filled with carbonate. They are surrounded by a rim of Limonite. The groundmass consists of Albite, Magnetite and a turbid to opaque glass basis(?). The limestone has been recrystallized at the contact with the basalt; the size of the Calcite-grains decreases with increasing distance from the contact. Close to the contact we find in the limestone a zone of reniform Limonite, originating from Chlorite: contact-metamorphosis?

C. Inclusions of Basalt in Limestone.

1. Findingplace: table-land between Abu Qanatir and El'Arnin. In a yellowish organogenic limestone (the yellow Rudist-limestone) there are small fragments of basalt.

2. Findingplace: on the W. slope of the wadi between Shefeya and El Fureidis. In this case we have to deal with fragments of basalt included in a younger "nari"-limestone.

In a fine-crystalline, flaky, somewhat breccious limestone there are fragments of fresh basalt. The Olivines have been altered along their rims, partly into yellow Serpentine, partly into red Iddingsite. (Of the Iddingsite an interference-figure could be made by means of an oil-immersion. The optic axial angle is about 30°; $\varrho < v$. The optical sign is positive.)

3. Findingplace: S. part of Es Salmaniyat. Also basalt inclusions in "nari"-limestone.

D. The Tuffs.

1. Findingplace: slope N. of Ijzim. The slide shows an agglomeration of a dark brown material and very large Olivine-crystals, which have been largely altered into Serpentine, Talc and carbonate. Between these minerals there is much calcareous cement. In several places we find a rather large Biotite. The brown material does not become dark between crossed nicols. This is because it consists of extremely fine squamae of Chlorites(?) etc. It frequently contains little round vesicles — generally filled with carbonate — and always grains of ore. In this brown mass we sometimes observe the contours of an Olivine-crystal, which has been entirely altered into yellowish-brown Serpentine and Talc. As mesostasis little needles of a colourless mineral with low refraction and bi-refringence, and with a negative elongation (Chalcedone?) occur.

2. Findingplace: somewhat E. of Zichron Jaacov on the main-road to Shefeya. Under the microscope the tuff appears to consist of a large quantity of small rhombohedra of carbonate and small pieces of Chlorite, which nearly everywhere has a low bi-refringence. Near the centre of the slide there is a distinct Plagioclase crystal.

3. Findingplace: 600 m. SW. of Shefeya. This substance too

consists largely of Chlorite and Calcite. The Chlorite forms well-outlined spots and spherolites; the Calcite is irregularly grained. Within Chlorite-spots we find small fragments of Limonite, which appear to be weathered basalt (sometimes we see weathered Feldspar-laths in the Limonite).

E. Iron Ores.

Findingplace: olive-yard behind Shefeya (boulders). Brown, Limonitic ore; in the slide yellowbrown to redbrown-transparent and dark opaque. The ore must have originated from the basalt, for in different places we see numerous, sometimes twinned Plagioclase-laths, and some Magnetite. Apparently the ore filled the fissures in the basalt. Afterwards the basalt itself was affected too. The Plagioclase was the last to be altered, but at length the Plagioclase too disappeared and in its place there came Limonite.

Another slide from the same locality shows how cubic crystals (square, rhombical and hexagonal sections) of distinctly concentric composition have been altered into Limonite. It may be that here we have to deal with a pseudomorphosis of Limonite after Magnetite. In that case, however, the Magnetite crystals were much larger than we are accustomed to with basalts of our region.

3. Chemical analysis of one of the basalts.

A chemical analysis has been made by mr. W. van Tongeren (Miner. Institute, Utrecht) of the dense basalt, bearing Zeolite and Leucite from the locality mentioned sub A 10 (Zuweiq). In table I, A 10 is this new analysis, I is the analysis of an olivine-basalt (? Pleistocene) from wadi Shakeiyif, L. Tiberias Transjordania (71a), II is the analysis of an olivinebasalt from Zeizun, Jarmuk valley, Transjordania (71a), III the analysis of an olivine-basalt (Pleistocene) from Nahalal, Plain of Esdraelon, Palestine (71a), and IV the analysis of a "mediterranean" basalt (Miocene) from Khéchen E. of Caïro (71a).

The following examples of Tröger (71b) have been added to this table:

a. Nepheline-basanite, Jesserken-Berg, Lobositz, Bohemia (71b, no. 591); b. Olivine-basalt, Drynoch, Skye, Scotland (71b, no. 379); c. Essexite-basalt, Utanjilua, Patagwa-river, North-Nyassa, East-Africa (71b, no. 382); d. Basalt, lava of 1920, Mauna Iki, Kilauea, Hawaii (71b, no. 378), and e. Tokéite (melanocratic olivinebasalt), Addis-Abeba, Abessinia (71b, no. 407).

	A 10	I	II	III	IV	a	b	c	d	e
SiO_2	45,13	41,45	45,50	43,86	50,1	44,52	46,61	43,49	50,32	43,60
AlO_3	11,40	17,73	17,73	16,25	17,7	14,28	15,14	16,70	12,83	10,65
FeO_3	4,53	2,26	1,71	7,44	0,65	6,36	3,49	4,17	1,74	3,53
FeO	8,69	9,22	9,07	3,46	7,85	5,39	7,71	9,09	9,93	7,15
MgO	8,89	9,76	9,59	5,49	5,0	7,13	8,66	8,20	7,39	12,62
CaO	9,83	10,64	9,64	10,46	10,0	10,20	10,08	10,05	11,06	17,42
Na_2O	2,63	2,45	2,67	2,32	3,5	3,76	2,43	2,72	2,38	1,30
K_2O	1,62	0,87	0,85	3,24	1,3	2,59	0,67	1,20	0,41	0,55
H_2O+	3,09	0,80	0,98	0,89	{ Ign.	3,53	2,07	1,41	0,33	1,96
$H_2O—$	0,87	1,30	0,32	0,88	{ 1,4	0,00	1,10	0,26	0,05	0,00
TiO_2	2,63	2,40	1,80	4,10	2,4	2,04	1,81	1,90	3,10	2,22
P_2O_5	0,45	0,96	0,26	1,00	—	0,56	0,10	0,68	0,30	—
MnO	0,14	tr.	tr.	tr.	—	—	0,13	—	0,10	—
S	—	0,00	0,00	—	—	0,00	—	—	—	0,00
CO_2	0,00	0,00	0,00	—	—	0,00	tr.	0,00	0,00	0,00
Cr_2O_3	0,04	—	—	—	—	—	0,04	0,00	0,00	0,00
	99,94	99,84	100,12	99,39	99,9	100,36	100,04	99,87	99,94	101,00
si	93,4	82,2	94,0	92,6	124,0	100	104	93	118	81
al	13,9	20,7	21,6	20,21	25,8	19	20	21	17½	11½
fm	56,9	50,9	50,6	47,0	37,2	44½	49½	49	48½	50½
c	21,8	22,6	21,3	23,7	26,5	24½	24	23	28	35
alk	7,4	5,8	6,5	9,1	10,5	12	6½	7	6	3
k	0,28	0,23	0,19	0,48	0,20	0,31	0,15	0,23	0,10	0,22
mg	0,48	0,57	0,58	0,37	0,50	0,53	0,59	0,53	0,53	0,69
Ls	0,62	0,78	0,74	0,83	0,75	0,86	0,63	0,75	0,50	0,43
Fs	0,78	0,71	0,60	0,64	0,39	0,62	0,58	0,62	0,55	0,97
Qs	—0,40	—0,49	—0,34	—0,47	—0,14	—0,48	—0,21	—0,38	—0,05	—0,40

TABLE I.

It is clear that the large quantity of H_2O+ in A 10, corresponds to the presence of a zeolitic mesostasis. I consider these Zeolites to be the weathering-product of the nephelinic mesostasis, which we described from several samples.

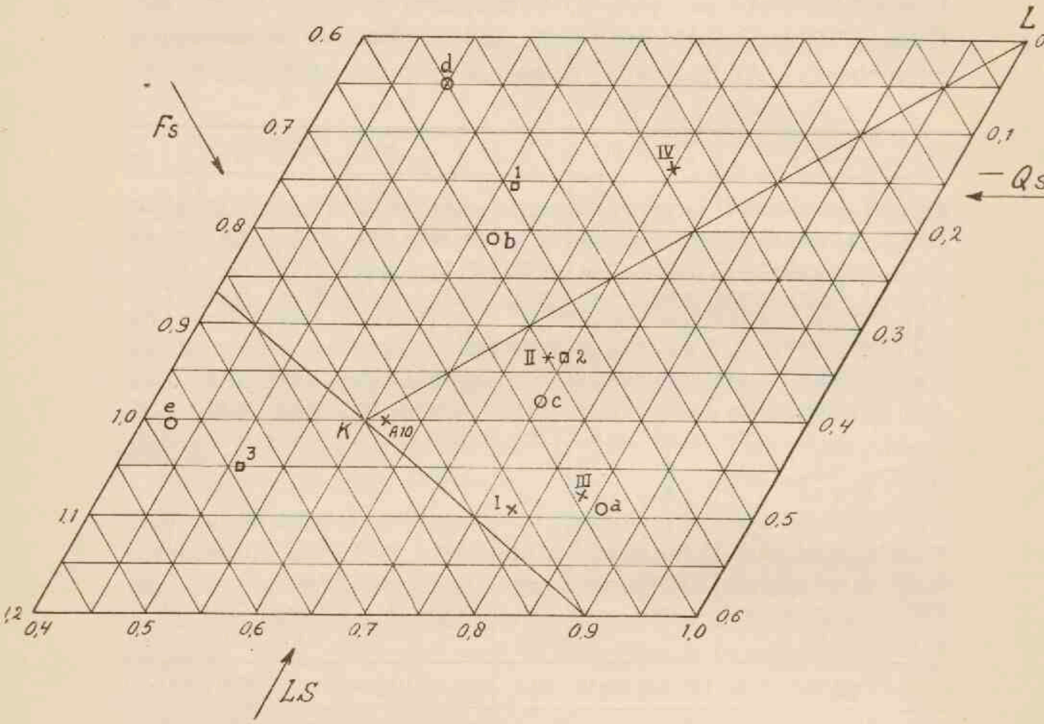


Fig. 2. Qs-Ls-Fs diagram (according to Niggli). For explanation, see text.

In order to get a clear insight into the chemical character of the new basalt, the

$$\mathrm{Ls}\left(=\frac{2\mathrm{al}+4\mathrm{alk}}{\mathrm{si}}\right),\ \text{the Fs}\left(=\frac{100-2\mathrm{al}}{\mathrm{si}}\right)\ \text{and the}\ \underset{\sim}{\mathrm{Qs}}\left(=\frac{\mathrm{si}-(100+4\mathrm{alk})}{\mathrm{si}}\right)$$

of the basalts of table I have been set out in fig. 2 in a triangular diagram (43b, p. 129, 131). In order to have the projection-points at as large a distance from each other as possible, only the surroundings of point k have been reproduced. Besides, point 1 is the projection-point of a normal gabbroid magma according to NIGGLI, 2 the projection-point of essexite-gabbro according to NIGGLI, and 3 the projection-point of pyroxenitic magma according to NIGGLI. Beginning with an examination of all the oriental basalts with regard to each other, we see that A 10 with regard to the others lies obviously to the left; from which it follows that the basalt must be relatively poor in Feldspars and rich in meta- and ortho-silicates. A rough measurement with a recording micrometer tells us indeed that the slide described under A 10 has a color ratio of nearly 70, which is more than the figures for olivine-basalt, common basalt and alcalibasalt given by TRÖGER (71b, p. 166). The rather large negative Qs of A 10, I, II and III make the presence of Feldspathoides presumable. An olivinenephelinite from Palestine has been described by FUCHS (29, p. 576); PICARD gave a description of a basanite and TYRRELL (71a, p. 412) presumes that a recent basalt of the Dead Sea contains Analcite and Nepheline. So, in Cisjordania, basalts, rich in alcali have indeed been found, but in the description of TYRRELL of the preparations belonging to I, II and III no Feldspathoides or other minerals that are rich in alcali are mentioned.

In my opinion it is probable that I, II and III are alcalibasalts. These rocks are characterized by the normative presence of Feldspathoides, whereas at the utmost these minerals occur as accessories. Osann defines the alcalibasalts in H. ROSENBUSCH "Elemente der Gesteinslehre 1923" somewhat differently, but fundamentally it comes to the same thing. Microscopically these rocks are normal basalts. From the 11 analyses quoted by OSANN, the Qs varies between abt. — 0,3 and — 0,7, the Ls between 1 and 0,68, the Fs between abt. 0,5 and 0,8. Basalt IV belongs in consequence of its greater richness in silicic acid to the normal basalts; its projection-point therefore lies above the line L—k: according to NIGGLI in the region of the normal gabbroid magma.

