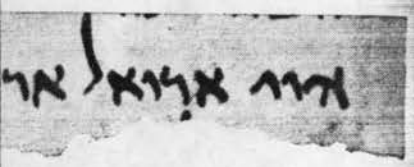

y where David encamped (Isaiah 29,1)

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ariel אריאל

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years now he has lived chiefly in Paris, though he has retained artistic contact with this country; one would like, however, to see him resident for longer periods, to ensure that the impact of the Israel landscape remain one of the mainsprings of his painting.

Another immigrant artist, a dedicated devotee of Israel's countryside, is Ludwig Schwerin, who has also painted works inspired by the Bible. Other artists who have portrayed or been inspired by this landscape are Jacob Pins, a pupil of Jacob Steinhardt, the late Menahem Shemi and Nahum Gutman, a member of the first group of pupils of the Bezalel School in the pre-World War One period.

There are a number of other younger artists who, notwithstanding the impressions and stimuli they have absorbed in the course of their studies and travels abroad, have not forgotten their own country. Those worthy of note are Jossi Stern, who came to Palestine in 1940 as a youth of seventeen and studied at the Bezalel School, and Moshe Gat, only 31, a native of Haifa, who was highly successful in Mexico, where he spent three years. Life in that country proved an unending source of inspiration to him and the influence of modern Mexican painting is reflected in his more recent pictures of types and life in Israel. Others who express their Israel environment in their art are Lea Nikel, Osias Hofsteter, Yehuda Bacon and Moshe Kupferman. Fortunately the list could be lengthened.

The *kibbutz* artists are perhaps deserving of a special study, because of the unique milieu in which they live and work. In their painting there is much that is relevant in the present context. The number actively engaged in painting—and sculpture—is large, but here we need mention only a few. There is Moshe Kagan of Kibbutz Shamir, who renders his native Galilee in water-colours and drawings, Shraga Weil of Kibbutz Ha'ogen whose work, however, is threatened by an overstated monumentality; and Shmuel Katz of Kibbutz Gaaton, who, though stimulated by his studies in Paris, and fairly extensive travels in Europe and Africa, has retained his Israel integrity. For our purpose artists who formerly lived in *kibbutzim* also belong to this category, so we may mention Abraham Ofek, born in Bulgaria, and Ruth Schloss, an excellent draughtswoman, who stresses the social aspect in her portraits, especially those of children.

Afforestation of the Desert

Israel Gindel

Afforestation, by the planting of suitable trees and shrubs, is one method by which arid zones, which in Israel cover large areas, can be ameliorated. Dr. Gindel, Professor of Sylviculture, and Head of the Department of Forest Ecology at the Hebrew University's Volcani Institute for Agricultural Research in Beit Dagon, has written many studies and books on afforestation and acclimatization of trees.

The flora and climatic conditions prevailing in the desert areas of the Negev and Judaea closely resemble those in the deserts of Syria, Iraq, Egypt, North Africa and the Sahara. Indigenous vegetation in all of these regions consists of the same principal species, namely, *Acacia Radiania Savi* (Shittim) and *Acacia Spirocarpa Hochst* (Sammuz), species of the *Tamaricaceae* family, *Haloxylon persicum (Cav.) Bge.* (Balbal), *Retama* (White Broom), and the like.

But Israel's wastelands are not only singularly unblessed by nature; they have suffered grievously from the depredations of the nomads, who have cut down all trees and even dug out roots for use as kindling, and for the manufacture of charcoal. This phenomenon becomes more and more evident as one travels southwards. From the climatic point of view the density of flora should have been greater in the northern part of the desert (which has a higher precipitation), but actually the number of plants per area-unit increases the further one goes south and reaches a maximum in the Araba. The reason is simple. The Beduin's habitat is mainly in the north of the Negev; they do not normally roam so far as its southern reaches.

