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The Mediterranean Coast of Israel: A Planner's Approach

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THE MEDITERRANEAN COAST OF ISRAEL - A PLANNER'S APPROACH

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NOTES:

1. Prior to reading this paper, please study the map of the country (located in the back-cover pocket), in order to get acquainted with names and locations of sites mentioned here thereafter.
2. No legal aspects were introduced in this essay since I lack the professional background for feeding in the information.

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S E C T I O N I

1. PHYSICAL STRUCTURE.

(a) Topography.

The Eastern Mediterranean coast of the country constitutes a strip of 210 miles long, within its natural boundaries, from the Litani river in the north to Wadi El-Arish in the south. (Of this 117 miles lie in Israel's pre-67 political boundaries as measured from Rosh-Hanikrah to the northern end of the Gaza Strip). It forms an almost straight line, interrupted at only two points, at the capes of Rosh-Hanikrah and at Mount Carmel. The coastal plain gradually widens from north to south: near Rosh- Hanikrah it measures only 2,5-3 miles,as against the latitude of Gaza,where it is 25 miles wide.

Such a coastline, poor in promontories and deep embayments, is often found when the shore is parallel to the principal mountain ridges inland; it is a "concordant" shore. A straight coast is often regarded as a sign of uplifting: on the sea bottom, new layers of generally horizontal rock, gradually build up; these bear no relationship to the profile prevailing before the invasion of the sea. The sea's regression thus left an almost flat surface, and the new shore formed an almost straight line. (Fig. 3).

Geologists are not sure whether this uplift movement is still in progress. On the other hand, a slight, steady rise in sea level is noticeable on the Levant coast, as on most other sea and ocean shores of the world. In Israel this new cycle of transgression due to melting of continental glaciers, is not yet strongly pronounced and is recognizable.only at certain spots inthe northern parts of the coast. Those

Those few headlands and indentations still existing are slowly disappearing by being erodedby ceaseless attacks of strong waves and breakers; the sand and gravel resulting from the destruction of the promontories are deposited, with loamsand and pebbles brought down by rivers and streams in the quiet water of the bays.

On the Israel coast this process of sidimentation is aided by the Mediterranean Longshore Current which flows counter clockwise from Gibraltar eastward along North Africa, then northward along the Levant Coast and, finally back to the west, skirting southern Europe. (see maps 1,2) This current carries vast amounts of sand which fill up the embayments along the coast and aid in a further straightening of the shoreline.

(b) Water Properties - Currents, Temperatures, Salinities, Chemistry (pollution).

Currents:

The most important currents influencing movement of beach sands are those that occur in shallow waters in contact with the sands. In this region two different kinds of nearshore currents are important for sand movement. One is the inner fringe of the general offshore current, and the other is the wave-induced current inshore of the surf zone. These currents are independent and can move in the same or opposite directions.

The main surface current in the eastern end of the Mediterranean Sea is directed northward; only a fringe of this current flows atop the shelf and, although its velocity must decrease markedly in shallow water near the beaches, it appears to be significant even here. The offshore current appears to be fastest in the fall and winter

when the parts of it nearest shore are also marked by low salinity, high nutrients, and high turbidity produced by a tongue of flooding Nile River which is carried alomg the entire coast at least to Lebanon. Movement of the offshore current is aided at this time by the general pressure of an atmospheric high pressure zone in the general area of the Nile Delta that produces winds from the southwest off most of Israel. During the summer the low pressure zone is located further northeast, so that winds off Israel are largely from the northwest. Although these summer winds are not strong, they are steady and appear to cause a decrease in velocity and even occasional reversals of the offshore current on the shelf.

Nearer shore than the general current is the longshore current preduced by waves acting against gently shelving beaches. The largest and longest period waves come from approximately 280°. This is also the direction of longest possible fetch; fetches from dther directions are restricted by nearness of the coasts of Cyprus, Greece and Egypt. Waves from about 280° apppoach the curved coast of Issael in such a way that before refraction the apex of the angle between wave crests and shoreline points south-westward; thus a longshore current to the northeast should be produced by the waves. The same waves approach the northern part of the coast parallel to the shoreline or with an angle in the opposite direction, so that longshore currents should be small and generally toward the south. In the northern half of Israel's shore only in ares of reversed trend of the shore, such as the south side of Haifa Bay, should the wave-induced current be northward and of high velocity. Another such area of reversed coastal trend north of the Lebanese border must also cause a nothward current, away from Israel.

Local storms can also be expected to produce waves capable of

considerable erosion and movement of beach sands. Between January and April strong winds from the southwest and west are more common than those from the north and northwest at Gaza than at Tel-Aviv, Netanya and Acre. During the rest of the year at all these four representative places such strong winds are too rare to be significant. Thus the strongest winds in the coastal region are from the southwest and these winds are more frequent south of Bat-Yam than north of it. Waves produced by such winds should form northward flowing longshore currents capable of bringing more sand to the beaches south of Bat-Yam than they carry away to beaches further north.

The longshore currents inshore of the surf zone northward between Egypt and Bat-Yam and southward between Bat-Yam and the Lebanon. At the narrow projecting point of Yavne-Yam an accumulation against the south side shows that the longshore current must be prevailingly northward. The groins and breakwaters of Yaffo and Tel-Aviv show only a slight tendency for longshore sand movement there again northward, Further north at Tel-Arshaff an accumulation of sand against the north side of a now destroyed Crusader jetty, indicates a longshore current from the north.

The longshore transport of water locally causes it to accumulate, raising sea level several centimeters. The abundance of rip currents along the entire coast of Israel warrants an understanding of them in order to prevent or reduce the number of drownings caused by them and to learn something of the degree to which they carry beach sand seaward to deeper water.

In summary: the inshore- or eastern- fringe of the general Mediterranean current generally moves northward along the entire coast of Israel and, the wave-induced longshore currents near the shore generally move from both south and north toward the soyth-central

part of the coast. Seasonal and shorter period reversals of direction occur for both currents. The velocity of each is sufficient to transport at least fine sand.

Temperatures and Salinities: The origin of the upwelled water is not far below 125m depth, since only a slight temperature drop is observed in this layer in the summer/fall months. At the surface and at 30m, the abruptness of the decrease in September and October is also indicative of upwelling. The salinity of the surface water shows a dip in August, especially conspicuous in the post-Aswan years, which can be interpreted as due to upwelling.

Along the eastern shore of the Mediterranean, the amount of upwellin depends upon the intensity and duration of the northerly winds. Summer winds in this area come from the N, NW and W quadrants. In former years the Nile fliw would have been an additional vector, since it raised the sea level in the south of the area and, supported by the counter-clockwise current, created a flow gradient from south to north.

The sharp drop in surface salinity which marked the arrival of the Nile flood in late August or early September, has disappeared. Lacking this freshwater dilution, and under the influance of the high evaporation rate, the surface water becomes relatively salty in the fall months and, during the winter overturn, this increases the salinity of the whole water column over the shelf. The only noticeable exceptions to the general rise in density are in the 50 to 75m layers between August and November, and here the decreased density can be attributed to a weaker upwelling than in former years.

Salinity rather than temperaturesdifferences is the main cause of the density increases. While salinity increases are the direct result of the cessation of the Nile floods, temperature changes are probably due to unrelated flunctuations which would cancel each other over a number of years. In both periods, the water column as a whole is least dence in August.

It can be expected that there will usually be some release of Nile water into the Mediterranean, the amount depending upon the state of the reservoirs and the height of the river level. As long as the Aswan Dam is operating to near full capacity, salinities in the Levantin Basin will go on increasing gradually. Winter mixing will include ever deeper layers, and may eventually reach the permanent pycnocline at about 300m, where the density is approximately 1,029. The nutrients accumulated below the pycnocline could greatly increase the productivity of the Levantine Bay if they were drawn up into the photic layer.

<u>In summary:</u> Comparisons made between oceanographic phenomena in the Mediterranean Sea off Israel for periods before and after the Aswan Dam show that the Aswan Dam eliminated the annual inflow of fresh water and the dilution of the sea water in the Levant Basin, Since 1965, the annual salinity cycle has undergone the most conspicuous changes: only one salinity minimum os recorded now during the year, in winter. The surface salinity has increased slightly since 1965 as a result of the elimination of the dilution of the sea water by the Nile flood and because of the annual high rate of evaporation. The density of the coastal waters has increased, being affected mostly by the salinity rather tahn by the temperature change. Since 1965 also upwelling has been somewhat less iltense and of shorter duration.

(c) The Beaches.

The bulk of the beach sand comes to Israel from the southwest by longshore transportation provided both by wave-induced and general offshore Mediterranean currents. Contribution of calcareous organic debris is important north of Athlit on open sea beaches, where the bulk of the sand consists of broken shells. Elsewhere, in Haife Bay and south of Athlit sand of organic origin is minor in quantity. South of Bat-Yam, sand provided by local erosion of sea cliffs must be negligible; some concentrations were noted only near Acre. Contributions of sand by rivers draining to the shores of Israel are also relatively unimportant, owing to the small number of rivers and to the fact that at least the larger ones have such low gradients near their mouths that they can transport little sand. Contribution of sand by wind is also insignificant, because of a prevailing onshore wind direction. The Nile is the only larger river that is competent to carry large quantities of sandy sediments to the sea along the northern coast of Africa. The Nile is also the chief source of the detrital and main fraction of the beach sands of Israel, although probably there is some supplemental contributions from sea cliffs and seasonal streams of Sinai.

When the sand from Egypt reaches Israel its movement continues to be controlled by the same currents that brought it. The general offshore Mediterranean current that moves chiefly northward carries some of the sand with it, probably even post the northern border of Israel. Some sand is washed shoreward by both wave and current action, adding to the beaches along the whole coast. By this action fine-

grained detrital sand is able to reach the back of Haifa Bay, by-passing the coarse organic sands on the beaches between Athlit and Haifa.

Owing to the concave shape of Israel's shore, the waves approaching Israel from about 280° produce a longshore transport of sand that is directed from both south and north toward the middle of the coast. South of Bat-Yam this wave-induced current supplements the offshore one in carrying sand north-eastward. North of Bat-Yam the currents are opposed, so that the sands brought to the northern beaches by the offshore current are transported back to south by the wave-induced current. Still further north, at the Lebanese border, another reversal of the wave-induced current causes sand to be lost to the north from Israel and no contribution can be made from the Lebanese coast.

In general, the source and movement of beach sand is such that the fine-grained detrital sands tend to accumulate on beaches in the southern middle part of Israel. The organic sands, on the other hand, remain near their sources on the northern beaches because of their coarseness and because locally they are protected from waves and currents by offshore reefs and irregular rocky shores.

Eventually sand must be lost from the beaches, in order that steady-state conditions be maintained and the beaches neither widen nor narrow. Some sand is dissolved and carried seaward to be deposited with the muds that cover the other half of the continental shelf. The rest is lost to the land by wind trasportation and deposition in the form of dunes. Wind losses also have occured during the past, as indicated by the presence of consolidated Pleistocene coastal dunes. In recent years losses of sand by mining operations have probably exceeded those caused by natural processes. One can astimate the total volume of beach sand on the basis of 180km of coast having beaches

with an average width of 50m , an average thickness of 2m, and an equal amount of sand on the adjoining shallow sea floor. Good estimates of the rate of contribution of sand from Egypt and of its rate of movement along Israel's beaches can be formed only by measurements of the rate of accumulation against experimental groins or harbour breakwaters, which are now in the process of being built across the Israeli beaches.

