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Objekttyp: **Article**

Zeitschrift: **Bulletin der Vereinigung Schweiz. Petroleum-Geologen und -Ingenieure**

Band (Jahr): **22 (1955-1956)**

Heft 63

PDF erstellt am: **28.04.2024**

Persistenter Link: https://doi.org/10.5169/seals-188030

Bull. Swiss Ass. Pet.-Geol. & Eng., vol. 22, no. 63, p. 41—54, 2 figs., 29th February 1956

The Oilfind of Heletz, Israel[1]

H. J. TSCHOPP[2])

Abstract

With the Heletz oilfind, recently discovered in the coastal area of Israel, the oil-crescent around the Arabo-Nubian shield starts to extend also along the Mediterranean Coast. The discovery well Heletz 1 is identical with the former Huleiqat well which had been drilled by Iraq Petroleum Company and was suspended at a depth of 1055 m in February 1948 just prior to the outbreak of the Arab-Israel War. — The well is located in the culmination area of a 50 km long gravity maximum whose structural character has been confirmed by seismic surveys and structure-drilling. — The forecast of a shaley-sandy facies (Kurnub-Equivalent) in the deeper Lower Cretaceous of Heletz led to the deepening of I.P.C.'s Huleiqat well (now called Heletz well) by the joint venture of Lapidoth and Israel Oil Prospectors. — The expected shaley-sandy facies was reached 280 m below the bottom of I.P.C.'s well. In the next 180 m occur five sands, the upper three containing saltwater, while the lower two, 1,80 m and 5,70 m thick, are saturated with oil of mixed base and with specific gravities of 0,8858 and 0,8763 respectively. — A production test of the lower oilsand gave 420 bbls/day through a $^5/_{16}$" choke. — Horizontal and vertical extension of the field are not yet known, but further sands and porous dolomites are expected in the deeper Lower Cretaceous, as well as thick zones of porous limestones and dolomites in the Jurassic. — There are good chances that additional pools will be discovered on and along this mayor gravity anomaly. — The oilfind of Heletz has given new impetus to the drilling activities in the coastal area where prior to Heletz already six dryholes had been drilled by the various companies operating in Israel.

I. Introduction

The discoverywell Heletz 1 lies in the coastal area 55 km south of Tel Aviv and 12 km from the Mediterranean Coast near Migdal-Ashqelon, fig. 1.

During the British Mandate of Palestine the Iraq Petroleum Co. covered the whole coastal area with a gravity survey. An extensive trend of positive anomalies was found continuing from the Sinai border for about 50 km over Beeri and Heletz to the area north of Negba, fig. 1.

In the Heletz area reflection- and refraction seismic surveys were carried out across the gravity maximum on behalve of I.P.C. The seismic results encouraged I.P.C. to drill their Huleiqat well which now is called Heletz.

The well was spudded on 25th. September 1947. Its first target the Cenomanian dolomites, was waterlogged (brackish water). The underlying Lower Cretaceous was encountered in a predominantly calcareous, non-sandy facies down to a depth of

[1]) Published with the kind permission of Lapidoth Israel Petroleum Co. Ltd. and Israel Oil Prospectors Corp. Ltd.

[2]) Chiefgeologist of Lapidoth and I.O.P. since December 1954, temporarely substituted by Dr. W. R. Fehr.