In antiquity, however, the deserts of the Negev and Judaea were pasture lands. Density of flora was greater, owing to richer water reserves in the soils, formed by the slow flow of gravitational water coming from the slopes of the surrounding hills and mountains. The hill country, of course, was well-wooded in ancient times. The water reserves allowed a growth of plants for longer periods of the year. Following the destruction of the forests and a process of erosion that continued for centuries, gravitational water carved out well-established beds ("wadis") leading towards the Red and the Dead Seas, and today, after a spell of rain in the highlands, the floodwaters sweep down as veritable torrents, capable of carrying away fully-loaded trucks.

The Hebrew word *midbar,* usually translated "desert" or "wilderness," is closely related to (and derives from the same root as) *dover* which means a pastureland (*vide* Micah 2, 12: "I will render them all as sheep in a fold, as a flock in the midst of their *pasture*;" Isaiah, 5, 17: "Then shall the lambs feed as in their *pasture*"). In the *War of the Sons of Light against the Sons of Darkness,* one of the recently discovered Dead Sea Scrolls, reference is made to the "Jerusalem desert," with the obvious sense of pastureland.

It is still possible to restore to *midbar* its ancient meaning. The soil can be improved by planting pasture forests like those existing in the deserts of Australia, Africa and Asia. These forests are made up of stunted trees and bushes, the leaves of which are of high nutritional value. Some of these species have already been acclimatized in this country by the author.

Denudation of natural flora is not a characteristic confined to arid areas. By the early years of Jewish resettlement of this country few of the ancient forests had survived. Extensive areas were exposed to thermodynamic factors. Strong winds, blowing continuously for days on end, raise and move the small dust particles from the naked soil, particularly eolithic soils, and from the mountains which are constantly weathering. Much of this dust never settles as it is so fine (5–10 μ in diameter) that gravitation does not affect it and it can form a cloud covering a large expanse. Such a cloud can become dense enough to shut out the sunlight even at midday. A slight breeze is sufficient to fill the desert air with dust, and it is only after a spell of rain that the air is clear. Measurements taken by the author showed that transpiration of dust-covered forest trees is 20–25 per cent lower than that of clean leaves, and since transpiration is related to photosynthesis yields will be smaller, too.

Amelioration of the wastelands and the creation of conditions suitable for settlement can only be achieved by planting a mosaic of forests, woods, windbreaks, shelterbelts and avenues, which can check the winds and prevent the formation of dust clouds. If we cover 25 per cent of the desert with plantations, and utilize a similar proportion for agricultural purposes its negative climatic conditions can be neutralized.

How do plants grow in the desert?

According to Eig and Zohary, desert flora is characteristic of the Irano-Touranian and Saharo-Sindian phytogeographical zones that account for about 60 per cent of the total area of Israel. Their borders, as well as the isohyetes of 200 and 400 millimetres (according to Ashbel), are marked on the map on page 17. Both isohyetes are very close to the borders of the two phytogeographical areas, because the amount of rainfall determines the composition and nature of the flora. In both lack of water is the principal factor responsible for the death of 80 per cent of the endemic natural vegetation. These plants spring up after the first rains and disappear when the amount of available water becomes insufficient. Desert scenery is very different in the spring (February–April), and in the critical dry months of the summer and autumn (June–November), when the entire area takes on the aspect of a wasteland, with only a handful of trees scattered at long intervals to testify to the life that pulsated here not long before.