Between Rafiah and Bat-Yam the beach is backed by dunes that lie againstold sea cliffs or atop low deltaic plains.Active dunes in this area extend as far as 5km inland from the shore, partly atop calcareous Pleistocene dune sand ridges, often referred to as Kurkar. Uncut by wave erosion, the presence of active dunes indicates that this part of the shore is now depositional in nature.

Between Bat-Yam and a point near Hadera (see Fig44) undercut sea cliffs of eolianite (Kurkar) back most of the beaches, indicating that the beaches are too narrow at least seasonally to protect the shore and that erosion is dominant. Only off deltas can deposition be considered important.

North of Hadera the shore is irregular with rocky points and beach rock alternating with short to long beaches, in this area erosional and depositional shores are approximately equal. At several points beachrock ridges lie a few hundred metres offshore and constitute reefs that also protect the shore from wave erosion. (Many of the more prominent sea cliffs once served as sites for Roman and Crusader fortifications; some of them were used earlier by Phoeniciams and later by Turks.)

In summary: The shore south of Bat-Yam is dominated by deposiotion,

that between Bat-Yam and Hadera - by erosion, and for that north of Hadera - deposition and erosion are about equally important.

All the beaches of Israel are littered with flat fragments of tar, the largest amounts occuring between the Rafiah and Caesarea (Fig1 the smallest amounts are near Haifa, and a second peak of abundance of tar is in the north, near Nahariya. The total amount does not exceed 25 tons. But locally , particularly in the south, many of the tar fragments liquify in the sun's heat and sink slightly into the sand. On all beaches the tar appears to be concentrated at the sand surface; on erosion of the beaches the tar becomes rolled about and mixed with sand to form spherical balls as much as 25cm in diameter. In contrast to the flat fragments, many of the balls are so dense that they cannot float in sea water. Possibly these balls eventually become transported seaward and deposited mostly beyond the surf zone.

The source of the tar could be either natural seeps or washings from ships. A ship is suggested by the probable increase in the abundance of beach tar during the past 30 years corresponding to the increased use of tanker shipping in the Mediterranean Sea with the probable accumulation of most of their debris at the eastern end of the sea. Further substantiation is given by the similarity in composition of a sample from Tel-Aviv to bunker oil.

that between [illegible] and Hadera - by erosion, and for the beach of Hadera deposition and erosion are about equally important.

(d) The Continental Shelf.

As the continental shelf off the coast of Israel slopes gently (Fig11) any change in sea level is also a change in the shoreline which moved several kilometers to the west with each regression.

Soudings show that the sea floor along the entire coast south of Haifa is gently sloping from near the shore to a depth of about 20m at about 1km seaward. In some areas the gentle slope extends deeper and further from shore. Such smooth profiles are characteristic of sandy bottoms. Cross-sectional profiles of the beaches (Figures 4,5) show that most have berms and that most of the berms occur on depositional shores. Erosional shores containing only relatively small amounts of sand have narrow beaches with no berms. The steeper slopes are usually those of coarser grain size; however, a secondary factor that causes beaches to be steep is the effect of offshore reefs and barriers in preventing access of large waves. Both the width and the steepness of the beaches undergo seasonal variations in response to high waves of winter storms.

2. ECONOMIC STRUCTURE.

(a) Urbanization.

Since 1950, when Ben-Gurion's policy of "population dispersion" started being practiced, there is a strong shift to the south in the coastal plain so that the mathematical center of gravity of the Jewish population which in 1948 lay northeast of Tel-Aviv, now lies in the vicinity of Lod.

By the end of 1967 the proportion of Jewish population living in urban settlements had reached 88,6%. The state of Israel (including Arab citizens) has an urban population of 82,2% and counts among the most urbanized states.

Modern trends of world development regard a farming population of about 15% as sufficient for the needs of a technically developed country. This is why national planners abandoned a previous thought of being able to reverse this rapid - and natural - trend of urbanization. In 1951, Sharon wanted to increase the rural population to 22,5%. A later plan (Dash 1964) aims at a distribution of the total population as follows: 43,6% in the three large cities i.e. Tel-Aviv-Yafo, Jerusalem, Haifa; 36,1% in medium and small towns; 20,3% in rural settlements, including non-agricultural population.

The development of the urban population shows a constant struggle between government efforts towards dispersal and economic tendencies towards concentration in the large cities.

The lack of growth of Tel-Aviv-Yafo - the conspicuous decline in the core - reflects only the change of the character of Tel-Aviv as a center of commerce and the growth of the Central Business District and a process of suburbanization. But the number of inhabi-

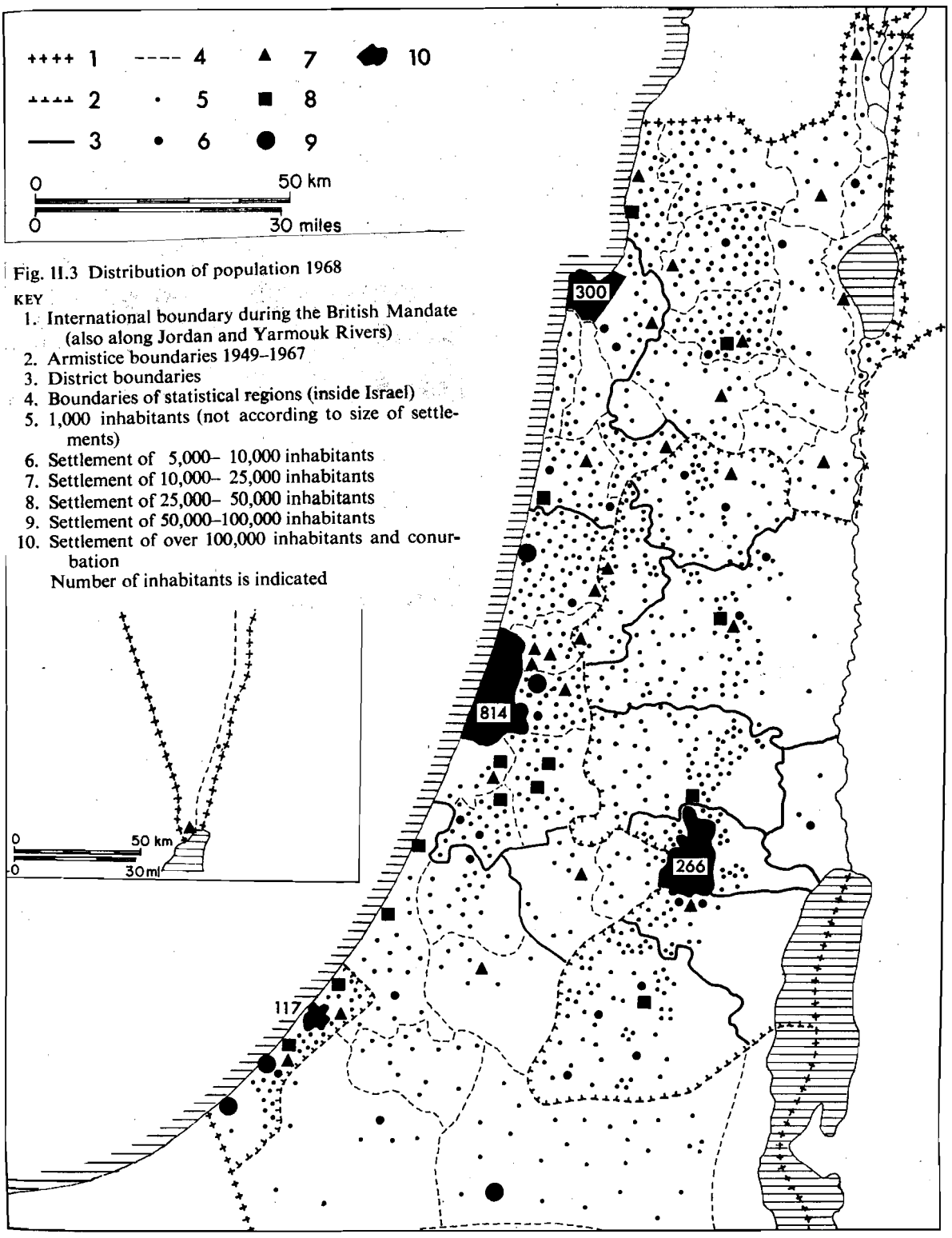


Fig. II.3 Distribution of population 1968

KEY

1. International boundary during the British Mandate (also along Jordan and Yarmouk Rivers)
2. Armistice boundaries 1949–1967
3. District boundaries
4. Boundaries of statistical regions (inside Israel)
5. 1,000 inhabitants (not according to size of settlements)
6. Settlement of 5,000– 10,000 inhabitants
7. Settlement of 10,000– 25,000 inhabitants
8. Settlement of 25,000– 50,000 inhabitants
9. Settlement of 50,000–100,000 inhabitants
10. Settlement of over 100,000 inhabitants and conurbation

Number of inhabitants is indicated

-tants of the surrounding towns has risen from 130,000 in 1951 to 351,000 in 1967. The continuous conurbation of Tel-Aviv therefore comprises a population of 750,000 or 33% of the total urban population. In addition there exists a belt of 15 settlements of urban character with a total population of 345,000 whose distance from the center of Tel-Aviv is no more than 12-20 km., and from the fringe of conurbation in some cases no more than 2 km., and only carefull planning could prevent their absorption into a conurbation of Greater Tel-Aviv, whose population already surpasses the million, almost half of all the population of Israel. Haifa has grown from 150,600 in 1952 to 209,000 in 1967, with a belt of suburbs, numbering 89,000 in 1967, as against 50,000 in 1952.

Another process of urbanization os represented by a group of 12 former agricultural settlements, all of them in the coastal plain, some of which had already started the process of urbanization during the secind World War. The total number of their inhabitants increased from 179,000 in 1952 to 300,000 in 1967. If the town of Petah Tiqwa (on the outskirts of Tel-Aviv), which lies in a category of its own and had 73,500 inhabitants in 1967, is added to this list, this group comprises 17% of the total urban population.

(b) Agriculture.

