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A table of contents for *Journal of the Transactions of the Victoria Institute* can be found here:

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JOURNAL OF
THE TRANSACTIONS
OF
The Victoria Institute
OR
Philosophical Society of Great Britain

VOL. LXXIII

1941



LONDON:

PUBLISHED BY
THE INSTITUTE, 1, CENTRAL BUILDINGS, WESTMINSTER, W.C.1

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844TH ORDINARY GENERAL MEETING.

HEL IN COMMITTEE ROOM 19, LIVINGSTONE HOUSE,
BROADWAY, S.W.1, ON MONDAY, MAY 26TH, 1941,
AT 5 P.M.

MR. L. C. W. BONACINA, F.R.G.S., VICE-PRES. R.MET.S., IN
THE CHAIR.

The Minutes of the previous meeting were read, confirmed and signed.

The CHAIRMAN then called on Miss C. M. Botley, R.R.A.S., F.R.Met.S., to read her Paper entitled "Climate and Weather in the Bible."

The Meeting was thrown open to discussion in which the following took part: Group Captain P. J. Wiseman, Colonel Molony, Dr. F. J. W. Whipple, Mr. F. E. Carruthers, Mr. Derek Schove and Mrs. Walter Maunder.

Written communications were received from the Rev. J. H. J. Barker, Dr. C. E. P. Brooks and Rev. Principal H. S. Curr.

CLIMATE AND WEATHER IN THE BIBLE.

By CICELY M. BOTLEY, F.R.A.S., F.R.Met. S.

FOUR centuries ago it was said that to many the city of Rome was "dearer, sweeter, and more beneficent than their own fatherland." Hyperbole may be, but expressive of the special regard in which some of us, without prejudice to other loyalties, hold the lands of the Bible, and which makes every detail about them of interest.

There is more than sentiment about this interest. That the Scriptures were inspired by God is not to be doubted. But since the message came through men it became strongly coloured by their environment, therefore any knowledge of such environment is of value.

One of the most outstanding features in any environment are those atmospheric conditions called weather and climate, and full comprehension of many allusions, indeed happenings, in the Bible is not possible without some knowledge, not only of actual

climatic conditions but of the ancient Hebrew ideas concerning them.

To take actual conditions first. Now it happens that the Bible was compiled in what Sir Napier Shaw calls "one of the most curious regions of the world from the point of view of weather and climate."¹ There is much desert—partly the "barren and thirsty land where no water is" of the Psalmist—and partly arid land made fertile by great rivers and careful irrigation. In contrast to this (cf. Deut. xi, 10) are lands which "drink water of the rain of heaven." Everywhere conditions are strongly seasonal; both Nile and Euphrates rise and fall, the rains come "in due season." Winter and summer are the two seasons (Gen. viii, 22) and are strongly contrasted. Amos mentions that the rich had winter and summer houses (iii, 15). The reason is, that unlike that of Britain, where local conditions act as a mask, the climate of Bible Lands shows clearly the rhythm of the atmospheric circulation.

In summer conditions are simple (Fig. 1). Atmospheric pressure is very low over S.W. Asia and N.E. Africa. Over the Sudan the flow of air is ultimately from the ocean (probably the Atlantic), and yields the rains which are the source of the Nile flood. Over Palestine and its neighbourhood, however, the air currents are northerly and dry. From June to September scarcely a drop of rain falls. Except in irrigated land vegetation withers and "the noise of a flame of fire that devoureth the stubble" is a familiar sound (Joel ii, 5). Fire breaks out easily in the dry scrub and spreads with fearful rapidity (cf. metaphors Is. ix, 8. Amos vii, 4, etc.). Over the heated ground whirlwinds develop and carry up sand and dust to great heights (cf. "pillars of smoke," Joel ii, 30). From a cloudless sky the sun blazes down; as Ben Sira says, "at noontide he scorseth (lit. "causeth to boil") the world." (Eccles. xliii, 3, Hebr.). It is not surprising then that popular superstition created a noontide demon, to whom Dr. Theodor H. Gaster² finds references in "the spoiler at noonday" of Jer. xv, 8, and in "the destruction that wasteth at noonday" of Ps. xci, 6. Indeed, the LXX version of this actually reads "destruction and the demon of noon" while the Vulgate has "daemonio meridiano."

There is one recorded case of sunstroke in Scripture, that of the Shunammite's son (2 Kings iv, 19).

The heat is dry and therefore more bearable than if the air

were moister and perspiration less free. But the loss of bodily fluid conduces to thirst, hence the frequent allusions to this, both actually (ii Cor. xi, 27) and metaphorically (Ps. xlii, 1, lxiii, 1).