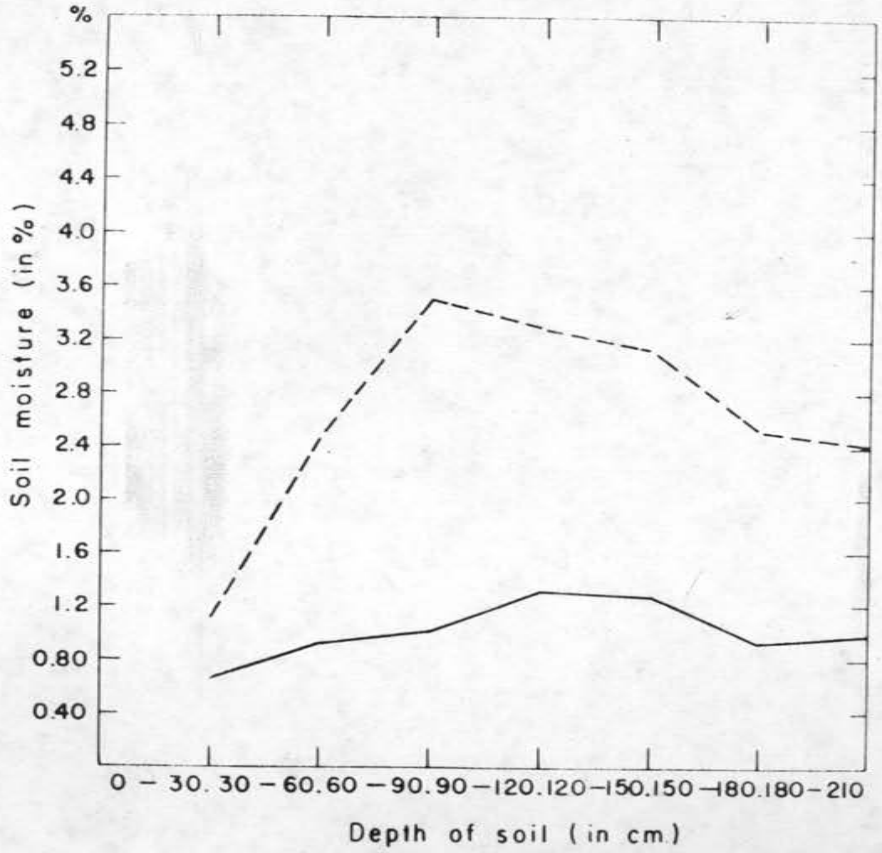
Most of the plants (75 per cent) bloom in March–May; during the rest of the year their number shrinks almost to zero. The range consists of twelve colours, of which four fifths are yellow, white, green and violet.

The natural flora also includes many shrubs or semi-shrubs, whose leaves either fall at the beginning of the dry season and stay exfoliated during most of the summer, like *Euphorbia thamnoides* (Woody Spurge) and *Anagyris foetida* (Bean Trefoil); or sprout smaller leaves, few in number, as is the case with *Astragalus* and *Atriplex*. Another group of plants drop their leaves entirely, their stalks carrying on a weak, periodical activity (e.g. *Retama*—White Broom).

But the plants that are most intriguing to the biologist, and most interesting from the arbo-sylvicultural point of view, are the trees and higher bushes that stay green during the summer. These continue their phenological functioning both in rainy and in dry years, even when annual rainfall does not exceed 30–40 mm. (the average being 100–200 mm). This amount of moisture is capable of wetting no more than 40–50

centimetres of the upper layer of the soil, while the root system reaches a depth of 1.5–3.5 metres, according to the species and age of tree. The question is where these plants get their water from since subterranean sources are too deep to be of any help.

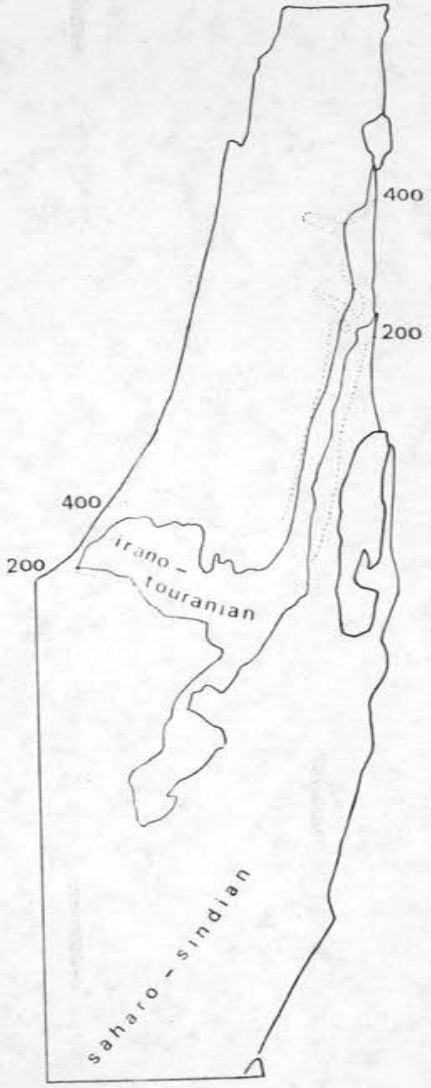
The eco-physiology of these plants is still not sufficiently clear, not because it cannot be studied but because arid zone research has been neglected, particularly in comparison to the study of more humid areas. Application of results reached in investigation of rainy areas to conditions