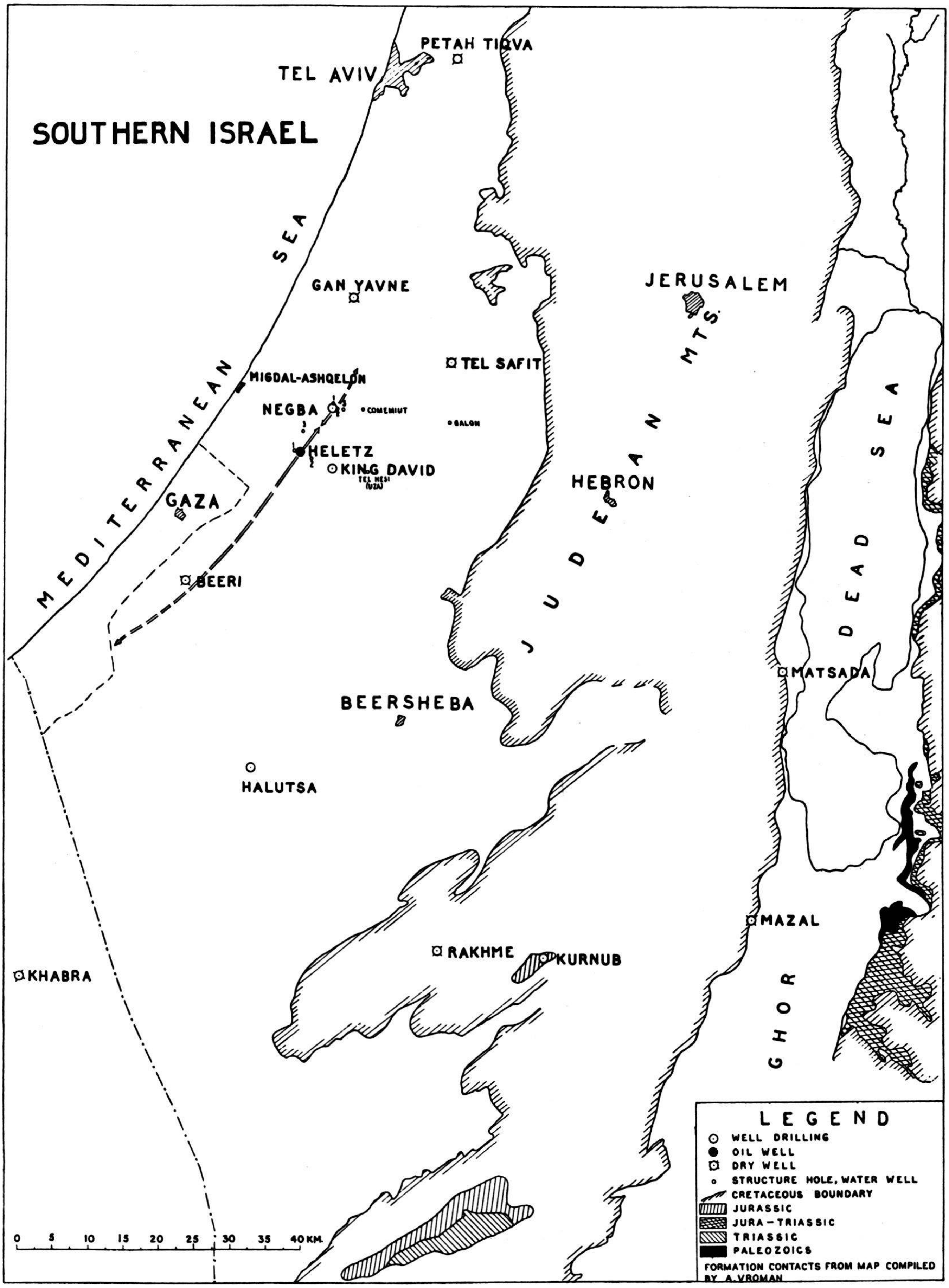

Fig. 1. Index Map

1055 m where, after setting $11^3/_4$" casing, drilling was suspended in February 1948, because of the growing political unrest.

Since the birth of the State of Israel on May 14th. 1948, respectively since the armistices with the Arab countries in 1949 additional refraction- and reflection-seismic investigations for water research were done in this area by The Weizmann Institute of Science. Valuable information was also furnished by wells drilled for water.

In 1951 M. W. Ball who had been called by the Government to prepare a general appraisal of the oilpossibilities of the country, qualified the Beeri-Heletz-Negba area as a good prospect (lit. 1). After a new oillegislation had been enacted in 1952 Lapidoth, advised by A. Foran and P. Salomonica, and Israel Oil Prospectors, advised by W. R. Fehr and J. Vroman, and other companies applied for exploration-licenses over the whole gravity maximum Beeri-Heletz-Negba. These and other licences were granted to Lapidoth and I.O.P. after both companies had merged to one joint enterprise.

Discouraged by the negative results of I.P.C.'s Huleiqat well and under the believe that this well is off-structure (lit. 1, p. 2 and 94), on the other side, attracted by a gas seepage in the vicinity of Beeri, 24 km south of I.P.C.'s Huleiqat well, Lapidoth and I.O.P. decided to drill a testwell near Beeri, after a reflection-seismic survey by the Weizmann Institute had confirmed the gravity maximum to coincide with structure. Drilling of Beeri 1 commenced on 8th. July 1954. The well was abandoned on February 4th. 1955 after having reached a total depth of 3646 m without encountering any sands in the Lower Cretaceous nor indications of oil and gas worth mentioning.

However, the oilpossibilities of a mayor trend of structures (indicated by gravity and confirmed by seismics) cannot be condemned on the negative results of one sole deep well like Beeri and of one uncompleted shallow well like Huleiqat. Moreover, by a subsequent revision of the cores and cuttings of the Beeri well and by its correlation with the Tel Safit well, drilled by Israel Mediterranean Petr. and Panisrael Oil Co., 24 km northeast of Heletz, the author came to the conclusion that the sand-bearing portion of the Lower Cretaceous penetrated in the Tel Safit well (Kurnub-Equivalent), the same as part of the Cenomanian are most probably faulted-off in the Beeri well along a set of faults with western downthrow. The Beeri well had unfortunately been located on the down-throw side of a fault or set of faults which had been detected by the seismic survey.