We have demonstrated already that Feldspathoides must have been present also modally in A 10, but that they have been altered into Zeolites. Leucite is accessory. In my opinion the rock is too rich in Feldspathoides to belong to the alcalibasalts. It is better to look upon it as belonging to the Nepheline-bearing olivinebasalts, alcalibasalts or to the more melanocratic basanites. The names used up to now for the cretaceous basalts of the Carmel (viz. basalt and olivinebasalt) are therefore insufficiently typical.

4. Summary.

The basalt that has developed as tuffs and dense bombs and partly as dense and vesicular lava, is basic and feebly alcalic. The minerals which were the first to crystallize in the basalts were the Olivine and Augite, which partly developed as titaniferous Augite. Both these minerals may show magmatic resorption. Of the crystals belonging to the second generation (groundmass), the Magnetite and the Augite and perhaps some Olivine were the first to crystallize; the Labradorite followed. Between those minerals a mesostasis of nephelinic composition crystallized. Hydrothermal action has afterwards altered the mesostasis for the greater part into Zeolites. Different vesicles were also filled with Zeolites. In the same period part of the Olivines were altered into Serpentine and into Iddingsite, afterwards into Talc and carbonate. Moreover — from the Olivine and the Augite together perhaps — Chlorite was formed. The Calcite-filling of the vesicular basalt is always of a later date than the filling with other hydrothermal minerals, for if both occur in one vesicle the other mineral lies as a rim around the Calcite. The vesicular basalt appears to be the most susceptible to alteration: it shows the strongest alteration of the groundmass. Here the Plagioclase was albitized.

Sometimes we see that the basalt has been quite altered into Limonite.

5. Some remarks.

On the N. side of Zichron Jaacov and SW. of Shefeya we see that the green basaltic tuff-slope is partly covered by fragments of "nari"-like limestone, which I consider to be rests of waste, tumbling down from the limestones which cover the basalts, and which were afterwards cemented by the process of weathering. This "nari", seen through the microscope has a weathered and somewhat breccious appearance. Moreover it contains rather many Chlorite scales and small spherolites, which come from the subjacent tuff. Once or twice I found a piece of fresh yellow Rudist-limestone among fragments of this "nari".

The basalt- and tuff-eruption was very probably submarine, for the eruptiva are intercalated between marine strata, lying elsewhere concordantly on top of each other. It is not impossible that here and there the summit of the volcanic strip rose above sea-level, the eruption having taken place in a shallow sea, as the underlying strata (yellow Rudist-limestone) have clearly neritic facies. One may see on the map that on culminating points W. of Shefeya and NE. of Zichron Jaacov the yellow limestone and even an important part of the "Mizzi Helu" seem to be lacking. This might point to a very local disconformity on several tops of the volcanic row that stuck out above the sea.

Where the centre of eruption is to be sought is not obvious either. N. of Zichron Jaacov one might take the tuffaceous hill, lying squeezed in between rocks older than the tuff (Cenomanian dolomite), for the upper part of a volcanic pipe, while the tuffaceous offshoot directed westward, interbedded between the upper Cenomanian "Meleke", might have been part of the volcanic belt. (See section K-L). We shall see, however, in the chapter on tectonics, that on the eastern as well as on the western side, this tuffaceous hill is bordered by a small fault. These small faults are post-Turonian, so that this tuffaceous hill might be interpreted as a post-Turonian trough-fault. The tuff E. of this wall has — as may be seen on the map — a strong dip to the E., the "Mizzi Helu" covering it conformably. The throw of the fault on the eastern side is sufficient to press the lower part of the tuff downward to the bottom of the valley. On the western side of the tuffaceous hill we see no stratification at all. But in the tuffaceous offshoot W. of it, there is a dip of 10° to the W.

On this side the following is peculiar: If we assume, that the tuff-offshoot lies normally in the yellow limestone — and I do not see any reason why this should not be the case — then we arrive at an inexplicable question, if we accept moreover that the present situation on the western side of the tuffaceous hill is only the result of one fault. In that case the tuffaceous hill would have to be taken as part of the normally intercalated tuffs and not as the upper part of the volcanic vent. Thus we might expect that on both sides of the fault, the tuff would be equal in thickness. But as a matter of fact the thickness of the tuff on the eastern side of the fault suddenly seems three times as much. Since moreover we do not see the base of the tuff on the eastern side of the fault, this is only a minimum.

In my opinion, similar phenomena can be explained in a most natural way, if we suppose that the tuff-offshoot really belongs to the eruption-belt, but that it is bounded on the eastern side by the eruption-chimney. Then the eastern side of the eruption-chimney might be invisible owing to a tectonic inclination.

Perhaps it may as well be possible to explain these phenomena, by supposing some more faults. The possibility exists too, that various details may in fact be otherwise, since the outcrops are by no means ideal. Moreover measurement of the thickness of the tuff is frequently impossible, owing to the fact that the tuff is often unstratified.

STRATIGRAPHY OF THE COASTAL PLAIN.

1. Outcropping material.

Four types of rocks are found outcropping in the coastal plain: a) the black earth, b) the yellow sands, c) the red sands and d) the "Kurkar", a calcareous sandstone. These four rocks can be discerned along the greater part of the Palestine coast. It is difficult, however, to determine their relative age. The three last are aeolian deposits, as we shall prove afterwards: one can cover the other.

a) The black earth extends from the mountain-border to the "Kurkar"-ridge along the coast, in a long strip from N. to S.; moreover it is found S. and SE. of Kh. esh Shuna and E. of Binyamina. Between the different ridges of "Kurkar" in the northern part of our region, narrow zones of black earth are found again. The black earth is partly alluvial ooze of the wadi's. At the border of the hills large fields of boulders may be intercalated. In Kabara it consists of boggy material with *Melanopsis buccinoidea* Oliv., some species of *Helix* etc. This material is very young; 10 to 20 years ago, we should have found moorland here. The soil fizzes with hydrochloric acid and shows a marked alcalic reaction. The boggy material contains moreover many Quartz grains.

b) The yellow sands mainly border the coast in a narrow strip, just at the outside of the true "Kurkar"-ridge; further to the S. this strip suddenly widens (as the coastal plain widens too) up to a breadth of 3—6 km. of dune-sand. This sand is very calcareous and contains, besides rests of *Lamellibranchiata*, also *Foraminifera*. We found near Kh. Hudeidun: *Rotalia beccarii* Lin., *Triloculina trigonula* (Lam.), *Elphidium crispum* (Lin.), finally *Spiroloculina* sp.; furthermore spines of *Echinoidea* and calcareous *Algae*. S.W. of Mallaha we found *Rotalia beccarii* (Lin.), *Triloculina tricarinata* (d'Orb.) and *Elphidium crispum* (Lin.), spines of *Echinoidea* etc. The yellow sands form recent dunes, which have a strong tendency towards moving to the NE. For the minerals in the Quartz-sands of the Palestine coast see RANGE (62, p. 52) and table III.

c) The red sands occur in the region between Wadi Zarganiya and Binyamina, and in the region S. of Kh. Tall ed Dodahan and Wadi Abu Hamad. They are non-calcareous and consist of Quartz grains, covered with a red film of Limonite.

d) The "Kurkar" is a porous calcareous sandstone. It forms a ridge about 20 m. in height, which runs along the coast. N. of Tantura there are even three ridges parallel to one other. Moreover we meet with a row of outcrops of this "Kurkar" along the border of the hills. These outcrops can reach a height up to 60 m. above sea-level. This we see e.g. NE. of Tall Mubarak, also on the main-road E. of the station of Zichron Jaacov and above Kh. Manara; finally a number of outcrops of the "Kurkar" are to be found in the coastal plain W. of Binyamina.

There is hardly any difference among the slides of the "Kurkar". We always see numerous sections of *Elphidium* and other *Foraminifera*, of *Lithothamnium* and other calcareous *Algae* and of spines of *Echinoidea*. From the slides we conclude, that the "Kurkar" for the far greater part consists of Quartz grains and moreover of grains of $CaCO_3$ which partly are fragments of *Lamellibranchiata*, partly have no recognizable structure. All those grains are cemented by the recrystallized material of the organic rests. Loose *Foraminifera: Rotalia beccarii* Lin., *Elphidium crispum* (Lin.) *Triloculina trigonula* (Lam.) and moreover Spines of *Echinoidea* from the "Kurkar" are to be found N.E. of Jazirat el Qusseib.

2. Drilling material.

Herewith table II. The Palestine Jewish Colonisation Association has had many borings made in the coastal plain S. of Binyamina. Dr. PICARD has summed up these borings in a — never published — communication „Ueber die Grundwasserverhältnisse der Gegend von Karkur, Pardess Hanna, Giveat Ada und Binyamina" (1934). With the author's consent I publish those results which are most important for us. The Cretaceous and lower Tertiary strata dip in all directions under the plain, where they are to be found at a great depth. On these strata there lie Diluvial deposits which grow thicker towards the W. The Pleistocene consists of sand, loamy sand, loam, hard calcareous sandstone ("Kurkar"), deposits of boulders which reach a thickness of several metres, and variegated marl. Near Karkur the complex has a thickness of about 30 m., near Pardess Hanna of about 50 m., in the direction of Chedera to the S. — outside our region — of 100 m. and more. Upper Tertiary is the blue marl (fr. marnes gris) found in bore-holes near Karkur, corresponding with the "Saki"-layers of LÖWENGART, found much farther to the S. Thus far Dr. PICARD. From the boring-profiles which were at Dr. PICARD's disposition, and from which I copied ten, it appears how irregularly red sand, "Kurkar", white sand and deposits of boulders can succeed one other. There is a total lack of continuous levels, even within a few hundreds of metres.

In the coastal strip, too, many borings have been made, nowhere, however, as deep as the blue clay, which LÖWENBERG and LÖHNSTEIN believe to have demonstrated at Atlit, N. of my region. They measured the electric conductive power of the underground and concluded to the existence of blue clay at a depth of 150 to 200 m. (39).

The boring of ZUCKERMANN N. of En Nazla had the following section:

to	8	m.	hard black earth
,,	8,5	,,	soft "Kurkar"-sandstone
,,	9,5	,,	normal black earth
,,	10,5	,,	hard black earth
,,	11	,,	"Kurkar" rock

to 13	m.	white sand with shells
,, 16	,,	"Kurkar" and yellow sand
,, 22	,,	hard sandstone
,, 24	,,	"Kurkar"

The samples of this boring were no longer available; the profile is based on communications of the ZUCKERMANN's. From this boring sand is always rising to the surface at the same time with the water. It contains the following fossils: *Rotalia beccarii* Lin., *Elphidium crispum* (Lin.), *Quinqueloculina* sp. etc., spines of *Echinoidea* and others.

The southern well of En Nazla had the following section: 2,5 m. black earth, then 17 m. Kurkar down to the groundwater; the central well of En Nazla: 1 m. black earth and 12 m. of "Kurkar" down to the groundwater.

According to information obtained the profile near the pumping-station of the village of Zichron Jaacov is: 1½ m. black earth, 8½ m. "Kurkar", 1½ m. soft grey rock, 10 m. "Kurkar" and sand, down to the groundwater.

In a well of the orange-yard SE. of Kh. el Fureidis, below the black earth 7 m. white sand and "Kurkar".

From these boring-results it appears that in the northern part of the coastal-plain "Kurkar" and white sand always lie under the black earth.

TABLE II.

List of borings.

(The numbers after the borings are the distances in metres from the railway-station of Binyamina).

BORING 1. 2000 E, 2400 S.
Alt. + 45 m.; depth in metres:

0—3,0	loamy sand, red.
3,0—4,3	loamy sand, yellow.
4,3—5,5	*"Chamrah", brown.
5,5—7,5	"Chamrah", dark.
7,5—8,9	"Chamrah", reddish.
8,9—9,3	reddish sand.

*) "Chamrah" is a local name for red earth or red loamy sand.

9,3—10,0	reddish "Chamrah".
10,0—12,4	loamy sand, red.
12,4—14,5	yellow sand.
14,5—15,5	"Chamrah", brown.
15,5—16,5	loam, brown.
16,5—20,0	sandy loam.
20,0—24,2	sandy loam, yellow.
24,2—26,4	sandy loam.
26,4—27,5	yellow sand.
27,5—32,0	grey clay, sandy.
32,0—34,0	grey sand with flint-pebbles.
34,0—34,3	grey clay.
34,3—34,5	yellow sand.
34,5—35,0	gray sandy clay.
35,0—35,8	yellow sand.
35,8—35,9	marl, grey.
35,9—38,2	yellow sand.
38,2—38,3	grey clay.
38,3—39,2	grey marl.