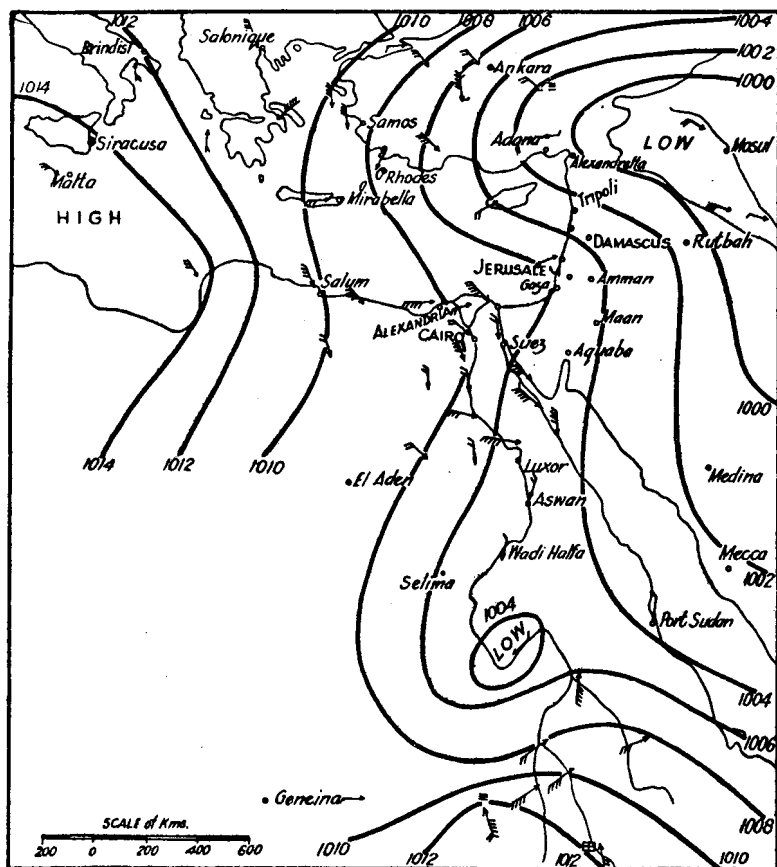


FIG. 1.—Pressure and winds at 8 h., 28.7.1934. *Prevailing summer type.*

In the heat streams and rivers shrink to a trickle or vanish altogether; no wonder Zechariah's vision of an ideal Palestine included perennial streams, "in summer and in winter shall it be" (xiv, 8).

“ But the healing of all things is the dropping from the clouds the dew which speedily refresheth the parched ground ” (Eccles. xliii, 22, Heb.). During the summer from late afternoon till early morning a “ cloud of dew ” (Is. xviii, 10) hangs over the high ground, formed by the forced ascent of moist air brought inland by the daily sea-breeze. The cloud is soon dissipated by the sun (Hos. vi, 4), but not before it has brought refreshment, and the occasional failure of the dew (as happened in July, 1916) means great hardship. It was in the absence of dew as well as of rain and the consequent utter barrenness that lay the terror of Elijah’s drought (1 Kings, xvii, 1) and the force of David’s curse on Gilboa (II Sam. i, 21).

As the year wears on the atmospheric situation changes. The Asiatic low pressure and its associated winds die away, and an Atlantic-Mediterranean circulation takes its place. Depressions from the Atlantic with their rain and wind begin to invade the Mediterranean which becomes stormy (Fig. 2). From Acts xxviii, 9, we learn that sailing was considered dangerous after the fast of the Day of Atonement 10 Tisri (September-October). On that day, too, the high priest prayed for rain; eleven days later, on the 7th day of Tabernacles, “ the great day of the feast ” water was poured beside the Temple altar “ that the rains of the year may be blessed to you ” (The Talmud).

How exquisite was the way then in which the Saviour (John vii, 37-8) used this “ raw material of Tabernacles ” for His own purposes—“ in the ancient festival the earth was to be fertilised, in the new usage of Tabernacles the spirit of man is to be made alive.” (V. Burch.)³

About the time of Tabernacles the first showers of the season—the “ former rains ” (*moreh*) fall. They are often accompanied by thunder and lightning (cf. Jer. x, 13) and are eagerly awaited since they moisten the soil which, after the summer is literally “ as iron,” and unworkable with the primitive tools of the ancient (and modern) peasant. “ Thou makest it soft with showers,” says Psalm lxxv, which was proper for Tabernacles.

As the season advances the Mediterranean becomes a trough of low pressure between the high pressures of Africa and Eurasia, and a highway for depressions (Fig. 2). No doubt St. Paul’s ship was caught in a procession of such bad-weather systems and “ driven up and down ” by the veering winds. They approach Palestine from the sea—Elijah told his servant to look seaward (I Kings,

xviii, 43); at last the man saw the first cloud, perhaps detached cirrus, blown ahead of the storm (cf. also Luke xii, 54). These depressions give the *geshem*, or winter rains, which are of great service in replenishing the water-supply both natural and

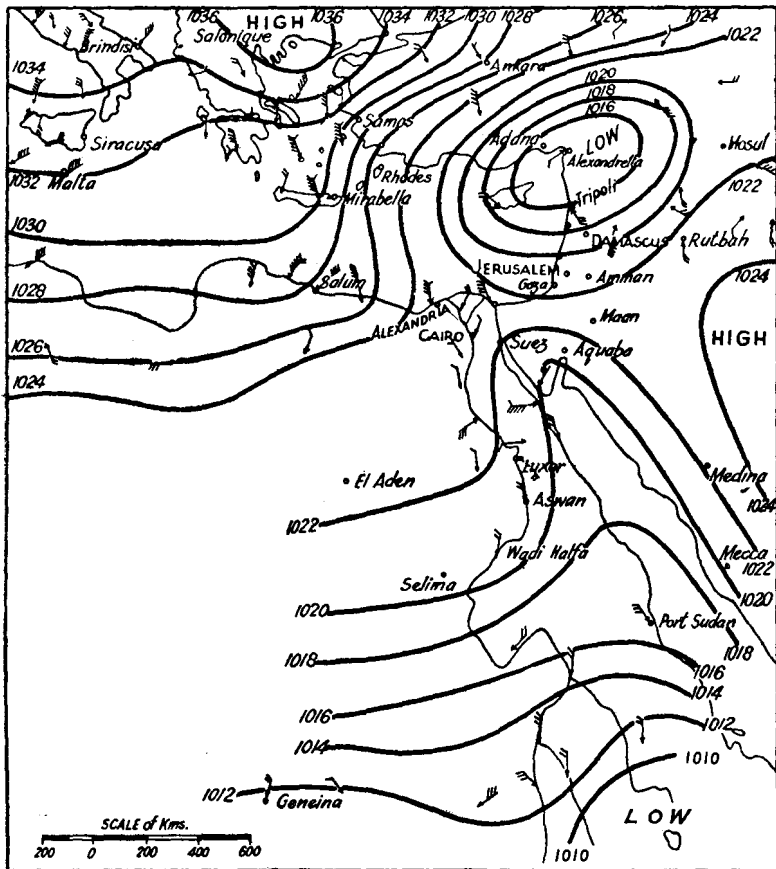


FIG. 2.—Pressure and winds at 8 h., 25.2.1938. Prevailing winter type.

artificial. Some authorities account for the decline in prosperity of many places and districts, e.g., Jerash, since Biblical times by a decline in rainfall, but it seems more likely that the secret lay in extensive and well-organised storage of water in cisterns

like the one in which Jeremiah was imprisoned. In Sinai, for instance, there are derelict cisterns with an estimated storage capacity sufficient for twenty times the present population. Such systems require peace for efficient maintenance, and would soon break down in times of anarchy such as followed the fall of Roman power.