At the same time, the Tel Safit log led to the assumption that I.P.C.'s Huleiqat well had not yet entered the sand-bearing section in the lower part of the Lower Cretaceous.

Though, before the deepening of the Huleiqat well could be recommended its structural position had to be verified as near as possible. This was done with the help of structure-drilling across Heletz (two holes)[3] and Negba (three holes).

II. Stratigraphy

The formations penetrated in the exploration wells, water wells and structure-holes range from Quaternary to Jurassic.

[3]) A third hole was drilled recently.

TABLE 1

	Beeri 1	Heletz 1 (Huleiqat)	Structure Holes Heletz 1	2	3	Negba 1	2	3	Water Wells Comemiut/	Tel Hesi/	Galon
Elevation	74	96,6	113	68,6	90,5	93,3	92,9	81	82	130	176,8
Pleistocene (Kurkar)	114	126	165	80	125	96	79	64,5	60	—	—
Mio-Pliocene (Sakieh)	299	193	307	22	98	67	68	40,5	60?	—	8 (incl. Olig.)
o v e r l a p	—	—	—	—	—	—	—	—	—	—	—
Eocene	14,5	—	—	143	18	41,5	50,5	203,5	140 approx.	250	240
Paleocene	—	—	—	—	—	—	—	—	—	30	72
Senonian incl. Maestr.	—	—	—	—	—	—	—	—	85	170	230 approx.
Turonian	152,5	—	—	—	—	—	—	—	260[6])	104[6])	109[6])
Cenomanian	420[1])	325[3])	96,5[5])	151[5])	51,6[5])	225[5])	160[5])	34,5[5])			
Alb. / Calc. Series	645[2])	691									
to			—	—	—	—	—	—	—	—	—
Neoc. / Kurnub Equiv.		180[4])									
Jurassic (upper to middle)	2001	—	—	—	—	—	—	—	—	—	—
Total Depth	3646	1515,3	568,5	396	293	430	358	348	610	604	670

All figures in metres.

1) Partly faulted off.
2) Lower part faulted off.
3) Upper part eroded off prior to Sakieh overlap.
4) Section only partly penetrated.
5) Upper Cenomanian.
6) Turonian and Cenomanian undivided.

1. Pleistocene-Kurkar

Kurkar is chiefly composed of a medium to coarse grained dune sand, sporadically cemented to hard calcareous sandstone. Some clay-admixture and a varying amount of flint and limestone-pebbles and boulders in the lower part. The flint seems to derive mainly from Eocene (lit. 2, p. 298).

Kurkarsand covers the surface from about 25 km inland to the coast. Its base slopes coastwards from about 100 m above sealevel at 7 km east of Negba to about 200 m below sealevel near the coast.

Commonly, Kurkar is attributed to the Pleistocene, but it may include still some Pliocene.

Kurkar and underlying Sakieh seem to be conformable in the area under consideration.

2. Mio-Pliocene-Sakieh

The Sakieh of the Heletz-Negba area is a sticky to sandy, green to darkgreen and grey marly clay or marl, usually rich in foraminifera. The foraminiferal assemblage, as far as it has been specifically determined by Z. Reiss of the Geological Institute, Jerusalem, contains:

Amphistegina lessonii D'ORBIGNY
Asterigerina planorbis (D'ORB.)
Bolivina directa CUSHMAN
Bolivina scalprata SCHWAGER
Cibicides concentrica CUSH.
Elphidium cf. crispum (LINNE)
Globigerinoides sp.
Globigerinoides conglobata (BRADY)
Nonion boueana (D'ORB.)
Siphonina reticulata (CZJZEK)
Sphaeroidina sp.
Spiroplectamina carinata D'ORB.
Streblus beccarii (LINNE)
Uvigerina pygmaea D'ORB.

This fauna is of Neogene age (for further studies of the Neogene see lit. 3 and 4).

From Heletz-Negba eastwards the Sakieh facies changes to chalks and limestones (lit. 2, pp. 283—284).

From the Heletz-Negba westwards the Sakieh increases in thickness rapidly: from 22 m in Heletz S.H. 2 to 96,6 m in Heletz 1 and to over 800 m (based on reflection-seismics) in the area 6 km farther west, fig. 2. At Gan Yavne, 16 km north of Negba the Sakieh is about 800 m thick and near the coast possibly around 1000 m or more.

3. Eocene

Across the Heletz east- and northflank and across the entire Negba high the Neogene rests on white chalks and green to bluegrey marls, locally with flints and a few limestones with Eocene fauna.