Boring 2. 1800 E, 2400 S.
Alt. + 45 m.; depth in metres:

0—0,8	brown "Chamrah".
0,8—1,7	nice red "Chamrah".
1,7—3,9	dark red "Chamrah".
3,9—4,9	brown loam.
4,9—6,0	grey clay.
6,0—6,6	brownish "Chamrah".
6,6—6,9	reddish "Chamrah".
6,9—7,8	red "Chamrah".
7,8—18,0	yellow sand.
18,0—19,0	brown "Chamrah".
19,0—23,5	reddish "Chamrah".
23,5—26,6	loamy sand, brown.
26,6—31,0	yellow sand.
31,0—32,5	grey clayey sand.
32,5—35,5	grey clay.
35,5—36,4	yellow sand.
36,4—37,3	sandy clay, grey.
37,3—40,9	grey clay with stones.
40,9—42,6	greenish clay with stones.
42,6—47,9	yellow sandstone.
47,9—51,6	grey marl.
51,6—71,0	grey marl with flint.

Boring 3. 1700 E, 2200 S.
Alt. + 35 m.; depth in metres:

0,0—0,8	brownish "Chamrah".
0,8—4,3	red "Chamrah".
4,3—6,5	grey "Chamrah".
6,5—7,0	brownish "Chamrah".
7,0—12,0	reddish "Chamrah".
12,0—16,8	brown loam, dark.
16,8—19,5	red "Chamrah".
19,5—20,6	reddish "Chamrah".
20,6—22,45	yellow sand.
22,45—24,4	sandy clay, grey.
24,4—25,0	clay, grey.
25,0—29,7	grey clay with pebbles of flint.
29,7—33,8	sand with stones.
33,8—37,0	white sand.
37,0—37,5	sandstone.
37,5—40,0	marl.
40,0—47,4	limestone and grey clay in thin strata.

BORING 4. 1100 E, 2100 S.
Alt. + 35 m.; depth in metres:

0—0,4	mould.
0,4—3,5	red "Chamrah".
3,5—7,2	reddish sand.
7,2—12,8	yellow sand.
12,8—16,1	yellow sand, light.
16,1—18,5	reddish sand, light.
18,5—26,5	white sand.
26,5—28,5	grey sand, grey clay.

BORING 5. 1800 E, 1800 S.
Alt. + 35 m.; depth in metres:

0—1,3	mould.
1,3—1,9	red sandy loam.
1,9—2,4	reddish loamy sand.
2,4—7,9	yellow sand.
7,9—9,3	white sand.
9,3—10,6	yellow sand.
10,6—11,9	red sand.
11,9—13,9	reddish sand.
13,9—14,7	sandy loam, red.
14,7—16,2	loamy sand, red.
16,2—17,1	reddish sand.
17,1—19,0	yellow sand.
19,0—26,0	white sand.

BORING 6. 900 E, 2800 S.
Alt. + 40 m.; depth in metres:

0—0,8	earth.
0,8—1,3	dark red "Chamrah".
1,3—4,0	red "Chamrah".
4,0—10,0	yellow sand.
10,0—13,0	brown sand, loamy.
13,0—17,6	yellow sand, a little cemented.
17,6—26,2	brown, below grey sand, cemented.
26,2—29,4	reddish brown "Chamrah".
29,4—33,6	yellow sand, loamy.
33,6—36,5	brown loamy sand with pebbles.
36,5—41,0	sand with boulders up to 4 cm. and clay-fragments.
41,0—43,8	yellow sand with pebbles.
43,8—47,3	grey sand.
47,3—48,5	yellow sand.
48,5—50,5	yellow sand with boulders.
50,3—51,3	white sand.
51,3—56,0	grey clay, sandy.

BORING 7. 500 E, 2900 S.
Alt. + 35 m.; depth in metres:

0—0,8	mould.
0,8—1,7	red "Chamrah".
1,7—2,2	grey "Chamrah".
2,2—3,4	brown "Chamrah".
3,4—4,8	red "Chamrah".
4,8—5,8	reddish "Chamrah".
5,8—6,5	reddish sand.
6,5—13,0	yellow sand.
13,0—14,3	grey sand.
14,3—23,0	red "Chamrah".
23,0—29,4	red sand.
29,4—33,4	yellow sand.
33,4—35,5	brown loam.
35,5—37,2	grey clay.

37,2—49,6	yellow to bluish sand and loam.
49,6—54,0	red "Chamrah".
54,0—55,8	red "Chamrah".
55,8—70,6	yellow sand.

BORING 8. 400 E, 2400 S.
Alt. + 30 m.; depth in metres:

0—3,1	brown "Chamrah".
3,1—3,9	red "Chamrah".
3,9—11,0	yellow "Chamrah".
11,0—14,9	reddish "Chamrah".
14,9—33,7	grey clay.
33,7—34,8	white sand.
34,8—36,7	yellow sand.
36,7—38,9	grey clay.

BORING 9. 2800 E, 2800 S.
Alt. + 55 m.; depth in metres:

0—1,4	"Chamrah", grey.
1,4—2,1	"Chamrah", red.
2,1—3,2	"Chamrah", brown.
3,2—5,5	"Chamrah", red.
5,5—6,1	sand, yellow.
6,1—8,4	"Chamrah", reddish.
8,4—8,9	"Chamrah", red.
8,9—10,7	"Chamrah", reddish.
10,7—12,2	sand, red.
12,2—13,8	sand, yellow.
13,8—15,7	sand, red.
15,7—18,3	"Chamrah", reddish.
18,3—19,2	sand, reddish.
19,2—23,0	sand, white.
23,0—26,4	sand, reddish.
26,4—33,0	sand, pure.
33,0—33,5	sand and loam.
33,5—34,5	loam, greyish blue.
34,5—35,0	clay with flint boulders, limestone.

BORING 10. 1800 W, 100 N.
Alt. + 15 m.; depth in metres:

0—4,0	red loam.
4,0—9,0	red loam, sandy.
9,0—12,0	red sand, loamy.
12,0—14,2	yellow sand, loamy.
14,2—15,0	pure, coarse sand.
15,0—17,0	loamy sand.
17,0—21,0	clay.
21,0—22,0	loam.
22,0—23,0	red sand.
23,0—25,0	pure sand.
25,0—25,1	stone.
25,1—28,5	sand, "Kurkar", shell-fragments.

These data have been translated from the tables supplied to me by the Geological Department of the Hebrew University, with a view to studying and possibly publishing them. Of the boring-material proper I have been able to get hold of a small portion only. As the description of this material corresponded fairly accurately with the material itself, I have presumed, that all the drill-logs, reproduced here-above, are fairly exact.

3. Origin of the "Kurkar".

In 1910 BLANCKENHORN (12) regards the calcareous sandstones along the coast of Palestine as Marine Diluvium. RANGE (61) too presumes in 1922 that the "Kurkar" is a marine deposit. In 1928, however, LÖWENGART (40) mentions, that the "Kurkar" is fossil dune-sand. He judges especially from the physiography of the "Kurkar". The outlines of the old dunes are, according to him, still recognisable.

In 1932 RANGE (62) composed a chronological diagram, in which he divided the calcareous sandstone into Alluvial terrestrial "Kurkar" and lower-Diluvial terrestrial and marine sandstones. In 1928 BLAKE (7) describes the Quaternary along the Palestine coast. Like LÖWENGART he calls the "Kurkar" fossil dune-sand. He was struck by the often steep dip and the variable strike of the layers. A sound argument for the terrestrial origin of the "Kurkar" may be obtained from Blake (9, p. 9). The Misses GARROD and GARDNER namely have subjected the quarries in the "Kurkar"-ridge near Atlit (immediately N. of my region) to a provisional survey. This quarry which lies a quarter of an hour's walk N. of the station Atlit showed according to the above mentioned authors, the following section:

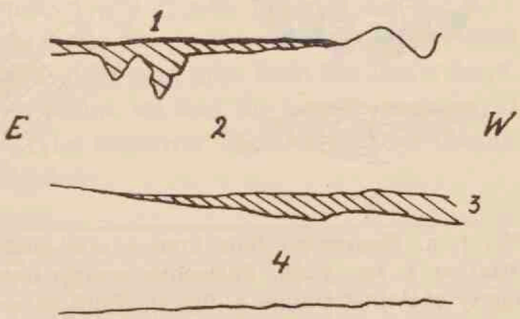


Fig. 3. Schematic cross-section through the quarry of Atlit. For explanation see text.

1. young "Kurkar".
2. red sand-layer with worked flints of Mousterian age and land shells, which have also been found immediately above and below this layer.
3. old "Kurkar".

An exact survey enabled me to modify the section as follows:

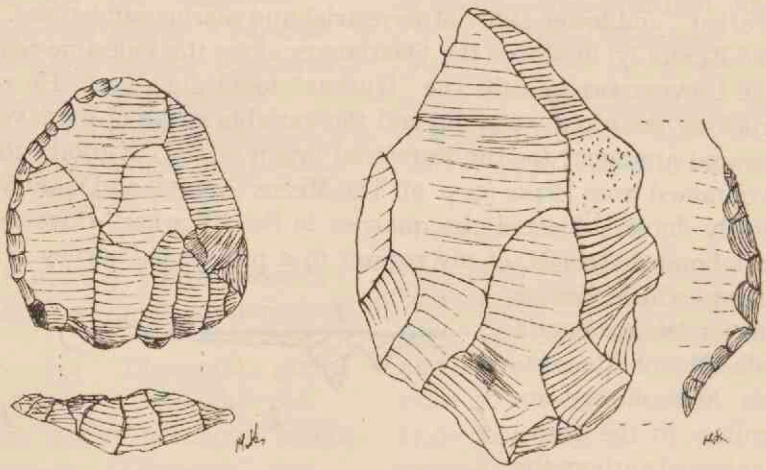
In fig. 3. 1. is a carstic "Kurkar"-surface with pockets of red sand, in which there are worked flints. A sample of these, which

I found, has a "Schlagbuckel" and "retouche" on one side (fig. 4a). This artifact dates from the Upper Mousterian.

2. is 7 m. of unstratified "Kurkar", with land-snails in the basal part: *Helix* (*Pseudofigulina*)? *cavata* Moussou, *Helix* (*Levantina*) *caisariana* Parr. and *Buliminus* sp., which even nowadays still live in the quarry.

3. is a red sand-layer,thinning out eastward. From this I gathered some badly preserved landsnails and a scraper, which in any case is Palaeolitic. (fig. 4b.).

4. is unstratified "Kurkar".



a. b.

Fig. 4. a. Mousterian flint from a sand-pocket of the quarry of Atlit (stratum 1, fig. 3). b. Palaeolitic scraper from the red sand-layer of the quarry of Atlit (stratum 3, fig. 3). (Both natural size).

This section proves the terrestrial character of the "Kurkar" An equivalent argument for the terrestrial origin of the "Kurkar". has been given by Picard. As he communicated to me by letter, near Chedera artifacts from the Bronzeperiod have been found cemented in the "Kurkar". The strong crossbedding (the angular difference was sometimes 60°) which I found near Dhahrat et Tahuna, may still be regarded as an indication that the "Kurkar" is an aeolian deposit, although this does not amount to an argument. Wavecutdeposits namely have a much more feeble cross-bedding generally speaking.

So we shall have to regard the "Kurkar" in our region as a terrestrial deposit. It is true that along the Palestine coast there are also young sandstones, the marine origin of which has been proved (in the sandstone there occur namely well preserved marine *Lamellibranchiata*, which owing to their large size cannot be supposed to have been transported by the wind) but in our region the "Kurkar" has exclusively the character of a fossil dune-formation.

Finally a remark as to the granular analysis, made by Prof. Dr. JUL. MOHR from a fragment of "Kurkar", which originated from Kh.el Mazra'a. The "Kurkar" was treated with hydrochloric acid, until all calcareous material had been dissolved. Then the Quartz grains were subjected to a granular analysis.

He found the following values:

Smaller than	20 μ	2,55 %
	20—50 ,,	1,9 %
	0,5—0,1 mm.	0,3 %
	0,1—0,2 mm.	76,9 %(!)
	0,2—0,5 mm.	17,3 %

Here we see that just as is the case in the sea- and coastal-sand of Java (41), the fractions of 0,5—0,25 mm. form the lion's share. In the fractions of 0,01—0,1 mm. we find the largest quantity of dark minerals. (See table III); moreover Microcline, acid Plagioclase, Orthoclase and Chalcedone.

	Rutile	Zirkon	Hypersthene	Turmaline	Staurolite	Cyanite	Saussurite	Yellow Augite	Epidote	Green Amphibole	Opaque
**Sand . . .	3	3	—	2	4	3	—	7	20*	28	31
***"Kurkar"	—	—	1	2	4	4	16	4	11	46	11

*Saussurite incl.
**Findingplace: near Caisaria
***Findingplace: near Kh. El Mazra'a

TABLE III Heavy minerals in "Kurkar" and yellow sand.