Some of the winter precipitation falls as snow. In southern Palestine this happens on the comparatively rare occasions when a cold wave out of Armenia arrives over the country, simultaneously with the "warm front" of a depression. Perhaps this occurred when "Tryphon made ready all his horsemen to come that night, but there came a very great snow by reason whereof they came not" (I Macc. xiii, 22). It is also recorded how Benaiah slew a lion "in time of snow" (II Sam. xxiii, 20), G. A. Smith⁴ thinks the beast must have wandered up from the warmer Jordan Valley. Snow falls throughout the winter on Hermon, whose beautiful snow-cap gave it its Biblical name of Sirion or "shining." Some believe it to be the scene of the Transfiguration, one ground being the comparison in Mark:—"white as snow" (ix, 3).

Upon a common sequel to these winter rains was probably founded one of those vivid Gospel parables which seem to be the words of an eye-witness of the occurrence mentioned. Not only are the ordinary winter rainstorms of Palestine heavier than those of Britain but, on occasion, they become veritable cloudbursts, such as that which swept away 100 villages near Damascus in 1937.

Such downpours are associated with a peculiar meteorological situation (Fig. 3) in which a tongue of low pressure extends northward from the Sudan to Sinai, and high pressure lies over the Sahara and Syrian deserts. In such a case there is much mixing of air currents over Palestine, warm moist air from the south being undercut by cold heavy northern air, and forced upwards, often violently, into higher and colder atmospheric regions. Rapid condensation takes place, the rains descend and the floods come, and should any poorly built house be in the way, great is the fall thereof (Matt. vii, 27). Any rivers affected by such storms rapidly become raging torrents, sweeping all before them as the Kishon swept the host of Sisera. Perhaps such floods may be what St. Paul calls "perils of waters" (II Cor. xi, 25) or more correctly "rivers" (*potamon*). It has been

pointed out he must have often used the Jerusalem-Antioch road which was crossed by many torrents from Lebanon. The rise of streams is incredibly rapid—following a cloudburst on the

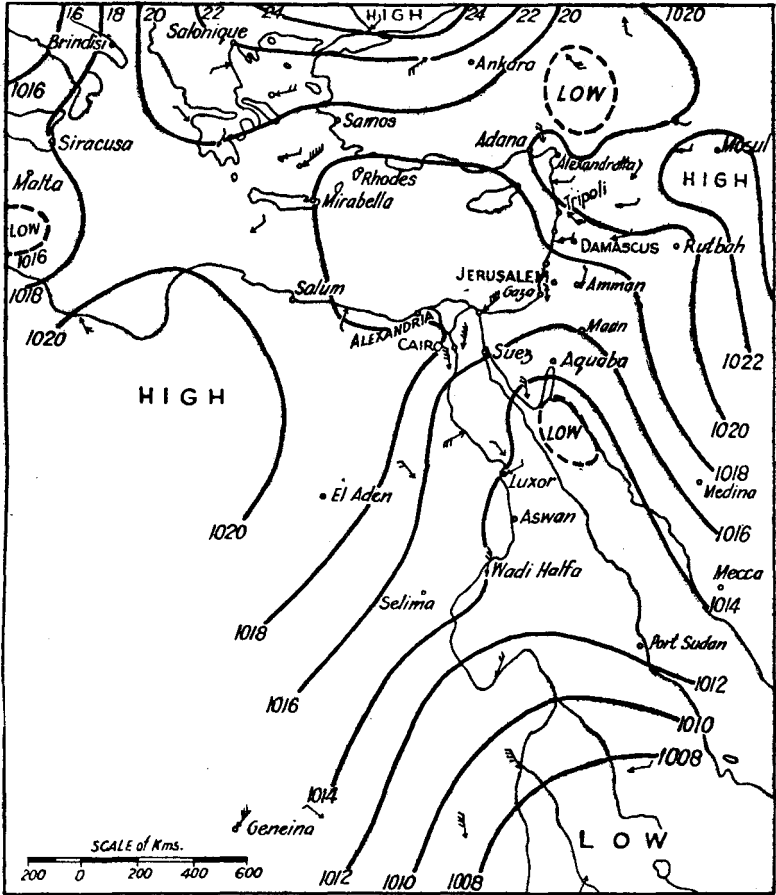


FIG. 3.—Pressure and winds at 8 h., 17-11-1937.

woulds the Lud at Louth (May 29, 1920) is reported to have risen 16 feet in 15 minutes !

Now the rapid uplift of moist air not only produces heavy rain but promotes the formation of hail of the large and dangerous

type which smote the Amorites (Josh. x, ii) and devastated Egypt (Exod. ix, 18-34). The account of the damage done is not exaggerated, *e.g.*, near Luxor in November-December, 1923, the growing crops were cut to pieces by hailstones, many of which measured more than $1\frac{1}{2}$ in. in diameter. As regards the casualties to the Amorites cases of death and injury are common in semi-tropical lands.*

The Bible account of the Egyptian plague and Josephus' story of the Amorite rout associate hail with thunder and lightning. This is natural, as the strong ascending currents which produce hail also promote electrical phenomena. The connection is also noted in Ps. xviii, 12, "hailstones and coals of fire."

The winter rains end about March and are followed by the showers known as the "latter rains" (*malkosh*). These mature the crops and are prized accordingly; it is because of their agricultural importance that they are linked in Scripture with the "former rains" (*e.g.*, Deut. xi, 14). Should they be deficient (Jer. iii, 3) the harvest is bad.

As their name indicates, it is with the "latter rains" that the rainy season really terminates.

In May precipitation falls off greatly, and by June summer conditions are re-established. "Rain in harvest" (May-June) is proverbial for "unseemly" (Prov. xxvi, 1, *cf.* I Sam. xii, 18).