The Eocene is missing in the culmination area of Heletz, is relatively thin on the Negba culmination, but attains considerable thickness in the Paleocene-Senonian basin (Shephela basin) which stretches between the Beeri-Heletz-Negba trend and the Hebron upwarp.

On the Negba high the Eocene ranges from Lower to Middle Eocene. The Lower Eocene foraminiferal fauna consists of [4]):

Bulimina serratospina F.
Bulimina tarda PARKER AND BERMUDEZ
Buliminella grata CUSHMAN AND PANTON
Cibicides cushmani NUTTALL
Cibicides pseudoconoidea CITA
Globigerina lineaperta FINALLY
Globigerinella micra (COLE)
Globorotalia aff. *globigeriniformis* (VAN BELLEN)
Globorotalia spinulosa CUSHMAN
Gümbelina venezuelana NUTTALL
Nuttallides trümpyi (NUTTALL)
Osangularia mexicana (C.)
Truncorotalia aragonensis NUTTALL
Truncorotalia crassata CUSHMAN
Truncorotalia pseudoscitula GLAESSNER
Truncorotalia wilcoxensis CUSHMAN AND PONTON

[4]) All determinations contained in this paper have been made by Z. Reiss, Geol. Inst. Jerusalem.

The M i d d l e E o c e n e is determined by the occurrence of:

Hantkenina sp.
Globigerinoides orbiformis (COLE)
Globigerinoides mexicana CUSHMAN

U p p e r E o c e n e is known only from the Shephela basin (Galon well), while. B a s a l E o c e n e, identified by the concurrence of *Truncorotalia simulatilis* SCHW. with an else Lower Eocene assemblage, makes its first appearance on the outer east-flank of the Heletz-Negba structures, f. i. in Heletz S.H. 2 and in the Comemiut waterwell.

4. P a l e o c e n e - S e n o n i a n (incl. Maestrichtian)

Paleocene and Senonian, including the Maestrichtian, form a conformable sequence of shales, marls and chalks, often bituminous (Senonian). The various stages diminuish in thickness from the Shepela basin towards the Heletz-Negba culmination. The waterwells of Galon, Tel Hesi (Uza) and Comemiut give clear evidence of a gradual stratigraphic pinch-out from the basin toward Heletz and Negba. Along the eastflank of these structures the pinch-out is superseded by the progressive overlap of the Eocene. As a matter of fact, no Paleocene or Senonian has so far been found in the culmination area of Heletz and Negba, see fig. 2.

5. T u r o n i a n - C e n o m a n i a n

Light coloured chalk, marl and limestone, sometimes dolomitic or altered to dolomite prevail in the Turonian and Upper Cenomanian, while the mainbulk of the Cenomanian is made up of dolomitized chalks, hard, fine to coarse crystalline dolomites with secondary porosity, cavernous (karstic), grey to darkbrown in colour. The Cenomanian dolomites represent an aquifer which carries freshwater in the eastern part of the coastal area (intake in the Hebron Mountains etc.), whereas westwards the water becomes gradually more and more brackish.

If diagnostic fossils are absent and dolomitisation has progressed, Turonian is rather hard to distinguish from Cenomanian in wells. For this reason both are shown subdivided in Table 1 only where satisfactory evidence from fossils is available. For instance, the Lower Turonian of the Beeri well was recognized by the appearance of *Globotruncana helvetica* BOLLI, *Globotruncana lapparenti coronata* BOLLI and *Globotruncana lapparenti lapparenti* BROTZEN, whilst the combined occurrence of *Globotruncana helvetica* BOLLI with *Globotruncana appeninica* RENZ in Negba S.H. 1, 2 and 3 in Heletz S.H. 2 and 3 suggests Upper Cenomanian. Rudists, bryozoa and some other macrofossils are frequent, but as a rule cannot be specifically determined from small well cuttings. The middle and lower part of the Cenomanian section sometimes contains *Orbitolina* of the *concava* group (Heletz S.H.1).

Where the Senonian is present, as in the waterwells of Comemiut, Tel Hesi and Galon, it can safely be expected that the uppermost portion of the underlying limestone-dolomite section belongs to the Turonian, as there is no proof for the existence of a mayor, regional unconformity between Senonian and the Turonian Cenomanian complex.

In the culmination area of Heletz Eocene overlaps onto Middle to Lower Cenomanian, in Negba onto Upper Cenomanian, and in the Beeriwell onto Lower Turonian.