4. Summary and discusion.

According to recent literature it is improbable that along the coast there exist outcrops of strata, belonging to the Pliocene or to older formations. As Pliocene are regarded the blue marls found by drilling near Karkur and Pardess Hanna (marnes grises). Everywhere on this Pliocene there lies Diluvium, which in opposition to the Pliocene is terrestrial.

This Diluvium (together with the Alluvium) consists of "Kurkar", white and red sand, and black earth with bog. LÖWENGART has tried to suggest that during the Quaternary the climate of Palestine was subject to fluctuations. Dry periods and wet ones are said to have succeeded each other. In order to prove this he gives the following arguments:

The red sands cannot have been formed any longer after the Campignian, for — he states — the red sands are often overspread with artifacts from the Campignian, which he never found *in* the red sand. This argument is not valid, for the weathering which caused the red sand to be formed may have continued, after the parent rock — from which they were formed — was covered with Campignian artifacts. Moreover LÖWENGART says, that in his drill-logs he found regular alternations of red sand and boulders on the one side, and "Kurkar" with white sand on the other side. This alternation in different sections is said to occur two to three times.

By means of the list of borings he adds to his publication, he does not succeed in making this two- or three-fold regular alternation plausible.His eleven drill-logs show an irregular alternation of red sand, white sand and "Kurkar", and at their bases sometimes a complex of boulders which he calls "Pluvial"; it is possible, however, that these boulders have a tectonic origin: A slight uplift of the hills might have caused stronger erosion and deposition.

The drill-logs I gathered from the southern part of the coastal-plain in our region (see table II) also show an irregular alternation of these rocks. None of the arguments which LÖWENGART puts forward for the alternation of dry and wet periods during the Quaternary, has been able to convince me. To me it seems more probable, that under different circumstances of groundwater-level and water-circulation, also under the present downfall-distribution, the lixivation and weathering into red sand may occur, while at the same time cementation into "Kurkar" may take place elsewhere, so that both rocks can be formed from the primary dune-sand. The formation of red sand, then, needs a relatively low groundwater-level, so that the downfalling rainwater, after having acted as a solvent, can convey the dissolved calcareous material. For the formation of the "Kurkar", on the contrary, a relatively high groundwater-level is needed, the water of which, saturated with Calcite, can easily evaporate at the surface; the cementing Calcite in that case will precipitate between the Quartz grains. On each cemented layer new white sand may be blown, which in its turn is cemented. In Pardess Hanna indeed, where red sand predominates, the groundwater-level lies lower than it does farther to the West. Of course later vertical movements have complicated the system. So we find the "Kurkar" everywhere along the coast in the sea as numerous rocks and small islands ("drowned Kurkar").

Having concluded that the "Kurkar" is aeolian material which was afterwards cemented, we must be careful with the conclusion that the "Kurkar"-rests along the mountain-border are e l e v a t e d rests. It is very well possible that the sand was blown against the mountain-slope and was cemented afterwards by water which streamed down the slope and evaporated. LÖWENGART (40, p. 513) evidently overlooked this possibility.

There is still another reason which made me look upon the red sands and the "Kurkar" as rocks which may as well have been formed in recent times and under the present conditions of temperature and downfall-distribution. As we have seen the *landsnails* in layer 2 (fig. 3) are the same, as those, which at present are still alive in the region. This makes it improbable, that the climate has since altered. In the recently published article by Dr. PICARD: "Inferences on the Problem of the Pleistocene Climate of Palestine and Syria, drawn from Flora, Fauna and Stratigraphy" (Proceedings of the Prehistoric Society for 1937 (Jan.-July)) it was most clearly expressed for the first time that the climate of Palestine and Syria during the entire Quaternary can hardly have altered. But in that case it is not permissible to assume another climate for the origin of the "Kurkar" and the red sand, which, as we know, are both

Quaternary. In other words, it must be possible for "Kurkar" and red sand, to originate nowadays, ceteris paribus.

REIFENBERG (63) also gives as his opinion that red sand may be formed under conditions existing at present.

The fact that we have found a Palaeolitic scraper between the "Kurkar"-complexes of Atlit, only means that the "Kurkar" of Atlit must partly be of Palaeolitic age. As we have seen, Dr. PICARD found objects from the Bronzeperiod cemented in the "Kurkar" near Chedera. This only means that the "Kurkar" of Chedera partly dates from the Bronzeperiod. As long, however, as there have not been found fossils of Pleistocene age immediately on the Pliocene "Saki"-layers, we are not allowed to assume that all yellow sand, red sand and "Kurkar" belong to the Diluvium: part of them might even belong to the Pliocene.

STRUCTURE AND GEOLOGICAL HISTORY.

The hilly country of our region forms the north western part of the Megiddo syncline (3, fig. 13, p. 131), which almost certainly is separated from the coastal plain by a fault, running nearly parallel with the coast. It is possible that this fault N. of Binyamina bends to the E. with the border of the hilly country. BLANCKENHORN (13) indicated this with some exaggeration on his map of 1912.

There is hardly any literature to show whether this fault, parallel to the coast, really exists. BLANCKENHORN marked it on his map of 1912 (13). RANGE (61) mentions no faults whatever along the Palestine coast. LÖWENGART'S observations as to the tectonics of Carmel have been slightly touched upon in the discussion of the "Kurkar". Besides he observes, without giving any arguments, that the southern border of Carmel is separated from the coastal plain by a fault which probably runs in the direction SE-NW. AVNIMELECH (3, p. 131) marks a fault running almost N-S. along the border of Carmel parallel with the sea-coast; he does not mention it in his text, however.

The existence of the fault is only suggested by morphology. It might be possible, however, that the straight and sharp separation between the hills and the coastal plain had been caused by shore-erosion; in other words, we might perhaps have to deal with a wavecut-cliff. The neighbourhood of the recent shoreline parallel with the border of the hills might cause us to suppose this. In that case the above-mentioned escarpment would be prediluvial, because, as we have observed, the whole of the coastal plain lay in all probability during the Quaternary above sea-level.

If the boundary mentioned is indeed o n l y a fossil coast-cliff, then a boring in the narrow coastal plain N. of Binyamina, after having pierced the Quaternary and eventually a few layers somewhat older, would immediately touch those layers of the Cenomanian which correspond to the Cenomanian in the hilly country of the same level. Borings down to this depth do not exist, however. The whole of the difficulty lies in our total ignorance of the underground of this part of the coastal plain. LÖHNBERG and LÖWENSTEIN, it is true, have tried to demonstrate with geophysical methods, that in the coastal plain of Atlit there are very thick layers of plastic clay under the Quaternary which are said to correspond to the Pliocene marine "Saki"-layers of southern Palestine. In fact layers of this kind have been discovered by drilling near Karkur and are some hundreds of metres thick. This boring, however, does not lie W. of the Carmel-border, but S. of it. If we suppose that the result of both geophysicists is correct, it becomes difficult to interpret the boundary between the plain and the hilly country as a normal coast-cliff. Given the uncertainties which, as is proved by practice, still exist in many geophysical results, we must not accept the conclusions of LÖHNSTEIN and LÖWENBERG as certainties. I have tried to find still more accurate arguments for the existence of a fault, but have not succeeded. Important faults running nearly from N. to S. have been demonstrated along the coast of southern Palestine by means of borings (see e.g. 3, p. 121 and 122). The presence of such a fault more to the N., viz. in our region, is therefore very probable, but not certain.

The other faults that occur in our map are of minor importance. As to a small fault which runs along the western side of Shefeya, I was obliged to accept it, because W. of it Lower Turonian has been found, while on the eastern side Upper Turonian suddenly appears at the surface and even a rest of Senonian crops out.

In the surroundings of Zichron Jaacov there are a number of small faults. So we see, that on the top of the mountain 260^z there lies a pale yellow crystalline, somewhat porous, limestone, on the same level as the yellow porous limestone of the Jabal ez Zakhuri, which on the top belongs without any doubt to the upper zone of the limestone we have designated as Turonian. Eastward lies a dense "Mizzi Helu"-like limestone, inclining to the E. (just the same as the topography). It is therefore probable, that between the tops 260^z and the Jabal ez Zakhuri, a small fault exists, because W. of the wadi between both tops, the "Mizzi Helu" lies much lower than E. of it.

Close to the eastern side of the buildings of Zichron Jaacov, a spot of "Mizzi Helu" borders to the E. on tuff which, as may be expected, seems to pitch under it; to the W., however, it borders on upper Cenomanian limestone, which to all appearance lies on a somewhat higher level. So there is every probability, that between the "Mizzi Helu" and the upper Cenomanian limestone there exists a small fault.

One or more minor faults must occur on the northern and western side of El Murabba'a as well. Otherwise the constant strike and dip in this flat region would oblige us to accept too great a thickness of the "Mizzi Helu". I did not succeed in locating these minor faults.

The small fault between El Murabba'a and Zuweiq may clearly be seen in the field. The bedded dolomite which here replaces the "Mizzi Helu" butts, in the direction of the strike against the unstratified Senonian.

A small fault SW. of Ard Abu Hamid is suggested in the field by the sharp, nearly vertical boundary between the flinty limestones and the dolomite. In general it is difficult to prove the existence of faults with Cenomanian outcropping on both of its sides, at least in our region because of the lack of uniformity of the stratigraphy of our Cenomanian. Therefore I cannot agree with SVERDLOV (70), who believes that the sharp boundary between flintbeds and dolomite E. of the station of Zichron Jaacov implies a fault between the two rocks.

The fact that the Senonian-Eocene chalk is unstratified, makes it difficult to trace tectonical details of those parts of the syncline of Megiddo which lie nearer the core.

As the map shows, we need not accept the fault of AVNIMELECH (3, p. 133 c).

During Cenomanian and Turonian the region was (like the whole of Palestine and Syria) a neritical sea. During the upper Cenomanian, submarine basalt-eruptions took place, the culminating volcanic tops of which lay possibly above sea-level. During Senonian, Danian and Eocene the marine sedimentation continued. Perhaps during the Eocene the Megiddo syncline was formed (AVNIMELECH 3, p. 129). To the SE. the Eocene attains a geosynclinal thickness of 1500 m. in the core of the syncline, while, according to BLAKE (10) in those times an island existed between Nablus and Beersheba (facial thinning out of the Eocene).

The fault which probably borders Carmel, was, according to LÖWENGART (40) formed at the latest in the Upper Miocene — Lower Pliocene (great thickness of the Saki-clays). According to LÖHNBERG and LÖWENSTEIN there are even two faults parallel to each other near Atlit. Perhaps by that time the eastern side rose above sea-level.

During or after the Pliocene, the coastal plain also appeared above sea-level, and the ridges of calcareous sand-dunes, which afterwards partly altered into "Kurkar" etc., were formed. It is not necessary that the "Kurkar"-ridge along the coast should be an anticline, though Blake thinks it is (7, p. 27), for it is difficult to trace tectonical structures in rocks with similar crossbedding.

We may consider the "Kurkar"-ridge as a fossil bay-bar, behind which the moors of Kabara lay, which have now been drained.

Lowering of the coastal block must have taken place in the Quaternary. In the first place we find drowned "Kurkar" and "Kurkar"-reefs in the sea. Secondly, according to the drill-logs in the "Kurkar" of the coastal plain often descends below sea-level. In the third place, there exists a drill-log of a boring near Pardess Hanna (43,4 m. above sea-level) in which at a depth of 46 m. a *horse-tooth* has been found. It must be remarked, however, that during the last few centuries the number of reefs along the coast has increased, which points to a renewed subrecent uplift.

Finally it is worth noting, that the hilly country has the form of a table-land, with a height of 140 to 160 m. Near Atlit, however, there suddenly rises a higher chain above the table-land. Geological and morphological fieldwork will have to be done in this region, before it will be possible to interpret these facts sufficiently.

GEOHYDROLOGY.

According to Dr. PICARD the most important groundwater-level is the Turonian, especially in those places where it is porous. As all layers incline to the E., we must bore E. of the outcrop of the Turonian, and in the places which are topographically lower than the outcrop, in order to get a sufficient water-supply. Those places are easy to find on the map.

The deep-lying "Kurkar" too forms a good groundwater-level. The number of wells and sources in the zone Atlit-Caisaria is enormous. In winter (600 mm. downfall) the water runs downward along the slopes of the hills and is retained by the "Kurkar".

Moreover there are a number of other places, where water may be found, e.g. in the tuffs and basalts. The water of the drinking-place on the way from Zichron Jaacov to Ard el Wad rises from the outcrop on the western slope of Jabal ez Zakhuri; the well-water of the orange-yards in the plain of Ard el Wad and N. of it also comes from the tuffs and basalts. The village of Shefeya receives its water from the same tuffs and basalts.

In our region there occurs only one continually flowing brook, namely the Nahr ez Zarqa. Its water comes from the Turonian. As in recent times the water-level of this well was lowered, a trench has been dug upwards of the source and nearly parallel to the strike of the strata. At present one may see how the water streams out of holes in the white porous limestone. Immediately below there lies the "Mizzi Helu", which is certainly less permeable.