Percentage of soil moisture beneath the canopy of a sixteen-year old wood of *Tamarix Aphylla* (broken line) and in an open area (solid line) at the end of the dry season. Southern Negev.

obtaining in deserts can easily lead to erroneous conclusions. Research conducted by the author over the past ten years has proved that xerophytic trees preserve their green foliage in arid zones by utilizing atmospheric moisture (dew, mist and water vapours). Repeated soil tests made during the summer proved that during the driest months there is more moisture around the roots of the trees than in an adjoining area, resembling the afforested area in every detail but on which no trees are growing. The figure on page 16 illustrates the amount of moisture in the soil and its distribution in depth both beneath a sixteen-year old wood of *Tamarix*, growing in the sands near Gvulot, and in an open, unplanted area, in the vicinity. Measurements were taken at the end of summer in October 1960, after three years of drought. In that year rainfall totalled 49 mm. instead of the usual average of 170 mm.

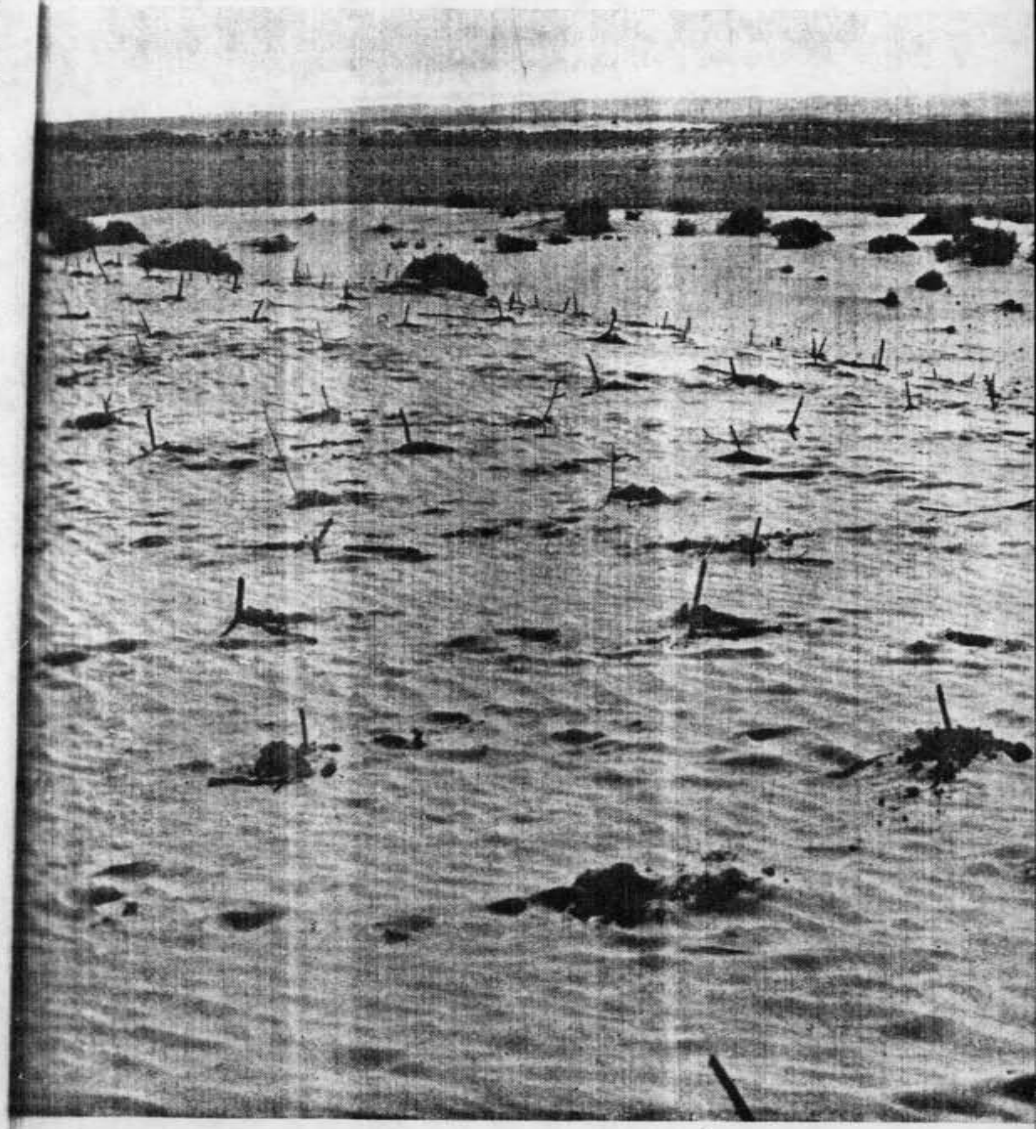
The diagram shows that, at the end of the dry season, there was still twice as much water in the forest soil as there was in the unplanted soil and more. Distribution of the moisture retained by the forest presents a different pattern—different from that of the open area. In the