6. Lower Cretaceous (Albian to Neocomian)

The most complete section of Lower Cretaceous, so far penetrated by a well in the vicinity of the Heletz-Negba structures is that of Tel Safit well, drilled between 6th. Octobre 1954 and 17th. March 1955 by Panisrael Oil Co., about 25 km northeast of Heletz. This well shew a Lower Cretaceous sequence which can be subdivided in an upper calcareous (about 700 m thick), and a lower shaley-sandy part (about 300 m thick), the latter called Kurnub Equivalent by the geologists of Panisrael Oil Co. (after the Lower Cretaceous Nubian sand of Kurnub [lit. 5]). This subdivision has been confirmed by the Heletz well, as far as this well has been deepened into the Lower Cretaceous.

a. The «Calcareous Series» of the Lower Cretaceous at Heletz consists predominantly of white to grey limestones, dense or chalky, occasionally dolomitic. Oolitic, algal, organic and detritic limestones are more frequent in the lower portion of this series. In the lowermost 100 m occur seams of iron-oolite. Shales, interbedded with limestones, form a distinct interval from 1096 m to 1141,5 m in Heletz 1. Sands are extremely rare: a chalky sand to sandy chalk being present between 1062,5 and 1073,2 m and between 1094 and 1096 m.

In the Lower Cretaceous, drilled by I.P.C., *Orbitolina discoidea* GRAS. has been recorded from different levels. In the part drilled by Lapidoth and I.O.P. *Orbitolina* of the *discoidea* group is rather frequent. In cores from 1194—1197,4 m and 1245,4—1249,2 m *Choffatella decipiens* SCHLUMB. occurs beside of *Orbitolina discoidea* GRAS. (Upper Aptian).

b. The Kurnub Equivalent was reached in Heletz 1 at 1335 m depth where the first quartz sand was met. The boundary with the overlying «Calcareous Series» is not sharp, rather transitional, limestones continuing to be present in varying amounts. On the whole, darkgrey pyritic shales and silts, with small siliceous concretions are the principal components of the Kurnub Equivalent. These shales may well have served as motherrock of the Heletz oil. Quartzsands, clean to dirty, fine to mediumgrained, are known from cuttings, cores and micrologs from the following intervals:

1336,3—1341,2 m: Sandstone, fine to mediumgrained (core).
Permeability 46 md, Porosity 10,8%
Total Water 70,4% (saltwater acc. electrolog)
Oilresidue none

1346,3—1348,2 m: Sandstone known only from cuttings and microlog (saltwater acc. electrolog)

1469,3—1471,3 m: Sand (core)
Permeability 980 md, Porosity 21,6%,
Total Water 85,6% (saltwater acc. electrolog)
Oilresidue none

1496,8—1498,5 m: Oilsand (sidewall cores) and impregnated Sandstone (core)

	Permeability	Porosity
Sidewall core from 1497 m	98 md	21,1%
Sidewall core from 1498 m	60 md	18,7%

1509 —1514,7 m: Oilsand and -sandstone with harder calcareous streaks (only hard streaks recovered in core)
A core-analysis of one of the recovered hard streaks furnished the following data:
Permeability 76 md, Porosity 9,1%
Residual oil 2% vol., 22% pore
Total Water 16,5% pore
This sand rests on limestone and dolomite, coarse crystalline, porous and oilimpregnated.

As only 180 m of the expected 300 m total Kurnub Equivalent have been drilled by Heletz 1, there is good chance that more and thicker sands may exist below the present bottom of the well.

The fossil content of the Kurnub Equivalent is fairly rich. Plantremains and fossil resin are plenty. Fragments of small oysters, gastropods and echinoids are found in cores and amongst the well cuttings. From a core between 1464,6—1470,4 m were collected:

Anomia ? subobliqua (CONRAD)
Pinna sp.
Protocyprina libanotica elongata (VOKES)
Ostracods

This fauna is still Lower Cretaceous.

7. Jurassic

The Beeri well and other wells drilled in the coastal area leave no doubt that a thick Jurassic section can be expected below the Lower Cretaceous of Heletz. The thick Jurassic section of Beeri whose Upper to Middle Jurassic age is proven by the occurrence of *Trocholina conica* and *Trocholina palestinensis,* contains various porous limestones and dolomites of varying thickness. Their accrued thickness, as judged from the microlog, amounts to about 735 m or about 37% of the total section attributed to the Jurassic.

Undoubtedly, similar conditions will be encountered in the Jurassic which underlies the Kurnub Equivalent of Heletz. A future deeptest at Heletz will explore such deeper prospects.

III. Structure

The results of structure-drilling in the Heletz-Negba area combined with the information obtained from the Heletz well and from waterwells drilled in the vicinity render a fairly clear picture of the Heletz-Negba eastflank. For the westflank we must rely, for the time being, exclusively on the results of the seismic survey by Weizmann Institute. Convergent seismic reflections along the westflank suggest formations which wedge out toward the crest. Whether these pinch-out formations represent Eocene or Upper Cretaceous has still to be cleared up. Thus, the westflank remains conjectural, untill the seismic picture is corroborated by the findings of future wells.