Late spring is the season for the hot winds called Kadim in Scripture, and scirocco or khamsin nowadays. The warm indraft in front of a south Mediterranean depression is made still warmer by coming off the heated deserts and arrives in Palestine or Egypt as "a dry wind of the high places—not to fan or cleanse" (Jer. iv, 11) from east or south—so "When ye see the south wind blow ye say there will be heat" (Luke xii, 53); or better still "burning heat" (*kauston*). In a scirocco shade temperatures of 113° F. are not uncommon. Near the desert, as in Egypt, the wind is heavily laden with sand which causes "a darkness which may be felt." Should one blow too early in the season much damage is done to crops like the ears Pharaoh dreamed of, "blasted by the east wind." These easterly winds may be very strong (*cf.* Ps. xlvi, 7). They also played their

* Discussing this battle (Palestine picture, Hodder & Stoughton, 1936, p. 172), D. V. Duff mentions he has seen "sheep and even cattle brained by the huge hailstones which fall occasionally in Palestinian storms."

part in the drama of the Exodus. An east wind (Exod. x, 13) brought the locusts; another "caused the sea to go back" or "along" as is the better rendering.

From his intimate knowledge of local conditions, Col. C. S. Jarvis,⁵ former Governor of Sinai, has suggested Moses led the Israelites along the sandy causeway which separates the great clay pan known as Lake Bardawil from the Mediterranean. The Egyptian commander, seeing his quarry out on the causeway, decided to send his chariots across the pan to cut them off. But he either failed to appreciate or else disregarded the weather. The strong east wind was causing a heavy sea, and on the Bardawil this means the possibility of flooding. Coming from the eastward, too, was the tall thundercloud characteristic of dirty weather in Sinai, and which perhaps the wind carried between the Egyptians and their prey. Exodus xiv, 20, states that the pillar of cloud was white and shining to the Israelites and dark to the Egyptians, and according to Col. Jarvis this describes accurately a typical Sinai cloudburst: "the cloud . . . is always intensely black but outside of its scope, the sun shining on the falling rain makes it appear as a shimmering silver curtain." This heavy rain would soften the ground so that the chariots "drove heavily" while the darkness and storm would upset the morale of the men. "Let us flee from the face of Israel for the Lord fighteth for them" (v. 25). Perhaps, even then, Jehovah's special association with thunder was recognised (cf. I Sam. vii, 10). But worse was to come—the rough sea had breached the causeway; the Mediterranean with the wind behind it came pouring in. Soon the whole Bardawil, which lies some feet below the sea, was flooded, "and the Lord overthrew the Egyptians in the midst of the sea." Col. Jarvis also remarks that this local thundercloud is "at night an intermittent blaze of fire"—a veritable pillar of fire and cloud.

The Exodus is not the only Biblical event associated with local peculiarities of climate. That most romantic of tales—that of Ruth—is connected with a climatic detail recently discussed by Dr. David Ashbel,⁶ of the Hebrew University, Jerusalem, whose recent studies of the climate of Palestine have been so fruitful. He points out that the westerly winds, after crossing Judaea, descend into the valley, being warmed and dried in the process. In this state they cross the Dead Sea and absorb moisture which, on rising to the hills of Moab 4,000

feet above, they precipitate as rain. Thus Moab often has good rains when there is drought elsewhere, and that was probably why Naomi and her family went there.

It would be tempting to connect one of the most tremendous of Our Lord's miracles—the stilling of the storm—with another point discussed by Ashbel.⁶ On arriving at the edge of the valley the Mediterranean sea-breeze spills over, reaching the Sea of Galilee below as a warm, gusty wind, somewhat dangerous to small boats. Or the historic storm may have been one of the local squalls to which all lakes surrounded by hills are subject.

Again, the general characteristics of the Palestinian climate are reflected in Scripture. The Old Testament is full of references to famine and drought which are ever-present dangers in a semi-arid country with a fluctuating rainfall. The sort of variations that occur are shown by the following figures for Jerusalem:—

Average rainfall	..	..	..	27 in.
Least recorded	..	..	..	12·5 in.
Greatest recorded	..	..	..	40 in.

Variations also occur in the length of the rainy season and in the distribution of rain throughout the season, *e.g.*, either the beginning or end may be dry, the rains stopping “when there was yet three months to the harvest” (Amos iv, 7). These variations are probably connected with changes in the general circulation of the atmosphere, which though rhythmical never repeats itself exactly, and about the realities of which we are still very ignorant.

One cannot reasonably doubt that it was because of this particular climate—semi-arid, with variable rains—that Palestine was chosen to be the home of a race with a definite mission to the world. “It is,” says Dr. Alfred Berthelet, “its very greatest educational peculiarity, that, being a country whose fertility is so completely dependent on the rain, it casts its people absolutely and decisively on the goodness of Heaven, and those who are familiar with the conditions that prevail in rural life testify that the more dependent man is for the prosperity of his labours on nature and natural phenomena against which he is helpless the greater is the devotion to God in his heart.”⁷

Even the pagan cults of Canaan reflect this tendency of associating control of the seasons with higher powers:—The

Ras Shamra tablets tell of the rivalry of Mot, god of aridity, and Baal, god of rain—and in this perhaps lay the fatal fascination of the Canaanite cults to the Hebrews. They were inclined to associate Jehovah exclusively with war, thus in national emergencies they turned to Him; but in peace, especially after a drought or two, they were apt to go after Canaanite gods, for they “did not know that I gave her corn and wine and oil” (Hos. ii, 5–7).

It is, of course, significant that Elijah’s campaign against the Tyrian Baal was connected with a drought. He was the first in the great line of prophets raised up to do battle for the true God.

But, though at last the faith of Israel was purified, certain primitive Semitic ideas about rain, etc., were retained. To the Semite the earth was a cupola rising out of the cosmic ocean, with (to the Hebrew) Jerusalem at its summit. The sky was another such solid dome or firmament resting on the circle of earth. Above this were reservoirs (called variously “chambers,” Ps. civ, 13, or “treasuries,” Job. xxxviii, 22) in which rain, snow or hail were stored by Jehovah. The Psalmist pictured Him storing the waters of the cosmic ocean or “deep” (Ps. xxxiii, 7). Rain was due to the opening of the sluices or “windows” in the firmament (Gen. vii, 11). During drought the heavens were said to be “shut up” (Luke iv, 25). Dew was supposed to fall (Num. ix, 11). It was only in 1814 A.D. that Wells proved it to be caused by condensation.