The dotted curves define the boundaries of the two isohyetes, indicating distribution of rainfall. The Irano-Touranian zone separates the Mediterranean from the Sahara-Sindian zone.

Mature *tamarix* in the Negev

A *tamarix* plantation to bind shifting dunes



latter the moisture increases slightly with depth. Here, the soil moisture distribution results not from the action of the trees, but from the loss of water as a result of physical evaporation. This loss decreases in deeper strata. In no stratum does the amount of water in a bare area equal that in the corresponding layer of the wooded area, except for the very deep layers (that is, from 2.5–5 metres) where rainfall can have no effect. This fact is of general significance for deep and porous soils under desert conditions, as proved by a series of studies conducted in a number of locations in this district. Surplus moisture under woods in dry areas came from only one source—atmospheric moisture, since xerophytic plants are morphologically constructed to benefit from it.

Dew and Mist in the Desert

Dew and mist are of maximum benefit in the desert and constitute an abundant source of water for xerophytic woody plants. Thanks to them plants maintain a turgor of cells, and a minimal quantity of moisture is retained round the roots in both rainy and dry years. In desert sands, for example, in a *Tamarix* forest this minimum is 1.8–2.2 per cent, in a bare area 0.4–0.6 per cent only in upper strata, and 0.7–1.0 per cent in the deeper (more than two metres). Attraction of atmospheric water is most pronounced in *Tamarix aphylla (Vahe) Karst,* the tree Abraham planted at Beersheba, significantly after a dispute with the Philistines about a well (Genesis 21, 33). This peculiar property is reflected in the morphology of the leaves which are covered with tiny salt crystals (chemically composed of NaCl or $CaCo_3$) and able to absorb atmospheric moisture even in a relative humidity as low as 70 per cent. It is noteworthy that the *Tamarix* blooms in August, after the minimal water resources outside its root area are exhausted. Furthermore, a study of the course of transpiration conducted in a *Tamarix* wood near Gvulot showed that the rate of transpiration is lower in the rainy months (December–April) than in the dry (June–October), which indicates that during the rainless season physiological activity is more intensive.