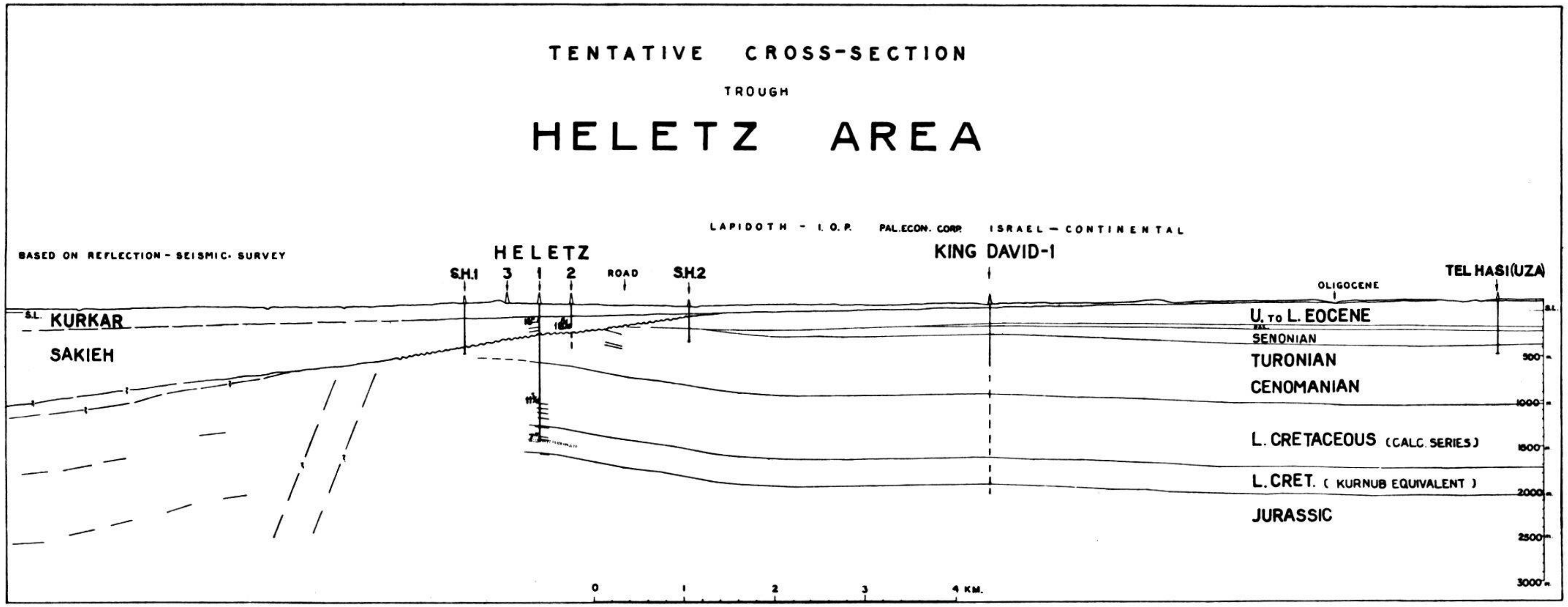

Fig. 2. Tentative Cross-Section

From dips obtained by Schlumberger dipmeter-survey in the Lower Cretaceous of Heletz 1 one is led to assume that the crest of the structure lies west of Heletz 1, while some of the seismic results point rather in the opposite direction, however, seismic results in the culmination area of the structure seem open to doubt. In Heletz S.H. 1 Cenomanian with *Orbitolina* cf. *concava* was found in a core from the bottom of the hole. How much deeper top Lower Cretaceous occurs here, can not be predicted with present information at hand. At best, top Lower Cretaceous may rise to approximately 500 m below sealevel (against 548 m subsea in Heletz 1), if the crest of the structure should lie in the neighbourhood of S.H. 1.

On the outer flank of Heletz, 5 km east of Heletz 1, Israel Continental Oil Co. is drilling King David 1. This well lies on the northend of a gravity maximum. The question whether this maximum reflects structure in the Cretaceous as suggested by fig. 2, can only be answered by the drill.

Extension and width of the Heletz structure are still little known. The results of the seismic survey tends to show that the structure plunges slowly in a southwesterly direction, and pritty steeply toward the northeast. In the area 4—5 km northeast of Heletz 1 gravity, refraction- and reflection seismics indicate a structural low which probably corresponds to an axial depression between the Heletz and Negba highs. Evidently, this saddle will provide the Negba high with a certain amount of closure toward the Heletz high, but the full amount of closure is still unknown. Toward the Comemiut waterwell the eastflank of Negba drops at least 200 m, and toward Gan Yavne the northwest flank plunges at least 800 m.