There were probably many popular weather sayings in Bible times, of which two appear in the Gospels (Matt. xvi, 2, 3).

“When it is evening ye say, It will be fair weather for the sky is red.”

“And in the morning, It will be foul weather to-day; for the sky is red and lowring.”

The last two words are important, and show accurate observation. There are *two* kinds of morning red, one a light clear hue implying little moisture in the air and therefore the probability of fine weather. But a sombre, cloudy red means much moisture and the chance of storm.

Any remarks about weather in Scripture would be quite incomplete with reference to its poetic aspect. The Psalms contain mention of the blessing of the rain (*e.g.*, lxxv, 9–10,

civ, 13, etc.). Only in a semi-arid country could the ideal king be compared to showers (Ps. lxxii, 6). Snow is wondered at:—

“The eye marvelleth at the beauty of its whiteness, and the heart is astonished at the raining of it” (Ecclus. xliii, 18).

While, as regards the sparkling frost,

“He causeth flowers to bloom like sapphires,” says the Hebrew version of Ecclus. xliii, 19.

As for the rainbow it inspired these stately lines:—

“Look upon the rainbow and praise Him that made it, very beautiful is it in the brightness thereof. It compasseth the heavens about with a glorious circle, and the hands of the Most High have bended it” (Ecclus. xliii, 11–12).

The rainbow plays a part in Scripture worthy of its beauty. It appears as the sign of the covenant with Noah (Gen. ix, 13); like unto it was the glory round the Being Ezekiel saw (Ezek. 1, 28); John the Divine saw it surrounding the Throne (Rev. iv, 8). But the Biblical poets not only rejoiced in the beautiful and useful aspects of the weather, their faith in God was such that, in what caused terror and discomfort to weaker spirits, they could see glory. They revelled in depicting Jehovah riding on the wings of the wind, enveloped in the black storm-clouds and shooting out the fiery darts of lightning (Ps. xviii, 9–14), or thundering “marvellously with His voice” (Job. xxxvii, 5). There are some moderns who share this spirit—it is told of the famous Pastor Theodore Monod that, when his young sons were frightened by a storm, he came amongst them Bible in hand and read Psalm xxix—“the Song of the Thunderstorm”—with its sevenfold refrain “the Voice of the Lord.”

It was to men who had been brought up in this robust tradition that the Holy Ghost manifested with “a sound from heaven as of a rushing mighty wind” (Acts ii, 2), perhaps something like the roar with which the Southerly Burster of Australia announces its coming.

To the Bible poets even the discomforts of weather could redound to the glory of God. The terrible heat of the summer sun inspired the Psalmist (Ps. xix, 6) and Ben Sira (Ecclus. xliii, 1–6). The latter also gave honourable mention to the bitter cold of winter (vv, 20, 21) and so does the author of “the Song of the Three Children,” known to many Christians as the Benedicite. This poem has been called “the true prayer of all

meteorologists" and with reason, for therein all the elements of weather and climate—showers, dew, winds, frosts, snow, ice, lightnings and clouds, cold and heat, summer and winter, join with the rest of creation animate and inanimate, with stars and hills and animals, with angels and with the children of men in one great song in which the common Creator and Lord is praised and blessed and magnified for ever.

REFERENCES.

The Bible. Except where stated the text used is that of the Authorised Version with Apocrypha.

¹ Shaw, "Manual of Meteorology," vol. 1, p. 11, 1926.

² Th. H. Gaster, "Some Ancient Oriental Folklore," *Folklore*, vol. 49, pp. 333-375, 1938.

³ V. Burch, "Anthropology and the Apocalypse," p. 170, 1939.

⁴ G. A. Smith, "Hist. Geog. of Holy Land," p. 65.

⁵ C. S. Jarvis, "The Forty Years Wanderings," *Blackwood's Magazine*, vol. 184, 1931.

⁶ D. Ashbel, *Q.J.R. Met. Soc.*, vol. 65, pp. 185, 1939; *Met. Mag.*, June, 1936.

⁷ A. Berthelet, "History of Hebrew Civilization" (English trans.) (Harrap & Co., London), p. 30, 1926.

The three charts are reproduced from *Q.J.R. Met. Soc.*, Vol. 64, 635-7, 1938 ("Great Floods in Sinai Peninsula, Palestine, etc.," by D. Ashbel) by kind permission of the Council, who loaned the blocks. Owing to war conditions Dr. Ashbel, in Jerusalem, was not accessible.

DISCUSSION.

The Chairman (Mr. L. C. W. BONACINA), in opening the proceedings, said: The Bible, especially perhaps the Old Testament, abounds in references to weather and climate, which could roughly be arranged in three classes: (1) references to particular events, like the crossing of the Red Sea or the shipwreck of St. Paul; (2) references to climatic peculiarities, such as the former and latter rains about which the prophets had so much to say; (3) references forming part of the magnificent nature imagery so conspicuous in the Psalms and elsewhere, culminating in certain chapters of the Book of Job, e.g., "Dost thou know the balancings of the clouds, the wondrous works of Him Which is perfect in knowledge?" Miss Botley, our

lecturer, has not neglected any of these aspects, and in calling upon her to deliver the lecture, I would remind you that she is a scholarly meteorologist who has made a special study of the bearings of her subject in the cognate fields of history, religion, folklore and mythology.

In opening the discussion the Chairman said : The audience will, I feel sure, agree that Miss Botley has given us a most stimulating and interesting address. She had well portrayed the rigor of summer heat and draught, and the vividness of the landscape in the Holy Land. There were two curious omissions to important weather events, probably due to intrinsic difficulty in giving a naturalistic interpretation thereof, namely, the Noachian Deluge and the promulgation of the Decalogue on Mount Sinai. The hail plague of Egypt, which I confess always to having read about with a certain thrill, fits in very well with what we know of the protracted and violent character of hailstorms in the Mediterranean region, though less frequent in Egypt than in other parts.

In proposing a vote of thanks and winding up the proceedings, the Chairman said that the liveliness of the discussion showed that there was plenty of scope for fuller treatment of the subject, and certainly no more congenial environment could be imagined for another paper by Miss Botley than this Society, where religion, philosophy and science have a common meeting ground.