But surplus moisture in the root area in forest soil is not characteristic only of the *Tamarix;* it is present under any other xerophytic tree or shrub, either endemic or acclimatized, even if it grows in isolation and sunshine penetrates through the foliage on all sides. It is also the case with exotic species, which have been planted in the desert with no water except for a limited irrigation during the first summer. Indeed, such trees develop xerophytic characteristics, resembling those of endemic plants, and survive by utilizing atmospheric moisture. If the quantity of such moisture does not suffice for new sprouting, the previous year's leaves continue the physiological activity, as is the case with certain species of eucalyptus, *Schinus* and *Pinus halepensis Mill. Pinus halepensis* and *Tamarix* sprout every year, even during the most severe drought, and even when several drought years occur in succession, as has happened only too often in the past decade.

Adaptation of Planting Methods

The behaviour of endemic and adapted plants in the desert determines the sylvicultural methods to be applied in establishing artificial plantations. The handful of trees per hectare which dot the arid zones does not reflect the vegetative potential which climatic and soil conditions, reinforced by research and experience, can reveal. The major problem is how to achieve effective exploitation of all available water resources to sustain the plants for as long a period as possible.

Experiments conducted in recent years have demonstrated that use of simple hygrophobic apparatus to collect dew and mist and to channel the water thus obtained into the pit surrounding the sapling will help it to survive even during the first dry summer after planting. The amount of dew that can be collected depends on the size of the apparatus used. In our experiments, we succeeded in securing 100–250 cubic centimetres per square metre, by using polyethylene and polyvinyl sheets.

The sheets, each 1.50–2.0 metres square, were arranged at a slope of 25–30 degrees, to facilitate flow of the water into the tree-pit. Plastic ducts were attached to the lower ends of the sheets. To create the necessary slope the soil was ridged or the sheets were placed on a wooden board.

These sheets also proved useful for the collection of rainwater. Light showers, of 0.5–1.0 mm which only wet one or two centimetres of the surface soil are quite frequent in these regions. The moisture usually evaporates completely within a few days owing to the strong sunshine in the intervals between the spells of rain.

A sheet of five square metres, supplying a pit one square metre in area, may provide five times as much water as is obtained from rainfall. The percolation is, consequently, fivefold.

It is widely believed that dew and mist are composed of distilled water, but this is not true for the desert and subtropical climates of Israel. Analyses have shown that the concentration of positive and negative ions in such water is ten times higher than it is in rainwater, and includes ions

of bicarbonate, nitrate, sulphate, chloride, sodium, potassium, magnesium and calcium. There are approximately 200 mg/l of soluble minerals in condensed dew and 400 mg/l in mist; the quantity varies with the seasons and districts. These ions originate in dust particles suspended in the air, which form nuclei for dew drops. During the dry season there are many sources of ions, mainly evaporation of sea water (the Mediterranean, Red and Dead Sea), of the Sea of Galilee and the Jordan River, and of water used for irrigation in adjacent districts, and the weathering of rock in the mountains.

The fact that atmospheric moisture has 40–70 mg/l of chloride and its pH is 6.4–6.9 is very important for plant nutrition in a desert environment, where the salinity of both soil and air is high. For purposes of comparison—the salinity of water coming from northern Israel via the national conduit is 300 mg/l.

Another method for preservation of moisture in the root area is to cover the surface of the soil around the plant. Gravel or small stones—not branches or stubble which catch fire easily—provide adequate cover as they constitute effective insulation against direct radiation, and ensure lower temperatures in the soil layers.

The growth of seedlings can be accelerated by planting them on the crest of ramparts, in which they can develop ramified and deep-penetrating root systems. This method is particularly suitable for loess and red loam soils which are heavy and imperforate. Measured comparison of this method to ordinary planting proved the former better in the earlier years, in the season after the rains, because of insulation of lower strata of soil and control of weeds, thereby contributing to maintenance of edaphic moisture.

An important source of water in the arid zones of Israel is, of course, the floodwater during the rainy season. Rainwater from the hill country flows in established beds, which constitute good areas for afforestation. The method adopted, requiring raising of the lower part of the slope in order to form an artificial dam is similar to that adopted in Arab vineyards and pomegranate, olive and fig orchards. In the season water in the soil can be increased by 300–500 mm., depending on the amount and distribution of rainfall.