When one goes to the E. in the southern part of the coastal plain (Binyamina-Pardess Hanna) the abundance of water of the Quaternary continually decreases. PICARD explains this by the fact that the Quaternary thins out towards the E.

The Eocene of Bath Shelomo also contains not unimportant groundwater levels. The flintbeds are impermeable just as the marlbeds mentioned by BLAKE, and the chalky strata which alternate with them, retain the water. The sources surrounding Bath Shelomo have been largely neglected.

PALAEONTOLOGY.

CEPHALOPODA.

Acanthoceras (?) rotomagense (Brongn).

Lit.: (18) List on p. 66/67, (26a) p. 326, 327, (42a) p. 929—931, (44c) Tome I p. 345—350. pl. 105—106, (45a) p. 147, (60) 2ème série p. 190—193. pl. XXV fig. 1—3, (63a) p. 15—17. pl. VI fig. 9, 10, 11, 12, 13, pl. VII fig. 1—3, (71) p. 12—13. pl. I fig. 3, pl. IV, (74) p. 589 fig. 2156.

The sutures of my two specimens have totally been effaced. Characteristic for *Acanthoceras* are the following features: the shell has no large umbilicus; the ornamentation consists of straight ribs, widening to the external side and provided with a number of nodes. A distinct carina is present, which is not common for this genus, but which — according to NEUMAYR — may exist. One might presume — from the presence of the carina — that the animal belongs to the *Prionotropidae*, but the straightness of the costae is in contradiction therewith.

The following characteristic features of *Acanthoceras rotomagense* also occur in the best preserved of my two specimens: on the last convolution there occur 18 straight costae provided with nodes (the majority of the authors count upwards of 20 costae, but 18 are also mentioned). The best developed row of nodes occurs along the internal side. A double row of somewhat less developed nodes occurs along the rim of the external side and on the external side itself. In the median line there should occur a row of slightly developed nodes, but on my specimen it is replaced by a slightly developed carina. The cross-section of the last convolution is rather a square. In its youth the section must have been rectangular

$$\left(\frac{\text{Breadth}}{\text{Height}} = \frac{4}{5}\right).$$

The specimen clearly deviates from the typical *rotomagense* in that the increase of the cross-section of the convolutions is too slight.

The proportion

$$\frac{\text{Cross-section of the mouth}}{\text{Cross-section of the entire shell}}$$

of my specimen is $\frac{33}{100}$ and of those of D'ORBIGNY it is $\frac{42}{100}$. This proportion in the specimens mentioned by PICTET (60 pl. XXV fig. 1b) approximates more closely that of mine.

So my fossil shows close affinity to *Acanthoceras rotomagense*, but differs from it especially as it possesses a median carina instead of a median row of nodes. Therefore it is not impossible that we have to deal with a variety of *Acanthoceras rotomagense*. In any case our specimen resembles more *Acanthoceras rotomagense* than the one from Palestine figured by TAUBENHAUS (71, pl. I fig. 3). The second fossil has been preserved much worse, but shows conformable features, so far as one may observe.

Both specimens were handed to me by childern from Shefeya. The findingplace was not known to them, but the limestone has the appearance of the yellow limestone of the upper-Cenomanian.

Ammonite (indeterminable).

In the Senonian chalk of Shefeya there occur fragments of closely ribbed Ammonites (*Crioceras* ? *Hamites* ?). The ribs are not dichotome.

Baculites sp.

Lit.: (51) p. 438. pl. X fig. 1—7, p. 442. pl. X fig. 8, 9.

Only one fragment, resembling PICARD'S *Baculites palestinensis* or *Baculites asper* Morton. Findingplace: 1500 m. NNW. of Bureika, in Senonian chalk.

GASTROPODA.

Nerinea requieniana d'Orb.

Lit.: (10a) p. 110. pl. VIII fig. 13, (16) p. 144, 145. pl. VIII (IV) fig. 65, 66, (43) p. 395—396. pl. XV fig. 1—4, (44c) Tome 2. p. 94, 95. pl. 163 fig. 1—3.

The very characteristic forms agree well with the descriptions and representations of BULLEN NEWTON (43) and BLANCKENHORN (16) and with the material of the geological department of the Hebrew University. Several of my specimens show a peculiarity which has not been mentioned in the literature above cited: from the mouth to the top they first increase slightly in transverse diameter, and a little before the middle this diameter begins to decrease in a normal way. The largest specimen is 20 cm. long.

Findingplaces: 1) Western slope of El Mitaman'a in flinty porous limestone (Cenomanian), and in blocks tumbled down on the path near the foot of this slope. 2) Somewhat E. of the curve of the path 800 m. N. of Shefeya in beds between "Mizzi Helu" and the overlying crystalline limestone (Turonian). 3) 400 m. SE. of Kh. Manara, in well stratified flinty limestone (Cenomanian). 4) 300 m. N. of Kh. Esh Shuna on the main-road in white porous "Meleke" (Cenomanian). 5) Between the ruins of Kh. Shefeya and Shefeya in the "Mizzi Helu". 6) At the foot of the western slope of El'Arnin W. of 'Ein Ghazal (boulder). 7) Between Es Salmaniyat and El Murabba'a in "Mizzi Helu" (Turonian). 8) On the western side of the plateau N. of El Murabba'a in "Mizzi Helu" (Turonian). 9) Near the northwestern edge of the fir-wood NW. of Shefeya in "Mizzi Helu" (Turonian). 10) Near the origin of Wadi El Hinu near Shefeya in "Mizzi Helu" (Turonian). 11) In the wadi on the northwestern side of Jabal ez Zakhuri in "Mizzi Helu" (Turonian). 12) Upwards of 300 m. E. of Kh. es Suwamir in the wadi, in flinty yellow limestone (Cenomanian). 13) About 600 m. W. of Shefeya in white crystalline limestone (Turonian). 14) Finally in a fragment of coral-limestone, upwards of 1200 m. SE. of 'Ein Ghazal, probably originating from the E. and of Turonian age.

Nerinea subgigantea Blanck.

Lit.: (9) p. 50, 51, (16) p. 151. pl. VII (III) fig. 58, 59a-b, (17) p. 10, (18) p. 270.

Large animals, which have never been found completely; near the base they are 3 cm. thick. Findingplace: on the western slope of El Mitaman'a and in loose boulders near the foot of this slope in flinty porous limestone (Cenomanian).

Nerinea ?nötlingi J. Boehm.

Lit.: (16) p. 152, (22) p. 207. pl. VII fig. 8, 10, 10a.

Close to the N. of Umm el Jarab there occur small *Gastropoda* in the "Mizzi Helu"; the cross-section of the chamber of one specimen is similar to that of *Nerinea cochlaeformis* Conr.; the last convolution, however, was entirely unlobated. The external side of the convolutions is concave. All these features tally rather well with the description of *Nerinea nötlingi* Boehm. The specimen being incomplete, I give this determination with some reserve.

Nerinea sp.

Indeterminable fragments from: 1) Kh. Shefeya, from white crystalline limestone (Turonian). 2) White porous "Meleke" W. of Bir Jabir (Cenomanian). 3) Near the northwestern side of the fir-wood NW. of Shefeya from "Mizzi Helu" (Turonian). 4) 700 m. W. of Shefeya from white crystalline limestone (Turonian).

Cerithium aff. *elias* Boehm.

Lit.: (16) p. 162, (22) p. 217. pl. VI fig. 6—8.

One little cast, 12 mm. long; differs from the typical form described by Boehm owing to the smaller number of spiral-lines on the convolutions and by a fine granulation of its ornamentation. Findingplace: Cenomanian, porous, flinty limestone on the western side of El Mitaman'a.

Cerithium spec. Picard.

Lit.: (52) p. 517, 518. pl. XXI fig. 4.

Two specimens, very similar to the forms found by Picard near Hassan er Raai. The longitudinal little lines are somewhat less visible. Findingplace: Senonian chalk of Shefeya.

Actaeonella salomonis Fraas.

Lit.: (16) p. 180. pl. X (VI) fig. 112—114, (22) p. 217. pl. V fig. 7, (28a) p. 240. pl. IV fig. 1.

Generally well preserved specimens. Findingplaces: 1) The Cenomanian, flinty, porous limestones on the western slope of

El Mitaman'a, as well as in boulders near the foot of this slope. 2) The layers between "Mizzi Helu" and the white crystalline limestone which lies on it (Turonian), of the northwestern side of the fir-wood NW. of Shefeya. 3) Perhaps the layers between the yellow Rudist-limestone and "Mizzi Helu" (Cenomanian-Turonian) of El Murabba'a.

Actaeonella sp.

Trochactaeon specimens with sharper tops than those of *Actaeonella salomonis*, occur in rather well stratified flinty limestones 300 m. SE. of Kh. Manara (Cenomanian).

Nerita aff. *mundae* Sharpe.

Lit.: (25).

The cast has a diameter of 19,6 mm. and consists of a spiral, increasing rapidly in breadth, which consists of 3 convolutions, having an entirely depressed umbilicus. The animal is ornamented with radial costae which are slightly crenelated (different from the literature). These costae do not cover the last convolution entirely; they begin on the first convolution, and continue to about half-way down the last, strongly inflated, convolution. Downwards there follow rows of separated tuberculae, which are partly intercalated between the costae (the number of the rows of tuberculae, however, is larger than the number of costae). The mouth has not been preserved. Findingplace: yellow Cenomanian Rudist-limestone, SW. of Abu Qanatir.

Levantina caisareana (Parr.).

Lit.: (1) p. 55. pl. X fig. 7—8.

Findingplace: Red sand from the quarry of Atlit (Palaeolitic and recent).

Melanopsis buccinoidea Oliv.

Lit.: (44a) p. 813. pl. XXIII fig. 1, (57) p. 125—127. pl. 8 fig. 28—42.

Findingplace: Kabara (recent).

Pecten (*Vola*) *shawi* Perv.

Lit.: (18) p. 191. pl. IX fig. 24a, b. pl. X fig. 75 (pars), (34) p. 130, (37) pl. 12, fig. 13, (70) pl. XI fig. 16, (72) p. 115. pl. XVIII fig. 4a-h.

The features of the costae are not entirely clear everywhere. Findingplaces: 1) Grey dolomite of the northwestern side of Zichron Jaacov. 2) White marl on the main-road from Zichron Jaacov to the railway-station. 3) Yellow limestone near the top of the slope of Khallat et Tina. 4) Yellow limestone upwards of 1 km. SW. of 'Ein Ghazal. 5) Several places in the grey dolomite about 500 m. NW. of Zichron Jaacov. 6) Grey dolomite on the southern side of the main-road from Zichron Jaacov to the railway-station; all from the Cenomanian.

Pecten ?karmeliticus Blanck.

Lit.: (18) p. 190. pl. VIII fig. 23a, b.

Only one specimen, which is badly preserved, slightly concave, especially near the beak. The furrow on the base of some of the middle costae is striking. (BLANCKENHORN'S specimen has such a furrow on only one costa which lies near the middle). Size about 5 × 5 cm. Findingplace: white, porous limestone ("Meleke") 300 m. N. of Kh. Umm el 'Alaq (Cenomanian).

Pecten (*Vola*) sp.

Breadth near the base (the lowest part has been broken off): 4,5 cm. height 3,8 cm. Cast of flat shell with 21 radial costae; the breadth of all is nearly equal, decreasing towards the beak. The middle costae are straight and higher; the lateral costae are slightly concave towards the external side and lower. Ears are not visible, lines of growth are not present. Findingplace: Grey dolomite of the southern side of the ruins in the wadi between Shefeya and El Fureidis.

Pecten sp.

Size: Breadth 5 mm., height 7 mm., angle near the beak 30°. From the base up to the middle of the shell there are 11 narrow radial little furrows, which near the middle are somewhat more separated from each other than on the sides. Ears not visible. Findingplace: Shefeya (Senonian), one specimen.

Pecten (*Entolium*) sp.

32 × 32 mm.; entirely smooth, very faintly concave, thin shell. The upper edges of the ears form an angle of nearly 180°. Shell rather circular, with weak lines of growth. The angle near the beak is slightly smaller than 90°. Findingplace: Yellow limestone 500 m. S. of the firm of Paster (Cenomanian).

Pecten indet.

Indeterminable rests from the following localities: 1) White, porous limestone of Bir Jabir. 2) Flinty limestones of the western slope of El Mitaman'a. 3) Yellow limestone 500 m. S. of the stone-works of the firm of Paster. 4) White, crystalline limestone ("Meleke") more than 1 km. E. of 'Ein Ghazal. All these finds originate from the Cenomanian.

Gryphaea vesiculosa Sow.