Group-Captain WISEMAN said : I have served in Palestine and Iraq for seven years, and know of no climate so remarkable as that of Palestine. In this small country, the size of Wales, so great is the variety in the weather, which may exist at the same time, that I have left Jerusalem (2,270 feet above sea level) in a snow-storm, and travelled by road to the Dead Sea (1,292 feet below sea level), where the temperature was almost tropical. At Gaza the rainfall is scanty, while 100 miles north, at Haifa, the rainfall is higher than in any part of the country.

Miss Botley relies—without sufficient reason—on Major Jarvis' explanation of the pillar of cloud and fire. He writes of the " huge column of cumulus, black in the centre with hard white edges. This column, which begins at the skyline and is most impressive, extends

to the zenith, constantly emitting lightning at night in an intermittent blaze of fire." But, as Major Jarvis points out, this is the herald of "a typical Sinai cloudburst." While this explanation may help us to understand the medium used by God, it utterly fails to account for the Biblical statements. It is unreasonable to imagine that the Israelites experienced stormy weather throughout the whole of their march. Over a year elapsed between Exodus xiii, 22, and Numbers xiv, 14. The Bible statements seem clearly to indicate something beyond the natural course of weather events.

The lecturer seems to have accepted the current evolutionary idea that "at last the faith of Israel was purified." I suggest that there is no evidence that Israel's faith was more pure at the end than at the beginning of their career. The citations from Genesis, the Psalms, or Job, could be paralleled from modern writers acquainted with scientific knowledge, and no one would suggest that this was due to ignorance. I would take particular exception to the implication of ignorance on our Lord's part when He spoke of the heavens being "shut up." One might more reasonably accuse any modern writer of speaking of the "setting sun." Those acquainted with the Babylonian writers will realise that the Bible narratives seem to have been amazingly preserved from making the grotesque mistakes made in the current literature of the time.

Lieut.-Colonel MOLONY said: This has been a very interesting paper throughout, and our sincere thanks are due to Miss Botley, and to Colonel Skinner, who persuaded her to write it. I shall confine my remarks to the great crossing of the Red Sea. Miss Botley does not precisely state her own opinion as to where this was, but she quotes Colonel Jarvis, who believes that it was along the narrow bank which separates Lake Bardawil from the Mediterranean. That is, some fifty miles E.N.E. of Port Said. But surely this takes us much too far from Marah, Elim, and other well-identified sites. I concur with Miss Botley in regarding the crossing as a miracle of coincidence, rather than as a physical marvel (and, indeed, the same may be said of most of the wonders of Moses' day). For this reason I think that we ought to reject the theory brought before us by Lieut.-Colonel Robertson in March, 1936, that the crossing was far to the south, where the Red Sea is deep.

General Sir C. Warren (who knew all the country well) read us a paper in 1917, in which he gives his belief that the crossing was north of the Bitter Lakes. This agrees with Professor Flinders Petrie's view, that it was at Serapeum, nine miles south of Ismailia. Now between Ismailia and the Bitter Lakes the Suez Canal runs through a cutting, some 12 feet deep. If the whole of the neighbourhood was some 15 feet lower in Moses' day, which seems likely, then at this place the extension of the Red Sea northwards would only have been 3 feet deep, a depth which might easily be dried out by a strong wind. All dwellers on the lower River Tay have been astonished by the effect which a strong S.W. wind has on that long lake. The only difficulty which arises is in connection with the *direction* of the wind, which the Bible says was east. One would have thought that a north-west wind would have been more effective. For if the north end of the Red Sea was near Ismailia, then there would have been nowhere from which the water blown away could be replaced.

Now the only known form of defence in Moses' day was a wall, hence when I read in Exodus xiv, 22, that the waters were a wall unto the Israelites on their right hand and on their left, I take this to mean that the waters connected with the Bitter Lakes to the south, and those connected with Lake Timsah to the north, which were not dried out, were a defence to the flanks of the Israelites.

I know that the song of Miriam says, Exodus xv, 8, "The floods stood upright as an heap." But this is poetry.

Petrie and Warren are great authorities, and when they agree, as they do here, and topography supports them, their opinions should be given weight when rival theories are brought forward.

Mr. D. JUSTIN SCHOVE, B.Sc., F.R.Met.S., said that as he was engaged in investigating climatic variations in relation to history, Miss Botley's remarks in this connection were of special interest to him. With regard to the Flood, if the distribution of the clay deposit were mapped, it would be at once apparent whether the cause was local or due to climatic change.

In the latter case, the change would be world-wide (*cf.* the Glaciation Crisis, the theory given by Peake and Fleure, "The Corridors of Time"); a chronology of more recent climatic calamities in the

Near East would provide a clue to the interpretation of the Great Flood, the earliest calamity of which there is any recorded attempt at human description.

With regard to the influence of climate on man's beliefs, the Mohammedan religion extended mainly over the region where the annual rainfall was less than 10 inches ; to what extent was this reflected in the references to climate given, *e.g.*, in the Koran ?

WRITTEN COMMUNICATIONS.

Mrs. MAUNDER, F.R.A.S., wrote : I have been greatly interested in Miss Botley's paper, and I write now, not to criticise any point, but rather to induce her to criticise some suggestions of mine on the weather and climate of the Bible, because I am not a practising meteorologist, and all the knowledge I have of that science is taken from Dr. C. P. Brooks' two books, "The Evolution of Climate" and "Climate Through the Ages."