Aeroplanes can be used for sowing desert areas and indeed in Central Asia the Russians have recorded the seeding of five thousand acres in a single workday. In this region, rapid sowing is vital to ensure that the seeds benefit to the full from a soil surface which remains wet for only

a few days or, at most, for a few weeks. Pasture plants and endemic trees and shrubs in the areas which get enough water in the rainy season can contribute much to achieving the objects set in all efforts to afforest the arid zones.

Conclusions

It should be clear from the foregoing that the frontiers of the desert recognized by phytosociologists are not fixed. They can be changed by harnessing the sylvicultural knowledge and experience that men have accumulated. Moreover, the existent flora of the desert is no indication of the vegetative potential that can be developed by artificial means. Scientific arbori-sylviculture has been conducted in Israel's arid zones for almost a quarter of a century and since 1943, when three observation points (Beth Eshel, Revivim and Gvulot) were established in the Negev by the Jewish National Fund, many thousands of trees have been planted as avenues lining roads, as windbreaks around fields and orchards, in woods and thickets. All this, however, is merely initial proof that the goal we have set ourselves is not beyond our reach. It is no more than the first stage in a project that can be advanced by applying new afforestation techniques and by adapting more xerophytic species already flourishing in deserts all over the world. What has been done and achieved so far is too limited to have any palpable effect in ameliorating the arid climate or soil.

To moderate the micro-climate in the barren areas, the surface must be covered with trees and shrubs, as protection against the hot sunshine and the dust-laden, often scorching, winds. The trees in a short time will provide a covering of twigs, leaves, shreds of bark, flowers and pollen, all of which will integrate and combine to form a layer of fertile humus. The plantations will at first have an artificial aspect, with trees in serried rows—to obtain the micro-climate desired they must be planted close together—but, in the long process of thinning and selection, even this will be remedied, and the woods will take on a more natural look.

* * *

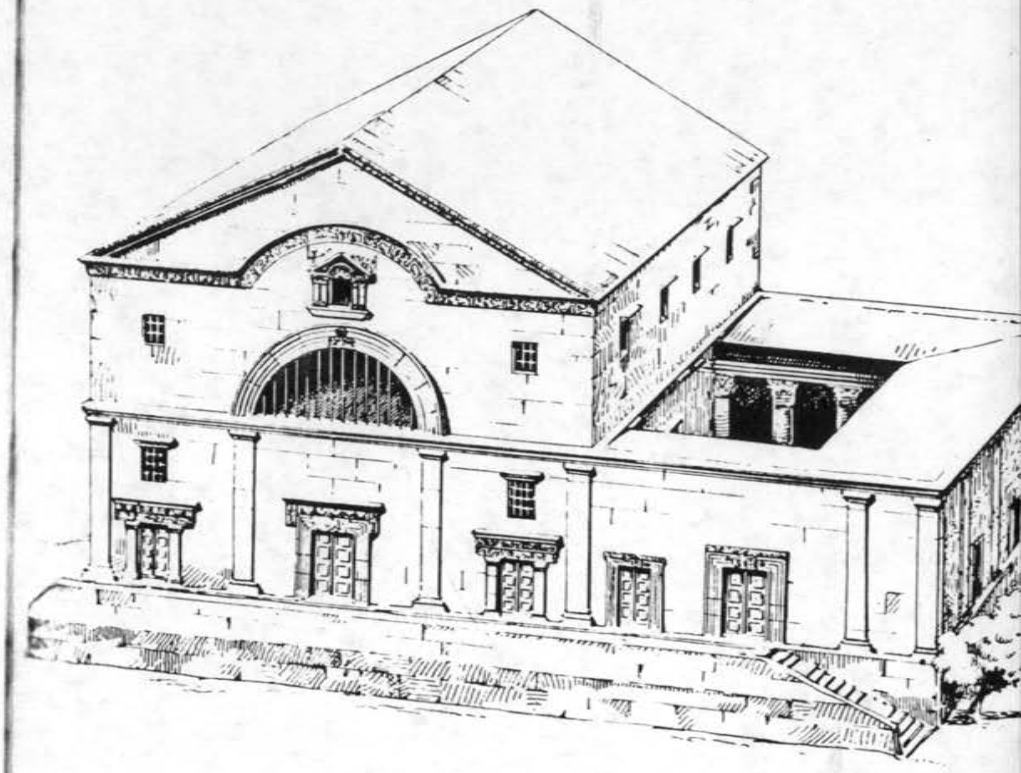
And finally a word about economic considerations. The object being to make the arid zones habitable by improving climate and soil, the economic aspect should not be permitted to weigh too heavily. Certainly the value of woods in dry regions should not be gauged in relation to those growing where there is abundant rainfall. Countries with extensive un-