Employment: In 1967 there were 104,700 people engaged in farming and fishing and they constituted 12.6% of the total labour force (10,3% of the Jewish labour force), but the net domestic income

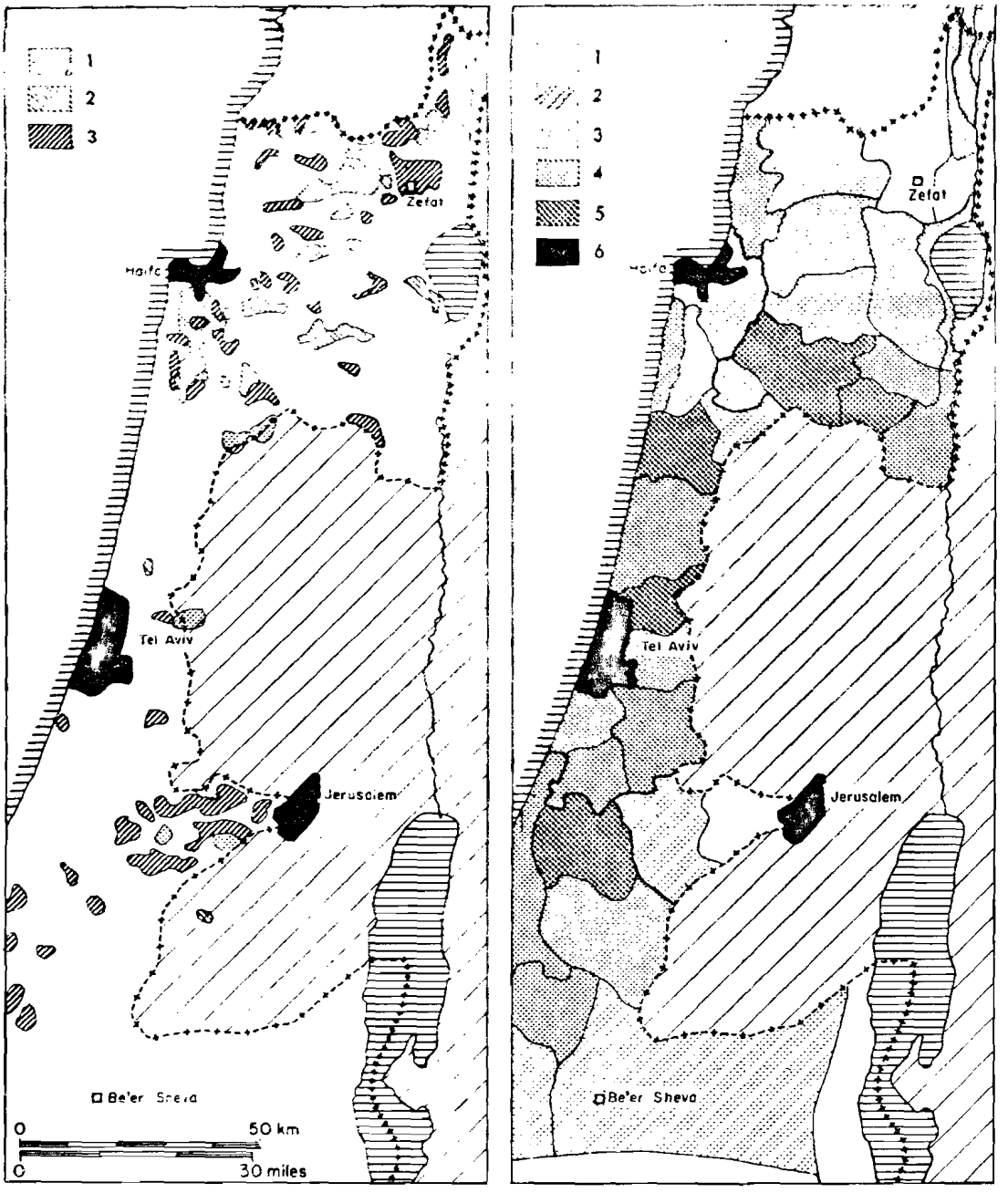


Fig. II.7 Utilization of lands (a) Afforestation (b) Cultivated land in per cent of total area (by statistical, natural regions)

KEY

1. Natural forest and Mediterranean shrub
2. Afforestation prior to 1948
3. Afforestation after 1948

KEY

1. Less than 10%
2. 11–25%
3. 26–40%
4. 41–60%
5. Over 60%
6. Conurbation

of these branches in 1967 amounted to only 9,5% of the national income. On the other hand export of agricultural products, including those of the food industry, constituted 24,7% of the total value of exports.

Citrus: Originally the plantation of orange groves was concentrated on the red sands of the coastal plain. The Shamuti variety of orange groves prefers light and medium soils and good drainage is a prerequisite. Citrus cultivation remains restricted to frost free areas, such as most of the coastal plain is, and to alluvial fans or gentle slopes where air drainage removes the cold air.

(c) Fisheries.

Supplies of fish to Israel are derived from three sources: Mediterranean Sea fishing (traling in-shore and deep-sea fishing), lake fishing (Lake Kinneret), and fish breeding ponds. Sea fishing has been expanding in recent years and Israeli fleets operate from the Canary Islands to the Indian Ocean, and also off the South African Cape. The upwards trend in the average yield per dunam (1 dunam is a ¼ of an acre) reached a point of 255 kg/dunam in 1971. Mediterranean fish landings totalled 3,800 tons in the same year, as compared with 2,800-3,000 tons in previous years. All fishery branches in the Mediterranean Sea have concluded their fishing seasons with reasonable profits. The purse seine fishery landings are also in an upward trend. In the Distant-Water fisheries, during the year of 1971/72 , 3 freezer trawlers fished hake in the southeastern Atlantic Ocean. That year, the landings exceeded by 1,600 tons those of 1970, totalling 6,743 tons of frozen fish,

of which only 5,150 tons were marketed. The upward trend in fish fillets prices on the world market caused the Atlantic Fishing Company Ltd. to consider the possibility of producing frozen hake fillets.

Fish Breeding Ponds: Fish ponds form a special feature of Israel's agriculture, which is highly localized and mainly handled by Kibbutzim. The main type of fish bred in these ponds is carp. In order not to compete with other agricultural land, fish ponds are located on poorly drained soils, especially on former swamps, and also use more saline water than crops. Conditions of plenty of water, available at relatively low cost are needed, and such conditions exist in some stretches of the coastal plain, like in the Zevulun Valley and the Carmel coast.

Fish ponds need high initial capital investment, but very little man power. They are highly remmerative in terms of income per working day, utilizing soils which would otherwise be unproductive. They are very much favoured by the Kibbutzim but hydrologists object to further expansion of their area, because their water demands are about five times as high as other crops on the same area.

Breeding of fish in ponds provides Israel's largest part of the total catch. In 1969, fishcatch totaled 21,400 tons, about half of which came from Israeli ponds. The satisfactory acclimatization of the silver carp in the fish ponds and its sales in the markets justify further expansion of the silver carp breeding. The chances of considerable development in the trout marketing seem improved in view of the rise in prices of all high quality fish in recent years.

Frozen and canned carp are being exported; efforts aimed at further development of the exports, especially in view of the possibility of increasing the yields, continue.

The future trends in development are:

1. Increasing the fish production, both for the local market and for export;

2. Reduction of fresh water consumption in the fish breeding industry;

3. Improvement of the production processes and technological progress;

4. Increasing the net production and the producers' profits.

(d) Industry.

In 1967 there was a 24,6% of the total labour force engaged in industry. This branch of mining and industry employed 203,800 people in 1967, taking the second place after services; it provides 24% of the net national revenue, while in gross value of production it takes first place with I.L. 5,9 billion compared with I.L. 1,6 billion for agriculture, and provides 85,6% of all exports.

By conventional standards of economic geography the natural conditions of Israel do not encourage the development of industry, as the country is almost completely lacking in sources of energy and is short of raw materials. Thus it utilized other elements of economic life, such as skill, geographical position, and the internal market. (There was no influx of "colonial" capital,

which is usually attracted by the possibility of the exploitation of rich natural resources).

The main branches of production were food processing, clothing-textiles, furniture and chemicals. Only two major plants were outstanding: the potash works at both ends of the Dead Sea and the oil refinery inHaifa. Today, export of diamonds is the largest item in Israel's list of industrial exports.

The government played a decissive role in the financial structure of Israel's industry. Not only did it encourage investment in industry, especially in "development"areas", by provision of land, services and tax reductions, but in many cases it went into partnership with private capital or granted loans on easy terms. As the development of industry is regarded by Israel's government not only as an economic asset but also as means for the absorption of immigrants and dispersal of population, priority was often given to plants which promised the employment of the largest number of people, sometimes in preference to considerations of profitability, and a system of subsidies to different industries was introduced, which is only now being slowly abandoned.

Energy: As for natural resources, only one minor oil region was discovered in the Heletz-Kohav area, in the coastal plain south of Ashkelon. (Since 1967, the oil fields off the shores of the Gulf of Sŭez have been utilized to supply the country's need supplemented by imported oil from Iran).

Sporadic drillings in different parts of the country,as well

as along the seashore and the continental shelf of Israel have until now proven dry and nothing can be said about their prospects. Part of the refined oil is transported by pipe to the Tel-Aviv area and to the port of Ashdod. As the refining capacity of the Haifa refineries, about 5 million tons per annum, surpasses the oil needs of the country, part of its production is re-exported.

The continuing closure of the Suez Canal and, Israel's uncertainty of being granted free passage when under Egypt's control, generated a remarkable project of a land bridge - the construction of a 160-miles long, 42-inches in diameter, crude oil trunk pipeline running from Eilat, on the Gulf of Aqaba, to the Mediterranean terminal at Ashkelon.

This conduit is Israel's current bid to play a larger role in the international oil industry's transport system. The first crude oil flowed through the pipeline early in 1969. The capacity of the line - owned and operated by the Eilat-Ashkelon Pipeline Company, a subsidiary of the Canadian APC Holdings - is put at 22 million tons/year. Additional pumping stations could, it is claimed, raise this annual capacity to 60 million tons. The formidable extent of this projected ultimate capacity can be judged from the fact that the biggest West European crude oil pipeline- the 40 inch diameter Trans Alpine Line (TAL) - has a potential maximum annual capacity of 50million tons. A refinery with a capacity of 3 million tons per year is under construction at Ashdod, 10 miles north of the pipeline terminal at Ashkelon.

Associated with the Eilat-Ashkelon pipeline are other am-

bitious plans for new refining and petroleum-chemical plants to be fed by the system Israel is mindful of the advent of the new giant supertankers of 250,000 deadweight tons and is planning for the reception of such huge vessels at the Eilat reception terminal. However, it is expected that smaller vessels will collect the crude at Ashkelon, so that accomodation of ship of up to 125,000 d.w.t. will prove sufficient for the moment.

Whether Israel will ever be able to attract sufficient oil transit business to warrant an annual throughput of 60 million tons is something outside the scope of this paper. All manner of political as well as petroleum considerations complicate the position and at the mpment such prospects look remote. Much of the oil going through the line is from Iran and is destined for Eastern Europe.

The energy supply to industry is based entirely on electricity, generated by thermic plants, using oil fuel (36% of the total oil consumption). The government-owned company supplies the whole country on a national grid, based on three main concentrations of plants: at Ashdod (300 megawatts installed generating capacity), Tel-Aviv (175 megawatts) and Haifa (525 megawatts) with auxiliary small plant at Jerusalem. In 1970 an additional plant (with a capacity of 300 megawatts) was being built for the Tel-Aviv area. The generated power in 1967 amounted to 4,6 billion kw/h and was distributed to industry (32%), water pumping (24%) and other uses (44%).

All electricity plants are located on shore sites, mainly in order to use sea water for cooling and to be near sources of underground water for steam generation. Another reason for

a shore site location, transport of oil by boat, has become obsolete with the construction of the fuel pipeline from Haifa.

The utilization of solar energy on a large scale is still in the experimental stage, but for household use it is already utilized in the form of water heaters, and almost all newly built houses, especially in the coastal plain, are already equipped with solar heaters.

In 1972, the U.S. and Israel signed a$32million desalination agreement that provides for the construction of three water-sweetening plants: two in Israel and one in the U.S.A. The two Israeli disalitation plants are to be built in Ashdod and in Eilat. The plants are planned to use revolutionary Israli invention which is based on the use of aluminum pipes.

On the other hand, Israel's Minister of Agriculture claims that the nation's only feasible source of extra irrigation water over the next decade would be treated sewage. Yet the plan depends on a I.L. 250 million loan from the World Bank, forthe construction of new sewage treatment plants in a number of cities. The Minister does not envision a feasible desalination process nor tapping of fresh natural water sources in the next decade.