In my paper on "Early Hindu Astronomy," read before the Institute in April, 1934, I found two significant dates—700 B.C. and 1600 B.C. About 700 B.C. there was a reformation of the Calendar in the Punjab, somewhat similar to ours in 1752, the only difference being that we dropped 11 days and the Hindu astronomers dropped 12, thus bring back the Calendar into adjustment with the seasons, particularly with the summer solstice—that is, with the Monsoon rains which occur there at that solstice. This meant that the origin of their calendar was about 900 years prior to 700 B.C. We can infer from this that the Hindu Aryans were invading the Punjab (with its well-watered plains) shortly before 1600 B.C. Elsewhere in meteorological history I found that these two dates were significant as regards sudden change of climate. For instance, to quote from Dr. Brooks ("Climate Through the Ages," p. 163) : "The change of Climate for the worse was very rapid, and, according to H. Gams and R. Nordhagen, in the Alps it 'had the appearance of a catastrophe.' There was, in fact, a sudden change from drought to deluge." So, too, it was in the Punjab. There are many hymns at this epoch testifying to disastrous floods at the fount of the Seven Rivers ; especially there was continual reference to the Great Vritra at this time : he was the Demon, slain by Indra, the Weather God,

and it was the slaying of him that gave Indra supremacy among the gods. From the many descriptions of Vritra, I judged it to be an enormous glacier which obstructed the rivers of the Punjab, at their sources high up in the Himalayas. It seemed to me that it was an obstruction on a great scale, like that of the Shyok dam, in 1926, on a small scale. I am not knowledgeable in the origin of words, but Sanskrit is closely allied to the European Aryan languages, and *vritra* is as like vitreous as glass is like glacier.

How long did the Great Vritra take to grow to his full length ? I judge that he came suddenly into existence about 1600 B.C. For in his "Our Mobile Earth" (published 1926), Dr. Daly told of his (then) recent discovery of sea caves, found on the ocean coasts all over the world, and all indicating a sea-level shift of about 20 feet. He writes : "Field studies in *all* the ocean basins—Atlantic, Pacific and Indian—show that there has been a world-wide sinking of sea-level, the land at most places remaining quiet. One naturally inquires for the cause of the lowering of sea-level. The best explanation seems to be an increase of the existing glaciers, particularly the ice-cap of Antarctica. For ice-caps, like all other glaciers, are formed by evaporation of sea-water and its subsequent precipitation as snow on the lands. The withdrawal of enough water from the ocean to supply only a fraction of the Antarctic ice-cap would lower general sea-level 20 feet."

"The increase of the ice-cap or caps has been tentatively referred to late Neolithic times, about 3,500 years ago. At that approximate date there was some chilling of the northern hemisphere at least, following a prolonged period of drought when the world climate was distinctly warmer than now. Late-Neolithic man lived in Europe 3,500 years ago." This date, "about 3,500 years ago," is near enough to my 1600 B.C. for the invasion of the Persians, by Persian Aryans, and this intensity of glaciation is *not* confined to the polar caps, for the high mountains, such as the highlands of Afghanistan, where these Persians had been living for some two or three hundred years previously, must have experienced a very great deterioration of climate, great enough to induce them to invade in great numbers the warm and well-watered plains of the Punjab.

In the Bible we know nothing concerning the date 1600 B.C., for at that time the children of Israel were in the Land of Egypt, and

this temporary increase in the ice-caps did not affect adversely the Nile, any more than it did Seven Rivers.

Now as to the date of the Deluge. If we take it according to the Septuagint Version as about 4000 B.C., then the account given in Genesis reads something like the catastrophic deluge in the Alps or in the Punjab Hills. The highlands of Armenia are of the same order as the highlands of Afghanistan. The description of them in the *Encyclopædia Britannica* is as follows: "On the north and west the slopes of Great Ararat are covered with glittering fields of unbroken *névé*. The only true glacier is on the north-east side, at the bottom of a large chasm which runs into the heart of the mountain. . . . The middle zone of Ararat, 5,000 to 11,000 feet, is covered with good pasture; the upper and lower zones are for the most part sterile."

This raises a question:—Which is the normal level of the ocean for our present geologic age? Is it the present level, or one 20 feet higher? This involves, however, a discussion too lengthy for a note to Miss Botley's paper.

Rev. J. H. J. BARKER, M.Sc., wrote: The subject under discussion is one which has interested me for many years, and I am very grateful for the erudite paper read by Miss Botley. Distance precludes my attendance and share in the discussion.

The terms "former" and "latter" rain give the impression that there are two periods of rainfall in Palestine separated by a non-rainy season. This is not the case. A glance at the monthly average rainfall of Jerusalem during the winter half of the year indicates that the rainy season is one, viz., October, 0·4 inches; November, 2·3 inches; December, 5·4 inches; January, 6·2 inches; February, 5·4 inches; March, 3·9 inches; April, 1·7 inches. The reason for the former and latter portions of the rainy season being so important is that any delay in the onset of the rains, or any early diminution towards the end of the season, would have disastrous effects. The early rain is required to soften the hard ground, while the latter rain fills the ears of grain preparatory to the summer drought. The grain harvest takes place in the early days of the dry period.

While allowing due weight to the ancient organisation of water storage, I do think that there is evidence of a decline in rainfall in

parts of Palestine and the Near East. G. A. Smith records the sites of many villages south of Beersheba indicating the presence of vegetation (and rainfall ?) in times long past. Two further factors must be considered to account for this. One, that lands bordering the desert not only have a seasonal variation in rainfall, but also a serious variation from year to year. Such variations seem to occur in cycles. At Jerusalem, as Miss Botley records, this variation is from 12·5 inches to 40 inches, with an average of 27 inches ; but in the Negeb the average rainfall is probably 15 inches or less. If the difference between average and lowest annual rainfall is half of what occurs at Jerusalem, *i.e.*, 7 inches, then drought conditions throughout the whole year become extremely severe. Such cycles of drought and rain account, I believe, for the prosperity of these border areas in times gone by ; then a dry cycle will be experienced and population will fade away, and with the incidence of the second factor, re-population in a more favourable period will become difficult.

The second factor is that of forestation. Trees assist precipitation. Careless cultivation and war means that trees are destroyed and not replaced, and in an area where the margin of rainfall is so scanty the reduction in precipitation as a result of deforestation means desert conditions. It is a well-known fact that parts of Spain suffered in this way as a result of the huge inroads made upon timber to build the Armada. Without the binding effect of vegetation the soil becomes friable, and even a solitary spate can sweep away and sweep bare many a stretch of land, which then becomes incapable of producing trees. We all know, too, that attempts to remedy this state of affairs were impossible while the Turk was in power in Palestine, for he taxed all trees. However, in more favourable parts, afforestation is now taking place, and possibly the precipitation will be so materially increased that one day the land even south of Beersheba will "blossom as the rose," and upon the ruins of ancient villages in the Negeb new centres of population will arise. An interesting commentary on the weather conditions of the south part of Palestine (though not further south than Beersheba) is found in Gen. xxvi. It would appear that there was drought at Gerar, for we have the term "famine" in verse 1 ; but in verse 12

Isaac reaps an hundredfold. Perhaps we have here some evidence of this type of rainfall variation from cycle to cycle of years.