inhabited humid zones—such as there are in America, Africa and Asia—need not afforest where annual rainfall is less than 16 inches. There are, however, countries that are less fortunate. Israel and India are cases in point. And even here some economic advantage may be reaped. Avenues, woods and windbreaks provide poles for local agriculture, raw materials for a chemical industry, etheric oils, pharmaceuticals and tannin.

APPENDIX ON BIBLICAL EVIDENCE OF THE VALUE OF DEW AND MIST

For the modern farmer in Israel, in daily contact with nature, dew and mist are two factors upon which he can rely. Certain dry crops such as maize, wheat, barley and sesame, flourish where there is heavy dew (as in the western Valley of Jezreel as compared with the eastern section of the Valley, which is less fortunate in this respect). In the Negev, again, it has been found that rain crops can withstand a dry season in the north-western Negev (rich in dew) better than in the east in which there is little dew. The ancient Hebrew prayer known as the Eighteen Benedictions contains a passage very meaningful for the Judaean husbandman—"Who bringeth down the dew"—recited in the dry summer months, while on the first day of Passover (which marks the beginning of the rainless season) a special prayer for dew is recited.

That the ancients from long personal experience appreciated the importance of dew for their crops is attested by many verses in the Bible. Isaac in blessing Jacob said: "So God give thee of the dew of heaven, and of the fat places of the earth" (Genesis 27, 28), while Moses in the first of his valedictory poems to Israel before his death in Moab juxtaposed "dew" with "rain" ("My doctrine shall drop as the rain, my speech shall distil as the dew"—Deuteronomy 32, 2), and further, in the next chapter, there is an even more significant reference "For the precious things of heaven, for the dew" (33, 13), and, again "Yea, His heavens drop down dew" *(ibid.,* 28). The prophetic books abound in allusions to the beneficent influence of dew for the tiller of the soil and a few examples will suffice. Micah says "the remnant of Jacob shall be . . . as dew from the Lord, as showers upon the grass (5, 6—again patent recognition of the importance of dew, akin to that of rain); "I will be as dew unto Israel; he shall blossom as the lily" (14, 6); and Zechariah: . . ."The ground shall give her increase and the heavens their dew" (8, 12). Naturally the withholding of dew is a disaster and the best-known reference in such a context is the passage in David's lament over Saul and Jonathan: "Ye mountains of Gilboa. Let there be no dew nor rain upon you" (2 Samuel 1, 21).



Capernaum. Model of reconstructed synagogue, showing the main edifice, with adjacent courtyard.

Ancient Synagogues in Galile

Nahman Avigad

Scattered over the face of Galilee are the ruins of elaborate buildings in the Graeco- style; these are the remains of the so-called "early synagogues" of the Roman peri distinguish them from the later synagogues of the Byzantine period of which traces hav found in most parts of Israel. When, almost a hundred years ago, the first systematic of the Holy Land was undertaken by the Palestine Exploration Fund, the explorers cou establish the true character of these buildings, not only because no ancient synagogue yet been discovered, but because the images carved into the stone led them to believ they were of pagan provenance. But a number of Hebrew and Aramaic inscriptions we