More important are the attempts for the utilization of nuclear power. Two nuclear reactors are already in operation, one near Yavne in the coastal plain, and the other , a larger one, near Dimona in the northern Negev. The plans for a large, combined nuclear power and desalination plant near Nitzanim in the southern coastal plain are still in the stage of deliberation. Advantage of the use of atomic energy, provided it can be produced at copetitive cost would be the possibility of long term fuel storage.

Raw Materials: The geological structure of Israel does not hold great promise for the occurance of mineral resources. The most important non-metalic mineral is cretaceous limestones quarried from the edge of the coastal plain together with local clays to serve the cement industry. Cement is produced in three factories: "Nesher" in Haifa, in Ramla near Tel-Aviv, and "Shimshon" near Jerusalem. Sand is found mainly along the coast and in the northern Negev.

The major part of Israel's industry depends upon raw materials or semi-finished goods, which have to be imported. Still, most of the industrial plants are only of medium or small size. These two features enable the industry to choose its location freely, according to the advantages of the market. For instance, in the cement industry the location factor is the proximity of clay to limestone and access to a railway line. These factors exist in the aforementioned spots on the coastal zone (Haifa and Ramla).

The production of super phosphates and aggregated materials, which is based on the phosphates of the Negev, is thus located in Haifa for main reasons of export and internal marketing. The decission to trasfer this industry to Arad (near the Dead Sea) was motivated mainly by the policy of population dispersal.

The location influence of ports on industries, based mainly on imported raw material, is small. Haifa shows no concentration of import-based industries: paper and cardboard, which depend entirely on imported materials, are concentrated in the Hadera and Petah tiqwa and motor assembly spread to Nazareth, Ashdod and ashkelon. All towns but Nazareth - which lies in the inland mountains - are on the coastal plain. For most of the industrial

products the strongest location factor is the market. Thus clothing leather and fashion goods are attracted, by their nature, to the largest concentration of customers, i.e. Tel-Aviv conurbation. This area has the strongest pull of industrial activities, concentrating 52% of all industrial establishments and 41,7% of all employees, although it contains only 35% of the population (all numbers based on Census of Industries, 1965). The adjoining area of Petah Tiqwa, which has strong industrial ties with Tel-Aviv, contains 4% of all establishments with 5,9% of all employees, against its share of 41% of the population.

The second area of industrial concentration is Haifa with 12,7% of all establishments, 14,8% of all employees and 12,2% of population. Thus three-quarters of all industrial enterprises with over two-thirds of all employees are concentrarted in the main urban concentrations. Of the remaining industries, 15,5% of all enterprises with 21,3% of all employees are situated in the coastal plain, taking advantage of its flat topography, water supply and good road and railway connections to the large urban centers, where the markets are. Of these only about 3% are situated in the development areas south of Rehovot. Only about 10% of industrial activity lies in the interior parts of the country and this includes the strongly localized extractive branches.

The prevailing tendency towards concentration in the coastal plain stands in direct opposition to the policy of dispersal of population . It also diminuates the economic development of the new towns, towns that can offer no attraction to compete with the advantages of the coastal plain. Their distance from ports and

markets raises the costs of transportation and prevents the close contacts necessary for industry. Also their population is usually less skilled and less trained than in long established towns and, because of their small size, most developing towns cannot offer sufficient variety. Thus, the only means of shifting industry from the coastal plain areas to inland areas is by strong government incentives, the outlines of which were mentioned before.

Still, Israel is the most industrially developed country in the Middle East and Eastern Mediterranean, due to the enthusiasm of its people and its location astride important world links. Through its harbours on the Mediterranean and Red Seas it has access to the raw materials and markets of the Atlantic community as well as of the tropical world. It also lies on easy shipping lines to the Communist world. Alas, its only - but crucial - handicap is that it does not "float" on vital subterrain oil seas.

(e) Tourism and Recreation.

Israel enjoys the upsurge of tourism in the last decade shared with other Mediterranean countries. This ranks almost equal with citrus and diamonds as one of the main sources of foreign currency earnings. The touristic advantages of all Mediterranean countries - including Israel - are: sunny climate, pleasant beaches, beautiful landscapes, rich historical heritage and treasures of art, architecture and archaeology.

In Israel the only natural recreation area is the seashore, which for most of its length is bordered by a narrow sandy beach, but the sea is treacherous. All planners have insisted on the reser-

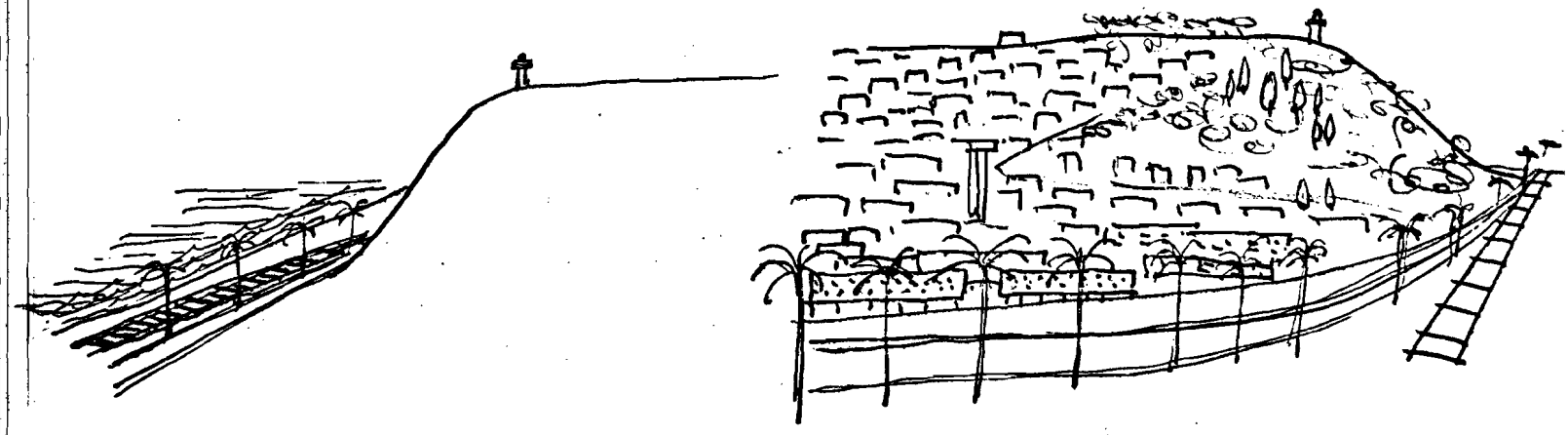
vation of recreational facilities wherever feasible.

The development of "bathing beaches" was transferred to the local and regional authorities, who were obliged by law to provide the necessary services. But the utilization of beaches evoked manyproblems of conflicting land uses. As the coast for almost all its length is traight the potentiol length of beach is only equal to the length of the coast line, whereas in countries with indented coasts, it is often double that length, providing facilities for the utilization of baysfor beaches and headlands for hotels or housing. The competing land uses in Israel incude housing and industry, power stations and later on atomic stations,sewage disposal and quarrying of sand and gravel. Although the Mediterranean coast is still alote to meet these demands, planners who anticipate an inevitable growth in these uses already set underway plans for the creation of artificial off-shore islands.

One such plan which involved reclamation of land from the sea off-shore Bat Galim (at the southern entrance to Haifa), was met with controversy regarding its rentability, but was also strongly attacked on grounds of aesthtic considerations, regarding the particular choise of location.

Today Mount Carmsl slopes drastically into the sea at this particular point, leaving only a very narrow strip of flat land just wide enough to accomodate the traffic communication lines, i.e. the railway and the highway, which run parallel and adjacent to each other. This type of an entrance to the city through a "bottle neck", ornamented withmajestic palm trees for a stretch

of several miles, creates a very dramatic and exciting effect of capturing the sight of the whole city in a glimpse. For, having passed around the "corner"(fig a) all of a sudden the magnificent view of an urban settlement climbing the Carmel slopes opens up (fig b). Reclamation of land at this spot would destroy this unique feature.



(a) (b)

(f) Traffic Communications.

Only bulk products which originate from a single source, such as a port, are suitable for railway transport. Haifa serves as the main loading station, sending 30% of all goods carried by rail and receiving 40%, while Tel-Aviv receives 12,5%, but dispatches less than 1%.

Unlike Europe or the U.S.A., in Israel the railway station - as a center of urban and commercial life - is an unknown sight. Railway development has had little impact on the location of industry and even less on urban geography. Being impeded by [illegible]

topography, the main track follows the coastal line, very close to the water. Parallel to it runs the, until recently, only highway of Israel.

Another plan for an off-shore airport north of Tel-Aviv, designated to serve domestic flights, although strongly backed by the Ministry of Communications, was met with such hard criticism from the public, the most vocal voices being raised by the Society for Environmental Quality, that it lost ots impetus and the idea had to be abandoned for the time being.

Shipping: Until 1965 the position of Haifa harbour was a main port of Israel, situated in an unfavourable location, as it lies close to the northern political boundary of the country, while most of the bulk for export is situated in the south, and the main import demands are in the conurbation of Tel-Aviv.

The port of Ashdod was put into operation for loading and unloading of vessels in Nov. 1965. This port also serves the Ashdod-Eilat "land bridge" over which European cargoes are transported to East Africa and the Far East. At present the port can service 14-16 ships simultaneously. This capacity is increased with the expansion of the southern of the citrus quay and the construction of a specialized container-service quay to house 40 ton bridge cranes. Ashdod port has been so congested that authorities are considering diverting cargo ships carrying imports to Gaza port. By Jan.'72 some 8,5 million crates of citrus have been exported through Ashdod, At the same time a new pier was dedicated at Gaza port; the first off-shore facilities of any kind built in Gaza, it juts about 80 meters into the sea, about [illegible] it can accommodate a large mobile crane and three [illegible] cranes.

Haifa is the town with the highest percentage of large plants among all industrial enterprises, concentrated around the harbour. The planning of the industrial zone at the south-east of the bay has proved successful, and there still exists a reserve of land for large scale industry south of the Qishon River. At the mouth of the river a small port was created to serve as a fidhing port. In the Qishon harbour is located the Israeli ship building industry, and a large area on both flanks is reserved for the construction of a free port. Large oil instalations, 2 km fuether north, facilitate loading of oil tankers. Most of Haifa's port installations handle general cargo, but a huge grain silo, the largest in the Middle East, with a storage capacity of 75,000 tons, handles about all bulk imports and exports of Israel. It is anticipated that the ports of Haifa and Ashdod would eventually constitute a single Mediterranean port, each supplementing the other and making possible an orderly operation and optimal utilization of manpower and equipment. Haifa also serves as the sole passengers harbour of Israel, but has no specialized facilities. The seashore has been oraganized only in few areas for swimming and boating, mainly because of conflicting demands on land use (port, navy, industry). It is a rare case that a great port and center of heavy industry is at the same time also a town of recreation.

Problems concerning traffic in the Mediterranean Sea:The pollution of the Mediterranean Sea ny oily ballast water discharged by tankers is particularly acute because of the following reasons:

1. the ratio of traffic-to-water surface is very high. 42,5%

of the world crude oil traffic in 1975 and 37,5% in 1980 will use this aterway and discharge its ballast water into this sea.

2. most of the prevailing winds of the Mediterranean are on-sore winds, causing fliating oil to be deposited on beaches in a relative short taime.

3. tankers on voyages between the Mediterranean and Atlantic on North Sea ports, will prefer to clean tanks on the ballast voyage after re-entering the Mediterranean, because of relative temperate weather conditions prevailing within this sea.