Dr. C. E. P. BROOKS wrote : I found Miss Botley's paper most interesting, and there is really very little that I could add to it. There are a good many references to Palestine in Professor J. W. Gregory's paper, "Is the Earth Drying Up?" (*Geograph. Journal*, Vol. 43, 1914). Unfortunately our Meteorological Library copy is still at South Kensington, so that I cannot consult it; but I remember having some correspondence with Gregory about it. He maintained that there is nothing in the Bible to suggest that the climate of Palestine differed appreciably from the present climate at any time; but from a close study of the dates of the various references, I concluded that the country had passed through several cycles of favourable and unfavourable conditions of rainfall. If these cycles really existed, they must have had a great influence on the various migrations into and out of Palestine, but my notes are not at present accessible.

I notice that Miss Botley has not referred to the first recorded successful long-range weather forecast, namely, the seven years of good Nile floods, followed by the seven years of poor floods. . . . There are several cycles of about 14 years (11 years, $12\frac{1}{2}$ years, 15 years, $16\frac{2}{3}$ years), and when these all fall in step they give a period of about seven years of good floods, followed by seven years of bad floods.

Rev. Principal H. S. CURR wrote : I regret that I have been unable to read the paper before the meeting, with the result that the remarks which follow may do no more than emphasise some aspects of the subject already discussed. That, however, is of such interest and importance to Bible students for an adequate appreciation of many passages that some observations may be made even at the expense of repetition.

The Bible contains narratives which deal with a considerable stretch of land and sea in the Near East, and in several of these there are allusions to climatic conditions. The overwhelming majority are concerned with Palestine, as one would expect, since it

was the tiny theatre in which the redemption of the world was consummated.

Palestine has been described as a museum country on account of the remarkable variety exhibited by its geography, its flora and fauna, as well as by its climate. Our present concern is with the last. In illustration of what has just been said about it, two brief statements by eminent authorities may be cited. Dr. R. A. S. Macallister writes: "The climate of Palestine is, on the whole, that of the sub-tropical zone, although, owing to the extraordinary variation of altitudes, there is probably a greater range of average local temperature than in any other region of its size on the world's surface. On the one hand, the summits of Hermon and of certain peaks of the Lebanon are covered with snow for the greater part of the year; on the other hand, the tremendous depression, in the bottom of which lies the Dead Sea, is practically tropical, both in climate and vegetation."* In these circumstances, it need be no matter for surprise to find Colonel C. R. Conder writing: "In the Bible we read of snow, hail, and ice, as well as of the desert whirlwinds and the sunstroke."† When we remember that Palestine is no larger than Wales, we shall be disposed to agree with the remark that there is no hundred miles on the globe to compare with it in sheer diversity of climatic conditions, with all that is thereby implied and involved.

The significance of these sentences can only be grasped to the full when we realise that Palestine was the cradle of the chosen people, the unique home of a unique race. It would be interesting and instructive to trace the effects on Jewish mentality and character of such a remarkable environment. The influence of climate on character has long been recognised. Thus the differences between the Scotsman and the Spaniard are partly explicable by such considerations. It is certain that, in the loving wisdom of God, the land of promise was the ideal training ground for the nation in whom all the families of the earth were destined to be blessed.

The climatic miracles recorded in the Bible must be of special interest to the meteorologist. There are stories of storms and droughts which are directly ascribed to the finger of God. The

* Hastings' Bible Dictionary (one vol.), p. 673.

† Hastings' Bible Dictionary, Vol. III, p. 643.

problems which these narratives raise will be more deeply understood by the scientific investigator of weather conditions. Although I disclaim all specialised knowledge on the subject, I venture to think that the conclusions of the meteorologist with regard to these miraculous interventions in the ordinary course and process of the Palestinian climate will support the contention of Calvin that God does not deviate in His mighty works further from the laws and workings of Nature than is absolutely essential for His gracious purposes.

AUTHOR'S REPLY.

I am much interested in, and obliged for, all the comments that have been made.

As regards Mrs. Maunder's date of 4000 B.C., it is interesting to note that Dr. Julian Huxley ("The Uniqueness of Man," London, 1941, p. 89) states that round about 4500 B.C. there was an elevation of land. This would mean increased snowfall round about the Mesopotamian basin and violent spring floods year after year. There is, too, the interesting theory that the Flood had nothing to do with Mesopotamia, but represents the flooding of the Mediterranean basin by the Atlantic at the end of the Ice Age.

I mentioned Colonel Jarvis' theory of the Exodus because of its meteorological interest. I am not archæologist enough to decide about routes.

I am sorry Group-Captain Wiseman misunderstood some of my remarks. Surely he will agree that, *as practised*, the Israelite faith had become contaminated with heathenism and needed purifying. Likewise, Luke iv, 25, was quoted solely with the object of illustrating the popular idea of the reason for drought, and with no thought of irreverence.

I agree with the Rev. J. H. J. Barker and Dr. Brooks about the part played by cycles of rainfall. These would have a marked effect on the prosperity of semi-arid districts.

The omissions mentioned by Mr. Bonacina were due to lack of space. As he says, the difficulty of a naturalistic explanation is great; indeed, "explaining away" is often not very profitable. Incidentally, however, there are some interesting remarks (too long

to quote) in "Once in Sinai," J. M. C. Plowden (Methuen, 1940), pp. 107-108.

With regard to Mr. Schove's query, my knowledge of the Koran is limited, but it seems that its meteorological references are not very striking. The most interesting local touch is the comparison of "the works of the unbelievers" with the desert mirage (*serab*): "the thirsty man takes it for water till he comes and finds that it is not." There is also mention of the fertilising power of rain, conspicuous in an arid climate.