Lit.: (18) p. 200. pl. IX fig. 42—43, (37) p. 69. pl. XI fig. 8—10, (50) p. 41, (60) (5ème série) p. 311. pl. CXCIV, (70) pl. X fig. 17—22.

Many specimens of the large variety mentioned by BLANCKENHORN from Carmel. Findingplaces: 1) Everywhere in the Cenomanian flinty limestones between El Fureidis and Kh. Es Suwamir. 2) Moreover in the Cenomanian flinty limestone on the top of El Mitaman'a.

Alectryonia carinata (Lam.)

Lit.: (18) p. 198, (30) p. 9. pl. LXXIV fig. 6, (60) (5ème série) p. 277.

Both valvae are considerably vaulted, 8 cm. long and strongly ribbed. Findingplaces: 1) Yellow limestone of Khallat et Tina. 2) Yellow limestone on the pathway to 'Ein Ghazal, N.W. of El Murabba'a. 3) Yellow limestone in the wadi-bottom 1 km. W. of Shefeya. 4) Yellow limestone 1 km. SW. of Es Salmaniyat; all from the Cenomanian.

Exogyra columba (Lam.).

Lit.: (18) p. 201, (30) p. 34. pl. LXXXVI fig. 9, (37) p. 60. pl. 10 fig. 8—10, (67) p. 73, 74, (70) pl. 10 fig. 4, 5, 8, 9, 14—16, (72) p. 123. pl. XLX fig. 2, (74) p. 427. fig. 786.

Size of the specimens only 2 cm. and smaller. Findingplaces: 1) Grey dolomite 800 m. E. of El Fureidis. 2) Yellow limestone 800 m. WNW. of Zichron Jaacov. 3) Yellow limestone of Umm et Tos. 4) Yellow limestone more than 1 km. SE. of 'Ein Ghazal. 5) Yellow limestone of Abu Qanatir. 6) Flinty limestone SE. of Kh. Manara (?); all from the Cenomanian.

Plicatula reynesi Coq.

Lit.: (18) p. 193, (37) p. 58. pl. 12 fig. 15, (70) pl. XI fig. 21—23.

Only one specimen, having somewhat fewer ribs than are visible on the figure by LARTET. Findingplace: Grey dolomite near the mouth of the wadi between Shefeya and El Fureidis (Cenomanian).

Chondrodonta munsoni (Hill).

Lit.: (18) p. 204, 205, (20) p. 96. pl. VIII fig. 1, 2, (21) p. 174. pl. IV fig. 1—3.

Fragments with radial ribs, always without chondrophore. The ribs of all samples (also the samples of BLANCKENHORN) are closer to each other than in the typical forms.

Findingplaces: 1) White porous limestone ("Meleke") of Bir Jabir. 2) Problematical fragments from yellow limestones of Khallat et Tina; all from the Cenomanian.

Ostreidae.

Indeterminable fragments from the following localities: 1) Yellowish to white crystalline limestone of Jabal ez Zakhuri (Turonian). 2) Variegated, yellow limestone in the wadi-bottom of the wadi running from N. to S. between Shefeya and El Fureidis (Cenomanian). 3) Flinty limestones SE. of El Fureidis (Cenomanian). 4) Yellow limestone of the northwestern side of Zichron Jaacov (Cenomanian). 5) Variegated yellow limestone near the church-yard of Zichron Jaacov (Cenomanian). 6) Yellow limestone

E. of Umm et Tos (Cenomanian). 7) Yellow limestone 600 m. S. of the stone-works of the firm of Paster (Cenomanian).

Protocardia hillana (Sow).

Lit.: (18) p. 244, (37) p. 53 pl. 12. fig. 9, (44b) p. 867—868. pl. XXVII fig. 2, 3, (70) pl. XI fig. 5.

Good specimen from the Cenomanian marl-bed on the main-road from Zichron Jaacov to the railway-station.

Cardium pauli Coq.

Lit.: (18) p. 230, (37) pl. XI fig. 1, 2, (70) p. 53. pl. 12 fig. 6.

Beautiful cast 7,5 cm. high, 5 cm. broad. Findingplace: White Cenomanian marl on the main-road from Zichron Jaacov to the railway-station.

?*Inoceramus* ?*lynchi* Conr.

Lit.: (18) p. 183. pl. VII fig. 11—13.

With regard to the shape, the animal has but little resemblance to an *Inoceramus*. The (only) specimen has badly crumbled off along its base. It is a right-hand shell, 3 cm. broad and nearly 3 cm. high. The shell is considerably arched and is provided with 18 strong concentrical costae. The area is smooth and is provided with a small wing. The lunula is smooth as well and also has traces of a small wing. The rim of the hinge is straight. Findingplace: yellow limestone 800 m. NW. of Shefeya (Cenomanian).

Arca ?*delettrei* Coq.

Lit.: (18) p. 212. pl. X fig. 60.

Cast corresponding with that of fig. 60a in (18). One beak has been broken off. Findingplace: white Cenomanian marls on the main-road from Zichron Jaacov to the railway-station.

Arca trigeri Coq.

Lit.: (18) p. 212, 213. pl. X fig. 61—63.

Beautiful cast of left-hand shell, the ornamentation of which is clearly visible (about 100 thin radial costae, crossed by lines of growth). Straight, taxodont hinge. Findingplace: 1 km. SW. of Abu Qanatir, yellow limestone (Cenomanian).

Leda perdita Conr.

Lit.: (18) p. 210, (37) p. 50. pl. 12 fig. 1, 2, (52) p. 521, 522. pl. XXI fig. 11, 12, (70) pl. VIII fig. 1, 2.

Several well determinable specimens, from the Senonian chalk of Shefeya.

Pholadomya vignesi Lartet.

Lit.: (10a) p. 94, 95. pl. V fig. 14—17, (18) p. 261, 262, (67) p. 83, 84. pl. IV fig. 24, (70) pl. XI fig. 9.

Two bad casts, showing the reticular ornamentation, pictures of which have been given by SHALEM and by BLANCKENHORN. The concentrical structure predominates, however. Findingplaces: 1) Yellow limestone 1 km. SE. of 'Ein Ghazal (Cenomanian). 2) Wadi 1 km. WNW. of 'Ein Ghazal, yellow limestone (Cenomanian).

Trigonia sp.

Typical specimens of *Trigonia*. Area smooth, concave; concentrical costae slightly bent, finely crenelated. Angle near the beak about 60°; length (from the beak down to the the base) 5 cm. Findingplace: 1) Yellow limestone 200 m. N. of Zichron Jaacov (Cenomanian). 2) Yellow limestone of Khallat et Tina (Cenomanian).

Caprinula ?cedrorum (Blanck.) fig. 5.

Lit.: (18) p. 224, (27) p. 64, 65, 66, fig. 59, 60, 61. pl. VI fig. 1. (See moreover: DOUVILLÉ, Études sur les *Caprines*, Bull. S.G.F. (3) XVI, 1888, p. 707—708, pl. XXII *Caprinula boissyi* d'Orb.).

Moderately well preserved lower shell of a genuine *Caprinula*. The shell is bent like a horn. The greater part of the marginal canals of the inside row is still present. These marginal canals have a polygonal cross-section. One may see on the ventral side, that the marginal canals on the forepart are larger than those on the hindpart. (On the forepart minimum cross-section: 2 mm. and on the hindpart maximum cross-section: 1,5 mm.) Moreover there are some smaller canals on the external border of the ventral side, intercalated between the marginal ones. Whereas the marginal canals of the ventral side form only one row, the structure of the dorsal side is much more complicated. On the dorsal side the cross-section of the polygonal marginal canals varies between 3 mm. and 1 cm. They have an irregular shape and in a cross-section, they form in some places one row, elsewhere two or more. Moreover, on the dorsal border outside the larger marginal canals we find a row of extremely small peripheral ones; on the forepart even two layers. The cross-section of these peripheral canals varies between 1 mm. and $\frac{1}{2}$ mm.

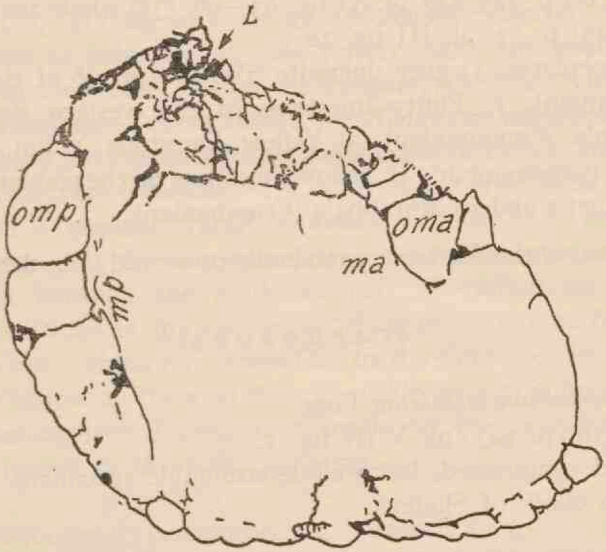


Fig. 5. Cross-section through Caprinula ?cedrorum (Blanck). (Natural size). Finding place: 1100 m. WNW. of Umm el Jarab.

The situation of the cardinal apparatus is analogus to that of *Caprinula boissyi* d'Orb. The o m a of our specimen possibly consists only of one cavity, and therefore is different from that of *Caprinula boissyi*. The hindpart of the ligament is folded inward towards the front. The mp is not clear and probably runs from the P towards the middle of the ventral side of the shell. The anterior alveole of the o m p is smaller than in most of the representations of *Caprinula boissyi*. The other parts of the cardinal apparatus can hardly be determined. The figures of *Caprinula boissyi* are more like mine, than those of *Caprinula cedrorum* by

DIENER and DOUVILLÉ (27). Findingplace of the specimen described above (the best one found by me): about 1100 m. WNW. of Umm el Jarab, in yellow limestone (Cenomanian). Other localities: 1) 800 m. NW. of Umm et Tos in white crystalline limestone (Cenomanian). 2) Yellow limestone on the northern side of Er Riba'at (Cenomanian).

Eoradiolites syriacus Conr.

Lit.: (18) p. 225, 226. pl. XI fig. 93—96, (35) whole text. pl. XIV fig. 1, (45) p. 33. pl. III fig. 10.

Findingplaces: 1) grey dolomite SW. of km. 38 of the railway (Cenomanian). 2) Flinty limestones of the western slope of El Mitaman'a (Cenomanian). 3) Yellow limestone 1 km. NW. of Shefeya (Cenomanian). 4) Yellow limestone on the plateau between Abu Qanatir and El Murabba'a (Cenomanian).

(The rest of the *Rudists* are too badly preserved to be determined).

SCAPHOPODA.

Dentalium cretaceum Conr.

Lit.: (16) p. 123. pl. V (I) fig. 1.

Several compressed, but well-determinable specimens from the Senonian chalk of Shefeya.

Dentalium octocostatum Fraas.

Lit.: (16) p. 123. pl. V (I) fig. 2—8.

Only one lower end which has been broken off; from the Senonian chalk of Shefeya.

ECHINOÏDEA.

Hemiaster (?) *saulcyanus* d'Orb.

Lit.: (10a) p. 67, 68, (15) p. 101—103. pl. VIII fig. 31, (44c) Tome 6 p. 258—259. pl. 890 fig. 1—8.

Rather numerous specimens. Here are some dimensions:

Length.	36,5	34,5	27,5 mm.
Breadth	36,5	32,5	25,5 „
Height.	24	21,9	17,5 „

In spite of the fact that several of the specimens found by me generally show the properties mentioned by BLANCKENHORN, there occur little divergences now and then: the foremost pair of ambulacral furrows of several specimens is clearly longer than the hindmost pair, and the greater part of my specimens are moreover more angular and oblong than the *Hemiaster saulcyanus* d'Orb. described and represented by BLANCKENHORN. These two facts point to a transition into *Hemiaster saulcyanus* d'Orb. var. *batnensis* Coq. Hardly any of my specimens, however, may be looked upon as belonging to this variety, since the apex hardly ever lies in the centre, but on the forepart, which is — according to BLANCKENHORN — characteristic for *Hemiaster saulcyanus*. (The angle between the foremost pair of ambulacral furrows is, moreover, too large for var. *batnensis*). The above-mentioned facts demonstrate that a gradual transition exists between the two forms. Worthy of note is that my forms show clear differences in height. The angle between the hindmost pair of ambulacral furrows is variable. None of my specimens belong to the related *Hemiaster syriacus* Conr., which has, according to the figures of BLANCKENHORN, no furrow on the anal side. *Hemiaster luynesi* is broader and thick. Findingplace: Cenomanian marls on the main-road from Zichron Jaacov to the railway-station.

Hemiaster (?) *saulcyanus* var. *batnensis* Coq.