4. when the Suez Canal is open, tankers sailing in ballast conditions towards the Persian Gulf, will prefer to complete tank cleaning before entering the Canal because of extra money paid to crew in the difficult climatic conditions of the Red-Sea.

5. on a ballast voyage of 7,000 miles from Northern Europe to the Persian Gulf via the Suez Canal, the bulk of the settled dirty ballast is discharged to the sea over a stretch of 900 miles in the eastern partof the Mediterranean, causing in thes area pollution to a greater extent than the average figures accepted by various papers.

6. the dhort voyages on the Southern europe - North Africa ballast route, do not provide the minimum of 50 hours required for the load on top cleaning operation. The separation of oil in a 17÷30 hours voyage is not efficient and dirty ballast with a high oil content is discharged overboard.

The anticipated volume of crude-oil sea traffic for the year 1975 in the Mediterranean Sea is expected to reach 700mTA, and in 1980 - 900mTA. The anticipated volume of oily ballast water to be handled in 1975 is 185mTA, and in 1980 - 230mTA.

3. ADMINISTRATIVE STRUCTURE.

Since 1966, Israel is a member of the IMCO.

In domestic dealing with marine-related issues, at the present, the roles are split among different authorities. These are the governmental and the semi-public bodies:

1) Ministry of Transport and Communications, The Department of Shipping and Ports - is responsible for the prevention and annihilation of water pollution(*). Under the Ministry's authority a special National Committee for the Prevention of Ocean Pollution had been established with an advisory - not executive - role;

2) Ministry of Agficulture, The Water Commissioner - has got regulatory and control powers on the quality of sea and river waters and sewage;

3) Ministry of Agriculture, Department of Fisheries;

4) Ministry of the Interiors, The Department of Planning - has established a special National Planning teamfor the preparation of a Master Plan for the coastal zone of Israel(**); it also has a "commission for shore waters" (in free translation from the Hebrew), which is in charge of granting approvals for every proposed construction in the sea;

5) Ministry of Tourism also has to approve any touristic project designed for the seashore;

(*) for its regulatory powers, see supplement # 4: order-Oil in Navigable Waters 1972.

(**)no material on this topic was yet made available for publication.

6) Mininstry of Development has a Department for Geological Survey;

to this Ministry the following marine-related, semi-public bodies have an administrative subordaination and an advisory authority:

- The Israel Institute of Petroleum - in pollution problems, in particular;
- Israel Oceanographic & Limnological Research;
- The Geological Institute;
- The Geophysical Institute;

7) The Israel Ports Authority - it was established in July 1961, in accordance with the "Ports Authority Act of 1961". In this Act the Authority is defined as astate corporation empowered "to acquire any right, to undertake any obligation, to be a party to any lawsuit and to any contract". The functions of the Authority are to plan, build, develop, manage, maintain and operate the ports. The guiding principle of the Authority's activities is to manage all the ports in general and each port individually as a self-supporting unit. The act also defines the areas which require governmental approval, such as development budget, tarrif changes etc.

The Authority comprises of 13 members appointed by the Government. Seven represent public bodies; these are: Shipping, Citrus Marketing Board, the Histadrut - the Federation of Labour, the Manufacturers' Assocaiation, the Haifa Labour Council. The other six represent the Government Ministries

of Finance, Commerce and Industry, the Transportation Ministry, Development, Agriculture and the Interiors. Current management is done by the Director General, with the assistance of a Head Office of five divisions: Engineering, Equipment and Handling Procedures, Administration and Organization, Personnel and Training;

8) The Society for Environmental Quality - again, has only advisory role.

S E C T I O N II

4. CONCLUSIONS AND RECOMMENDATIONS.

To conclude: the coastal zone of Israel is facing an ever growing pressure of varied and conflicting land uses. Spreading urbanization, from Nahariya in the north to Ashkelon in the south, gnaws agricultural areas; the needs for commercial ports and industrial plants stand in conflict with recreational uses of the seashore and, as described before, the natural conditions of land shelf structure, topography and climate, are favourable for both industry and residence so that the narrow stretch of the coastal zone attracts more and more of them.

It seems that the most critical region is in the vicinity of Tel-Aviv with a stronger pull northwards. Since a similar urban "spill" happens around Haifa, pushing southwards, without careful planning it may not be long before Israel faces a situation of continuous urban stretch of about 150 km long. As, at the beginning of 1973, the Time Magazine put it: " From the Lebanese border town of Nahariya to Ashkelon in the south, Israel's coastline is becoming an urban sprawl much like the Boston - Washington metropolitan corridor. Israeli planners already refer to their emerging mini - Bos - Wash as NASH."

- the vulnerability of the country's greatest population concentrations, especially if Israel would be compelled to pull back to its pre-'67 political boundaries with Jordan (with a proposed creation of a Palestinian state on that area), calls for a greater depth of physical space in these areas. Practically speaking: settle on the sea;

-- in no way can the government's policy of population dispersal be superimposed on its citizens by force, and eventually it is bound to give in to natural forces that affect the shifting of population towards the big cities. Even if much higher taxation is put upon urban dwellers, it is not going to discourage this general trend;

- it becomes obvious that the trend of concentrated urbanization on the coastal zone is gaining momentum rather than diminishing. The immediate danger to the area under discussion is of "spreading Urbanization";

- the stress on the coastal plain cannot be released or cancelled but, it can be re-directed, i.e. the direction of the spread can be controlled;

- it is suggested that instead of allowing the urbanization process to spread longwise, provision should be made to allow a wide-wise spread and strictly controlled areas be defined;

- a new approach is suggested for treating the coastal plain as one entity, rather than keeping the conventional way of dividing the country into cross-sectional regions, Northern Region, Zevulun Valley, Carmel, Sharon, Judea and Negev, each with its proportional section of the coastline;

- this implies the creation of <u>one</u> matriarchal authority to deal with <u>all</u> matters and problems of the coastal plain, the shoreline, the territorial seawater and its continental shelf;

- this suggested authority will comprise of an equal representation of all the interest groups, as well as the public. It will have planning, zoning, development, regulatory and control powers and will hold responsibilities as for:
  (a) the preparation of comprehensive plans (proceeded after a careful conduct and investigation of the real needs of the area, done on the basis of field surveys in situ);
  (b) grant permits and leases for the different users and control their execution to follow the outlines of the plans; it will also lease off-shore lands;
  (c) acquire lands for public ownership, when necessary for preservation or when such use is required (like a public beach);
  (d) develop public oriented projects and provide the facilities (like marinas, parking for beach-goers etc.);

- the power of policy making will remain with the governmental instancies , e.g. the Ministry of Development;

- the geophysical features of Israel's Mediterranean coastline provide for sandy beaches between El-Arish and Herzliya suitable for recreational uses, and eroded beaches between Netaniya and Hadera, which are hazardous for bathers. This suggests development of the first section for touristic and urban purposes and the inland areas of the second - for agricultural uses with much approved conservation of its citrus groves and fish ponds. The detailed allocation of lands for industrial versus housing, commercial and touristic uses should be made on a small regional and local scale (beyond the scope of this paper);

- a strictly limited development is recommended for the area between Netaniya and Hadera, leaving the coastline intact in order to preserve its wild beauty (instead of fighting nature; in this particular zone any man-made breaker is bound to cause further erosion of the beach). The strip of the coastline should be made accessable to nature-lovers, bird-watchers, scuba-divers and the like, but no facilities for public bathing should be provided. The land east of the coast, now utilized for agriculture, should be kept for this use;

- the acuteness of the problem is most strongly felt in two focal points: Tel-Aviv and Haifa. The geophysical condi-

tions of the Tel-Aviv zone do;not suggest a solution of reclamation of land from the sea. It seems that rather a floating artificial island would be applicable for this region. On the other hand, for the Haifa zone - construction of an artifacial peninsula is a more suitable approach to the problem; (see map 3)

- it is recommended that the proposed artificial peninsula be located opposite Hadera, rather than in close proximity to Haifa;;

- the proposed artificial floating island - as opposed to reclaimed land, here - would not interfere with the currents and waves nor with the natural beaches. One method of achieving this is by creating an island supported by piles and protected on the seaward side by an encircling breakwater consisted of cylindrical coated-fabric bags full of water and lying side by side. This arrangement would damp the waves because, when struck by an oncoming roller, a secondary wave would be generated inside each bag, this secondary wave rebounding against the end of the bag to meet the following sea;

- keystone to the island's economy could be on-the-spot undersea fish farming industry, submarine laboratories and research vessels coupled with off-shore oil and natural gas search drilling installations and sand dredging. A marine zoo with observation posts could add attraction

to the island, as well as a boat building complex could contribute to its economy. The hot cooling water from the industrial plants could be used for tank heating, it would warm the lagoon created between the island and the mainland. Fish food could be made from processed sewage and manufacturing of fertilizers - from seaweed;

- supplementing the suggested pattern of urban settlements on the Mediterranean coast of Israel is a new city,now under construction, on a 40-sq.-mi. strip of coastal land below the Gaza border town of Rafah (in a corner of the Israel-occupied Sinai Peninsula). By the end of 1974, a settlement large enough to support 350 families will have been built, scheduled to grow , by the end of the century, to a community of 232,000 people. In order to control pollution and congestion, manufacturing will be limited to light industry and scattered on the edges of the city. More than 50% of the work force will have service jobs connected with the tourist industry that is expected to develop from the sandy beaches near by and the warm, rain-free skies overhead during nine months of the year; Its initiator, Defence Minister Moshe Dayan, believes that Israeli settlements in northern Sinai can, not only to provide needed Israeli housing but, also make Egyptian attack impossible, by creating a buffer zone, with sattelite towns as far as the Sinai hills 50 miles away;

- protection of the oceanic environment is the responsibility of local (municipal), national and international authorities which set up the allowable standards for damage as a result of each of the relevant uses of the seas. These uses are determined by the same authorities. The planner on his part will suggest engineering solution which will provide for the disposal of sewage into the sea within the allowable limits. The turbulant dispersion is essential for the implementation of "conventional" solutions. But, quite often there is not enough supporting information about the local water circulation, its magnitude and reliability, in the planning stage. When exchange of big mass of water between the shore area and the deep sea, between surface and depth, does not occur, there is a great danger of a slow - but steady - increase in the concentration of certain polluting materials, in the area relatively close to the outlet. Especially when dealing with solid pollutants which in such case sink to the bottom, in the vicinity of the outlet, and are easily drifted towards the shore, or, on the other hand, those light materials which float on the waves and are carried landwards by the wind.

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Explanation of Fig. 11:
Topography of the deep-sea floor and continental slope of the eastern Mediterranean Sea.