A well is now drilling on the Negba high.

IV. Structurel Evolution and Migration of Oil

1. The main folding of the Beeri-Heletz-Negba trend of structures occurred in early Senonian.

Evidence: Some or all of the Senonian members are thinning or pinching out to ward the structural culminations.

Oil: At the end of Cenomanian times the Kurnub Equivalent carried approximately 1350 m of overburden (700 m calcareous Lower Cretaceous plus 650 m Cenomanian). The resulting compaction of the Kurnub shales (motherrock) must have been in a sufficiently advanced stage to expulse most of the hydrocarbons from the shales and to move them into the nearest sands (primary migration). Thereafter, the Senonian folding movements provided the necessary structural traps (Heletz high and others) and the required pressure gradient to force the hydrocarbons from the structural lows into the culmination areas (secondary migration).

If we apply similar considerations to the Jurassic of the coastal area, we may conclude that — due to the considerable deepening of the Jurassic basin from east to west — most of the indigenous Jurassic hydrocarbons should have migrated toward the eastern margin of the Jurassic basin long before structural traps were created by the Upper Cretaceous folding. There are, however, some indications that uplifting movements took place at the verge of Jurassic to Cretaceous times (f. i. Lower Cretaceous Nubian sand overlaps onto different beds of the Upper Jurassic at Kurnub) which might have created satisfactory traps.

2. The climax of folding and intensive denudation of the crestal areas in the coastal region had already passed prior to Lower Eocene times when all Senonian and Turonian (Negba) and even part of the Cenomanian (Heletz) had been removed from the culmination areas.

Evidence: Big progressive overlap of the Lower to Middle Eocene from the Shephela basin toward the culmination areas of Heletz and Negba, first over Paleocene and Senonian, then over Upper Cenomanian of Negba and possibly also over Middle Cenomanian of Heletz (since the Eocene is absent in Heletz 1 and S.H. 1, Eocene together with part of the Cenomanian may have been removed by a post-Eocene, pre-Sakieh erosion).

Oil: Any oil or gas that could have migrated into the Cenomanian would likely have been tapped and flushed out during the pre-Lower Eocene erosional phase, while accumulations in the deeper Lower Cretaceous had good chances to remain intact.

3. There are some indications that the various Eocene subdivisions thicken toward the Shephela basin. Thus, the folding movements continued or renewed, though in a much slighter degree, during Eocene times.

4. Posterior folding movements must have occurred in an interval from Oligocene to early Miocene times, i. e. pre-Sakieh, when the area emerged from the Eocene sea and subsequent erosion cleared all (Heletz) or part (Negba) of the Eocene from the culmination areas.

Evidence: Upper Eocene is absent at Negba, and no Eocene at all is left below the Sakieh overlap in Heletz 1 and S.H. 1.

Oil: Continued drainage of any oilaccumulations which may have been left in the Cenomanian.

5. Transgression of the Mio-Pliocene Sakieh sea from west to east, accompanied by a pronounced west-tilt of the coastal area along a hinge line which approximately follows the eastflank of the Heletz-Negba structures.

Evidence: Sakieh overlaps onto the truncated Heletz-Negba structures. Sakieh grows rapidly in thickness from the culmination areas toward the Mediterranean Coast where the total amount of tilt may reach or exceed a thousand metres (see also lit. 5 and 6).

Oil: The sharp downtilt to the west and the resulting reduction of structural closure to the east may have caused decantation and spillage of oil from traps with an originally small closure. Accumulations in structures with large overall closure, like Heletz, will probably not have been adversely affected by this tilt, except for a new rearrangement of the reservoir-fluids within the structure.

6. Continuance of the epeirogenetic tilt during Pleistocene-Kurkar times.

Evidence: The thickness of Kurkar which appears to overlie the Sakieh conformably, gradually encreases toward the Mediterranean Sea.

V. Well Heletz No. 1

Elevation above mediterranean sealevel 96,63 m (K.B.)

Iraq Petroleum Co. comenced drilling on 25th. September, 1947 and suspended well in February, 1948, at a depth of 1055,5 m.

Lapidoth - I. O. P. resumed drilling on 26. August, 1955, at 1055,5 m and completed well on 12th. October, 1955, as a producer.

Total Depth: 1515,3 m.

Coring: In the first 710 m about 71 m of cores were taken by I.P.C. We have no record of the amount of coring between 710 m and 1055,5 m.

Between 1055,5 m and 1515,3 m Lapidoth-I.O.P. cored a total of 40 m (8 cores), and 7 sidewall cores were obtained by Schlumberger sidewall coring.

Lithology: See under II. Stratigraphy and Table II.