Some specimens from the same locality, which show the following points of resemblance, should be considered as belonging to this variety: foremost pair of ambulacral furrows longer than the hindmost pair, angle between the foremost ambulacral furrows between 90° and 100°, apex nearly in the middle.

Discoïdea ? sp.

One specimen, badly preserved. The ambulacral fields are narrower than those of *Discoïdea* ? *dendroides* Blanck. (15, p. 93 pl. VII fig. 93). A reconstruction of the animal shows that it consists of a hemisphere, the intersection of the ambulacral fields lying on the pole. Diameter: 9 cm. The boundary-lines of the ambulacral plates form an acute angle with the ambulacra. Findingplace: flinty limestones near Kh. es Suwamir (Cenomanian).

Spines of Echinoidea fig. 6.

Lit.: (33) pl. 13 fig. 5, (46) p. 200 [orig. Atti Soc. Ital. Sc. Nat. 61, 1922, p. 72] (47) p. 9—12. pl. 4 fig. 1—16.

In the slides of the "Kurkar" there sometimes occur peculiar circular little figures, consisting of 3 concentrical circlets, the two external ones being joined one to the other by radial little pillars, the two internal ones having only traces of such little pillars. The core may be filled with calcareous material. The middle circlet has small thickenings on the spots where the radial pillars intersect it. The size is about 0,3 mm. This little figure corresponds entirely with the cross-sections made by me of recent *Spatangus*-spines of adult specimens, and with the figure by J. PIA (47). Oblique and lengthwise sections are also to be found in the slides, from which it may be concluded that the small "pillars" are in reality longitudinal "lamellae". Moreover it is peculiar that the optical axis of the Calcite-crystalls lies lengthwise in the small pillar, a fact which is also mentioned by PIA and which is also to be seen in the cross-sections of my *Spatangus*.

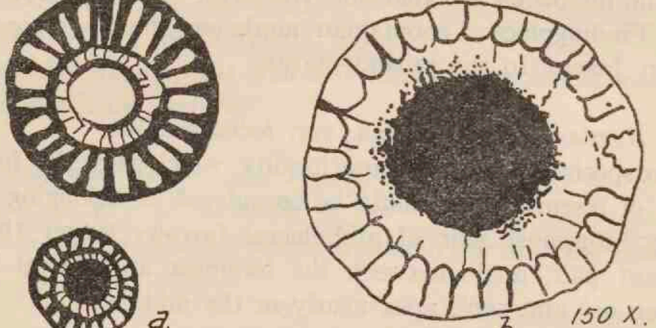


Fig. 6. a. Cross-sections through spines of sea-urchins from the "Kurkar". b. Cross-section through recent Spatangus-spine.

Good cross-sections of this type are to be found near Kh. es Shomarya and elsewhere (similar little spines also occur in the dune-sands, probably they are spines of *Echinoidea* just as well).

Another type consists of a circlet with regular radial lamellae, thinning out towards the centre. The core is filled with very porous material. Such a type corresponds somewhat with cross-sections of *Echinus*-spines. Findingplace: also Kh. Esh Shomariya and elsewhere.

PROTOZOA.

Alveolina sp.

In two spots in the "Mizzi Helu" I found some nearly globular *Alveolinae*. Such globular *Alveolinae* were already found once by FRAAS (28a, p. 227. pl.. II fig. 8 a, b, c) in about the same level near Jerusalem (FRAAS mistook them for *Nummulites*). Afterwards GÜMBEL called them *Alveolina fraasi* Gümbel (31, p. 251, 252). My specimens, however, do not belong to this species, the number of the chamberlets of each convolution being too small. My specimens resemble much more the Tertiary *Alveolina ovulum* Stache. Cross-section 3,2 mm.; the length of an other specimen is 1,7 mm. Findingplaces: 1) Umm el Jarab (Turonian). 2) 700 m. E. of Es Salmaniyat (Turonian).

The other *Foraminifera* either have not been determined as to their species, or they are recent and very common.

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CONTENTS.

STELLINGEN

I

De jonge kustzanden tusschen Julianehaab en C. Farvel (Z. Groenland) zijn in twee sediment-petrographische provincies te scheiden: 1e. in een noordelijke Amphibool-provincie, 2e. in een zuidelijke Granaat-Hyperstheen-provincie. Het eerste mineraal stamt uit Julianehaab-granieten, het tweede en derde uit oude granulieten.

II

Het is niet waarschijnlijk, dat het klimaat van Palestina en Z. Syrië zich gedurende het Quartair belangrijk heeft gewijzigd.

(L. PICARD, Proc. of the Prehist. Soc. for 1937 p. 58—70).

III

C. E. WEGMANN's opvatting dat de depressie der landoppervlakte van centraal Groenland ouder is dan het landijs, berust op plausibiliteitsgronden; de juistheid van zijn opvatting is moeilijk te bewijzen.

(Mitt. der Naturforschenden Gesellschaft Schaffhausen XIII 1937 No. 3, Seite 15—23).

IV

E. KRAUS' bedenkingen tegen de opvatting van E. SEIDL aangaande de plooiing der Alpen zijn gerechtvaardigd.

(Z. D. G. G. Bd. 86, 1934, S. 699—701).

V

O. FLÜCKIGER heeft niet bewezen dat bultrotsen en ribbelingen analoge verschijnselen zijn; hij bewijst wel dat bultrotsen geen afgeschuurde prae-glaciale uitsteeksels zijn.

(Peterm. Mitt. Ergänz. Bd. XLVIII 1934, Heft 218, S. 1—26).

J. VROMAN

VI

TRECHMANN's argumenten voor veranderingen van het klimaat van Malta gedurende het Quartair, zijn weinig overtuigend.

(Geol. Mag. Vol. LXXV 1938, p. 1—26).

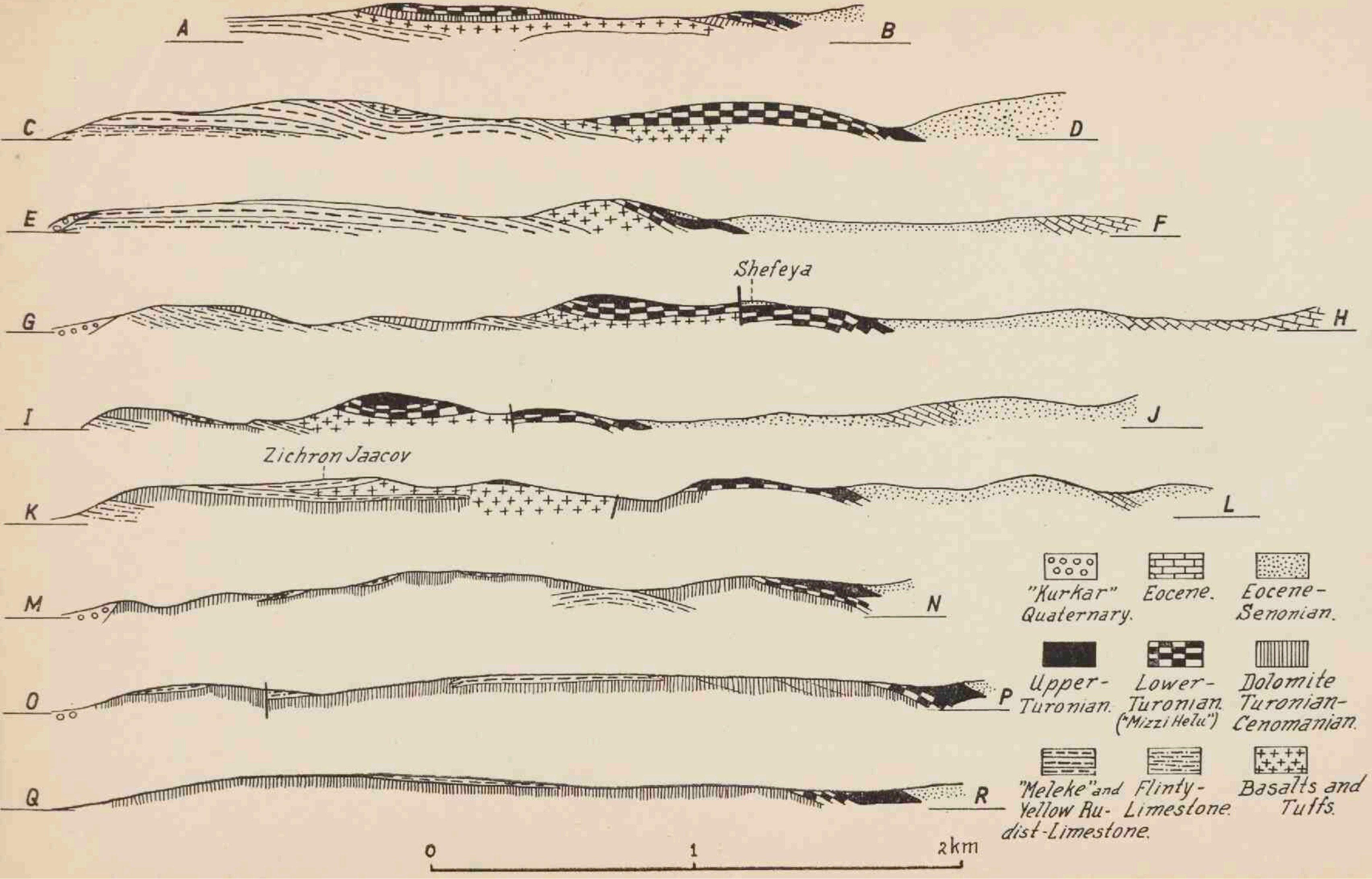
VII

Het voorvoegsel ,,alkali" heeft voor het woord ,,bazalt" een andere beteekenis dan voor het woord ,,gabbro".

VIII

Het is niet waarschijnlijk dat de Middel-Atlantische Oceaanrug zijn ontstaan heeft te danken aan het omhoog dringen van simatisch materiaal zooals STILLE vermoedt.

(Geotektonische Probleme im atlantischen Raume 1937. Bericht über den Verlauf der Feier 250. Wiederkehr usw.).