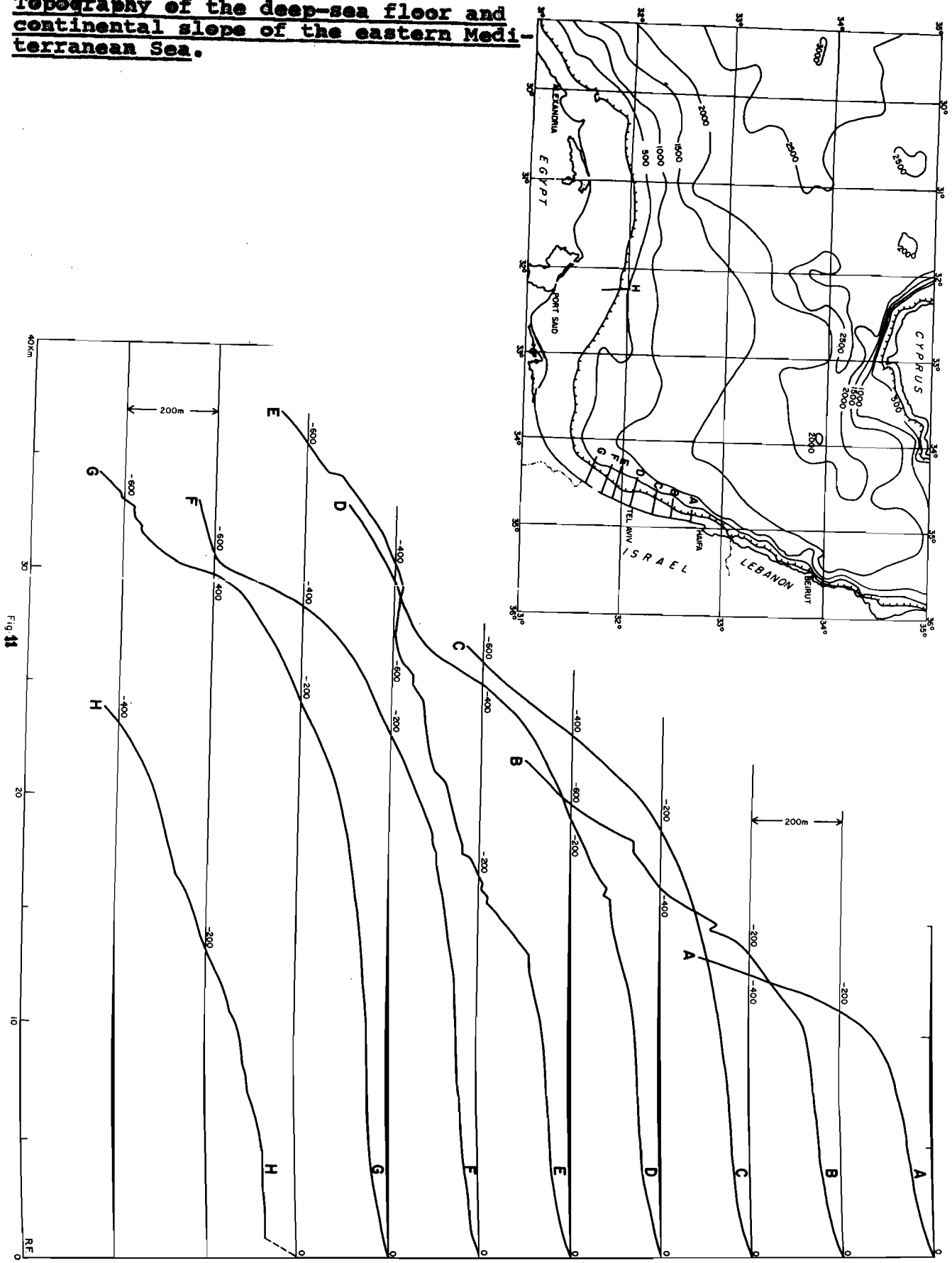

Fig 11

#2

Explanation of Fig.44:
Diagram illustrating source, movement, and fate of sand on Mediterranean beaches of Israel.

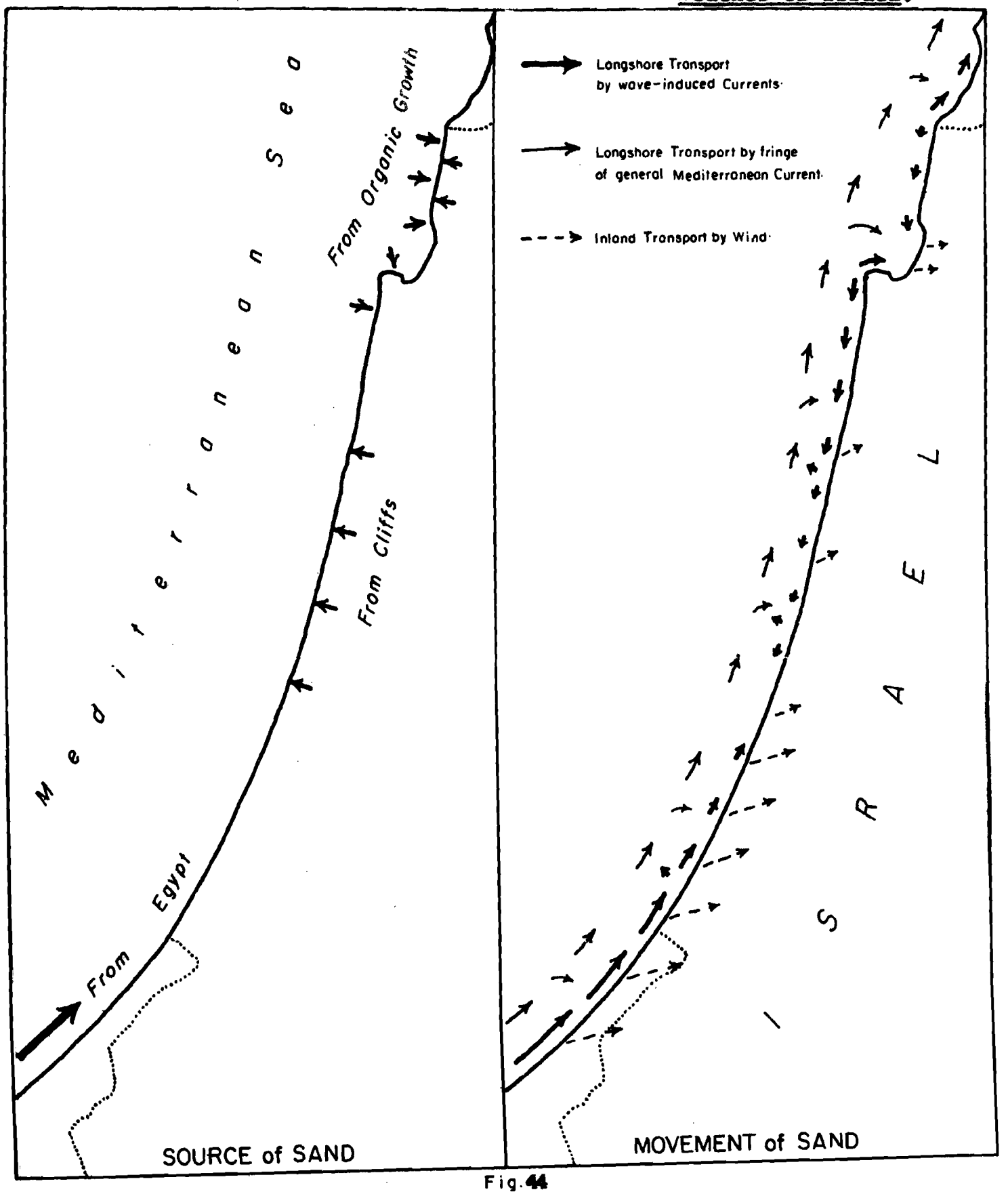

Fig.44

EXPLANATION OF FIG. 1

Location and characteristics of beach sands along Mediterranean coast of Israel. From left to right: (1) Positions of samples from beaches (composite samples from wave-washed zone), dunes, shallow sea floor, and rivers. Stippled areas show distribution of modern active dunes. Numbers around margin of map are coordinate system of Israel in kilometres. (2) Dominance of Recent coastal erosion or deposition at the site of samples as estimated from nature of coastal topography. (3) Distribution of beachrock as judged from field observations supplemented by aerial photographs. (4) Areas protected by offshore reefs are shown by circles. (5) Portions of the beach where mining of sand has been extensive, indicated by black lines, are based on field observations plus unpublished data supplied by A. Braunfeld, Geological Survey of Israel. (6) Longshore wave-induced currents during the dates of the survey were measured as the distance traveled in one minute by oranges or pieces of tar cast into the water (both are so dense that they float with little surface exposed to wind). (7) Slope of wave-washed zone was taken from beach profiles of Fig. 3. (8) Median diameters of whole samples and of acid-insoluble residues are from cumulative grain-size curves constructed from measurements at $\sqrt{2}$ grain-size progressions measured by settling tube of Emery (1938). Points for beach sands are connected by lines; those for nearby dune and sea-floor sands are unconnected. (9) Grain-size distribution cumulated to 100 per cent is for insoluble residue only (detrital grains). (10) Percentages of calcium carbonate were determined by weight loss on treatment with cold dilute hydrochloric acid. (11) The amount of tar on the beaches is shown by semi-quantitative estimates of the number of 100 square centimetre squares that are covered by tar in a typical strip one metre wide across the beach. (12) Colour of whole untreated beach sands is from the colour chart of Goddard et al (1951). (13) Heavy minerals of the 62 to 500 micron size fraction are cumulated to 100 per cent (measurements by M. Pomerancblum) and arranged from left to right in order of increasing stability — augite, hornblende, epidote, garnet, staurolite, tourmaline, rutile, and zircon. (14) Roundness of 20 detrital grains in each sample is based on Krumbein's (1941) chart for visual estimation.