TABLE II

HELETZ No. 1

AGE		LITHOLOGY	Depth	Thick.	Drilled by
PLEISTOCENE (KURKAR)		**SAND,** loose, with streaks of sandstone	om – 126 m	126 m	Iraq Petroleum Co.
MIO-PLIOCENE (SAKIEH)		**MARL,** grey, foraminiferal, glauconitic, pyritic	126 m – 319 m	193 m	Iraq Petroleum Co.
CENOMANIAN		**LIMESTONE,** dolomitic, and **DOLOMITE,** grey to brown, fine to coarse, crystalline; grey to brown, fine to coarse, crystalline; sporadic rudists, *Eoradiolites lyratus*; *Cuneolina* sp., *Orbitolina* cf. *concava*	319 m – 644 m	325 m	Iraq Petroleum Co.
NEOCOMIAN TO ALBIAN	CALCAREOUS SERIES	**LIMESTONE** predominant, white to grey; occasionally dolomitic, oolitic and detritic in lower part, interbedded with **SHALES,** sandy, grey. Seams of iron-oolite in lowermost room; sand rare. Abundant *Orbitolina* cf. *discoidea* and fragments of macrofossils. *Choffatella decipiens* in lowermost 150 m	644 m – 1335 m	691 m	Iraq Petroleum Co. / Lapidoth-L.O.P.
	KURNUB EQUIV.	**SHALES** pred., darkgrey, sandy, pyritic. with siliceous concretions; **LIMESTONES** ptly. dol. also oolitic, detritic, some iron-oolite; **SANDS;** plantremains; macrofossils, *Orbitolina*, *Choffatella*	1335 m – 1515 m	180 m	Lapidoth-L.O.P.

S c h l u m b e r g e r L o g g i n g : Gammalog from 0—1500 m; electro- and micrologs from 1055,5—1514 m; dipmeter survey (11 dips).

C a s i n g s i n t h e H o l e : 16" casing at 182 m set by I.P.C.
11 3/4" casing at 1055,5 m set by I.P.C.
7" casing at 1506 m set by Lapidoth-I.O.P.

D r i l l s t e m T e s t s : Tests with Johnston Formation Tester were carried out at the following intervals:

1. Interval 1062,5—1073 m: Chalky sand to sandy chalk.
   Result: Saline water with much H_2S. No signs of hydrocarbons.
   The water contains 6134 Cl p.p.m. and 764 SO_4 p.p.m.
2. Interval 1496,8—1498,5 m: Oilsand with some quartzitic sandstone.
   Result: During the test which lasted 92 minutes, about 71 bbls of oil with gas had filled the pipe through a 1/4" choke.
   Analysis of the oil (still slightly polluted with drill mud) made by Consolidated Refineries Ltd., Haifa:
   Density at 15 ^{0} C: 0,8858 — 28,4 API

Destillation:	over at 100 ^{0}C	10,0 %	vol.
	„ „ 200 ^{0}C	23,3 %	vol.
	„ „ 300 ^{0}C	44 %	vol.
	Residue	54,3 %	vol.

Total Sulphur	1,63 % wt.
Wax Content	13,3 % wt.
Pour Point	+ 45 ^{0} F

The gas contains 80,0 % methane and 20,0 % petroleum gases.

3. Interval 1509—1515,3 m. Oilsand with hard calcareous streaks from 1509 to 1514,7 m, underlain by limestone and oil-impregnated, coarse crystalline dolomite from 1514,7 m to bottom at 1515,3 m.
   Result: Oil with gas started to flow trough a 1/4" choke after 42 minutes.
   Analysis of oil (slightly polluted will drill mud) made by Consolidated Refineries Ltd, Haifa:

   Density at 15 ^{0} C: 0,8763 — 30 API

Destillation:	over at 100 ^{0}C	9,5 %	vol.
	„ „ 200 ^{0}C	25,2 %	vol.
	„ „ 300 ^{0}C	46,7 %	vol.
	Residue	51,6 %	vol.

Total Sulphur	1,51 % wt.
Wax Content	8,3 % wt.
Pour Point	+ 50 ^{0} F

P r o d u c t i o n T e s t : The tubing test of the interval 1509—1515,3 m gave the following result:

Time (24 hrs)	Choke	Pressure Top	Pressure Bottom (at 1493 m)	Temperature	Oil
1st. Day	5/16"	128 lbs	1862 lbs	140 F	420 bbls
2nd. Day	4/16"	130 lbs	1868 lbs	140 F	330 bbls
3rd. Day	3/16"	140 lbs	1898 lbs	140 F	198 bbls

F u r t h e r W e l l s : Heletz 2 is drilling 400 m southeast, and Heletz 3 400 m northwest of Heletz 1.

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Manuscript received Dec. 7th, 1955.