A
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Zichron Jaacov
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Q
R
"Kurkar" Quaternary.
Eocene.
Eocene-Senonian.
Upper-Turonian.
Lower-Turonian. ("Mizzi Helu")
Dolomite Turonian-Cenomanian.
"Meleke" and Yellow Rudist-Limestone.
Flinty-Limestone.
Basalts and Tuffs.
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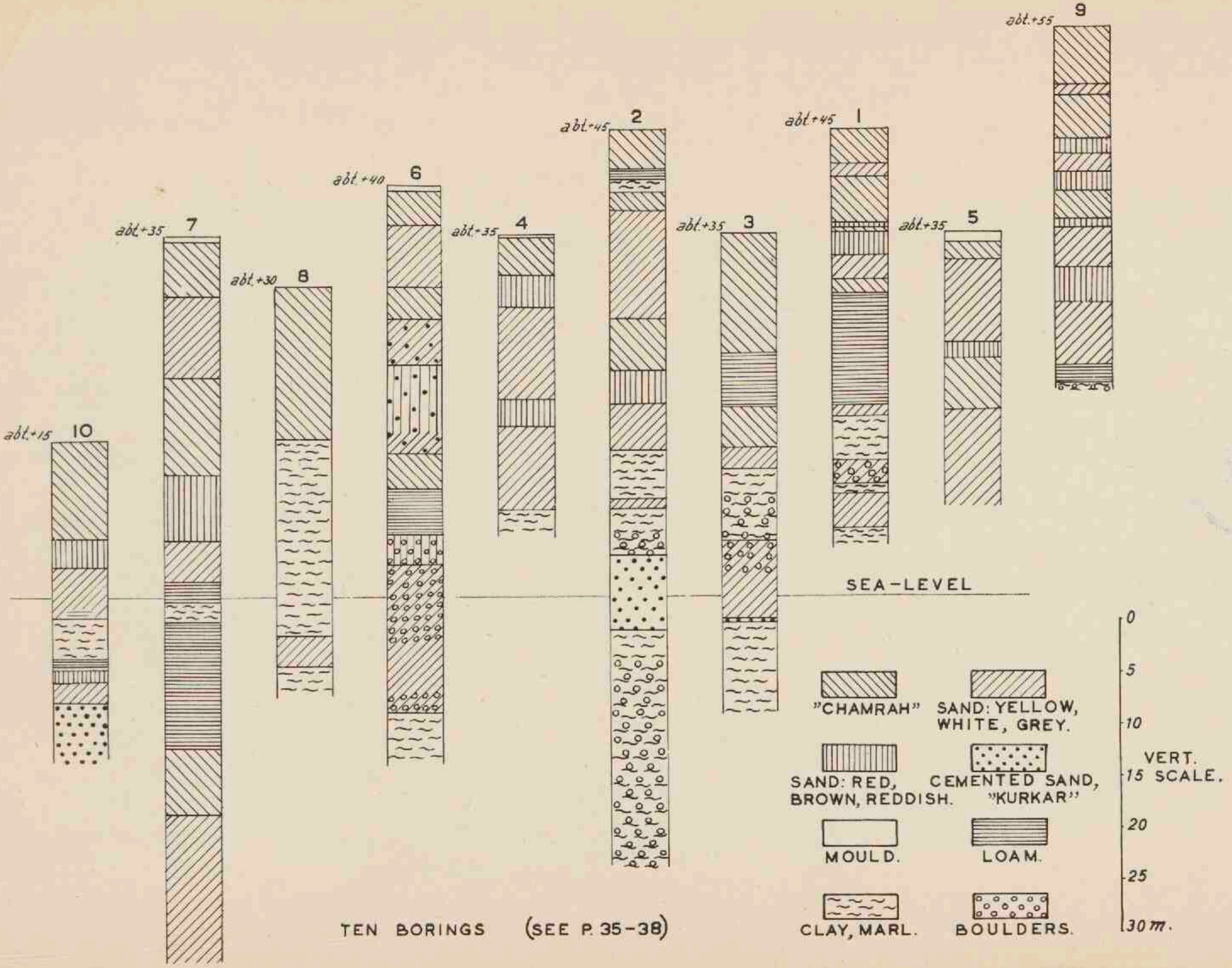
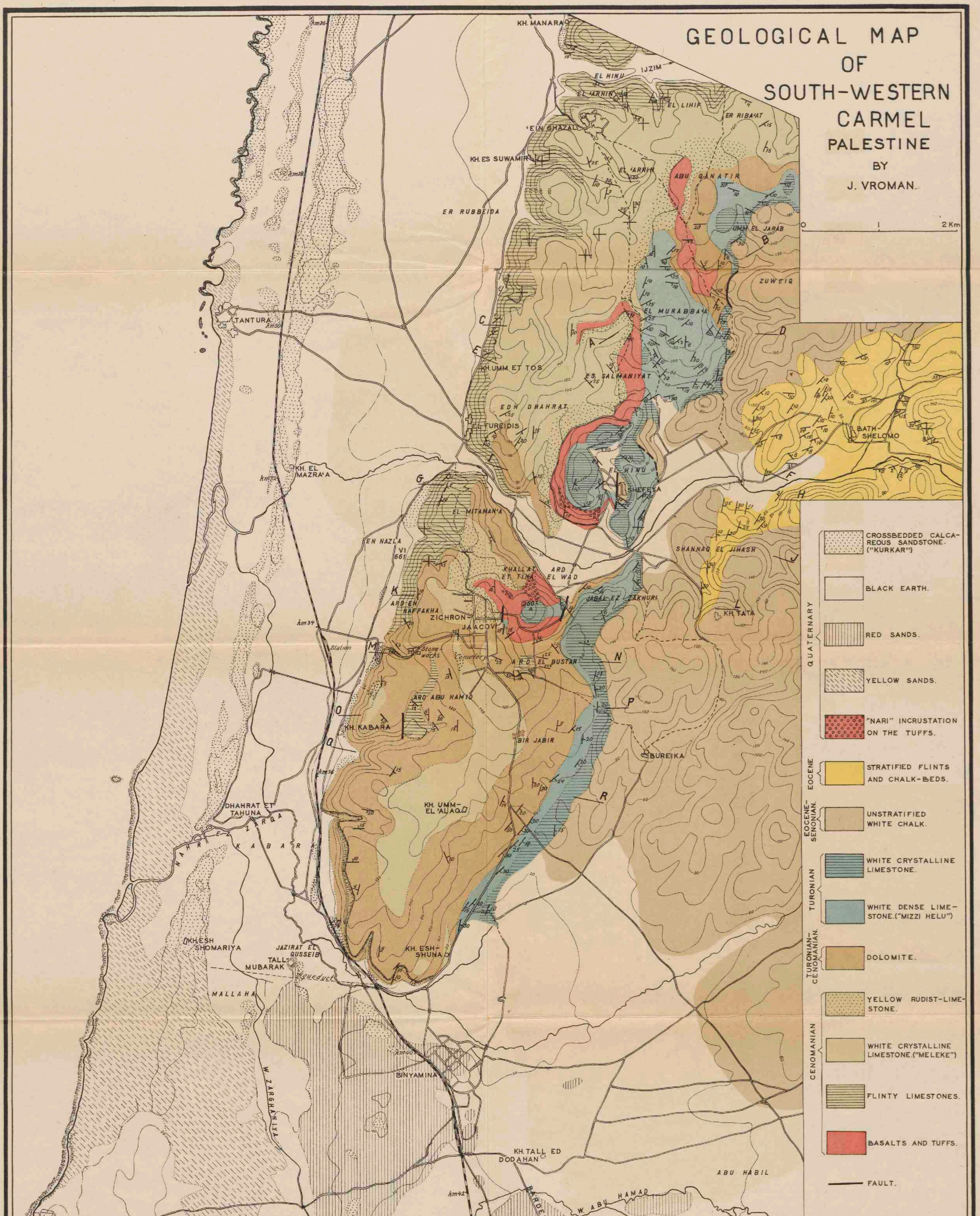


TEN BORINGS (SEE P. 35-38)


GEOLOGICAL MAP OF SOUTH-WESTERN CARMEL PALESTINE
BY J. VROMAN.
0 1 2 Km
QUATERNARY
CROSSBEDDED CALCAREOUS SANDSTONE. ("KURKAR")
BLACK EARTH.
RED SANDS.
YELLOW SANDS.
"NARI" INCRUSTATION ON THE TUFFS.
EOCENE
STRATIFIED FLINTS AND CHALK-BEDS.
EOCENE-SENONIAN.
UNSTRATIFIED WHITE CHALK.
TURONIAN
WHITE CRYSTALLINE LIMESTONE.
WHITE DENSE LIMESTONE. ("MIZZI HELU")
TURONIAN-CENOMANIAN.
DOLOMITE.
CENOMANIAN
YELLOW RUDIST-LIMESTONE.
WHITE CRYSTALLINE LIMESTONE. ("MELEKE")
FLINTY LIMESTONES.
BASALTS AND TUFFS.
FAULT.
STRIKE AND DIP.
A B SECTION-LINES.
TANTURA
CAESAREA
BINYAMINA
ZICHRON JAACOV
BATH-SHELOMO
KH. MANARA
EL FUREIDIS
SHEFEYA
J.v.D.

Form. V 44.

INTERNATIONAL AGREEMENT.
ARRANGEMENT INTERNATIONAL.

PERSONAL CARD.
CARNET INDIVIDUEL.

Treatment Centres. Centres de traitement.	*Identification Number at Centre. Numéro d'inscription au Centre.*
1st Centre	....
2nd "	....
3rd "	....
4th "	....
5th "	....
6th "	....
7th "	....
8th "	....

This card must be presented, at each Centre, to the Medical Officer in charge who will himself record upon it all the necessary particulars relating to the disease, to the pathological examinations made and to the treatment.

Ce carnet doit être présenté, dans chaque Centre, au médecin traitant qui inscrira lui-même toutes les mentions relatives aux particularités de la maladie, aux examens biologiques et au traitement.

L 12 - 7420 - '28

NOTE.

I. The abbreviations B; S; C; are employed to indicate the different affections treated (*see* Ministry of Health Circular 634). The Medical Officer in charge of the case will strike out those not affecting the patient.

II. In recording the results of the Bordet-Wassermann tests the notation recommended by the Health Committee of the League of Nations should be used viz.:—

+ + for strongly positive;

+ for positive to a degree which is diagnostic;

$\pm$ for doubtful; and

— for negative.

If possible, the method of test employed should be indicated, in brackets, after the result.

III. In the column headed „Treatment and Observations," the nature and the doses of the drugs prescribed are to be inserted; also the method of administration, the following abbreviations being employed, viz.:—

V. for the intravenous method;

M. for the intramuscular method;

O. for administration by mouth;

F. for inunction.

IV. When a patient embarks he should be informed, if possible, of the address and the hours of consultation of the Treatment Centre at his port of destination.

NOTE.

I. Les abréviations B; S; C; servent à désigner les diverses affections traitées (voir Vocabulaire Médicopharmaceutique). Le médicin traitant rayera celles dont le malade n'est pas atteint.

II. En notant les résultats des réactions Bordet-Wassermann, faire usage de la nomenclature suivante que le Comité d'Hygiène de la Société des Nations a racommandée :—

+ + *pour réaction fortement positive;*

+ *pour réaction positive permettant d'établir un diagnostic;*

$\pm$ *pour réaction douteuse; et*

— *pour réaction négative.*

Où possible, indiquer, après le résultat et entre parenthèses, la méthode adoptée.

III. Dans la colonne intitulée „Traitement et Observations," inscrire la nature et les doses des médicaments prescrits; ainsi que le mode d'administration, en employant les abréviations :—

V. pour la voie intraveineuse;

M. pour la voie intramusculaire;

O. pour la voie buccale;

F. pour la voie cutanée (frictions).

IV. Lorsqu'un malade s'embarque, l'adresse du Centre de Traitement du port de destination et les heures des consultations lui seront, si possible, indiqués.

Diagnosis / *Diagnostic* B; S; C.

Laboratory Examinations.
Examens de laboratoire.

Date.	Material Examined. * *Prod. examinées.* *	Result (*see* Note II. on page 2). *Résultat (voir Note II. page 2).*

* Blood: cerebro-spinal fluid; pus; serum.
Sang; Liq-céphalo-rachidien; pus; sérosité.

Treatment.
Traitement.

Date.	Name of Centre. *Nom du Centre.*	Treatment and Observations. *Traitement et Observations.*

Treatment.
Traitement.

Date.	Name of Centre. *Nom du Centre.*	Treatment and Observations. *Traitement et Observations.*

Treatment.
Traitement.

Date.	Name of Centre. *Nom du Centre.*	Treatment and Observations. *Traitement et Observations.*

Treatment.
Traitement.

Date.	Name of Centre. *Nom du Centre.*	Treatment and Observations. *Traitement et Observations.*

Treatment.
Traitement.

Date.	Name of Centre. *Nom du Centre.*	Treatment and Observations. *Traitement et Observations.*

Treatment.
Traitement.

Date.	Name of Centre. *Nom du Centre.*	Treatment and Observations. *Traitement et Observations.*

Treatment.
Traitement.

Date.	Name of Centre. *Nom du Centre.*	Treatment and Observations. *Traitement et Observations.*

This card is issued to sailors for the purpose of securing continuous treatment which is free of cost at many ports. It should be carefully kept by the sailor. At many of the principal ports there are Centres at which this treatment can be carried on. The address of the Treatment Centre and the hours of attendance can be learned on application to the Port Sanitary Authority or to any of their officers.

Le présent carnet est remis aux marins en vue de leur assurer un traitement continu et gratuit dans les différents ports. Il devra être conservé soigneusement. Dans chacun des principaux ports se trouve un Centre de Traitement. L'adresse de ce Centre de Traitement et les heures où l'on peut s'y présenter peuvent être demandées aux médecins sanitaires ou à n'importe quel officier du port ou des douanes.

Diese Karte wird den Matrosen zugestellt um ihnen eine ununterbrochene und in vielen Häfen kostenfreie ärztliche Behandlung zu gewähren. Der Matrose soll sie sorgsam aufbewahren. In jedem bedeutenden Hafen befindet sich ein Centralbureau für diese Behandlung. Die Adresse des Centralbureaus und die Besuchstunden sind von der Hafenverwaltungsbehörde oder von irgend einem der Beamten erhältlich.

Questo „carnet'' è rimesso alla gente di mare allo scopo di garentire la cura, senza interruzione e gratuita nei diversi porti. Il „carnet'' deve essere conservato accuratamente. In ciascuno dei porti principali si trova un Centro di Cura. L'indirizzo di questo Centro di Cura e l'orario nel quale è consentito di presentarvisi, possono essere richiesti ai medici di porto od agli ufficiali di porto o della dogana.

El presente carnet es remitido a los marinos con el fin de asegurarles un tratamiento, continuo y gratuito, en los diferentes puertos. Debe ser conservado cuidadosamente. En cada uno de los puertos principales se encuentra un Centro de Tratamiento. Las señas, o lugar de este Centro de Tratamiento, y las horas en que se pueden presentar, allí, pueden ser preguntadas a los médicos sanitarios, o a cualquier oficial del puerto o de las aduanas.

Dit boekje wordt aan de zeelieden uitgereikt om hun een voortdurende en kostelooze behandeling te verzekeren in de verschillende havens. Het moet zorgvuldig bewaard worden. In ieder der voornaamste havens bevindt zich een Centraal Bureau voor de Behandeling. Het adres van dit Bureau en de uren waarop men zich kan melden, kunnen aan de havenartsen of aan ieder ander arts, verbonden aan de haven of aan de douane, gevraagd worden.