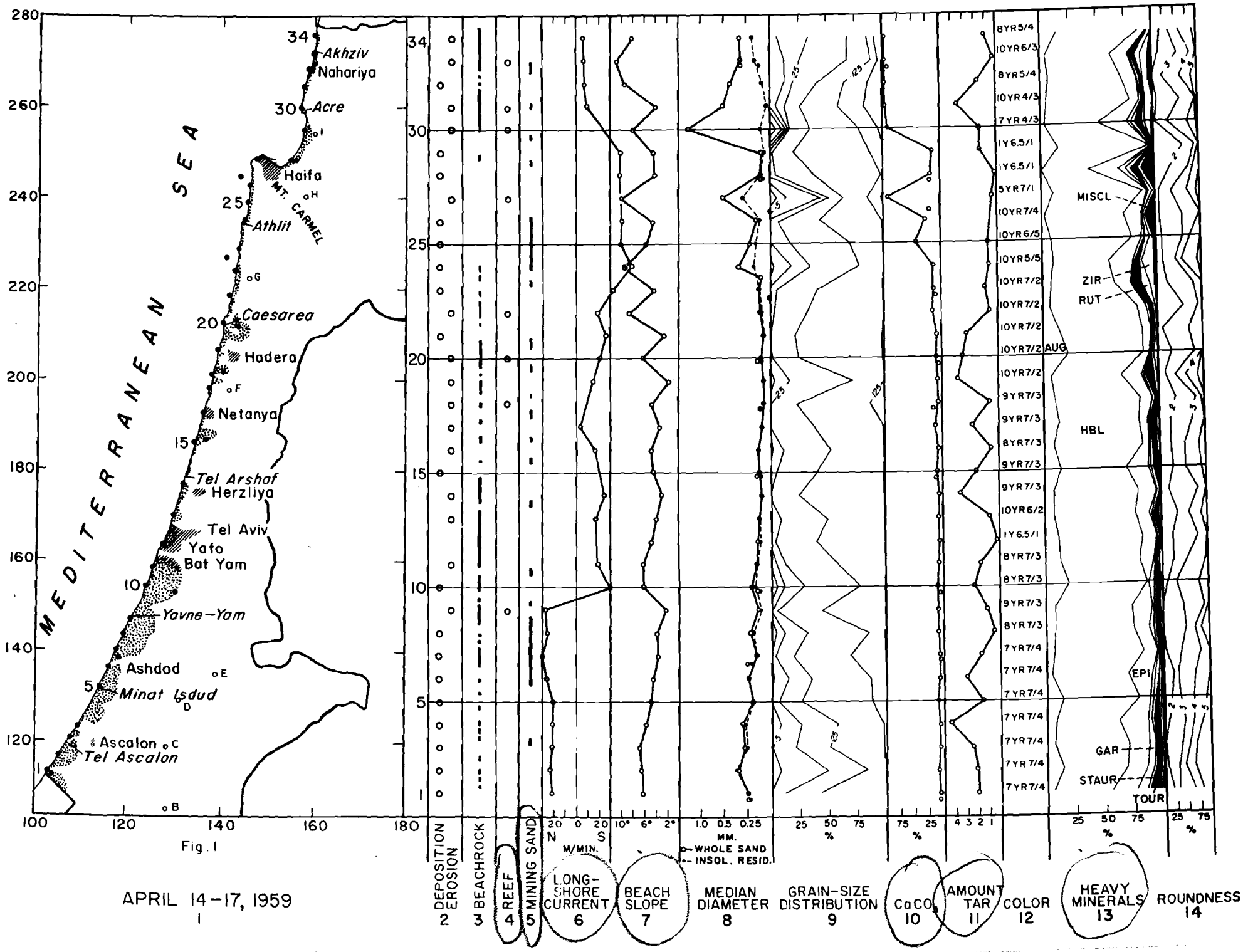

Fig. 1

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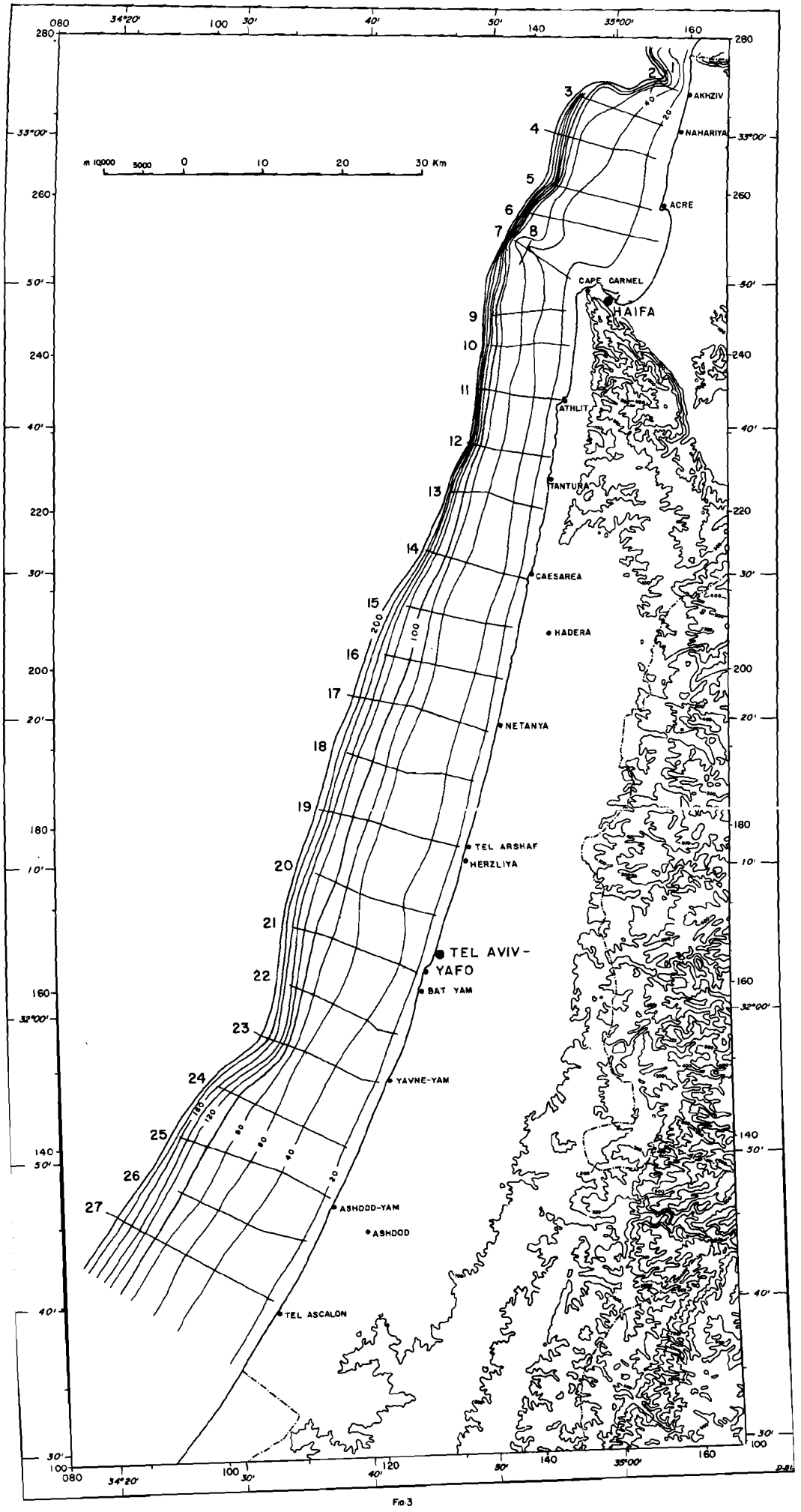
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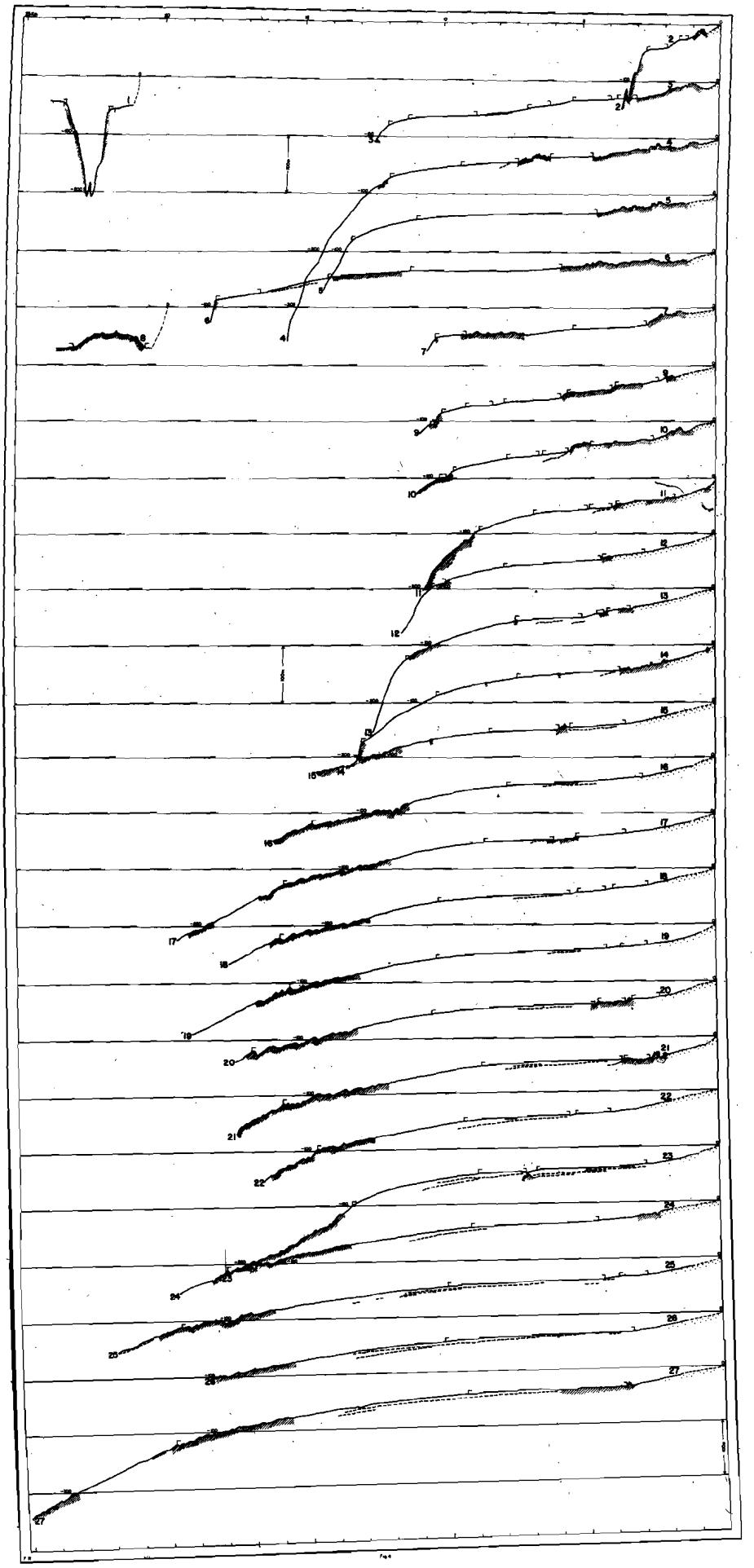
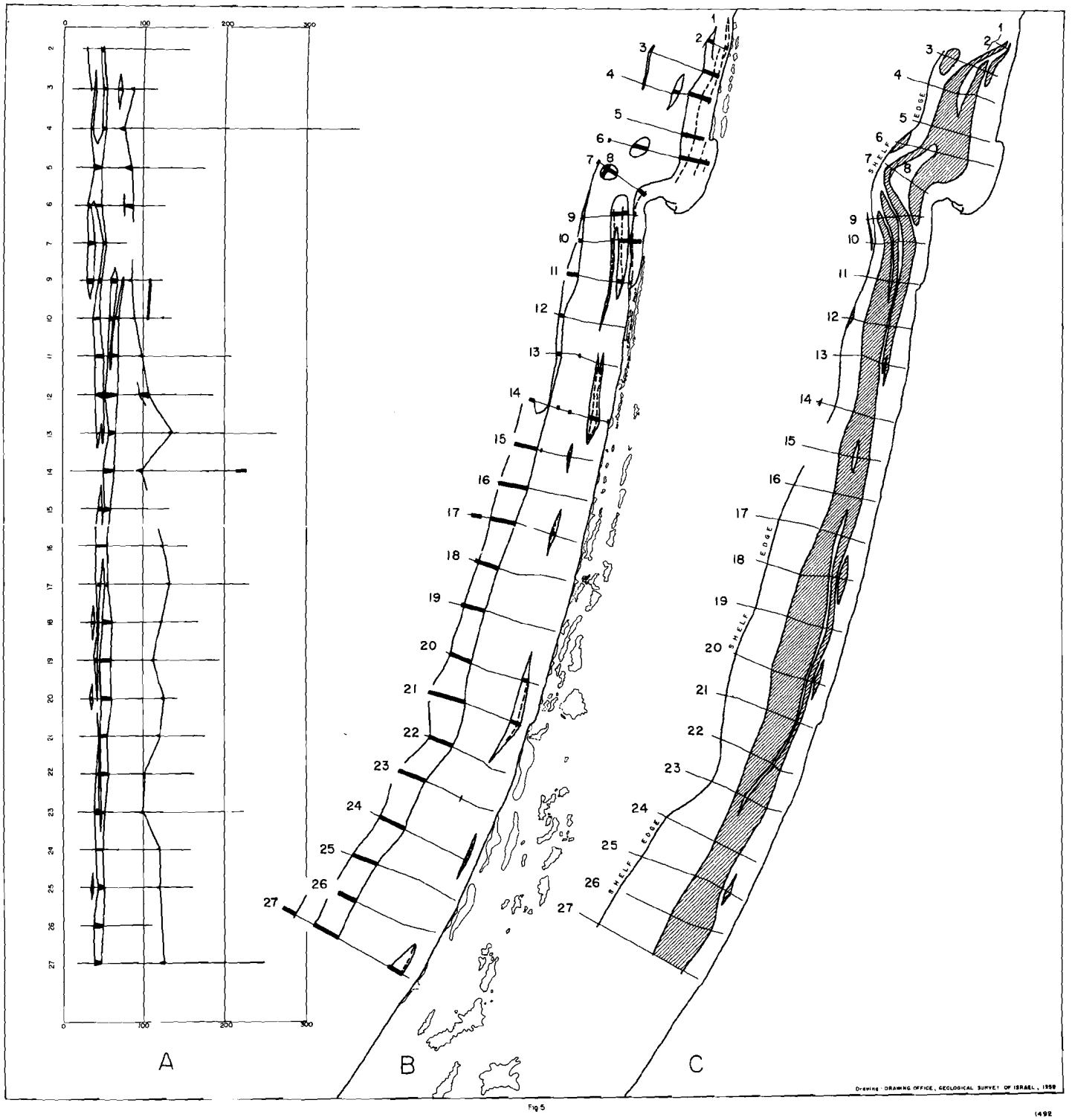
Fig.3

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Drawing: DRAWING OFFICE, GEOLOGICAL SURVEY OF ISRAEL, 1958

Fig 5

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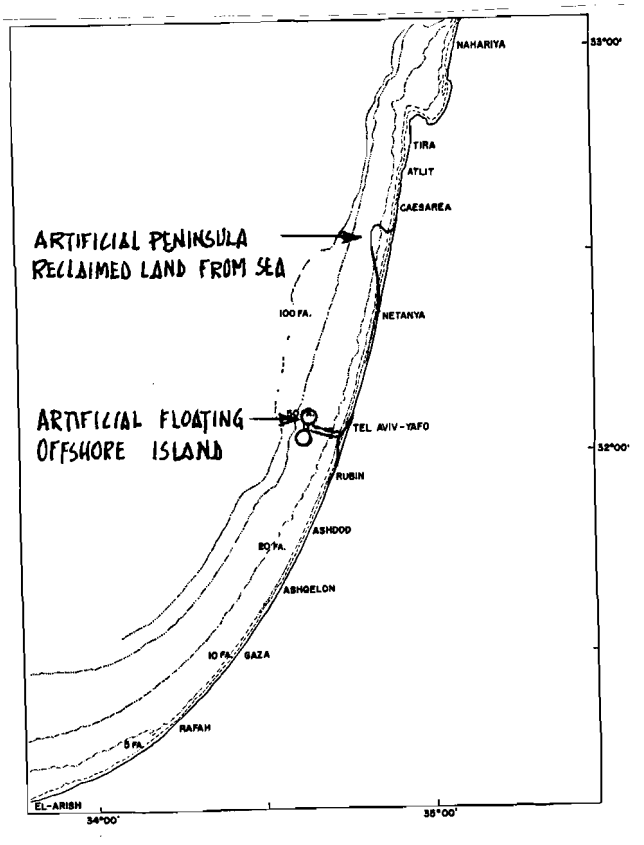


MAP 3: THE PROPOSED COASTLINE PROFILE OF ISRAEL.

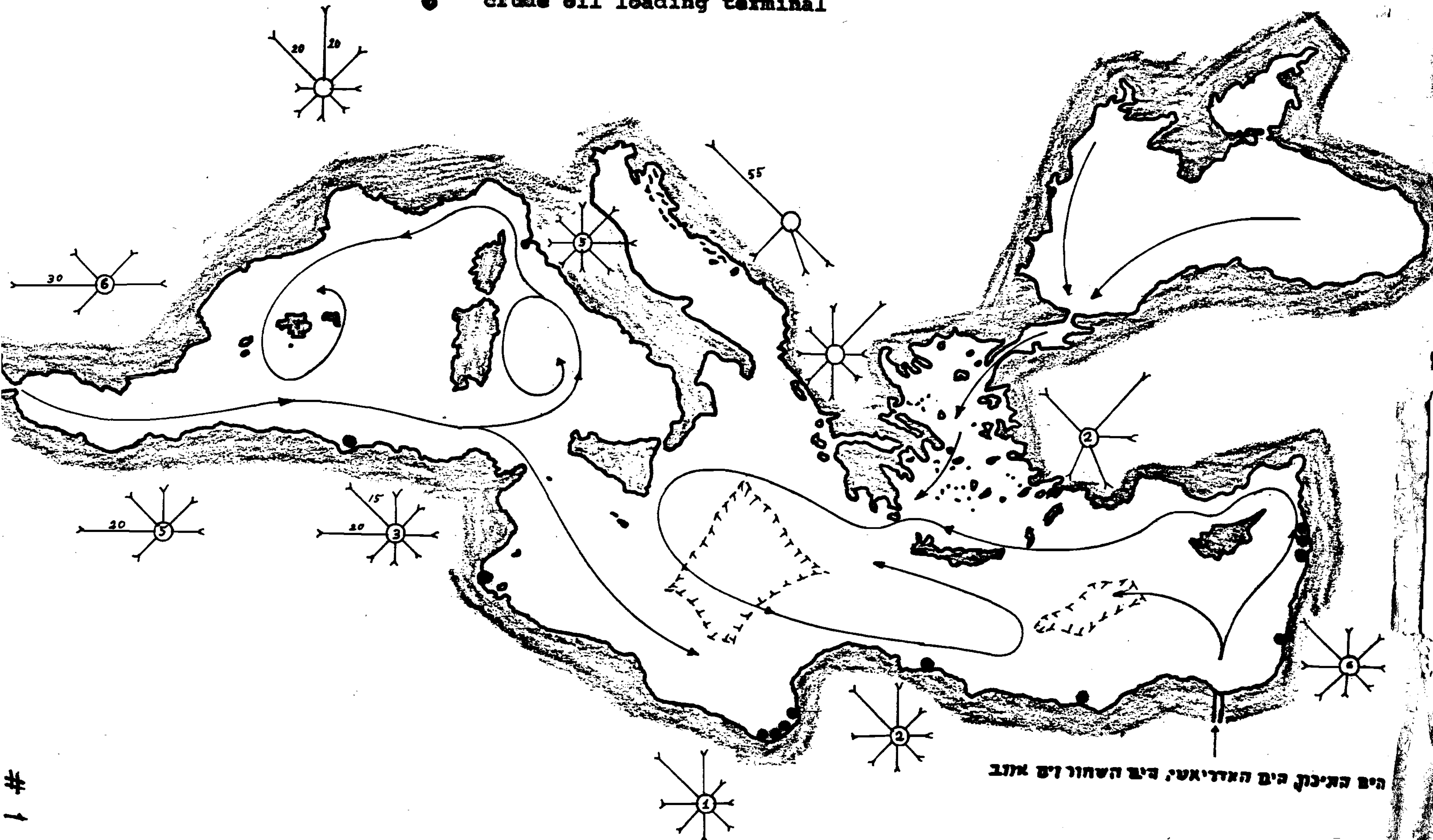
#3

משטר הזרמים ורוחות בחודש ינואר

Pattern of Currents and Winds in January

TTTTT area permitted for ballast discharge from tankers

● crude oil loading terminal



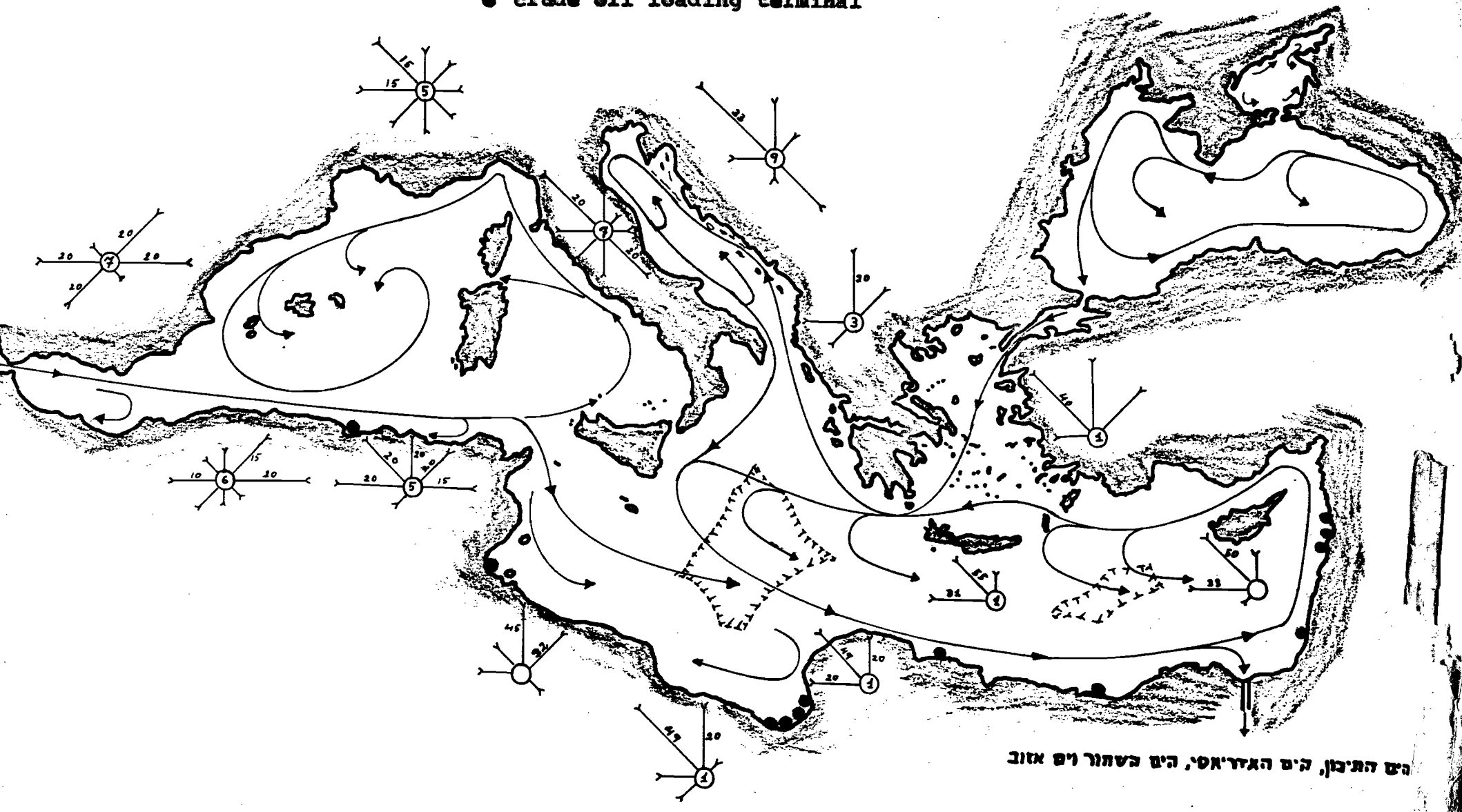
MAP 2.

Pattern of Currents and Winds in July

משטר הזרמים ורוחות בחודש יולי

זזזזז area permitted for ballast discharge from tankers

● crude oil loading terminal



ים התיכון, ים האדריאטי, הים השחור וים אזוב